PHYSICS

BOOKS - PRADEEP PHYSICS (HINGLISH)

ELECTROSTATICS

SOLVED EXAMPLES

1. What are some other applications of electrostatics?

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2. Is a charge of $\left(5.8 \times 10^{-18}\right)C$ possible?

A. yes

B. No

C. May be

D. Cannot be determined

Answer: B

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3. What is the charge on a body from which one million electrons are removed?

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4. How is force between two charges affected when each charge is doubled and distance between them is also doubled?

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5. Two equal like charges in air repel eachother with a force F. By what percentage should each charge be reduced so that the force between them in medium of dielectric constant 2 reduces by 28%`?

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6. Calculate the number of electrons which should be removed from a conductor so that it acquires a positive charge of $3.5nC$?

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7. An object has an excess charge of $\left(-1.92 \times 10^{10-7}\right)C$. How many excess electrons does it have ?

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8. Which is bigger, a coulomb or charge on an electron ? How many electronic charges from one coulomb of charge ?

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9. How much positive and negative charge is there in a cup of water ?

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10. If a body gives out 10^9 electrons every second, how much time required to get a total charge of $1C$ from it ?

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11. A metal sphere has a charge of $-6.5\mu C$. When 5×10^{13} electrons are removed from the sphere, what would be the net charge on it?

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12. Two bodies A and B carry charges $-3.00\mu C$ and $-0.44\mu C$. How many that they acquire equal charges?

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13. A free pith ball p of 10g carries of $5 \times 10^{-8} C$. What must be the nature and maganitude fo charge that should be given to another pith ball Q fixed 7 cm below the former ball, so that upper ball is statinary ?

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14. Force of attraction between two point charges placed at a distance 'd' is F. What distance apart should they be kept in the same medium, so that the force between them is 2F ?

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15. Two charged particles having charge $2.0 \times 10^{-8} C$ each are joined by an insulating string of length 1 m and the system is kept on a smooth horizontal table. Find the tension in the string.

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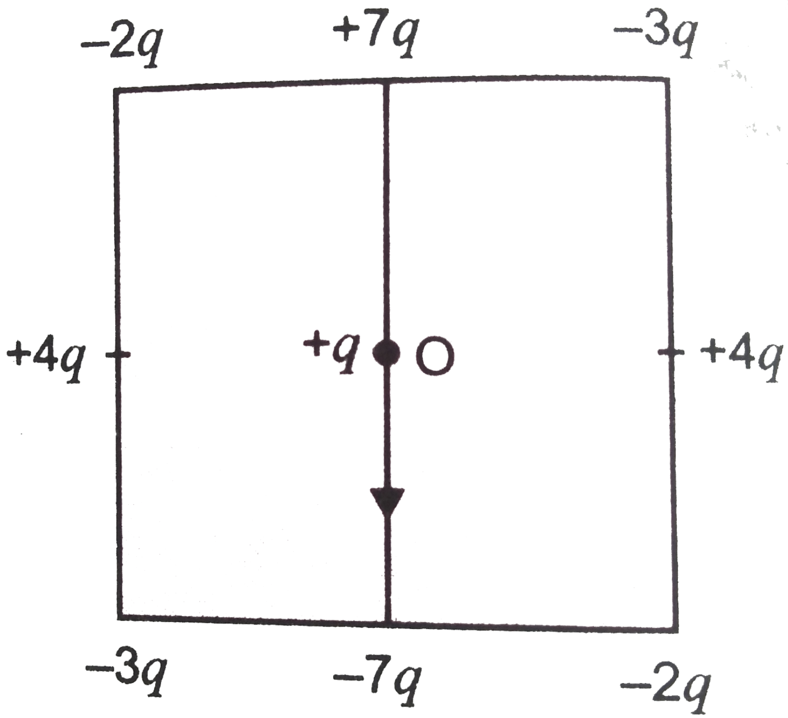
16. A particle carrying charge + q is held at the center of a square of each side arranged on the square as shown in Fig. If q = 2 muC, what is the net force on the particle?



A. $36 \times 14 \times 4 \times 10^{-3} N$

B. $16 \times 14 \times 4 \times 10^{-3} N$

C. $26 \times 14 \times 4 \times 10^{-3} N$

D. $6 \times 14 \times 4 \times 10^{-3} N$

Answer: A

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17. Coulomb's law for electrostatic force between two point charges and Newton's law for gravitational force between two stationary point masses, both have inverse square dependence on the distance between the charges/masses (a) compare the strength of these forces by determining the ratio of their magnitudes (i) for an electron and as proton (ii) for two protons (b) estimate the accelerations for election and proton due to electrical force of their mutal attraction when they are 1 A apart.

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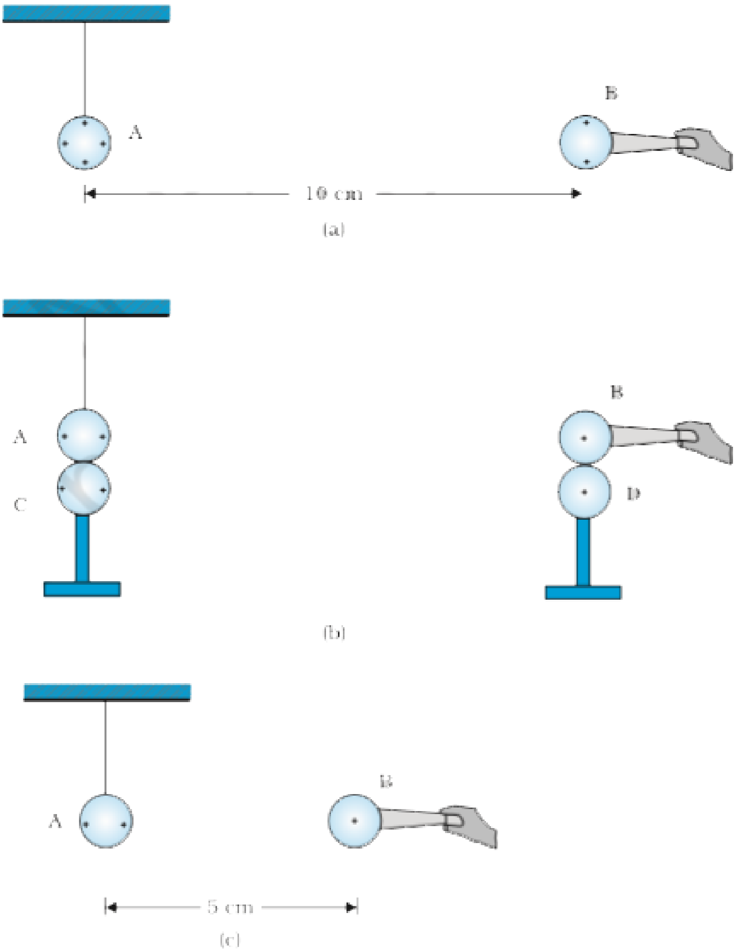
18. A charged metallic sphere A is suspended by a nylon thread. Another charged metallic sphere B held by an insulating handle is brought close to A such that the distance between their centres is 10 cm, as shown in Fig. 1.7(a). The resulting repulsion of A is noted (for example, by shining a beam of light and measuring the deflection of its shadow on a screen). Spheres A and B are touched by uncharged spheres C and D respectively, as shown in Fig. 1.7(b). C and D are then removed and B is brought closer to A to a distance of 5.0 cm between their centres, as shown in Fig. 1.7(c). What is the expected repulsion of A on the basis of Coulomb's law? Spheres A and C and spheres B and D have identical sizes. Ignore the sizes of A and B in comparison to the separation between their centres.



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19. Two electrons and a positive charge q are hold along a straight line. At what position and for what value of q will the system be in equilibrium.

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20. The two point charges $4\mu C$ and $1\mu C$ are separated by a distance of 2 m in air. Find the point on the line joining the charges at which net electric field of the system is zero.

A. $\frac{4}{3}m$ from $1\mu C$

B. $\frac{2}{3}m$ from $1\mu C$

C. $\frac{4}{3}m$ from $4\mu C$

D. $\frac{2}{3}m$ from $4\mu C$

Answer: C

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21. Ten positively charged particles are kept fixed on the x-axis at points x=10cm, 20cm, 30cm, ..., 100cm. The first particle has a charge $1.0 \times 10^{-8} C$, the second 8×10^{-8} C, the third $27 \times 10(- 8)$C and so on. The tenth particle has a charge $1000 \times 10^{-8} C$. find the magnitude of the electric force acting on a 1 C charge placed at the origin.

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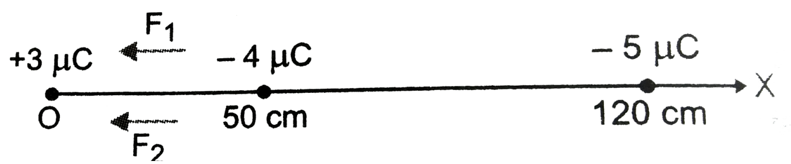
22. Three point charges are placed at the following points on x-axis : $3\mu C$ at $x = 0$, $- 4\mu C$ at $x = 50cm$ and $-5\mu C$ at $x = 50cm$ and $-5\mu C$ at $x = 120cm$, Calculate the force on $-4\mu C$ charge.



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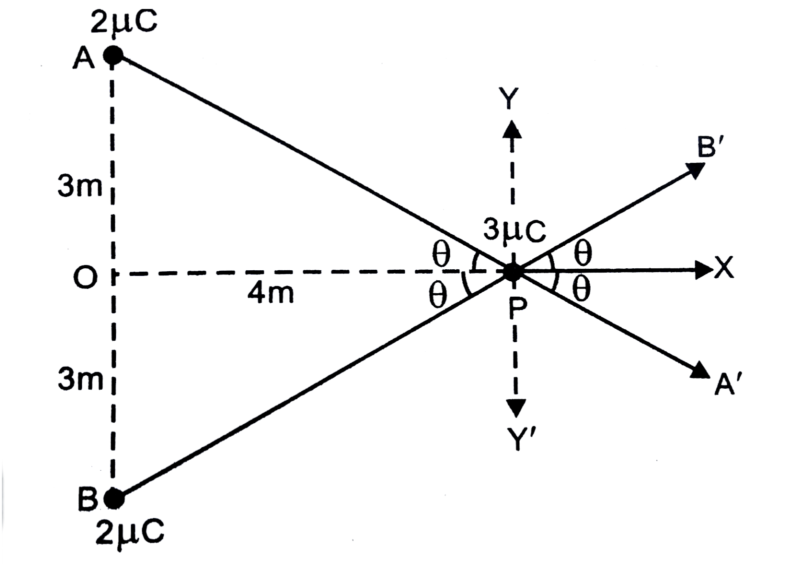
23. Two equal positive charges, each of $2\mu C$ interact with a third positive charge of $3\mu C$ situated as shown in Fig. Calculate the magnitude and direction of the force on the $3\mu C$ charge.



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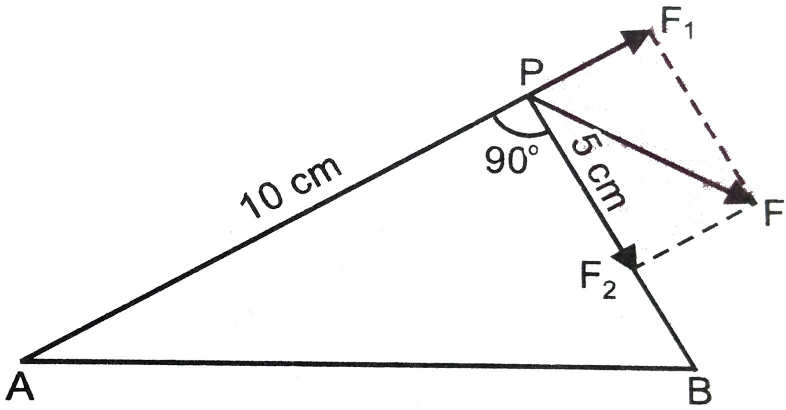
24. Find the magnitude of the resultant force on a charge of $1\mu C$ held at P due to two charges of $+2 \times 10^{-8} C$ at A and B respectively.

Given AP = 10 cm and BP = 5 cm.

$\angle APB = 90^{\circ}$, Fig.



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25. Consider three charges q_1, q_2 and q_3 each equal to q, at the vertices of an equilateral triangle of side l. What is the force on a charge Q placed at the centroid of the triangle?

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26. Consider the charges q,q and -q placed at the vertices of an equilateral triangle of each side l. What is the force on each charge ?

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27. A particle of mass m and carrying charge -q_1 is moving around a charge $+q_2$ along a circular path of radius r period of revolution of the charge -q_1 about $+q_2$ is

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28. Two identical conducting spheres, fixed in space, attract each other with an electrostatic force of $0.108N$ when separated by $50.0cm$, centre-to-centre. A thin conducting wire then connects the spheres. When the wire is removed, the spheres repel each other with an electrostatic force of $0.0360N$. What were the initial charges on the spheres?

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29. Two fixed point charges $+4e$ and $+e$ units are separated by a distance 'a'. Where should a third point charge be placed for it to be in equilibrium?

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30. A copper atom consists of copper nucleus surrounded by 29 electrons. The atomic weight of copper is $63.5 mole^{-1}$. Let us now take two pieces of copper each weighing $10g$. Let us trandfer one elcetron from one piece to another for every 100 atoms in that piece. What will be the Coulomb force between the two pieces after the trandfer of electrons, if they are $1cm$ apart? Avogadro number $= 6 \times 10^{23} mole^{-1}$, charge on an electron $= -1.6 \times 10^{-19} C$

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31. An infinite number of charges each equal to $4 \mu C$ are placed along X-axis at $x = 1m, x = 2m, x = 4m, x = 8m$ and so on. Find the total force on a charge of 1C plaaced at the origin.

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32. Three point charges + q each are kept at the vertices of an equilateral triangle of side l. Determine the magnitude and sign of charge to be kept at the centroid so that charges at the vertices remain in equillibrium.

A. $Q = \dfrac{2q}{\sqrt{3}}$

B. $Q = \frac{q}{\sqrt{2}}$

C. $Q = \frac{3q}{\sqrt{3}}$

D. $Q = \frac{q}{\sqrt{3}}$

Answer: D

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33. The electric charge of macroscopic bodies is actually a surplus or deficiency of electrons. Why not protons?

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34. Two free protons and two free electrons are separted by the same distance. Compare Coulomb's forces of repulision between the pair of protons and pair of electrons.

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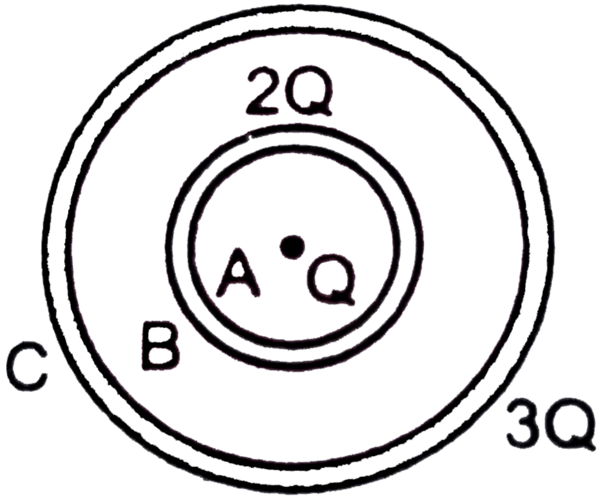
35. A charge Q is kept in the inner cavity and a charge 2 Q is given to the inner shel. A charge 3 Q is given to the outermost shell, as shown in Fig. 1 (a).22 Find the charges at the surfaces A,B and C.



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36. A negatively charged ebonite rod attracts a suspended ball of straw. Can we infer that the ball is positively charged ?

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37. Can two similarly charged bodies attract each other?

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38. A body A repels another body B, A attracts body C, C repels body D. It is given that body D is positively charged. What is the charge on body B.

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39. Explain why a neutral object can be attracted to a charged objec. Why can this neutal object not be repelled by a charged object ?

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40. When a hand apporaches a charged weight suspended with a silk thread, the weight is attracted towards the hand. Why does this occur ?

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41. How can you charge a metal sphere negatively without touching it?

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42. An insulating rod carries some net charge, and a copper sphere is neutral. The rod and the sphere do not touch. Can there be force of attration/repulsion between the two?

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43. Neutral metal objects, especially in industry, are are often coated with electrically charged paint or powder particles. How do these particles stick on the metal objects ?

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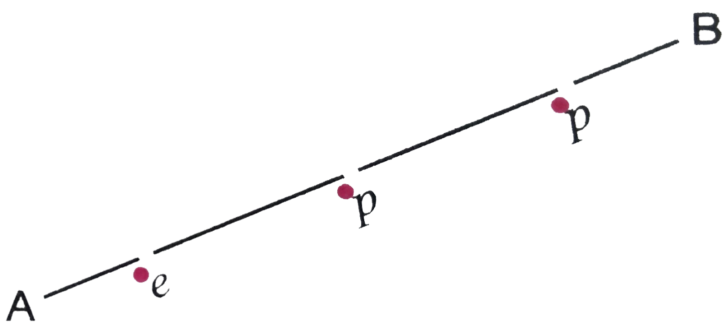
44. Figure 1(a).24 shows two protons (symbol P) and one electron (symbol e) on a straight line AB. What is the direction of net electrostatic force on the central proton?



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45. Give some points of dissimilarity similarity between electrostatic forces and gravititaonal forces.

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46. The electrostatic force between two charges is a central force. Why?

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47. How is coulomb force between two charges affected by the presence of third charge.

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48. If two objects repel one another, you know both carry either positive charge or negative charge. How would you determine whether these charges are positive or negative ?

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49. Is coulomb's law in electrostatics valld in all situations ?

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50. What is the cause of charging ?

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51. An isolated conducting sphere id given s positive charge. Does its mass increase, decrease or remain the same ?

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52. An ebonite rod is rubbed with fur or wool. What type of charges do they acquire ?

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53. What is meant by quantisation of charge ?

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54. What do you mean by additivity of electric charge ?

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55. what do mean by conservation of electric charge ?

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56. Is the total charge of the universe conserved ?

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57. Why does an ebonite rod get negatively charged on rubbing with fur ?

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58. A glass rod rubbed with silk acquires a charge $+1.6 \times 10^{-12} C$. What is tha charge on the silk?

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59. Name any two basic properties of electric charge.

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60. what is the value of charge on an electron ? Is a charge less than this value possible ?

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61. Does motion of a body affect its charge ?

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62. Give two points of distinction between charge and mass.

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63. What is the basic cause of quantization of charge ?

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64. Can ever photons can have a charge? If not why?

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65. Which of the following quantities depends on state of rest or motion of a body : (a) mass (b) length (c) time (d) charge density and (f) phase ?

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66. Is the force acting between two point charges q_1 and q_2 kept at some distance in air, attractive or repulsive when:

$(i) q_1 q_2 > 0$

$(ii) q_1 q_2 < 0$

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67. A positively charged glass rod is brought near an uncharged pith ball penduium. What happens to the pith ball ?

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68. Why is it not possible to charge just one end of a metal rod ?

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69. Why is it easier to charge a ballon on a dry day than on a humid day ?

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70. Does Coulomb's law of electric force obey Newton's third law of motion ?

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71. Is the electric force between two electrons greater than the gravitaonal force between them ? If so, by what factor ?

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72. Eletrostatic forces are much stronger than gravitatinal forces. Give one example.

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73. Let $\left[\in_0\right]$ denote the dimensional formula of the permittivity of vacuum. If $M = mass, L = \ \leq n > h, T = time$ and $A = elctriccurrent$, then :

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74. Write down the value of obsolute permittivity of free space.

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75. What is the force of repulsion between two charges of $1C$ each, kept $1m$ apart in vacumm ?

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76. Define dielectric constant of a medium in terms of force between electric charges.

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77. What is the relevance of large value of $K(=81)$ for water ?

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78. Force of attraction between two point electric charges placed at a distance d in a medium is F. What distance apart should these be kept in the same medium, so that force between them becomes $F/3$?

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79. In coulomb's law, on what factors does the value of electrostatic force constant K depend ?

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80. When two charges q_1 and q_2 are kept at some distance apart, force acting between these charges is F. If a third change q_3 is placed quite close to q_3 is placed quite close to q_2 what will happen to the force between q_1 and q_2 ?

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81. Consider three charged bodies P,Q and R. If P and Q repel each other and P attracts R, what is the nature of force between Q and R ?

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82. Does the coulomb force that one charge exerts on another , charge if other charges are brought near by?

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83. A copper sphere of mass $2g$ contains nearly 2×10^{22} atoms. The charge on the nucleus of each atom is $29e$. What fraction of the electrons must be removed from the sphere to give it a charge fo $+2\mu C$?

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84. Give four properties of electric charges.

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85. Dielectric constant of a medium is unity. What will be its permittively ?

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86. Two small balls having equal poistive charges Q(coulomb) on each are suspended by two insulating strings of equal length L(metre) from a hook fixed to a stand. The whole set up is taken in a satellite into space where there is no gravity (state of weightlessness). The angle between the two strings is...............and the tenison in each string is..................newtons.

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87. An attractive force of $5N$ is acting between two charges of $+2\mu C$ and $-2\mu C$ placed at some distance. If the charges are mutually touched and placed again at the same distance , what will be the new force, between them ?

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88. Two point charges of $+2\mu C$ and $+6\mu C$ repel each other with a force of $12N$. If each is given an additional charge of $-4\mu C$, what will be the new force?

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89. Determine the force between two free electrons spaced 1 angstrom $\left(10^{-10}m\right)$ apart.

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90. What is the Importance of expressing coulomb's law in vector from ?

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91. State superposition for electrostatic force on a charge due to a number of charges.

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92. Two indentical metallic spheres A and B, each carrying a charge q repel each other with a force F. A third metallic uncharged sphere C of the same size is made to touch the spheres A and B alternately and then removed away. What is the force of repulsion between A and B ?

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93. Calculate force on an electron in a unifrom field of $5 \times 10^4 N/C$ due north.

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94. What is a shark POD ?

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95. Charges $\pm 20 nC$ are separated by $5 mm$. Calculate the magnitude and direction of dipole moment.

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96. Two charges of $\pm 1000\mu C$ are separated by $2mm$. This dipole so formed is held at an angle of 30° with a uniform electric field of $15 \times 10^4 N/C$. Calculate the torque acting on the dipole.

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97. A dipole consists of an electron and a proton separated by a distance of $5 \times 10^{-9} m$. The dipole is aligned in a uniform electric field of $1.44 \times 10^4 N/C$. Calculate potential energy of dipole to hold it at 60° with the direction of electric field.

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98. Calculate the electric field strength which is required to just support a water drop of mass 10^{-3} kg and having a charge $1.6 \times 10^{-19} C$.

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99. A particle of mass $10^{-4} kg$ and charge $5 \mu C$ id thrown at a speed of $20 m/s$ against a uniform electric field of strength $2 \times 10^{5} NC^{-1}$. How much distance will it travel before coming to rest momentarily?

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100. A free pith ball of mass $6g$ carries a positive charge of $(1/3) \times 10^{-7} C$. What is the nature and magnitude of charge that should be given to a second pith ball fixed $5cm$ vertically below the former pith ball so that the upper pith ball is stationary.

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101. A small sphere of mass $1g$ carries a charge of $+6\mu C$. The sphere is suspended by a string in an electric field of $400NC^{-1}$ acting downwards. Calculate tension in the string. What will be the tension if charge on the sphere were $-6\mu C$?

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102. An electron falls through a distance of $1.5cm$ in a uniform electric field of value $2 \times 10^4 N/C$, opposite to direction of fall. Compare the time of fall with 'free fall under gravity'.

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103. A charged particle of charge $2\mu C$ and mass 10 milligram, moving with a velocity of $1000 m/s$ enters a uniform electric field of strength $10^3 N/C$ directed perpendicular to its direction of motion. Find the velocity and displacement of the particle after $10s$.

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104. Two point charges $+6q$ and $-8q$ are placed at the vertices B and C of an equilateral triangle ABC of side a. Obtain an expression for magnitude and direction of resultant electric field at the vertex A due to these two charges.

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105. Two charges each of $1\mu C$ but opposite in sign are $1cm$ apart. Calculate electric field at a point distant $10cm$ from the mid point on axial line of the dipole.

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106. Two charges $+20\mu C$ and $-20\mu C$ are held $1cm$ apart. Calculate the electric field at a point on the equatorial line at a distance of $50cm$ from the center of the dipole.

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107. What is the magnitude of electric intensity due to a dipole of moment $2 \times 10^{-8}C - m$ at a point distant $1m$ from the centre of dipole, when line joining the point to the center of dipole makes an angle of 60° with diople exis ?

A. $191 \cdot 1N/C$

B. $238 \cdot 1N/C$

C. $400N/C$

D. $840N/C$

Answer: B

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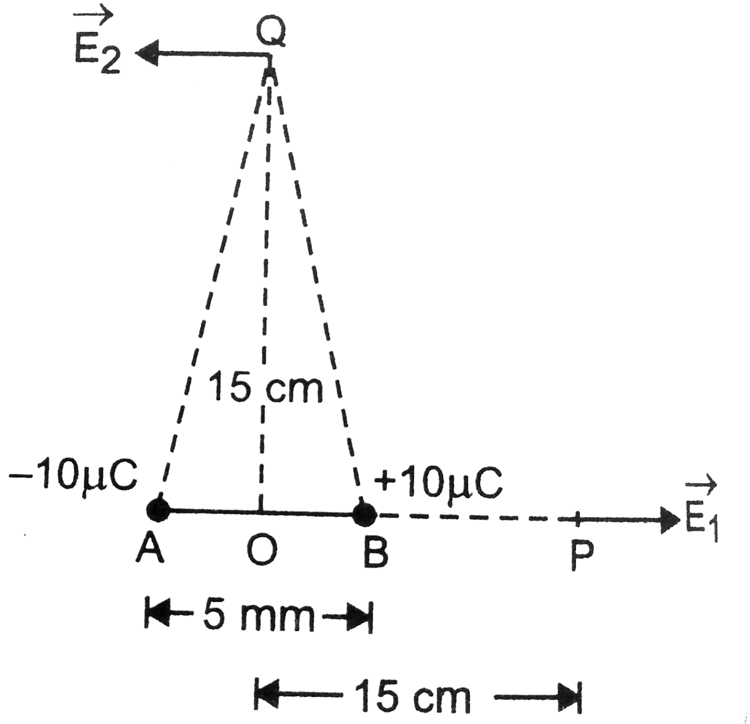
108. Two charges $\pm 10\mu C$ are placed $5 \cdot 0mm$ apart. Determine the electric field at (a) point P on the axis of dipole $15cm$ away from its center on the side of the positive charge. As shown in Figure and at (b) a point Q. $15cm$ away form O on a line passing through O and a line passing through O and



normal to the axis of the dipole as shown in Fig.

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109. The electric field due to a short dipole at a distance r, on the axial line, from its mid point is the same as electric field at a distance r' on the equatorail line, from its mid point. Determine the ratio r/r' oon the equatorial line, from its mid point. Determine the ratio r/r'.

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110. Two charges $\pm 10\mu C$ are placed $5 \times 10^{-3}m$ apart. Determine the electric field at a point $Q, 0 \cdot 15m$ away from O, on a line passing through O and normal to the axis of the diople.

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111. An electric dipole consists of two charges of $0.1\mu C$ separated by a distance of $2.0cm$. The dipole is placed in an external field of $10^5 NC^{-1}$. What maximum torque does the field exert on the dipole?

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112. An electric dipole of moment $5 \times 10^{-8} C - m$ is aligned in a uniform electric field of $1 \cdot 44 \times 10^{4} N/C$. Calculate potenitial energy of the diople at 60° with the direction of electric field.

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113. A diople consisting of an electron and a proton separated by a distance of 4×10^{-10} m is situated in an electric field of intensity $3 \times 10^{5} NC^{-1}$ at an angle of 30° with the field. Calculate the diople moment and the torque acting on it. Charge e on an electron $= 1 \cdot 6 \times 10^{-19} C$.

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114. An electric dipole of dipole moment 4×10^{-5} Cm is placed in a uniform electric field of $10^{-3} N/C$ making an angle of 30° with the direction of the field. Determine the torque exerted by the electric field on the dipole.

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115. Three charges, each equal to q, are placed at the three. corners of a square of side a . Find the electric field at. the fourth corner.

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116. A pendulum bob of mass 80mg and carrying a charge of $2 \times 10^{-8} C$ is at rest in a uniform, horizontal electric field of 20k Vm^{-1}. Find the tension in the thread.

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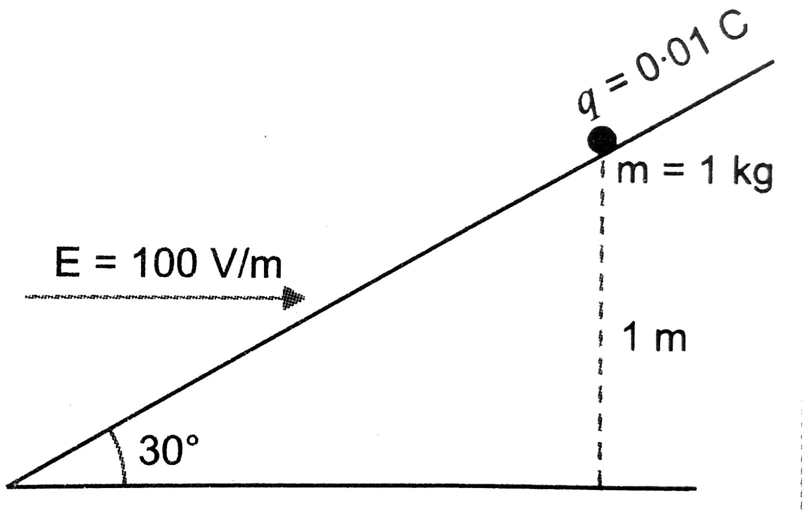
117. An inclinded plane making an angle of $30°$ with the horizontal electric field of $100 Vm^{-1}$ as shown in Figure. A particle of mass $1kg$ and charge $0 \cdot 01C$ is allowed to slide down from rest from a height of $1m$. If the coefficient of friction is 0*2, find time taken by the particle to reach the bottom.



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118. A point charge $+Q$ is placed in the vicinity of a conducting surface. Draw the electric field lines between the surface and the charge.

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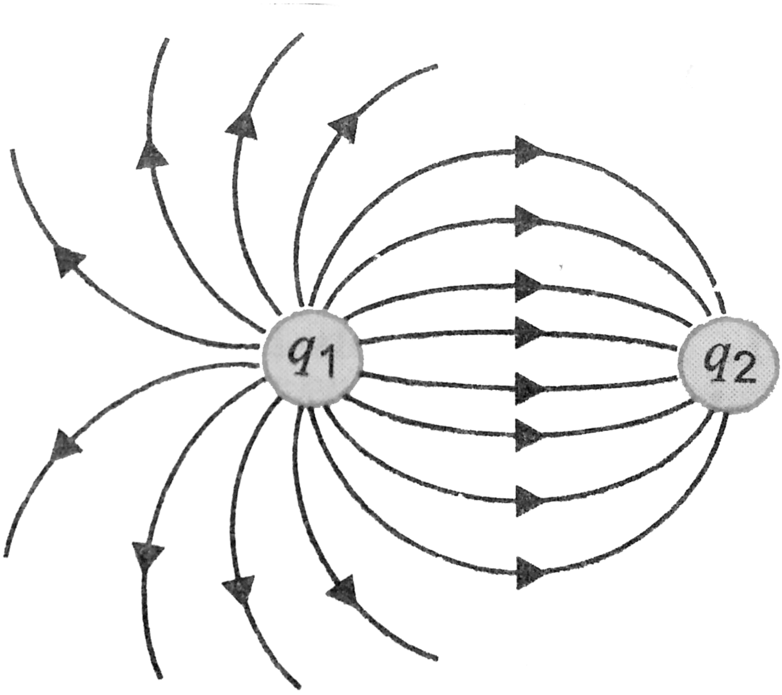
119. Figure shows the electirc field lines for two point charges separated by a distance. What are the signs of q_1 and q_2 ? Can you determine the ratio $q_1 \mid q_2$?



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120. (a) An electrostaic field line is a continous curve. That is a field line cannot have sudden breaks. Why not ?

(b) explain why two filed lines never cross each other at any point.

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121. When does a charged circular loop behave as a point charge.

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122. Why is direction of an electric field taken outward for a possitive charge and inward for a negative charge.

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123. Can electric field lines of force form closed loops ? Give reason for your answer.

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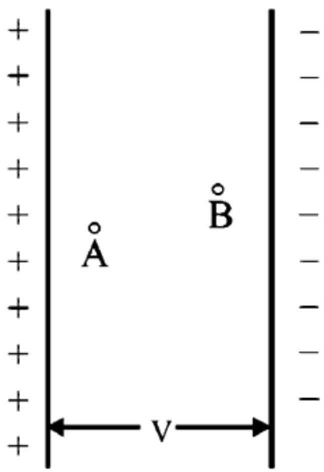
124. Two protons A and B are placed in between the two plates of a parallel plate capacitor charged to a potential difference V as shown in the figure. The forces on the two protons are identical.



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125. A point charge placed at any point on the axis of an electric dipole at some large distance experiences a force F. What will be the force acting on the point charge when its distance from the dipole is doubled.

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126. What is electric field intensity at a point at a distance r meter from q coulomb of a charge in free space ?

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127. A point charge q is placed at the origin . How does the electric field due to the charge very with distance r from the origin ?

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128. Is electric field inensity a scalar or vector quantity? Give its $S. I. unit.$

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129. Write the dimensional formula of electric field.S

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130. A proton is placed in a unifrom electric field directed along the positive x-axis. In which direction willl it tend to move?

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131. Name any four vector fields.

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132. How does a free electrons at rest move in an electric filed.

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133. Four charges of same magnitude and same sign are placed at the corners of a square, of each side$0 \cdot 1m$. What is electric field intensity at the center of the square?

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134. Force experienced by an electron in an electric field $\vec{E}$ is F newton. What will be the force experiended by a proton in the same field ?

Take mass of proton 1836 times the mass of an electron.

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135. What is the use of the concept of electric field intensity ?

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136. Name the physical quanity whose SI unit is NC^{-1} ?

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137. Why is electric field intensity inside a charged conductor zero ?

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138. Draw electric lines of forces due to an electic dipole.

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139. Two point charges of $+3\mu C$ each are $100cm$ apart. At what point on the line joining the charges will the electric intensity be zero ?

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140. What is nature of sysmmetry of field due to a point charge ?

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141. When is an electric line of force straight ?

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142. When is an electric line of force straight ?

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143. Define electric dipole moment. Write its SI unit ?

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144. What is an ideal dipole ?

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145. In which orientation,a diole placed, in a uniform field is in (i) stable (ii) unstable equilibrioum?

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146. what is the net force on a dipole in a uniform electric field ?

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147. How does a torque affect the dipole in an electric field ?

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148. Which rule gives you the direction of torque ?

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149. What happens when an electirc dipole is held in a non uniform electric field ?

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150. At what points, dipole field intensity is parallel to the line joining the charges ?

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151. How much is the diople moment of non-polar molecule ?

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152. When does an electric dipole placed in a non-uniform electirc field experience a zero torque but non-zero force.

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153. When is the torque on a dipole in a field maximum ?

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154. Will an electric dipole have translational motion when placed in a non -uniform electric field? Give reason for your answer.

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155. Why no two electric lines of force can interscet each other ?

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156. Why do we obtain a neutral point in the space between two like charges ?

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157. Define electric field intensity at a point.

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158. Give two properties of electric field lines.

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159. A charged particale is free to move in an electric field. Will it always move along an electric line of force ?

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160. What does $(q_1 + q_2) = 0$ signify ?

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161. An electric dipole is placed at rest in a uniform electric field, and released. How will it move ?

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162. Define the term electrons diople moment. Is it scalar or vector ?

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163. what is the direction of field intensity at a point (i) on axail line of dipole and (ii) equatorial line of diople ?

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164. what is the nature of sysmmetery of the electric field due to (i) point charge and (ii) electric dipole ?

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165. when an electric dipole is suspended in a uniform electric field, then under what conditions the dipole is in (i) stable equilibrium and (ii) unstable equaliibrium.

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166. Show that when an electric dipole is placed in a uniform electric field $\vec{E}$, petential energy U is given by $U = -\vec{P}, \vec{E}$

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167. An electric dipole is held at an angle θ in a uniform electric field E. Will there be any (i) net translating force (ii) torque acting on in ? Explain.

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168. A Uniform electric field of $10NC^{-1}$ exists in the vertically downward direction. Find the increase in the electric potential as one goes up through a height of 50cm.

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169. The electric potential V at any point x,y,z (all in metre) in space is given by $V = 4x^2$ volt. The electric field at the point $(1m, 0, 2m)$ is .... $\frac{V}{m}$.

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170. What do you understand by ECG and EEG ? What is their basis ?

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171. Three charges $+q, 2q$ and $-4q$ are placed on the three vertices of an equale-laterail triangle of each side$0 \cdot 1m$. Calculate electrostatic potential energy of the system, take $q = 10^{-7}C$

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172. The total electric flux emanating from a closed surface enclosing an alpha particale (e = electronic chage) is

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173. A surface element $\overrightarrow{dS} = 5\hat{i}$ is placed in an electric field $\vec{E} = 4\hat{i} + 4\hat{j} + 4\hat{k}$. What is the electric flux emanating from the surface ?

A. $20 units$

B. $25 units$

C. $10 units$

D. $15 units$

Answer: A

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174. S_1 and S_2 are two bellow concentric spheres enclosing Q and $3Q$ respectively as shown in Figure. What is the ration of electric flux through S_1 and S_2? What would be electric flux through S_1 ? If air inside S_1 is replaced by a medium of dielectric constant 3 ?

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175. A uniform electric field exists in space. Find the electric flux of the filed thourgh curved surface area of the cyclinder with its axis paralel to the field.

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176. A charge of $17 \cdot 7 \times 10^{-4} C$ is distributed over a large sheet of area $400 m^2$. Calculate the electric field intensity at a distance of $10 cm$ from it.

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177. The potential difference between a cloud and the Earth is $10^7 V$. Calculate the amount of energy dissipated when the charge of $100C$ is transferred from the cloud to the ground due to lighting bolt.

A. zero

B. $10^7 J$

C. $10^9 J$

D. $10^5 J$

Answer: C

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178. If $20J$ of work has to be done to move an electric charge of $4C$ from a point, where potential is $10V$ to another point, where potential is V volt, find the value of v.

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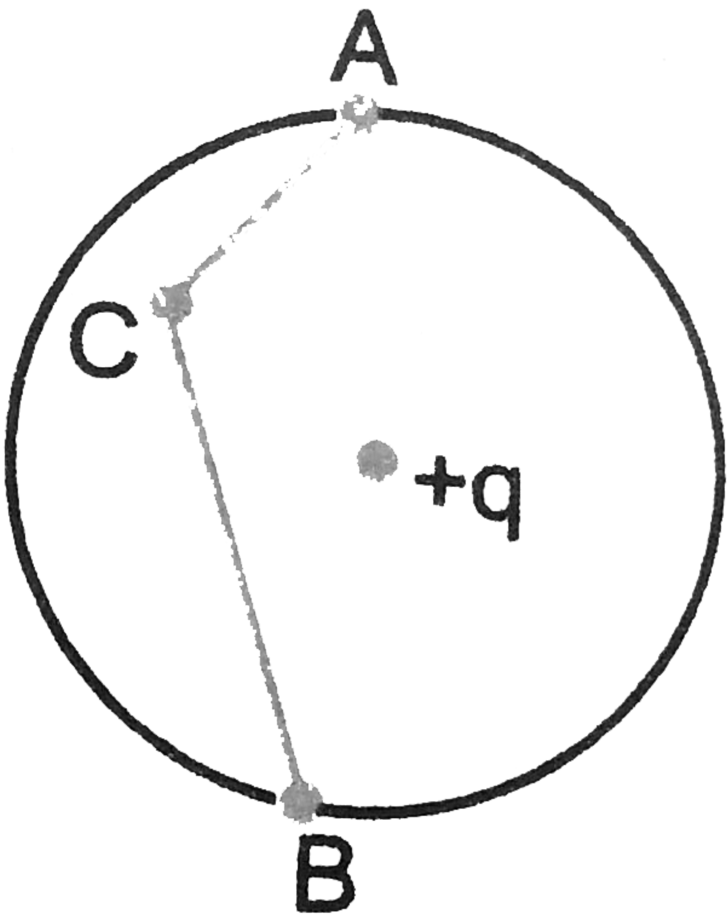
179. If a point charge $+q$ is taken first from A to C, and then from C to B of a circle drawn with another point charge $+q$ at the center (Fig) then along which path more work will be done ?



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180. Two metallic spheres of radii R and $2R$ are charged so that both of these have same surface charge density, σ . If they are connected to each other with a conducting wire, in which direction will the charge flow and why ?

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181. Electric field intensity at a point B due to a point charge Q kept at a point charge Q kept at point A is $24NC^{-1}$, and electric potential at B due to the same charge is $12JC^{-1}$. Calculate the distance AB and magnitude of charge.

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182. Calculate the electric potential at the center of a square of side $\sqrt{2}m$, having charges $100\mu c$, $-50\mu C$, $20\mu c$ and $-60\mu C$ at the four corners of the square.

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183. Determine the electric potential at the surface of a gold nucleus. The radius is $6.6 \times 10^{-15}m$ and the atomic number $Z = 79$. Given charge on proton $1.6 \times 10^{-19}C$.

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184. A metal wire is bent in a circle of radius 10 cm. It is given a charge $200\mu C$ which is spread on it uniformly. Calculate the electric potential at its center.

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185. The electric potential at 0.9m from a point charge is $+50V$. What is the magnitude and sign of the charge ?

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186. (a) Calculate the potential at a point P due to a charge of $4 \times 10^{-7}C$ located 9 cm away.

(b) Hence obtain the work done in bringing a charge of $2 \times 10^{-9}C$ from infinity to the point P. Does the answer depend on the path along which the charge is brought ?

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187. An infinite number of charges each numerically equal to q and of the same sign are placed along the x-axis at

$x = 1, x = 2, x = 4, x = 8$ and so on. Find electric potential at $x = 0$.

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188. Two charges $3 \times 10^{-8}C$ and $-2 \times 10^{-8}C$ are located 15 cm apart. At what point on the line joining the two charges is the electric potential zero ? Take the potential at infinity to be zero.

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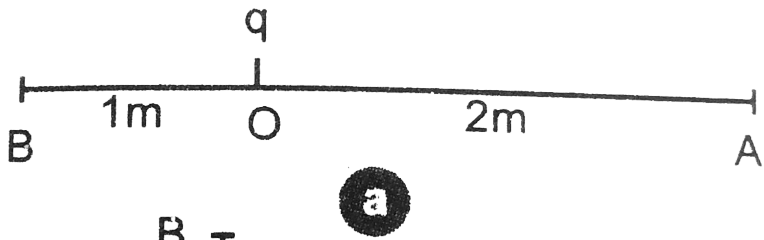
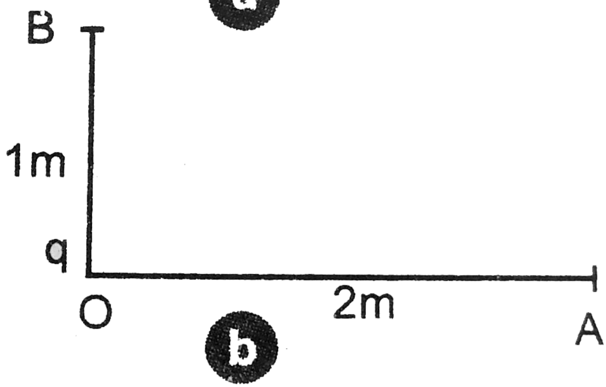
189. A charge $q = +1\mu C$ is held at 0 between two points A and B such that $AO = 2m$ and $BO = 1m$ Calculate the value of potential differences $\left(V_A - V_B\right)$. What will be the value of potential differences $\left(V_A - V_B\right)$ if position of B is charged as shown in Fig ?





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190. Four point charges $+1\mu C$, $+1\mu C$, $-1\mu C$ and $-1\mu C$ are placed at the corners A,B,C and D of a square of each side 0.1 m (i) Calculate electric potential at the center O of the square (ii) If E is middle point of BC, what is work done in carrying an electron from O to E ?

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191. An ammonia molecule has permanent electric dipole moment = 1.47D, where 1D = 1 debye unit $= 3.34 \times 10^{-30} Cm$. Calculate electric potential due to this molecule at a point 52.0 nm away along with axis of the dipole. Assume V = 0 at infinity.

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192. To what potential, must we charge an insulated sphere of radius 14 cm so that its surface charge density of $1 \mu C m^{-2}$?

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193. Calculate the voltage needed to balance on all drop carrying 10 electrons when located between the plates of a capacitor which are 5 mm apart. Mass of oil drop is $3 \times 10^{-16} kg$(take $g = 10 m/s^2$)

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194. A small particale carying a negative charge of $1.6 \times 10^{-19} C$ ia suspended in equilibrium between the horizontal metal plates 5 cm apart, having a potential difference of 3000 V across them. Find the mass of the particle.

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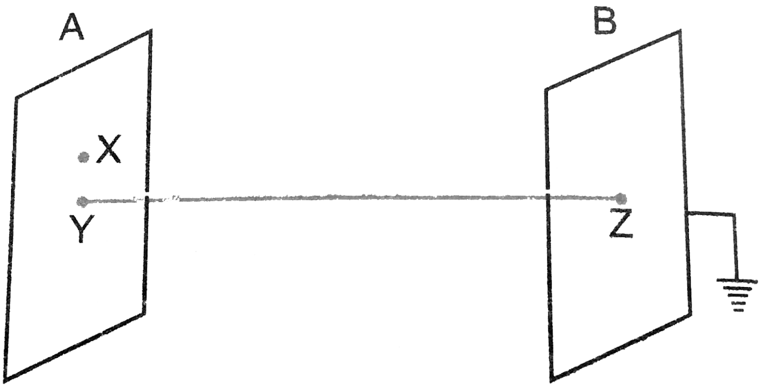
195. Two identical plane metallic surfaces A and B are kept parallel to each other in air separated by a distance of 1.0 cm as shown in fig. Surface A is given a positive potential of 10V and the outer surface of B is earthed. (i) What is the magnitude and direction of uniform electric field between points Y and Z ?

(ii) What is work done in moving a charge of $20 \mu c$ from point X to

Y, where X is situated on surface A ?



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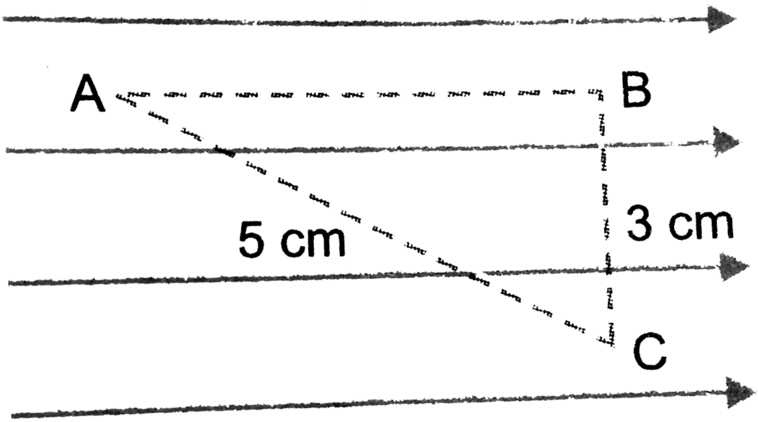
196. Three points A,B,C lie in a uniform electric field E of $5 \times 10^{3} N/C$ as shown in Fig. Find the potential difference between

A and C.



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197. Two positive point charges of $0.2\mu C$ and $0.01\mu C$ are placed 10 cm apart. Calculate the work done in reducing the distance to 5 cm.

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198. Two point charges $20 \times 10^{-6}C$ and $-4 \times 10^{-6}C$ are separated by a distance of 50cm in air, Find (i) the point on line joining the charges, where the electrostatic potential is zero (ii) Also, Calculate the electrostatic potential energy of the system.

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199. The kinetic energy of a charged particle decreased by 10 J as it moves from a point at potential 100 V to a point at potential 200V . Find the charge on the particle.

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200. Two particles have equal masses of 5.0 g each and opposite charges of $+4.0 \times 10^{-5}C$. They are released from rest with a separation of 1.0 m between them. Find the speeds of the particles when the separation is reducced to 50 cm.

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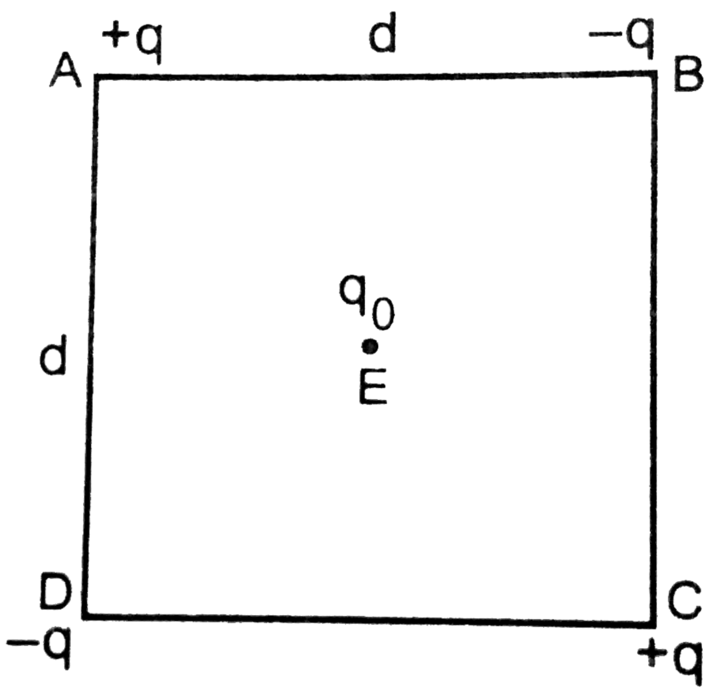
201. Four charges are arranged at the corners of a square ABCD pf side d, as shown in Fig. Find the work required to put together this arrangement (b) A charge q_0 brought to the center E of the square, the four charges being held fixed at the corners . How much extra work in needed to do this ?



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202. (a) Determine the electrostatic potential energy of a system consisting of two charge $7\mu C$ and $-2\mu C$ (and with no external filed) placed at $(-9cm, 0, 0)$ and $(9cm, 0, 0)$ respectively.

(b) How much work is required to separate the two charges infinitely away from each other ?

(c) Suppose that the same system of charges is now placed in an external electric field $E = A \times 1/r^2$, where $A = 9 \times 10^5 Cm^{-2}$.

What would the electrostatic energy of the configuration be ?

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203. Three point charges $+Q$, $+2Q$ and $-3Q$ are placed at the vertices of an equilateral triangle ABC of side l. If these charges are displaced at the find points A_1, B_1 and C_1 respectively, find the amount of work done in shifting the charges to their new positions.

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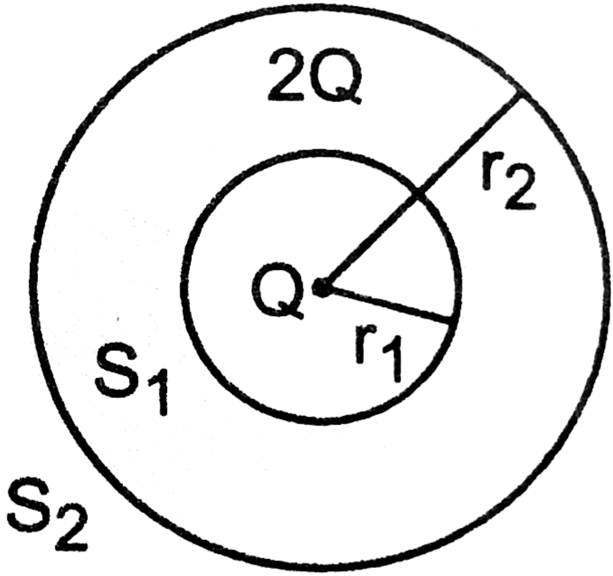
204. S_1 and S_2 are two concentric spheres enclosing charges Q and 2Q respectively as shown in Fig.



(i) What is the ratio of electric flux through S_1 and S_2 ?

(ii) How will the electric flux through the sphere S_1 charge, If a medium of dielectric constant K is introduced in the space inside S_1 in place of air?

(iii) How wil the electric flux through sphere S_1 change, if a medium of dielectric constant K is introduced in the space Inside S_2 in place of air?

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205. Consider a uniform electric field $E = 3 \times 10^3 \hat{i} N/C$. (a) What is the flux of this field through a square of 10 cm on a side whose plane is parallel to the yz plane ? (b) What is the flux through the same square if the normal to its plane makes a 60° angle with the x-axis ?

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206. The electric field componets due to a charge inside the cube of side 0.1m are $E_x = \alpha x$, where $\alpha = 500(N/C)m^{-1}$, $E_y = 0, E_z = 0$. Calculate the flux through the cube and the charge inside the cube.

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207. Consider a unifrom electric field $\vec{E} = 4 \times 10^3 \hat{i} NC^{-1}$ (i) What is the flux of this field thorough a square of side 10cm on a side whose plane is parallel to Y-Z plane ? (ii) What is the flux through the same square if normal to this plane makes an angle of 60° with the X-axis ?

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208. Careful measurements of the electric field at the surface of a box inidcates that the net outward flux through the surface of box is $60 \times 10^3 Nm^2C^{-1}$. Find (i) the net charge inside the box ? (ii) If the net outward flux through the surface of box were zero, could you conclude that there were no charges inside the box ? Explain your answer.

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209. A uniformly charged conducting sphere of 2.4 m diameter has a surface charge density of $180.0 \mu C / M^2$ (ii) Find the charge on the sphere. (ii) what is the total flux leaving the surface of the sphere ?

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210. A charge Q is placed at a distance $\frac{\alpha}{2}$ above the centre of a horizontal, square surface of edge a as shown in figure (30-E1). Find the flux of the electric field through the square surface.

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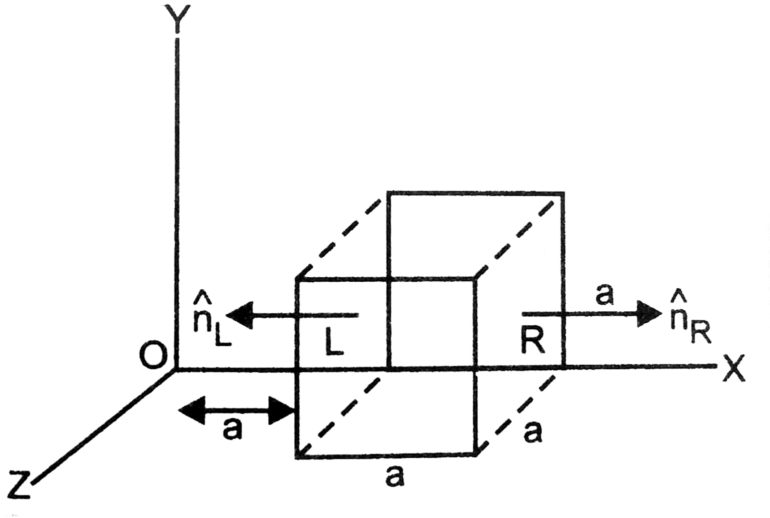
211. The electric field componenets in Fig are $E_x = \alpha x^{1/2}, E_y = E_z = 0$ in which $\alpha = 800 N/C - m^{1/2}$. Consider the cube shown in Fig. Calculate (a) the flux ϕ_E through the cube, and

(b) the charge within the cube. Assume that $a = 0.1m$.



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212. An electric field is uniform, and in the positive x-direction for positive x, and uniform with the same magnitude , but in the negative x-direction for negative x. It is given that $\vec{E} = 200\hat{i}N/Cf$ or $x > 0$ and $\vec{E} = -200\hat{i}N/C$ for x gt 0. A right circular cylinder of length 20 cm and raidus 5cm has its center at the origin and its axis along the x-axis so that one face is at $x = +10cm$ and the other is at $x = -10cm$.

(a) What is the net outward flux through the side of the cylinder ?

(b) What is the net outward flux through the cyclinder ? (c) what is net charge inside the cylinder ?

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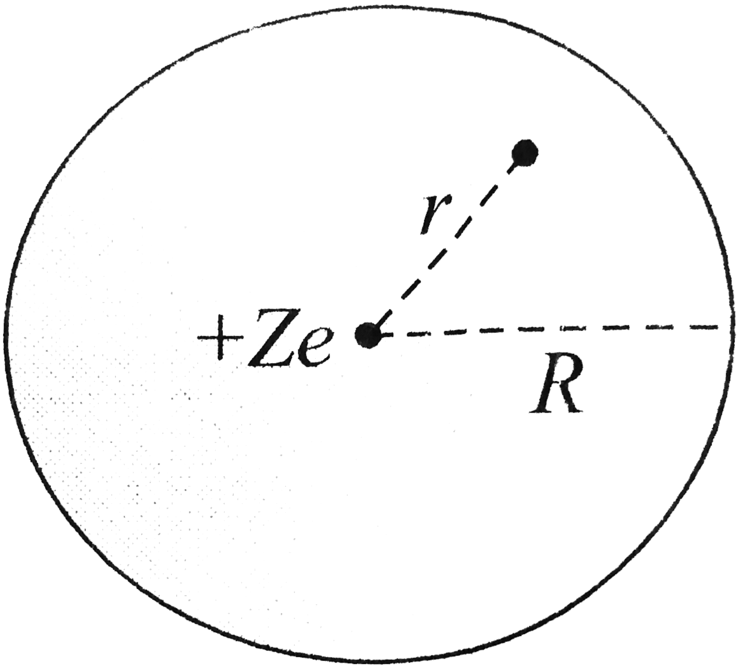
213. According to early model of an atom,the atom is considered it to have a positively charged point nucleus of charge Ze surrounded by a uniform density of negative charge up to a radius R. The atom as a whole is neutral. The electric field at a distance$r$

from the nucleus is $(r < R)$



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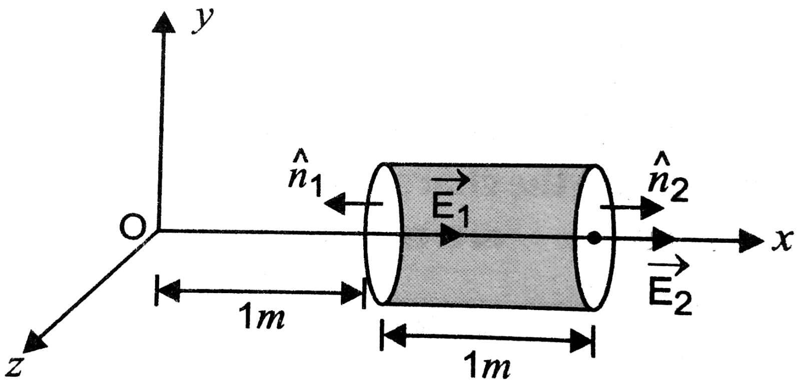
214. A hollow cylindrical box of length 1m and area of cross section $25cm^2$ is placed in a three dimensional co-ordinate system as shown in Fig, The electric field in the

region is given by $\vec{E} = 50x\hat{i}$, where E is in NC^{-1} and x is in meter.

Find

(i) Net flux through the cylinder

(ii) Charge enclosed by the cylinder.



A. (i) $0.625 Nm^2/C$, (ii) $3.506 \times 10^{-12} C$

B. (i) $0.125 Nm^2/C$, (ii) $1.106 \times 10^{-12} C$

C. (i) $0.330 Nm^2/C$, (ii) $2.550 \times 10^{-12} C$

D. (i) $2.125 Nm^2/C$, (ii) $6.106 \times 10^{-12} C$

Answer: B

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215. An infinite line charge produces a field of $19 \times 10^{4} NC^{-1}$ at a distance of 5cm. Calculate the linear charge density.

A. $1.5\mu C/m$

B. $1.0\mu C/m$

C. 0

D. $0.5\mu C/m$

Answer: D

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216. Two large, thin metal plates are parallel and close to each other. On their inner faces, the plates have surface charge densities of opposite signs and of magnitude $19 \times 10^{-22} Cm^{-2}$. What is E (a) to the left of the plates (b) to the right of the plates

(c) between the plates ?

Here, $\sigma = 19 \times 10^{-22} Cm^{-2}$

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217. A plastic rod of length 2.2m and radius 3.6 mm carries a negative charge of $3.8 \times 10^{-7} C$ spread uniformly over its surface. What is the electric field near the mid-point of the rod, at a point on its surface?

A. $8.6 \times 10^{5} N/C$

B. $-8.6 \times 10^{-5} N/C$

C. $8.6 \times 10^{-5} N/C$

D. $-8.6 \times 10^{5} N/C$

Answer: D

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218. A large plane sheet of charge having surface charge density $5 \times 10^{-16} Cm^{-2}$ lies in XY plane. Find electric flux through a circular area of radius 1cm Given normal to the circular area makes an angle of 60° with Z-axis.

A. $5.26 \times 10^{-9} Nm^2 C^{-1}$

B. $zero$

C. $4.44 \times 10^{-9} Nm^2 C^{-1}$

D. None of these

Answer: C

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219. Two large metal plates each of area $1m^2$ are placed facing each other at a distance of 5 cm and carry equal and opposite charges on their faces. If the electric filed between the plates is $1000NC^{-1}$, find the charge on each plate.

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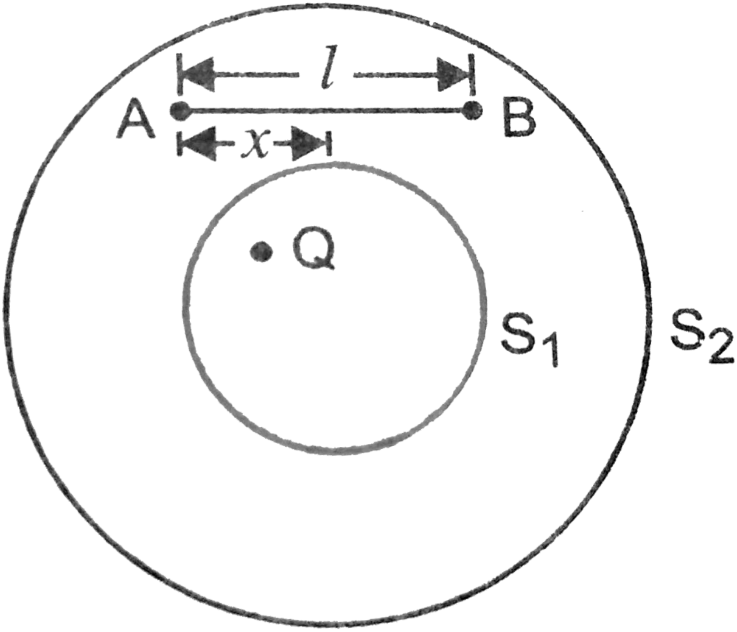
220. IN fig, calculate the total flux of the electrostatic field through the spheres S_1 and S_2. The wire AB shown here has a linear charge density λ . Given by $\lambda = kx$, where x is the distance measured along the wire from end A.



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221. An indinitely long positively charged wire has a linear charge density λcm^{-1}. An electron is revolving around the wire as its center with a constant velocity in a circular plane perpendicular to the wire. Deduce the expression for KE of electron. Plot a graph of K.E as a function of charge density λ.

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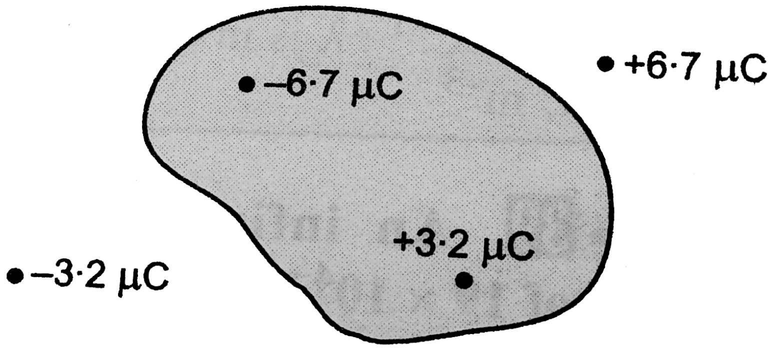
222. Fig shows a closed surface surrounding some electric charges (a) what is the net electric flux through the surface? (b) Is the electric flux directed inward or outward from the surface ?



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223. Two charges $4\mu C$ and $-4\mu C$ are placed at $(-3, 0, 0)$ and $(3, 0, 0)$ cm respectively in an external field given by

$E = \frac{9 \times 10^6}{r^2} Cm^{-2}$, Find the energy of the system in this external field.

A. $-2.4J$

B. $2.4J$

C. 0

D. $-1.4J$

Answer: A

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224. An electric is fired directly towards the center of a large metal plate that has excess negative charge with surface charge density $= 2.0 \times 10^{-6} C/m^2$. If the initial kinetic energy of electron of electron is 100 eV and if it is to stop due to repulsion just as it reaches the plate, how far from the plate must it be fired ?

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225. Three charges 0.1 coulomb each are placed on the corners of an equilateral triangle of side $1m$. If the energy is supplied to this system at the rate of $1kW$ how much time would be required to move one to the charges on to the midpoint of the line joining the two ?

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226. A wire AB of length L has linear charge density $\lambda = Kx$, where x is measured from the end A of the wire. This wire is enclosed by a Gaussian hollow surface. Find the expression for electric flux through the surface`.

A. $\frac{KL^2}{2\varepsilon_0}$

B. $\frac{KL}{2\varepsilon_0}$

C. $\frac{KL^2}{\varepsilon_0}$

D. $\frac{KL}{\varepsilon_0}$

Answer: A

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227. Express the unit of electric potential in terms of the basic units of S.I.

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228. Is the electrostatic potential necessarily zero at a point where the electric field strength is zero? Give an example to illustrate your answer,.

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229. Can there be a potential difference between two adjacent conductors that carry same amount of positive charge ?

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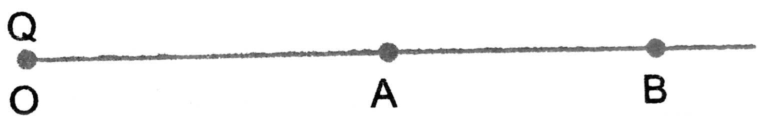
230. A point charge Q is placed at the point O as shown in Fig. Is the potential difference $(V)_A - V_B)$ positive, negative or zero if Q is (i) possible (ii) negative ?



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231. Two large parallel thin plates having uniform charge densities $+\sigma$ and $-\sigma$ are kept in X-Z plane at a distance d apart. Sketch an equipotential surface due to electric field between the plates. If a particle of mass m and charge $-q$ remains stationary between the plates, what is the magnitude and direction of the filed ?

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232. Can we produce high voltage on the human body without getting a shock ?

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233. The electrostatic field due to a point charge depends on the distance r as $\left(l/r^2\right)$. Similarly, indicates how each of the following quantities depends on r : (a) Intensity of light from a point source

(b) Electrostatic potential due to a point source (c) Electrostatic potential due to a distance r from the center of a charged metallic sphere of radius R $(r < R)$.

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234. A metal sphere A of radius a is charged to potential V. What will be its potential if it is enclosed by a spherical conducting shell B of radius b and the two are connected by a wire ?

A. $\frac{b}{a}V$

B. $\frac{a}{b}V$

C. $\frac{a^2}{b}V$

D. $\frac{a}{b^2}V$

Answer: B

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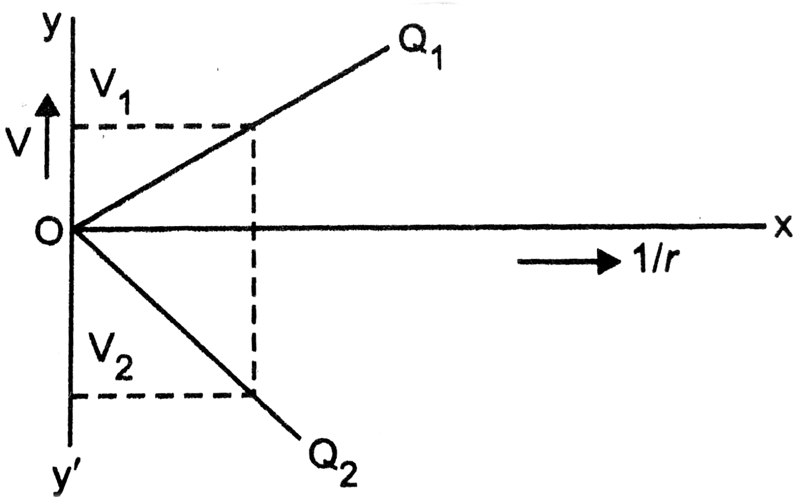
235. Fig.1 shows the variation of electric potential V with $1/r$, where r is the distance from the two charges Q_1 and Q_2. Determine



(i) signs of two charges Q_1 and Q_2

(ii) Which of the two charges has a larger magnitude ? Justify.

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236. State whether the electric potential at the center of the squares shown in Fig. (i) and (ii) is same or different.

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237. n charged drops, each of radius r and charge q, coalesce to from a big drop of radius R and charge Q. If V is the electric potential and E is the electric field at the surface of a drop, then.

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238. Suggest a configuration of three point charges separated by finite distances that has zero electric potential energy.

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239. If a point charge is taken throgh some distance in a circle around a charge q, what will be the the work done?

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240. Two charges of magnirude $-2Q$ and $+Q$ are located at points $(a, 0)$ and $(4a, 0)$ respectively .

What is the electric flux due to charges through a sphere of radius '3a' with its center at the origin.

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241. A sphere S_1 of radius r_1 encloses a total charge Q. If there is another concentric sphere S_2 of radius $r_2\left(>r_1\right)$ and there be no additional charges between S_1 and S_2 find the ration of electric flux through S_1 and S_2,

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242. A spherical rubber ballon carries some charge distributed uniformly over its surface. The balloon is blown up to increase in its size. How does the total electric flux coming out of the surface change?

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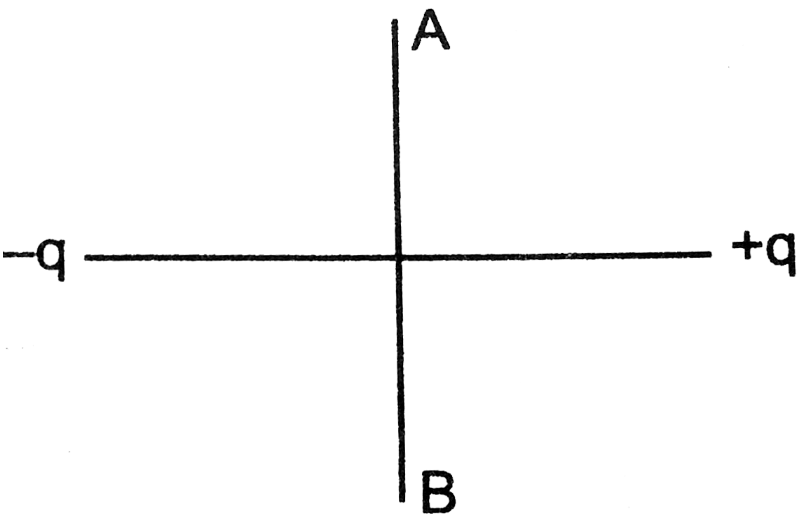
243. A charge q is moved from a point A above a dipole moment p to a point B below the dipole on equatorial plane without acceleration. Find the work done in the process.



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244. Define the unit of electric potential.

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245. IN a conductor, a point P is at higher potential than another point Q. In which direction do the electrons move?

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246. How much is the electric potential of a charge at a point at Infinity?

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247. What are the points at which electric potential of a dipole has (i) maximum value (ii) minimum value ?

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248. Can you say that earth is an equipotential surface ?

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249. How much work is doen in moving a $500\mu C$ charge between two points on an equipotential surface ?

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250. Name the physical quanity which has its unit joule $co\underline{o}mb^{-1}$. Is it a scalar or vector ?

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251. In a certain $0.1m^3$ of space, electric potential is found to be 5 V throughout. What is the electric field in this region ?

A. $50V/m$

B. $zero$

C. $0.5V/m$

D. None of these

Answer: B

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252. Will there be any effect on potential at a point if the medium around this point is changed ?

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253. Electric potential at any point in equatorial plane of a dipole is ....

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254. The middle point fo a conductor is earthed and its ends are maintained at a potential at the two ends at the middle point?

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255. Do electrons tend to go to regions of high potential ?

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256. Suppose that the earth has a net charge that is not zero. Is it still possible to adapt the earth as a standard reference point if potential and assign the potental `V = 0 to it?

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257. The dimensional formula for electric potential is

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258. A hollow metal sphere of radius $5cm$ is charged such that the potential on its surface is $10V$. The potential at the center of the sphere is -

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259. Electric field due to an electric dipole is cylindrically symmetric. Comment.

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260. Write an expression for potential at a point P $(\vec{r})$ due to two point charges q_1 and q_2 at $\vec{r}_1$ and $\vec{r}_2$ respectivley.

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261. Draw an equipotential surface for a uniform electric field.

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262. Can two equipotential surfaces cut each other?

Watch Video Solution

263. what is the SI unit of line interfral of electric field ?

Watch Video Solution

264. What work must be done in carrying an α - pariclae across a potential difference of 1 volt?

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265. Define the term potential energy of charge q at a distance r in an external electric field.

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266. What will be the electrostatic potential energy of the dipole, when placed at right angle to the field ?

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267. Give expression for 'potential energy' of charge 'q' at a distance 'r' in an external electric filed ?

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268. How many electron- volt make one joule?

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269. What is the potential energy of two equal negative point charges $2\mu C$ each held 1m apart in air ?

A. $0.018J$

B. $0.036J$

C. zero

D. None of these

Answer: B

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270. No work is done in moving a test charge over an equipotential surface, why?

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271. 5 J of work is done in moving a positive charge of 0.5C between two points. What is the potential difference between these points ?

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272. A charge of $+1C$ is placed at the centre of a spherical shell of radius 10cm. What will be the work done in moving a charge of $+1\mu C$ on its surface through a distance of 5 cm?

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273. When a $2\mu C$ charge is carried from point A to point B, the amount of work done by the electric field is $50\mu J$. What is the potential difference and which point is at a higher potential ?

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274. What is the work done in moving a test charge q through a distance of 1 cm along the equatorial axis of an electric dipole ?

Watch Video Solution

275. Define the term potential energy of charge q at a distance r in an external electric dipole ?

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276. Name the principle which is mathematical equivlanet fo coulomb's law and superposition principle.

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277. If the radius of the Gaussion surface enclosing a charge q is halved, how does the electric flux through the Gaussion surface change?

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278. A charge q is placed at the centre of a cube of side l what is the electric flux passing through two opposite faces of the cube ?

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279. Two concentric spherical shells of radii R and 2R are given charges Q_1 and Q_2 respectively.

The surfaces charge densities of the outer surfaces are equal. Determine the ratio $Q_1 : Q_2$.

A. $1:2$

B. $4:1$

C. $1:4$

D. $2:1$

Answer: C

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280. Can Gauss's law in electrostatics tell us exactly where the charge is located within the Gaussian surface ?

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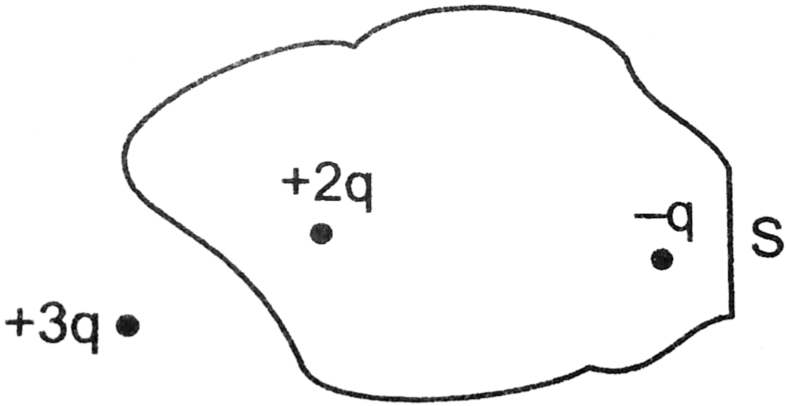
281. Fig shows three point charges $+2q$, - q and $+3q$, What is the electric flux due to this configuration thorugh the surface S ?



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282. What is the relation between electric intensity and electric flux ?

Watch Video Solution

283. What is the number of electric lines lines of force that radiate outwards from one coulomb of charge in vacumm ?

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284. What is the SI unit of surface intergal of electric field ?

Watch Video Solution

285. An electric dipole of diople moment $20 \times 10^{-6} Cm$ is enclosed by a closed surface. What is the net electric flux coming out of the surface ?

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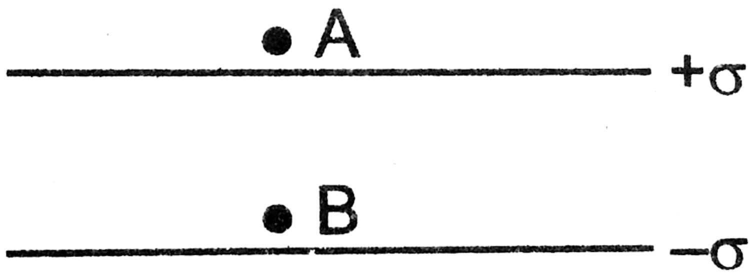
286. Two plane sheets of charge densities $+\sigma$ and $-\sigma$ are kept in air as shown in Fig. What are electric field intensities at points A and B ?



A. $\frac{\sigma}{\varepsilon_0}, 0$

B. $0, 0$

C. $\frac{\sigma}{\varepsilon_0}, \frac{\sigma}{\varepsilon_0}$

D. $0, \frac{\sigma}{\varepsilon_0}$

Answer: D

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287. Justify that electrostatic potential is constant throughout the volume of charged conductor and has same value on its surface as inside it.

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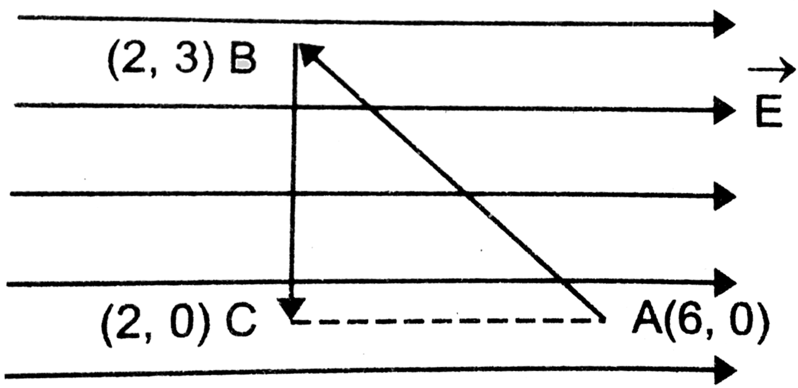
288. A test charge q is moved without acceleration from A to C along the path from A to B and then from B to C in electric field E as shown in Fig. (i) Calculate the potential difference between A and C (ii) At what point [of A and C] is the electric potential more and why?



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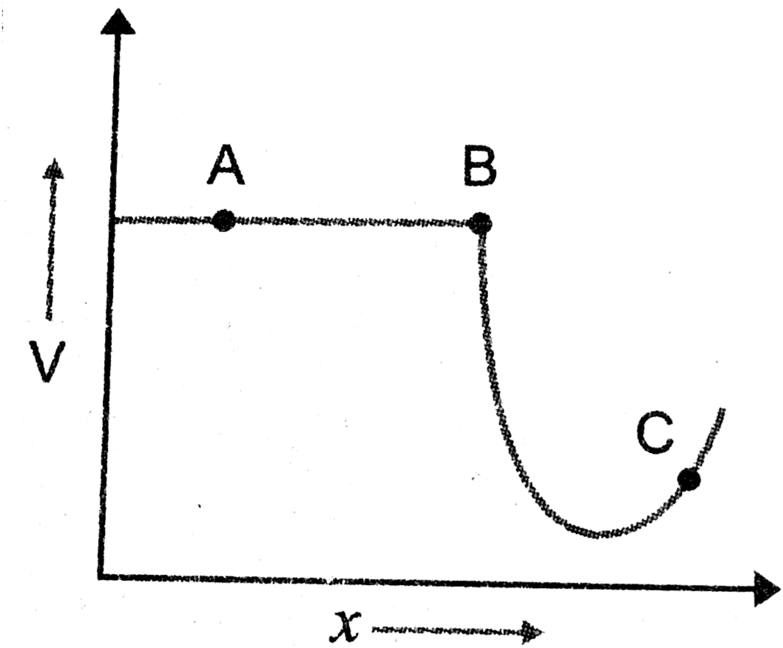
289. Fig shows the variation of electrostatic potential V with distance x for a given charge distribution.



From the points marked A,B and C, indentify the point at which electric field is (i) zero

(ii) maximum.

Explain your answer in each case.

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290. The electric potential V at any point x, y, z (all in meters) in space is given by $V = 4x^2$ volts. The electric field at the point (1m, 0, 2m) is.................V/m.

A. -8

B. -4

C. -2

D. $zero$

Answer: A

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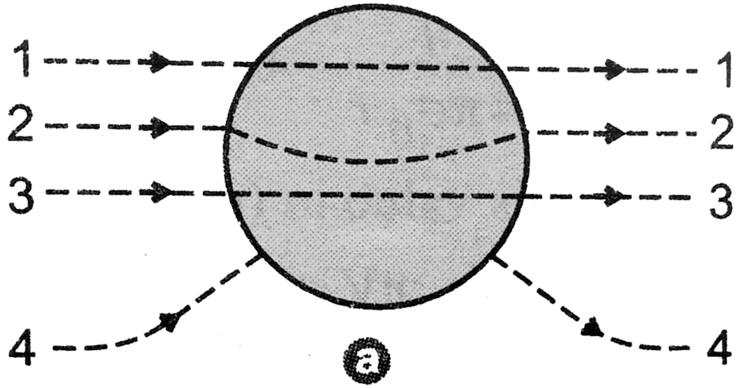
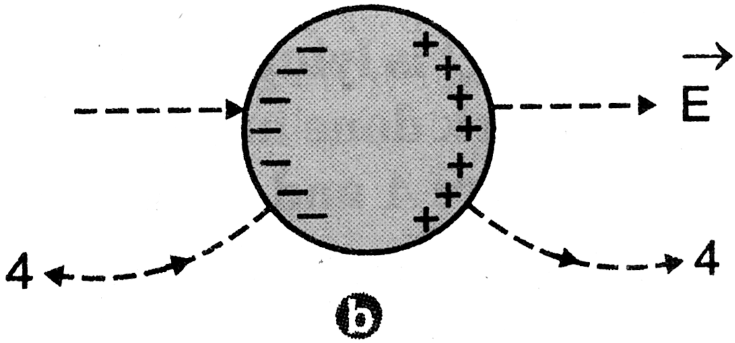
291. A metallic solid sphere is placed in a uniform electric field, Fig. Which path is followed by the lines of force ?





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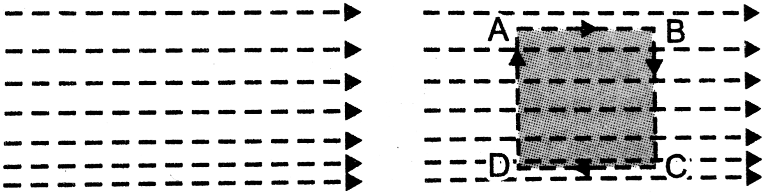
292. Can we create an electric field in which all the lines of force are parallel but their density increases continusously in a direction per-pendicular to the lines of force, fig.



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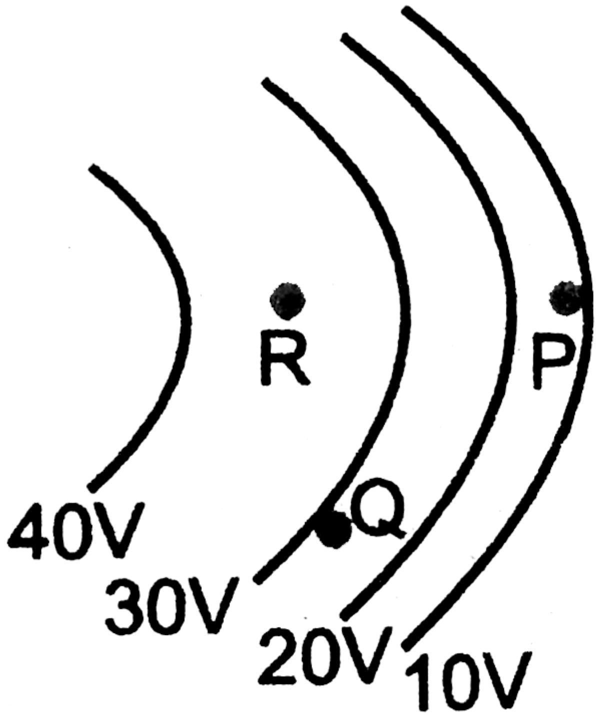
293. Fig. shows lines of constant potential in an electric field. Out of the three given points P,Q,R where is electric field intensity maximum and where is it minimum ?



A. maximum at Q and minimum at P

B. maximum at P and minimum at Q

C. maximum at Q and minimum at R

D. maximum at P and minimum at R

Answer: D

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294. Electric charge is distributed uniformly on the surface of a spherical rubber ballon. Show how the value of electric intensity and potential vary (i) on the surface (ii), inside and (iii) outside ?

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295. Draw 3 equipotential surfaces corresponding to a field that uniformly increases in magnitude but remains constant along positive Z-direction. How are these surfaces different from that of a constant electric field along Z-direction ?

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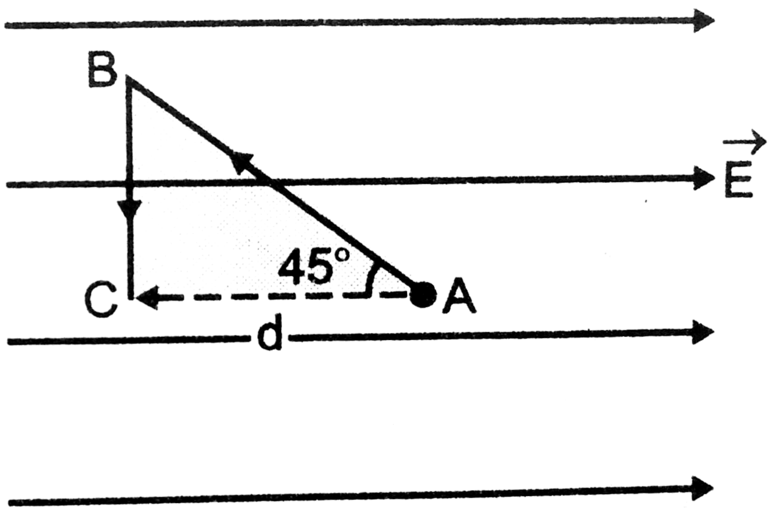
296. A test charge q_0 is moved without acceleration from A to C over the path ABC as shown in Fig.

Calcualate potential difference beetween A and C.



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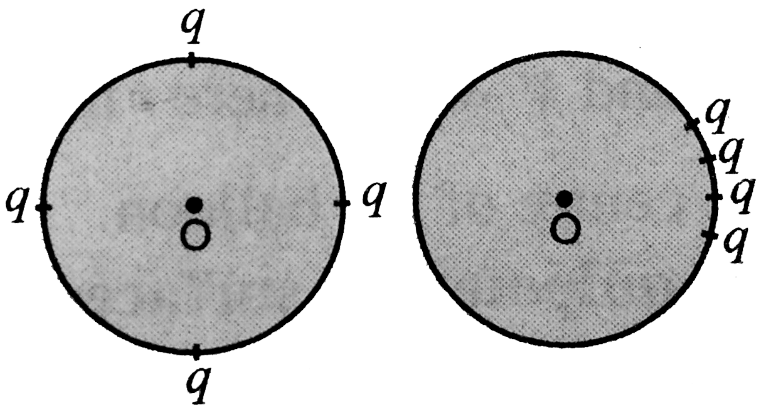
297. Electric potential at a point 0 due to a number of a point charges equidistant from 0 si V_1 when charges are uniformly distributed and it is V_2 when charges are non uniformly distributed , Fig. Is `V_(1) = V_(2) ? Justify.



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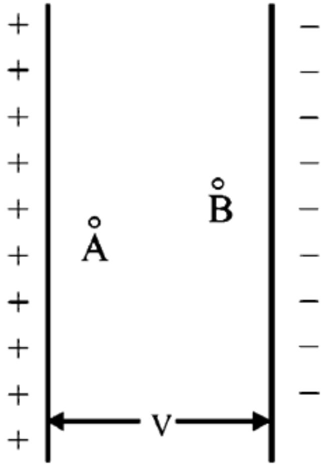
298. Two protons A and B are placed in between the two plates of a parallel plate capacitor charged to a potential difference V as shown in the figure. The forces on the two protons are identical.



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299. Define surface density of charge and potential of a charged and potential of a charged spherical conductor. Establish a relation between them.

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300. A charge $+Q$ is lying at the center of a circle. What is work done in carrying charge q from A to B, where A and B, both lie on the circle.

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301. Around a point charge of $1nC$, what is the distance of an equipotential surface of $0.9V$?

A. 10 m

B. 0.1 m

C. 20 m

D. 9 m

Answer: A

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302. A proton is released from rest in a unifrom electric field. Does the proton's electric potential energy increase or decrease? Does the proton move towards a location with a higher or a lower electric potential.

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303. When a proton approaches another fixed proton, what happens to :

(a) the kinetic energy of the approaching proton

(b) the electric potential energy potential energy of the system and

(c) the total energy of the system ?

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304. Write an expression for potential energy of two charges q_1 and $q_2 at \overrightarrow{r_1}$ and $\overrightarrow{r_2}$ in a uniform electric field $\vec{E}$.

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305. Equipotential surfaces are perpendicular to field lines. Why ?

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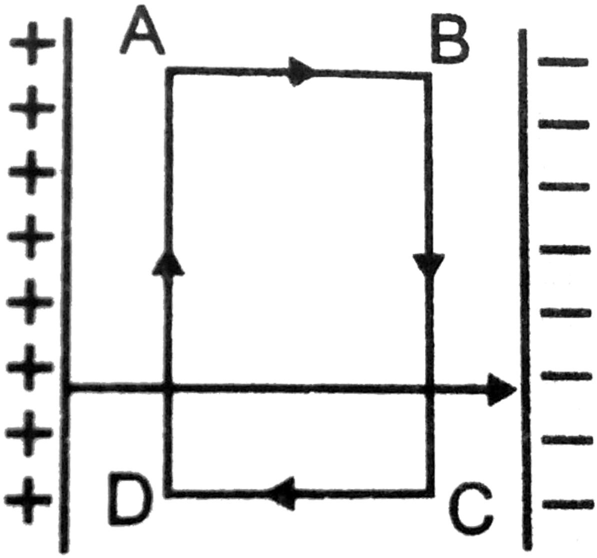
306. A uniform electric field E axis between two charged plates as shown in Fig. What would be work done in moving a charge q along the closed recetangualr path ABCDA ?



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307. The same Gaussain surface is used to surround two charged objects. The net number of field lines penetracting the surface is same in both the cases, but the lines are oppositely directed. What can you say about the net charge on the two objects?

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308. Charge q_1 is inside the Gaussain surface , charge q_2 just outside the surface. Does the electric flux through the surface.Does the electric flux through the surface depend on q_1 ? Does it depend on q_2 ? Explain.

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309. Using Gauss's law, derive an expression for the electric field intensity at any point near a uniformly charged thin wire of $charge/length = \lambda C/m$.

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310. Define electric flux. Write its SI unit. A charge q is enclosed by a spherical surface of radius R. If the radius is reduced to half, how would the electric flux through the surface change ?

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311. A hemispherical body of radius R is placed in a uniform electric field E. What is the flux linked with the curved surface if, the field is (a) parallel to the base, (b) perpendicular to the base.

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312. Explain what is meant by an electric line of force? Give its two important properties ?

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313. Give two properties of electric lines of force. Sketch them for an isolated positive point charge and an electric dipole.

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314. Derive genral expression for rectangular components of electric intensity due to point charge in space.

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315. Derive an expression for force and torque acting on an electric field. In which situation, torque on the dipole is (i) maximum and (ii) minimum

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316. Derive an expression for potential energy of an electric dipole in a uniform electric field. In which situation, the potential energy fo dipole is (i) maximum and (ii) minimum.

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317. Explain the physical meaning of potential and potential difference. Find a relation for electrostic potential at a point due to a point charge.

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318. What do you understand by potential gradiednt ?

Establish a relation between electric field and potential gradient.

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319. Establishthat electrostatic forces are conservative. Give two example of conservative forces.

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320. What do you understand by electrostatic potential energy ? Find an expression for electrostatic potential energy of a system of two point charges.

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321. State and prove Gauss's law in electrostatics.

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322. State Gauss's Theorem in electrostatics and deduce coulomb's law from Gauss's theorem.

Watch Video Solution

323. Explain the conept of electric potential energy.

Derive an expression for potential energy of a system of two point charges. Generalise the expression fo N discrete charges.

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324. Derive an expression for the electric potential at any point P at a distance r from the center of an electric dipole, making angle α with its axis.

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325. Using Gauss's law, derive an expression for the electric field intensity at any point near a uniformly charged thin wire of $charge/length = \lambda C/m$.

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326. A potential difference of 250 Volt is applied across the plate of a capacitor of 10 pF. Calculate the charge on the plates of the capacitor.

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327. Diameter of a spherical conductor is 1 meter. What is its capacity ?

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328. Calculate the capacitance of a parallel plate condenser of two plates $100cm \times 100cm$ each separated by 2mm thick glass sheet of K = 4.

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329. The capacity of a capacitor becomes $10\mu F$ when air between the plates is replaced by a dielectric slab of K = 2. What is the capacity of the condenser with air in between the plates ?

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330. Three capacitors of $1\mu F, 2\mu F$ and $3\mu F$ are joined in series. How many times will the capacity become when they are joined in parallel ?

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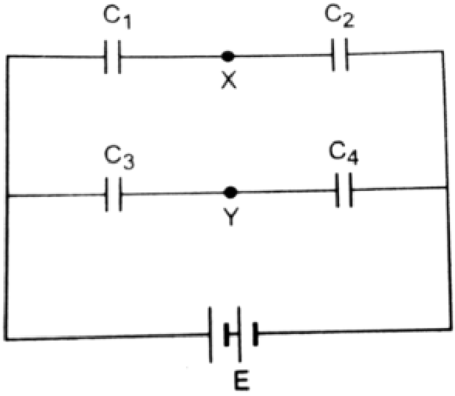
331. In fig potential difference between the points X and Y, when $C_1 = 2\mu F, C_2 = 3\mu F, C_3 = 4\mu F, C_4 = 5\mu F$ and e.m.f of battery is 5 V.



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332. Calculate energy stored in a capacitor stored in a capacitor of $5\mu F$ when it is charged to a potential of 250 volt.

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333. What capacitance is required to store an energy of 100 kWh at a potential difference of $10^4 V$?

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334. A $600pF$ capacitor is charged by a $200V$ supply. It is then disconnected from the supply and is connected to another uncharged $600pF$ capacitor. What is the common potential in V and energy lost in J after reconnection?

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335. A 400 pF capacitor, charged by a 100 volt d.c supply is disconnected from the supply and connected to another uncharged 400 pF capacitor. Calculate the loss of energy.

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336. Find the capacitance of a system of three parallel plates, each of area A $metre^2$ separated by distances d_1 and d_2 metre respectively. The space between them is filled with dielectrics fo relatives dielectric constants K_1 and K_2. The dielectric constant of free space is $\in_0$.

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337. Why are lighting stroms so dangerous ?

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338. Eight identical spherical drops, each carrying charge 1 nC are at a potential of 900 V each. All these drops combine together to from a single large drop. Assume no wastage of any kind. Take capacitance of a sphere of radius r as proportional to r.

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339. As isolated sphere has a capacitance $60pF$. (i) Calculate its radius. (ii) How much charge should be placed on it to raise its potential to 10^4V ?

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340. If the capacitance of a conductor carrying a charge of 58C is 0.05 F, calculate its potential.

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341. When 1.0×10^{12}electrons are transferred from one conductor to another, a potential difference of $10V$ find the capacitance of the two -conductor system .

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342. Calculate the capacity of unknown capacitance is connected across a battery of V volts. The charge stored in it is $360\mu C$. When potential across the capacitor is reduced by 120V, the charge stored in it becomes $120\mu C$.

Calculate (i) the potential V and unknown capacitance C. (ii) What will be the charge stored in the capacitor. If the voltage applied had increased by 120 V

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343. A charge of $+2.0 \times 10^{-8}$ C is placed on the positive place and a charge of $-1.0 \times 10^{-8}C$ on the negative plate of a parallel- plate capacitor of capacitance $1.2 \times 10^{-3}\mu$ F. Calculate the potential difference developed between the plates.

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344. Two parallel plate air capacitors have their plate areas 100 and $500 cm^2$ respectively. If they have the same charge and potential and the distance between the plates of the first capacitor of 0.5 mm, what is the distance between the plates of second capacitor ?

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345. What is the area of the plates of a 2 farad parallel plate air capacitor, given that the separation between the plates is 0.5 cm?

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346. A parallel -plate capacitor having plate area $25.0 cm^2$ and a separation 2.00 mm between the plates .the capacitor is connected to a battery of 12.0V.(a)find the charge on the capacitor

.(b) the plate separation is decreased to 1.00mm. Find the extra charge given by the battery to the positive plate.

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347. The thickness of air layer between two coating of a spherical capacitor is 2cm. The capacitor has same capacitor as the sphere of 1.2m diameter. Find the radii of its surfaces.

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348. Calculate the capacitance of a spherical capacitor consisting of two concentric spheres of radius 0.50m, 0.60m. The material filled in the space between the two spheres has a dielectric constant of 6.

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349. what is the capacitance of a 1m long hifi cable where the central conductor is 1mm in diameter and the shield is 5mm in diameter ?

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350. The outer cylinder of a cylindrical capacitor of length 0.15 m and radial 1.61 cm and 1.5 cm is earthed while inner cylinder of this capacitor is given a charge of $8\mu C$. Find the capacitance and potential of inner part of the capacitor.

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351. Seven capacitors each of capacitance $2\mu F$ are to be connected in a configuration to obtain an effective capacitance of $\left(\frac{10}{11}\right)\mu F$.

Which of the combination (s) shown in figure will achieve the desired result?

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352. Two capacitors of capacitance of $6\mu F$ and $12\mu F$ are connected in series with a battery. The voltage across the $6\mu F$ capacitor is 2V. Compute the total battery voltage.

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353. Two capacitors of capacitances $3\mu F$ and $6\mu F$, are charged to potentials 2V and 5V respectively. These two charged capacitors are connected in series. Find the potential across each of the two capacitors now.

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354. In fig. $C_1 = 20\mu F$, $C_2 = 30\mu F$ and $C_3 = 15\mu F$ and the insulated plate of C_1 is at a potential of 90 V, one plate of C_3 being earthed. What is the potential difference between the plates of C_2 three capacitors being connected in series ?

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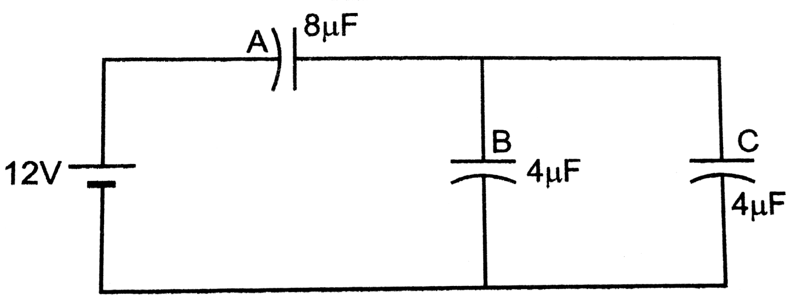
355. Find the charge appearing on each of the three capacitors shown in Fig.



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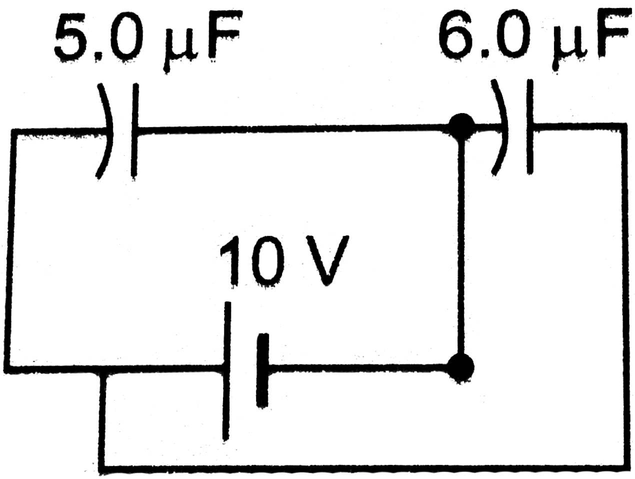
356. Find charge supplied by the battery in the arrangement shown in figure.



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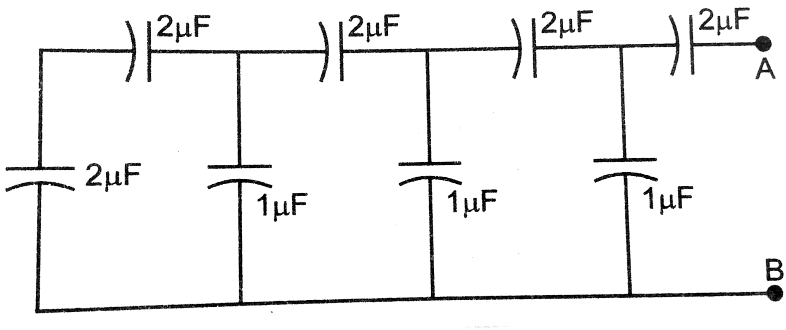
357. Find the capacitance of the combination shown in Fig.



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358. It is required to construct a 10μ F capacitor which can be connected across a 200V battery . Capacitance $10\mu F$ are available but they can withstand only 50V ,Design a combination which can yield the desired result .

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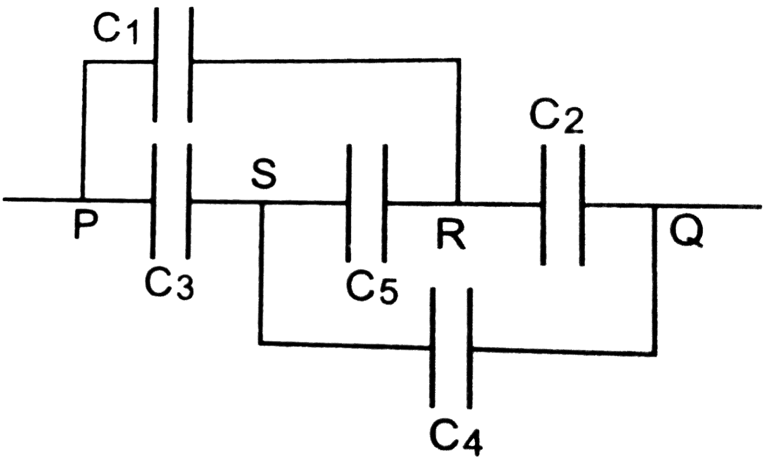
359. In fig, the values of capacitances are as follow

$C_1 = C_2 = C_3 = C_4 = 4\mu F, C_5 = 5\mu F$ Calculate the equivalent capacitance between the points P and Q. If a battery of 10 volt is connected between these points, what will be the charge on each capacitor ?



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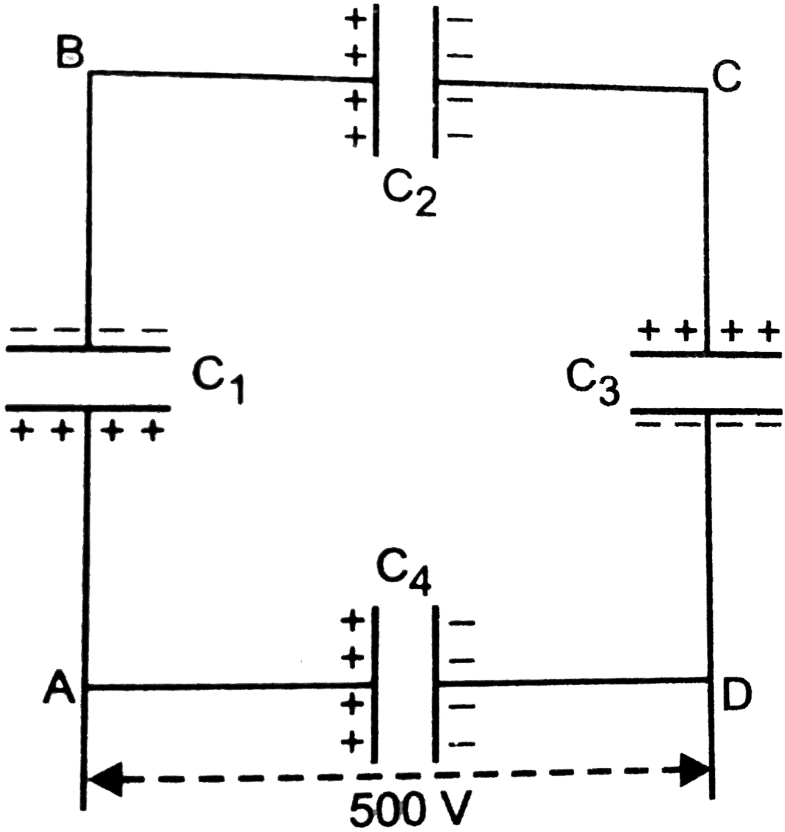
360. A network of four $10\mu F$ capacitors is connected to a 500V supply as shown in Fig. Determine the (a) equivalent capacitance of the network and (b) charge on each capacitor.



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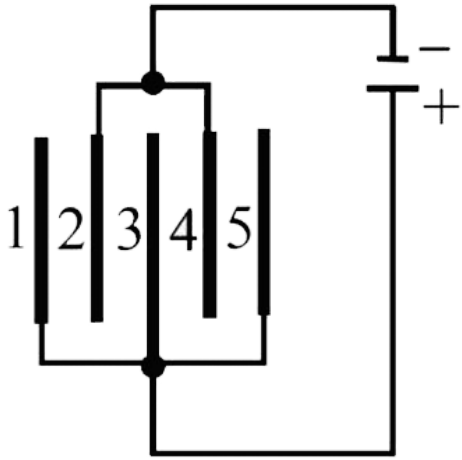
361. Five identical capacitor plates, each of area A, are arranged such that adjacent plates are at a distance d apart, the plates are connected to a source of emf V as shown in the figure



The charge on plate 1 is ....and on plate 4 is............

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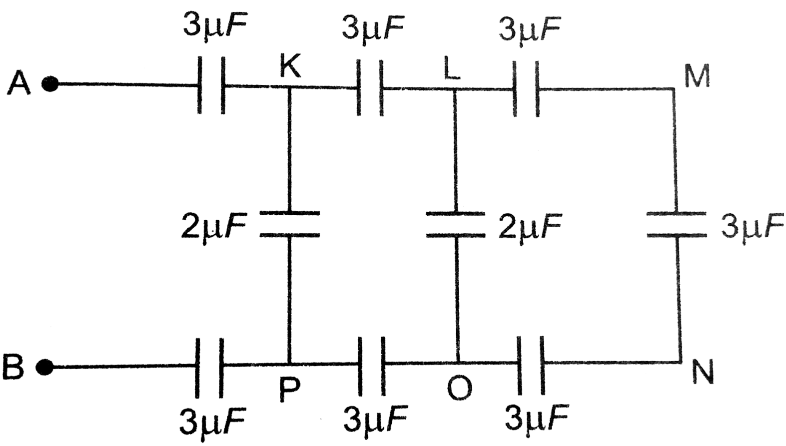
362. Find equivalent capacitance between A & B, Fig.



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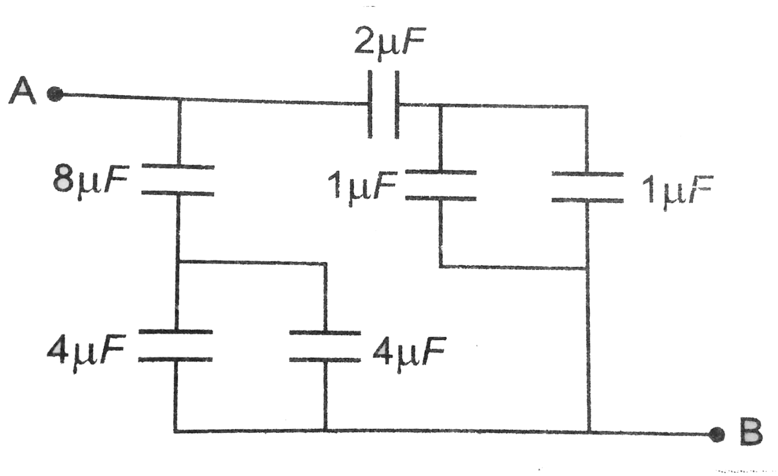
363. In Fig., find equivalent capacity between A and B.



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364. A $12pF$ capacitor is connected to a 50 V battery. How much electrostatic energy is stored in the capacitor ? If another capacitor of $6pF$ is connected across the combination, find the charge stored and potential difference across each capacitor.

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365. Find the ratio of potential differences that must be applied across the parallel and series combination of two capacitors C_1 and C_2 with their capacitance in the ratio 1 : 2 so that energy stored in the two cases becomes the same.

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366. A capacitor is charged to potential V_1. The power supply id disconnected and capacitor is connected in parallel to another uncharged capacitor. Calculate common potential of the combination of capacitors. Show that total energy of the combination is less than sum of energies stored in them before they are connected.

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367. Two capacitors of unknown capacitance C_1 and C_2 are connected first in series and then in parallel, across a battery of 100V. If the energy stored in the two combinations is 0.045 J and 0.25 J respectively determine the values of C_1 and C_2. Also calculate the charge on each capacitor in parallel combination.

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368. Find the ratio of potential difference that must be applied across the parallel and series combination of two capacitors C_1 and C_2 with their capacitance in the ratio 1:3 so that energy stored in the two cases becomes the same.

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369. A capacitor charged from a 50 V d.c. supply is found to have charge of $10\mu C$. What is the capacitance of the capacitor and how much energy is stored in it?

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370. A capacitor of capacitance $6\mu F$ is charged to a potential of 150V. Its potential falls to 90V, when another uncharged capacitor is connected to it. Find the capacitance of the second capacitor and the amount of energy lost due to the connection.

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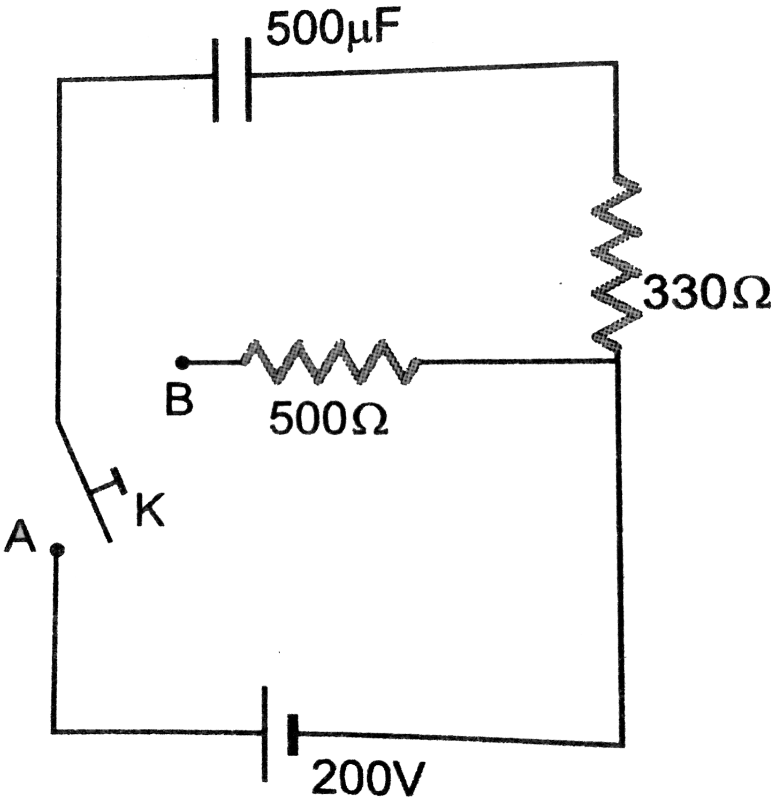
371. In the circuit shown in Fig. the key K was initally in contact with the teminal A. What amount of heat will be generated in 500Ω resitance, when the key k is brought in contact with terminal

B ?



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372. A 900 pF capacitor is charged by 100V battery.

(a) How much electrostatic energy is strored by the capacitor ?

The capacitor is disconnected from the battery and connected to another 900 pF capacitor. How much is the electrostatic energy stored in the system ?

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373. Keeping the voltage of the charging source constant, what would be the percentage change in the energy stored in a parallel plate capacitor, if the separation between in plates were to be decreased by 10% ?

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374. A parallel plate capacitor with air in between the plates has a capacitance of $8pF$. The separation between the plates is now reduced to half and the space between them is filled with a medium of dielectric constant 5.

Calculate the value of capacitance in the second case.

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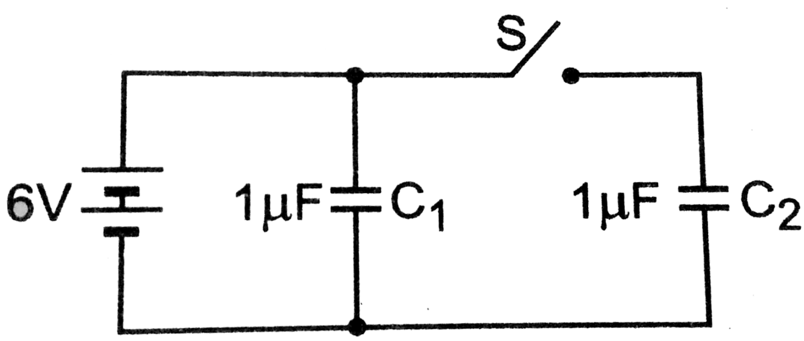
375. Fig, shows two indentical capacitors C_1 and C_2 each of $1\mu F$ capacitance connected to a battery of 6V. Inditally, swich S is closed. After some time, the swich S is left open and dielectric slabs of K = 3 are inserted to filll completely the space between the plates of two capacitors . How will (i) the charge and (ii) potential difference between the plates of the capacitors be affected after the slabs are inserted ?



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376. An ebomiote rod (K = 3), 6 mm thick is introduced between the plates of a parallel plate capacitor of plate area $4 \times 10^{-2} m^2$ and plate separation 0.01m. Find the capacitance.

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377. A dielectric slab of thickness 1.0 cm and dielectric constant 5 is placed between the plates of a parallel plate capacitor of plate area $0.01 m^2$ and separation 2.0 cm. Calculate the change in capacity on introduction of dielectric. What would be on the change, if the dielectric slab were conducting?

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378. A slab of material of dielectric constant K has the same area as the plates of a parallel capacitor, but has a thickness $\left(\frac{3}{4}d\right)$, where d is the separation of the plates. How is the capacitance changed when the slab is inserted between the plates

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379. A parallel plate capacitor is maintained at a certain potential difference. When a 3mm thick slab is introduced between the plates, in a order to maintain the same potential difference, the distance between the plates is increased by 2.4 mm. Find the dielectric constant of the slab.

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380. Assuming ab expression for the potential of an isolated conductor, show that the capacitance of such a sphere will be increased by a factor n, if it is enclosed within an earthed concentric sphere, the ration of the spheres being $n(n - 1)$.

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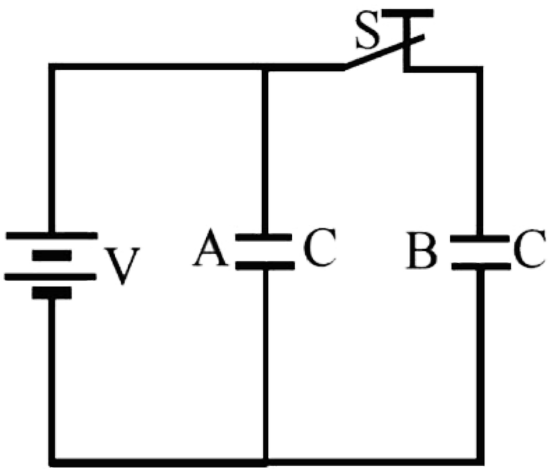
381. The figure shows two identical parallel plate capacitors connected to a battery with the switch S closed. The switch is now opened and the free space between the plates of the capacitors is filled with a dielectric of dielectric constant(or relative permittivity) 3. Find the ratio of the total electrostatic energy stored in both capacitors before and after the introduction of the dielectric.



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382. A parallel plate capacitor contanins a mica sheet (thickness $0.5 + \times 10^{-3}m$) . And a sheet of fiber (thickness $0.5 \times 10^{-3}m$) . The dielectric constant of mica is 8 and that of thye fiber is 2.5 Assuming that the fiber breaks down when subjected to an electric field of $6.4 \times 10^6 Vm^{-1}$. , find the maximum safe voltage that can be applied to the capacitor.

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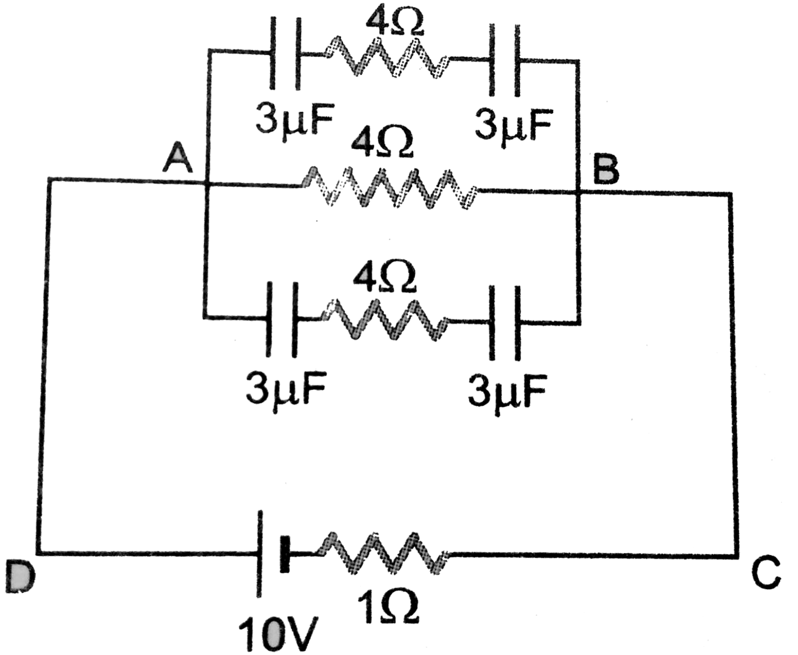
383. In the circuit shown in Fig. each capacitor has a capacity of $3\mu F$. Calculate the quantity of charge on each capacitor.



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384. The area of each plate of parallel plate air capacitor is $150 cm^2$. The distance between its plates is 0.8 mm. It is charged to a pot. Diff of 1200 volt. What will be its energy ? What wil be the energy when it is filled with a medium of K = 3 and then charged. If it is charged. If it is charged first as an air capacitor and then filled with this dielectric, what will happen to energy ?

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385. An air -filled parallel-plate capacitor is to be constructed which can store$12\mu C$ of charge when operated at $1200V$. What can be the minimum plate area of the capacitor?The dielectric strength air is $3 \times 10^6 Vm^{-1}$.

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386. Two identical metal plates are given poistive charges Q_1 and $Q_2\left(< Q_1\right)$ respectively. If they are now brought close together to form a parallel plate capacitor with capacitance C, the potencial difference between them is

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387. A capaitor of capacitance $C_1 = 1.0\mu F$ withstands teh maximum voltage $V_1 = 6.0kV$ while a capacitor of capacitance $C_s = 2.0\mu F$, the maximum voltage $V_s = 4.0kV$. What voltage will the system of these two capacitors withsatand if they are connected in sereis ?

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388. A molecule of a substance has a permanent electric dipole moment of magnitude 10^{-29}C m. A mole of this substance is polarized at low temperature by appling a strong elecrostatic field of magnitude $10^6 Vm^{-1}$. The direction of the field is suddenly changed by an angle of 60°. Estimate the heat released by the substance in aligning its dipole along the new direction of the field. For simplicity, assume 100% polarisation of sample.

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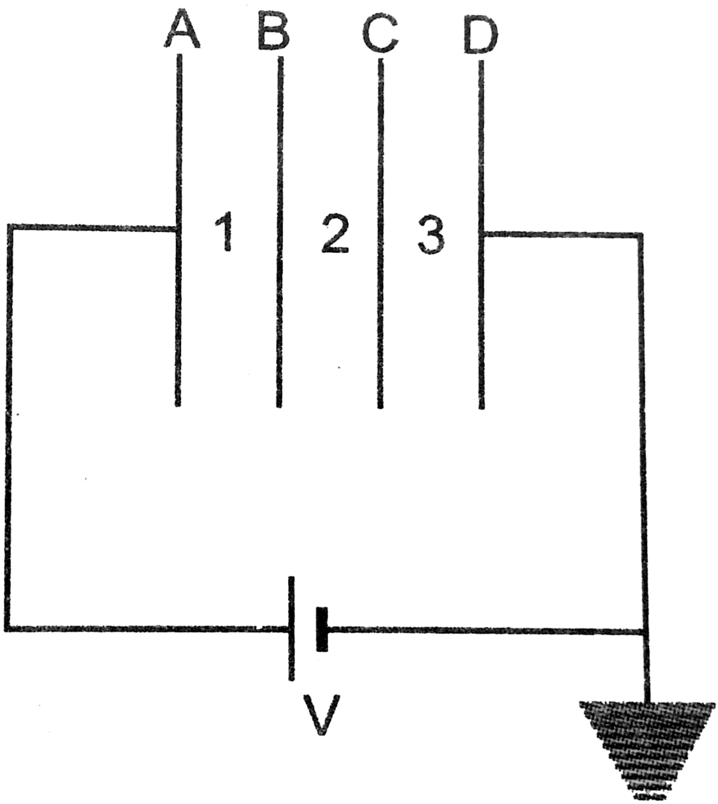
389. A,B,C,D are four 'thin', similar metatllic parallel plates, equally separated by distanace d, and connected to a cell of p.d. (V), as shown in Fig.



(i) write the potentials of A,B,C and D.

(ii) If B and C be connected by a wire, then what will b e the potentials of the paltes ? (iii) How will the electric fields ? (iv) Will the charges on the plates A and D change ?

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390. A student requires a capacitor of $3\mu F$ in a circuit across a potential of 1000 V. A large number of $2\mu F$ capacitors are available to him, each of which can withstand a potential difference of not more than 300 V. How should the student arrange these capacitors so that he may use minimum number of condensers ?

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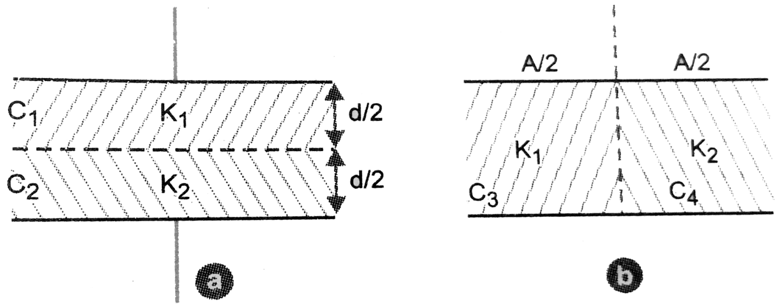
391. A capacitor is filled with two dielectrics of same dimensions, but of dielectric constants 2 and 3 respectively. Find the ratio of capacitances in the two arrangements shown in Fig.



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392. A parallel plate capacitor of plate area $(1 \times 3)m^2$ and plate separation 5.0 mm is charged to 10 kV in air. Find charge density and field displacement.

Watch Video Solution

393. Two infinitely large sheets having charge densities σ_1 and σ_2 respectively $\left(\sigma_1 > \sigma_2\right)$ are placed inbetween two plates such that there is no effect on charge distribution on plates. This charge is moved at an angle of 45° with horizontal towards plate having charge density σ_2, through a distance a lt d. Find work done by electric force.

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394. Two copper spheres of same radill, one hollow and other solid are charged to same potential. Which if any of the two will have more charge ?

Watch Video Solution

395. Two identical metal plates are given poistive charges Q_1 and $Q_2\left(< Q_1\right)$ respectively. If they are now brought close together to form a parallel plate capacitor with capacitance C, the potencial difference between them is

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396. Why is earth considered as zero of potential in practice ? Justify.

Watch Video Solution

397. What is the physical signifance fo capacitance ?

Watch Video Solution

398. Can you place a parallel plate capacitor of one farad capacity in your house ?

Watch Video Solution

399. An air capacitor is given a charge of $2\mu C$ raising its potential falls to 50V, what is the dielectric constant of the medium ?

Watch Video Solution

400. By what factor does the capacity of a metal sphere increase if its volume is tripied ?

Watch Video Solution

401. What is the effect of presence of a dielectric medium on

(i) capacitance of a parallel plate capacitor

(ii) electrostatic force between two charges ?

Watch Video Solution

402. A parallel plate capcitor of capacitance C is charged to a potential V by a battery. Without disconencting the battery = distance between the plates of capacitor is triple and a dielectric medium of K = 10 is introduced between the plates of capacitor. Explain giving reasons how will the following be affected ?

(a) Capacitance of capacitor

(b) Charge on capacitor

(c) Energy density of capacitor.

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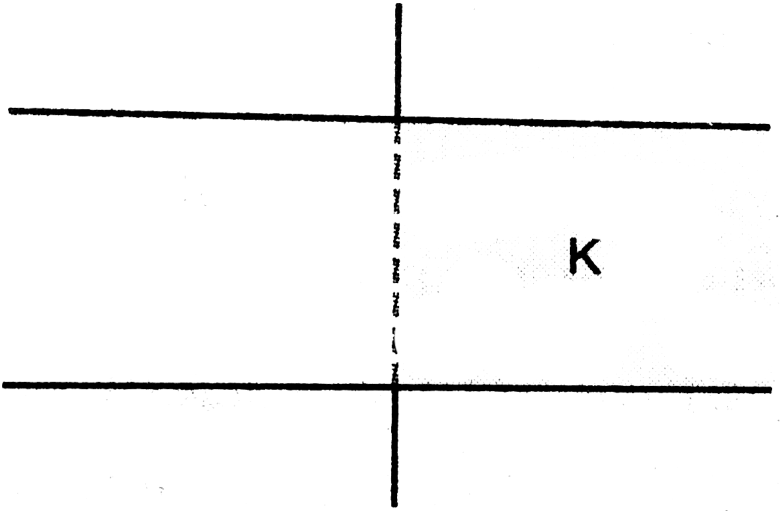
403. As shown in Fig, a dielectric material of dielectric constant K is inserted in half portion between plates of parallel plate capacitor. If its initial capacitance is C, what is the new capacitance

?



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404. A technican has only two capacitors. By using them singly, in series kor in parallel, he is able to obtain th capacitane of 4,5,20 and 25 micro farad. What are the capacitance of the two capacitors ?

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405. Two isolated metallic solid spheres of radii R and 2R are charged such that both of these have same charge density σ. The spheres are located far away from each other and connected by a thin conducting wire. Find the new charge density on the bigger sphere.

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406. An uncharged capacitor is connected to a battery. Show that half the energy supplied by the battery is lost as heat while charging the capacitor.

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407. A spherical shell of radius R_1 with uniform charge q is expanded to a radius R_2. Find the work performed by the electric forces in this process.

Watch Video Solution

408. Two chareged sperical conductors of radill R_1 and R_2 when connected by a connecting wire acquire charges q_1 and q_2 respectively. Find the ratio of their charge densities in terms of their radil ?

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409. A capacitor is charged through a potential difference of 200V, when 0.1 C charge is stored in it. How much energy will it release, when it is discharge ?

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410. What is the dielectric constant of metal ?

Watch Video Solution

411. Is there any kind of material which when placed between the plates of capacitor reduces its capacitance ?

Watch Video Solution

412. The inroduction fo dielectric slab between the capacitor plates increases the capacitance. Why ?

Watch Video Solution

413. Where is the knowledge of dielectric strength helpful ?

Watch Video Solution

414. During lightning, you are safer inside a house than under a tree. Why?

Watch Video Solution

415. The safest way to protect yourself from lighting is to be inside a car. Comment.

Watch Video Solution

416. A sensitive instrument is to be shifted from the strong electrostaic field in its environment. Suggest a possible way.

Watch Video Solution

417. Faraday entered a big metallic cage supported on insulating pillars and then charged the cage by a powerful electric machine. He remained quite safe inside the cage. Do you believe on this happening ?

Watch Video Solution

418. Can ever the whole charge of a body be transferred to the other ? If yes, how and if not, why not ?

Watch Video Solution

419. Define capacitance of a consutor.

Watch Video Solution

420. The Capacitance of a conductor is 1 Farad. What do you mean by this statement ?

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421. Write the physical quantity that has its unit coulomb $volt^{-1}$. Is it a vector or a scalar quantity ?

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422. Write two applications fo capacitors in electrical circuits ?

Watch Video Solution

423. In what form is the energy stored in a charged capacitance ?

Watch Video Solution

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424. What is the basic purpose of using a capacitor?

Watch Video Solution

425. Write down the expression for the capacitance of a spherical capacitor.

Watch Video Solution

426. Sketch a graph to show how charge Q given to a capacitor of capacity C varies with the potential difference V.

Watch Video Solution

427. For a given potential difference, does a capacitor store more or less charge with a dielectric than it does without a dielectric.

Watch Video Solution

428. Is there any condutor which can be given almost unlimited charge ?

Watch Video Solution

429. Two spheres of silver of same radill, one soild and the other hollow are charged to the same potential, which one has greater charge ?

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430. The distance between the plates fo a parallel plate capacitor is d. A metal plate of thickness $d/2$ is placed between the plates, what will be the new capacity ?

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431. Can there be a potential difference between two adjacent conductors that carry same amount of positive charge ?

Watch Video Solution

432. Find the dimensions of capacitance.

Watch Video Solution

433. On which factors does the capacitance of a capacitor depend /

Watch Video Solution

434. A parallel plate capacitor has capacitor has a capacity of $6 \mu F$ when dielectric medium separting the plates.

Watch Video Solution

435. Can we give as much charge to a capacitor as we wish?

Watch Video Solution

436. You are with two capacitors of capacities C_1 and C_2. How will you combine them in the circuit so as to lower the capacitance of the circuit ? Write an expression for the total capacitance.

Watch Video Solution

437. If two isolated spherical conductor each having a define capacity are far apart and are connected to eachother by a fine wire, how do you calculate the capacity of the combination ? In joining them with wire, have connected them in parallel or in series ?

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438. A parallel plate capacitor with air inbetween the paltes has a capacitance of 8 pF. The separation between the plates is now reduced by half and the space between them is filled with a medium of dielectric constant 5.

Calculate the new value of capacitance.

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439. Write different expression for the energy stored in a capacitor.

Watch Video Solution

440. A uniform electric field E exists between two oppositely charged plates (Fig. 3.38). What will be the work done in moving a charge q along a closed rectangular path ?

.

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441. Where does the energy of a capacitor reside ?

Watch Video Solution

442. What is the basic difference between a charged capacitor and an electric cell ?

Watch Video Solution

443. Why is a space ship entering the ionosphere not sufficiently heatedd, though temperrataure at the top of ionosphere is nearly 700 K ?

Watch Video Solution

444. Define polarization density.

Watch Video Solution

445. Define dielectric strength of a medium. What is its value for vacuum.

Watch Video Solution

446. What is the relation between dielectric constant and electric suseptibillity ?

Watch Video Solution

447. Why does the electric conductivity of earth's atmosphere increase with altitude ?

Watch Video Solution

448. Why does the electric field inside a dielectric decrease when it is placed in an external field ?

Watch Video Solution

449. Show that the SI unit of ε_0 may be written as farad $meter^{-1}$.

Watch Video Solution

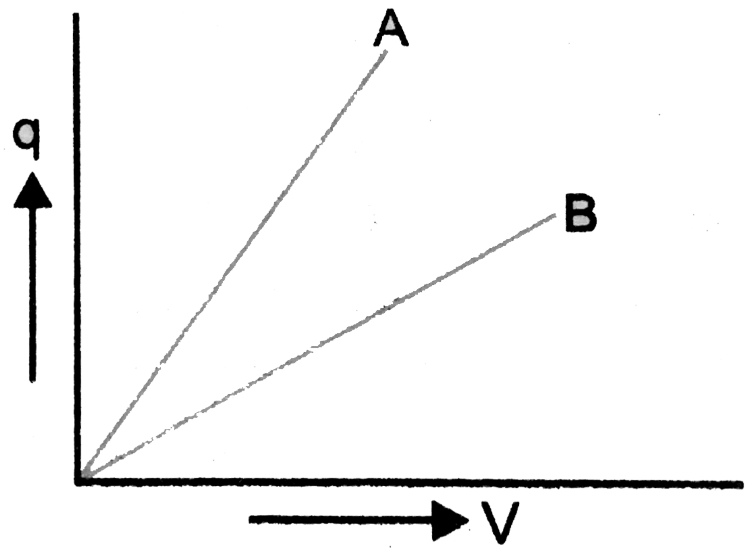
450. What is a capacitor ?

Watch Video Solution

451. The difference between the radill of the two spheres of a spherical capacitor is increased. Will the capacitance increase or decrease ?

Watch Video Solution

452. The given graph in Fig. shows the variation of charge q versus potential difference for two capacitors C_1 and C_2. The two capacitors have same plate sepration, but the plate area of C_2 is double that of C_1.



Which of the lines in the graph correspond to C_1 and C_2 and why ?

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453. The space between the plates of a parallel plate capacitor is filled conseutively with two dielectric layers fo thickness d_1 and d_2 having relative permittvities $\in_1$ and $\in_2$ respectively. If A is area of each plate, what is the capacity of the capacitor ?

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454. An uncharged insulated conductor A is brought near a charged insulated condutor B. what happens to charge and potential of B ?

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455. n small drops of same size are charged to V volts each .If they coalesce to from a single large drop, then its potential will be -

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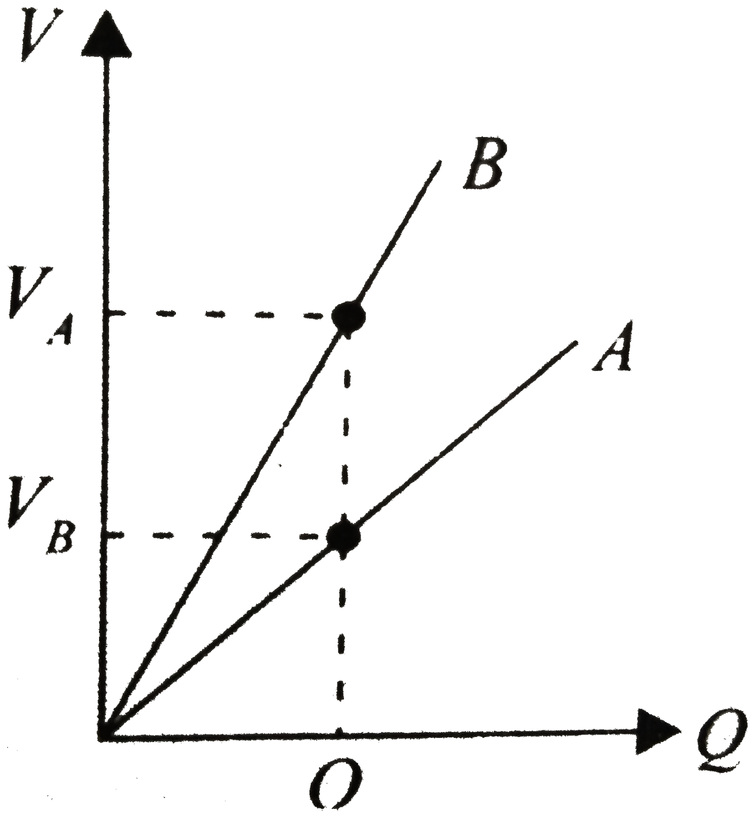
456. Shows the variation of voltage V across the plates of two capacitors A and B versus incease in charge Q stored in them. Which of the capacitors has higher capacitance? Give reason for your answer.



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457. Two circular metal plates each of radius 10 cm are kept parallel to each other at a distance of 1mm. What kind of capacitor do they make ? Mention one application of this capacitor. If the radius of each of the plates is increased by a factor of $\sqrt{2}$ and thier distance of seperation is decreased to half of its inital value, calculate the ratio of capacitance in the two cases. Suggest a possible method by which the capacitance in second case is increased to n times.

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458. A slab of material of dielectric constant K has the same area as the plates of a parallel plate capacitor, but has a thickness $3d/4$. Find the ratio of the capacitance with dielectric inside it to its capacitance without the dielectric.

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459. Two capacitors of capaciatance $3\mu F$ and $5\mu F$ respectively are joined in parallel and the combination is connected in series with a third capacitor of capacitance $2\mu F$. What is the resultant capacitane.

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460. Given a battery, how would you connect two capaitors, it series or in paralllel for them to store the greater (a) total charge (b) total energy ?

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461. A metal foll of negative thickness is intorduced between two plates of a capacitor at the center. What will be the new capacitance of the capacitance ?

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462. Two capacitors of capacitance of $6\mu F$ and $12\mu F$ are connected in series with a battery. The voltage across the $6\mu F$ capacitor is 2V. Compute the total battery voltage.

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463. If the potentail difference across a capacitor is doubled, what happens to : (a) the charge on the capacitore and (b) the energy stored in the capacitor

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464. On charging a parallel - plate capacitor to a potentia V, the spacing between the plates is halved and a dielectric medium of $\in_r = 10$ is introcded between the paltes, without disconnecting the dc source. Explain using suitable expression how the (a) capacitance (b) electric field (c) energy density of the capacitor change.

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465. The plates of a plane capacitor are drawn apart keeping them connected to a bettery. Next, the same plates are drawn apart from the same initial condition keeping the battery disconnected, In which case is more work done?

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466. The battary remains connected to a parallel plate capacitor and a dielectric slab is inserted between the plates. What will be the effect on its (i) capacity (ii) charge , (iiI) potential difference (iv) electric field, (v) energy stored ? Justify your answer.

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467. In the above question, if battery is removed after charging the condenser & dielectric slab inteoduced, how are all the fice parameters affected ?

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468. Where does the loss of energy in the above question go ?

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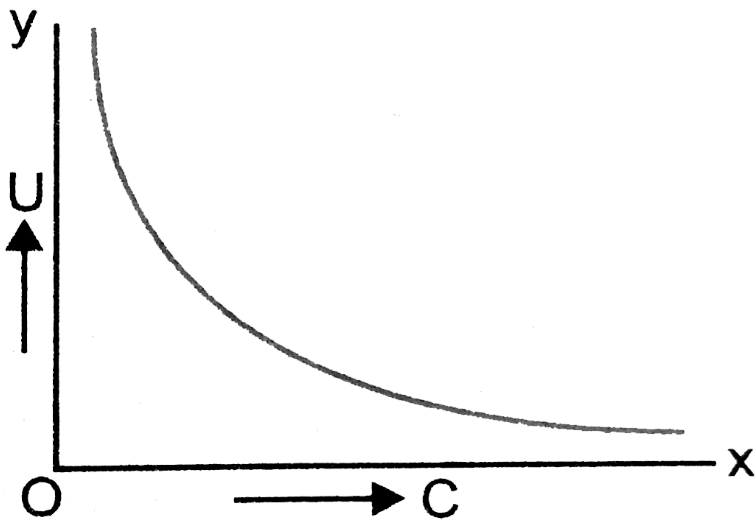
469. The graph in Fig, shows variation of total energy U stored in the capacitor against the value of the capacitance C itself. Which of the two - the charge on capacitor or potential used to charge is kept constant for this graph ?



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470. Derive an expression for energy stored in a parallel plate capacitor fo capacitane C with air as medium between the plates having charges Q and $-Q$. Show that this energy can be expressed in terms of electric field as $\frac{1}{2} \in_0 E^2$ Ad, where A is area of each plate and d is the separation between the plates. How will the energy stored in a fully charged capacitor chanege when the separation between the plates is doubled and the dielectric medium of constant 4 is introduced between the plates ?

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471. An air capacitor is given a charge of $2\mu C$ raising its potential to 200V . If on inserting a dielectric medium, its potential falls to 50V, what is the dielectric constant of the medium ?

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472. What is the effect of temperature on dielectric constant ?

Watch Video Solution

473. What are dielectric substances ? Which of the following is a dielectric : Sillicon, mica,carbon ?

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474. Why does a charged glass rod attract a piece of paper ?

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475. If dielectric strength of air (minimum field required for ionisation of a medium) is $3MV/m$, can a metal sphere of radius 1cm hold a charge of 1 coulomb ?

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476. Explain the term electric field intensity. Establish that electric field inside a charged conductor is zero.

Watch Video Solution

477. What is a capacitor ? Define its capacitance. Explain the units of capacitance.

Watch Video Solution

478. Define capacitance of a conductor. Obtain an expression for capacity of an isolated spherical conductor.

Watch Video Solution

479. Derive an expression for equivalent capacitance of three capacitors C_1, C_2 and C_3 when connected (i) in series (ii) in parallel.

Watch Video Solution

480. Three capacitors f capacitanes C_1, C_2 and C_3 are connected (i) in series, (ii) in parallel. Show that the energy stored in the series combination is the same as that in parallel combination.

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481. When two charged conductors having different capacities and different potentials are joined together, show that there is always a loss of energy.

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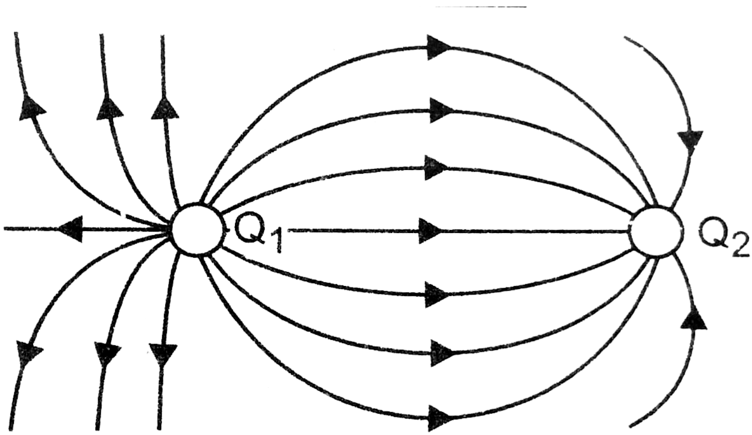
482. A few electric field lines for a system of two charges Q_1 and Q_2 fixed at two different points on the X-axis are shown in Fig.



(i) what is the nature of charges ?

(ii) which one of the two is bigger ?

(iii) What is the ratio of magnitude of two charges ?

(iv) Where can the electric field due to two charges be zero ?

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483. A charge Q is enclosed by a spherical Gaussian surface of radius R. If the radius of the sphere is double, how will the outward electric flux charge ? If a charge $-Q$ is brought outside the Gaussian surface, will the electric flux reduce to zero ?

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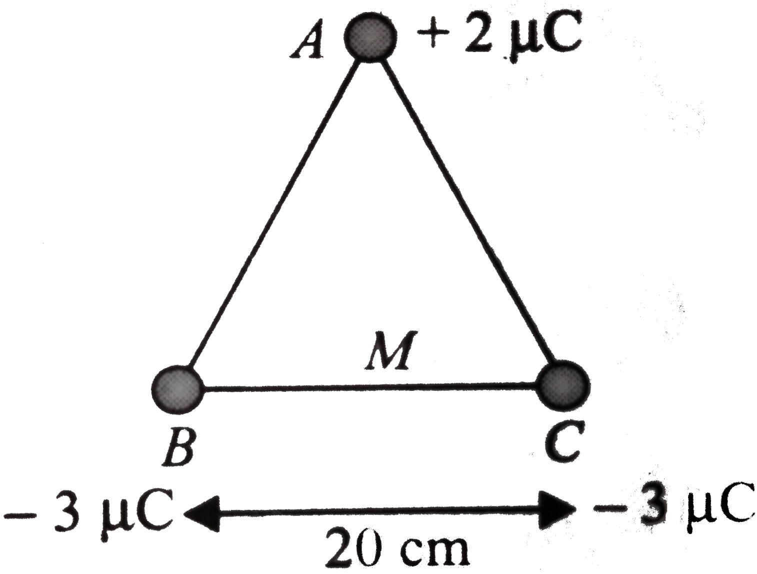
484. Three point charges of $+2\mu C$, $-3\mu C$, and $-3\mu C$ are kept at the vertices A, B, and C, respectively of an equilateral triangle of side 20 cm. what should be the sign and magnitude of the charge (q) to be placed at the midpoint (M) of side BC so that the charge at A remains in equilibrium?



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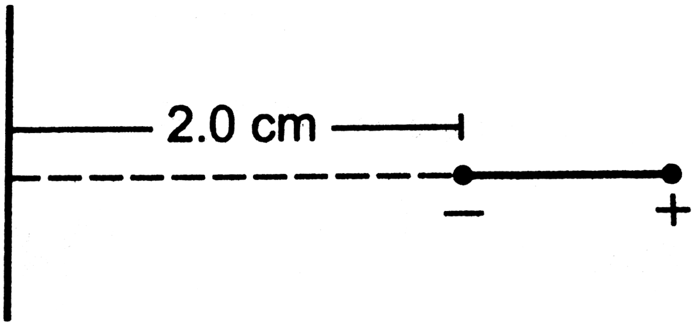
485. An electric dipole consists of charges $\pm 2.0 \times 10^{8} C$ separated by a distance of 2.0×10^{-3} m. It is placed near a long line charge of linear charge density $4.0 \times 10^{-4} Cm^{-1}$ as shown in figure (30-W4), Such that the negative charge is at a distance of `2.0 cm from the line charge. Find the force acting on the dipole.



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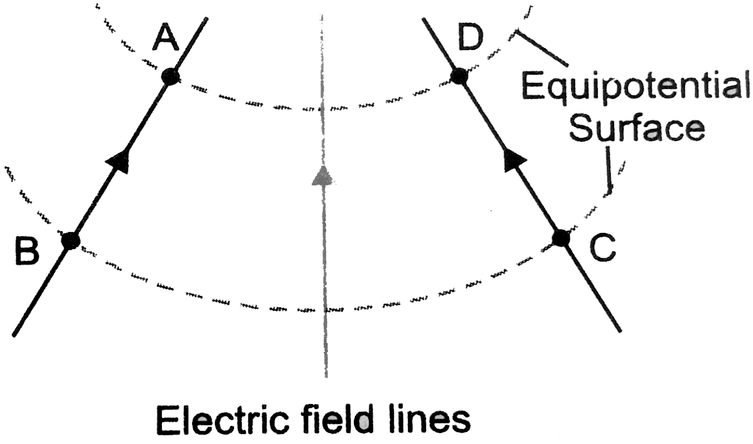
486. When an electron moves from A to B along and electric field line as shown in Fig. the electric field does $3.94 \times 10^{-19} J$ of work on it. What are the electric potential differences

$\left(V_B - V_A\right), \left(V_C - V_A\right), \left(V_C - V_B\right)$?



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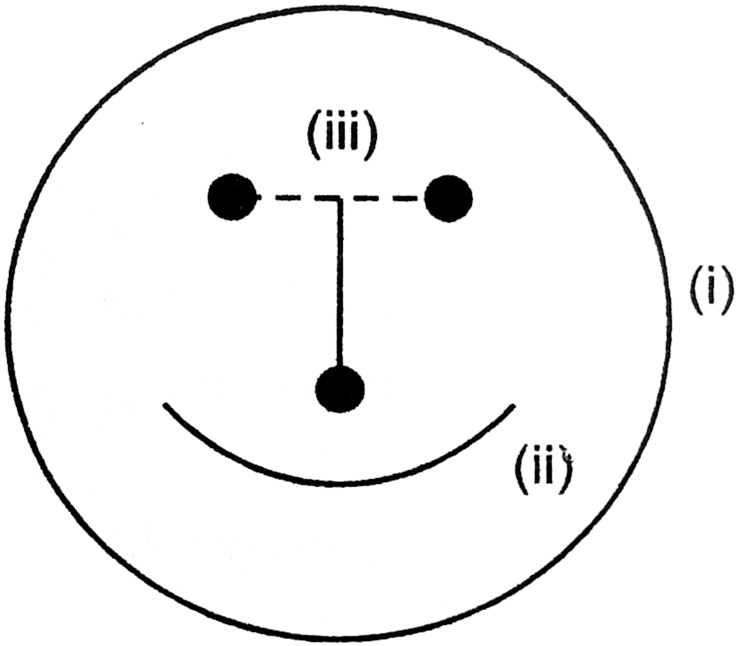
487. The smilling face of Fig, consists of three parts ,

(i) a thin rod of charge $-3.0\mu C$ that forms a full circle of radius 6.0 cm.

(ii) a thin rod of charge $2.0\mu C$ that forms a circular are of radius 4.0 cm, subtending an angle of 90° about the centre of full circle, and

(iii) and electric diipole with dipole moment $= 1.28 \times 10^{-21}$ Cm perpendicular to a radial line as shown in Fig. What is the net electric potentail as the centre ?



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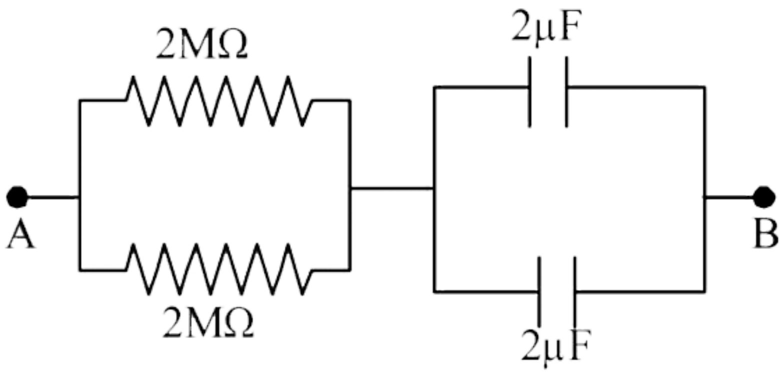
488. At time t=0, a battery of 10 V is connected across points A and B in the given circuit. If the capacitors have no charge initially, at what time (in seconds) does the voltage across them beocme 4V?

$[Take: In5 = 1.6, In3 = 1.1]$.



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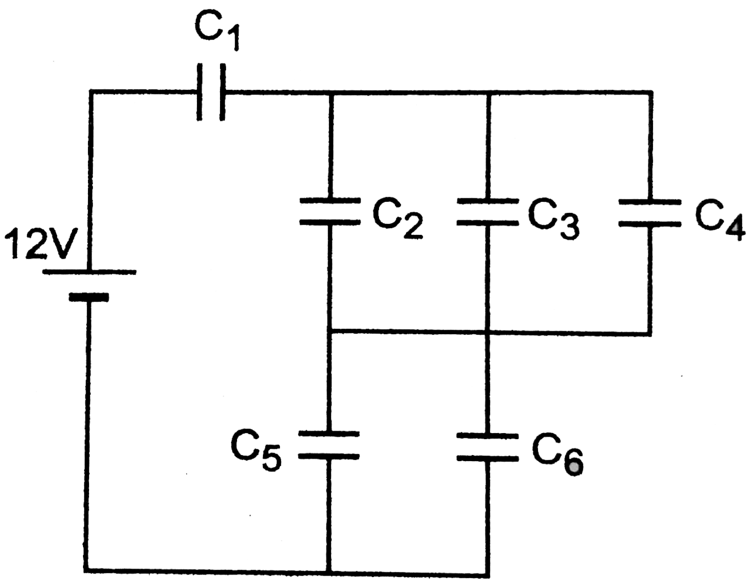
489. In the circuit shown, $C_1 = C_5 = C_6 = 6.0\mu F$ and $C_2 = C_3 = C_4 = 4.0\mu F$. What is the net charge stored on the capacitors and charge on C_4 only ?



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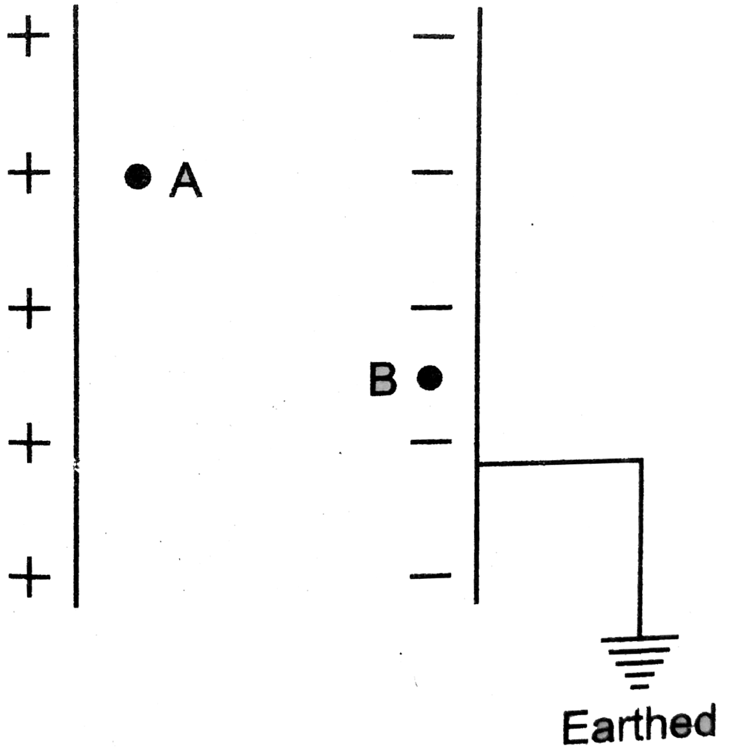
490. In a parallel plate capacitor shown in Fig, the potential difference of 100V is maintained between the plates. If distances between the plaes is 5mm, what will be the electric field at points

A and B ?



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491. The electrostatic potential inside a charged spherical ball is given by $\phi = ar^2 + b$, where r is distance from the center of the ball, a and b are constants. Calculate the charge density inside the ball.

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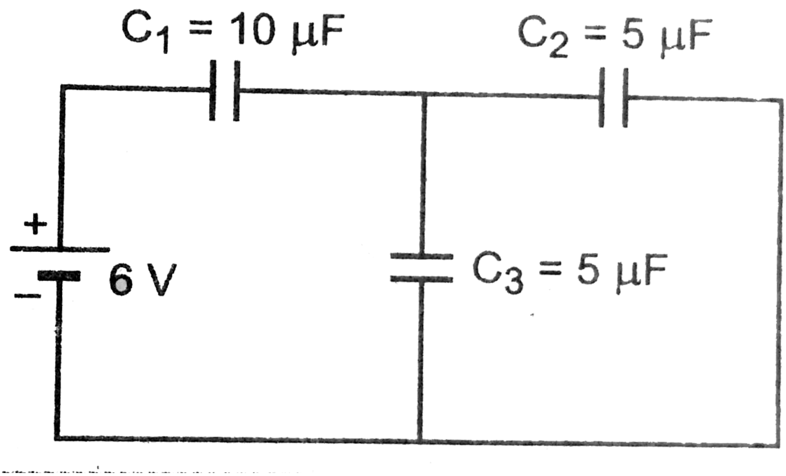
492. Three capacitors C_1, C_2 and C_3 are connected to a 6 V battery, as shown in Fig. Find the charges on the three capcitors.



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493. Fig. shows a network of capacitors where the numbers inidicate the capacitance in microfarel. Find the value of capacitance C if the equivalent capacitance between A and B is to be $2\mu F$.

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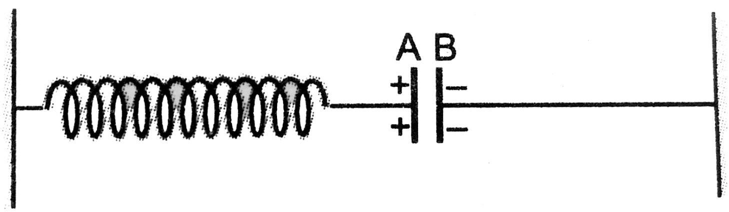
494. Plate A of parallel plate air filled capacitor is connected to a spring having force constant k and plate B is fixed. They are held on a frictionless table top as shown in Fig. If charge $+q$ is placed on plate A and a charge -q on plate A and a charge -q on plate B, by how much does the spring expand ?



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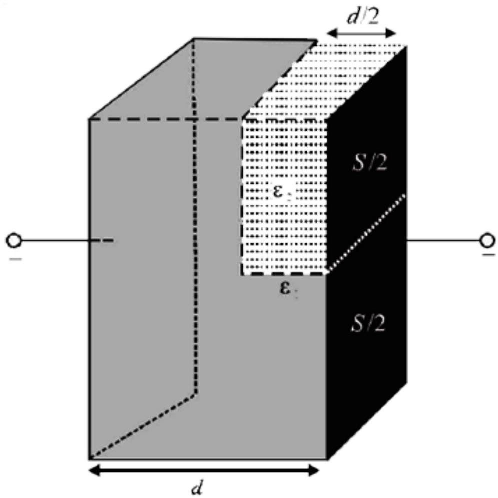
495. A parallel plate capacitor having plates of area S and plate separation d, has capacitance C_1 in air. When two dielectrics of different relative primitivities ($\varepsilon_1 = 2$ and $\varepsilon_2 = 4$) are introduced between the two plates as shown in the figure, the capacitance becomes C_2. The ratio $\frac{C_2}{C_1}$ is



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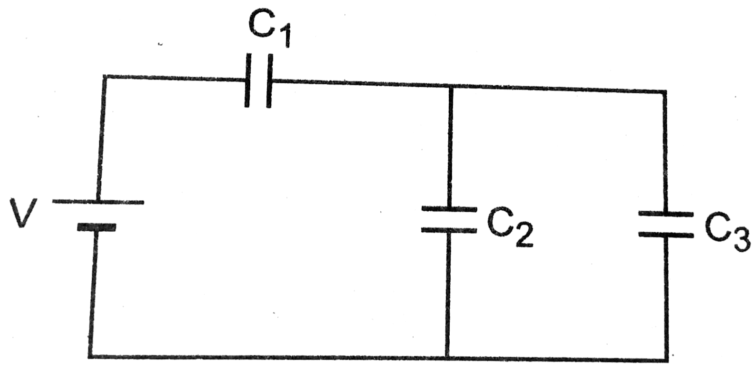
496. Plot 1 in Fig gives the charge q that can be stored on capacitor C_1 versus electric potential V set up across it. Plots 2 and 3 are simillar plots for capacitor C_2 and C_3 respectively. The three capacitors are connected to 6.0 V battery as shown here. Calculate charge stored in capacitor C_2.



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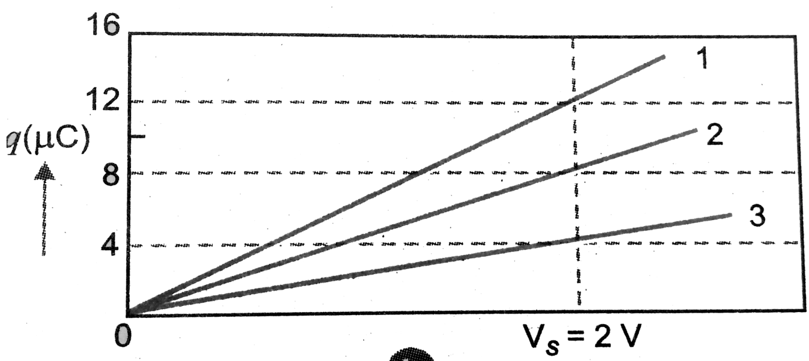

b

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497. Two charges $+q$ and $-q$, each of mass m, are revoloving in a circle of radius R, under mutal electrostatic force, Find (i) speed of each charge (ii) kinitic energy of the system (iii) potental energy of the system and (iv) total energy of the system.

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498. Two long wires are placed on a smooth horizontal table. The linear charge densities of these wires are $\pm\lambda C/m$. For unit length of the wires, calculate the work requrired to increase the separation between the wires from a to 3a.

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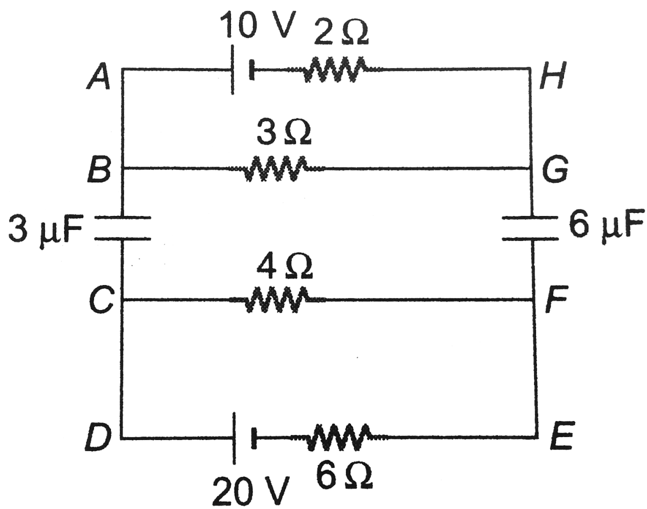
499. In the circuit shown in figure, find the steady state charges on both the capacitors.



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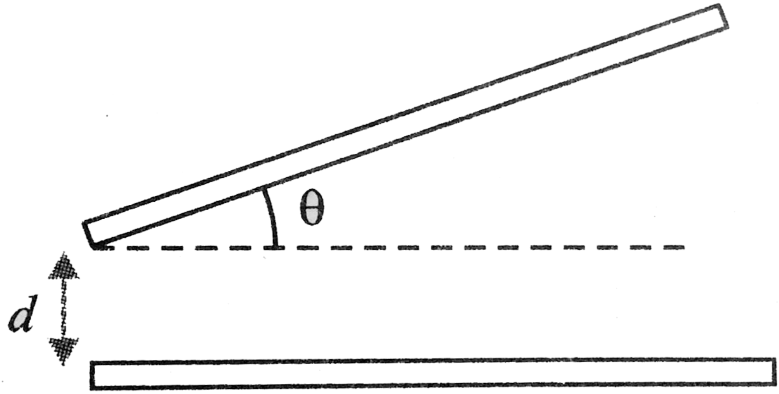
500. A capacitor has two square plates each of sidel making an angle θ between them as shown in Fig. Calculate capacitor of the arrangement for small values of θ



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501. What is the force between two small charged spheres having charges of $2 \times 10^{-7} C$ and $3 \times 10^{-7} C$ placed 30cm apart in air ?

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502. When a glass rod is rubbled with a silk cloth, charges appear on both. A similar phenomenon is observed with many other pairs of bodies. Explain how this observation is consistent with the law of conservation of charge.

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503. Four point charges $q_A = 2\mu C, q_B = -5\mu C, q_C = -2\mu C$ and $q_D = -5\mu C$ are located at the corners of a square ABCD of side 10 cm. What is the force on a charge of $1\mu C$ placed at the center of the square ?

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504. (a) An electrostaic field line is a continous courve. That is a field line cannot have sudden breaks. Why not ?

(b) explain why two filed lines never cross each other at any point.

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505. Two point charges $q_A = 3\mu C$ and $q_B = -3\mu C$ are located 20 cm apart in vaccum (a) what is the electric field at the mid point O of the line AB joining the two charges ? (b) If a negative test charge of magnitude $1.5 \times 10^{-9}C$ is placed at the point, what is the force experienced by the test charge ?

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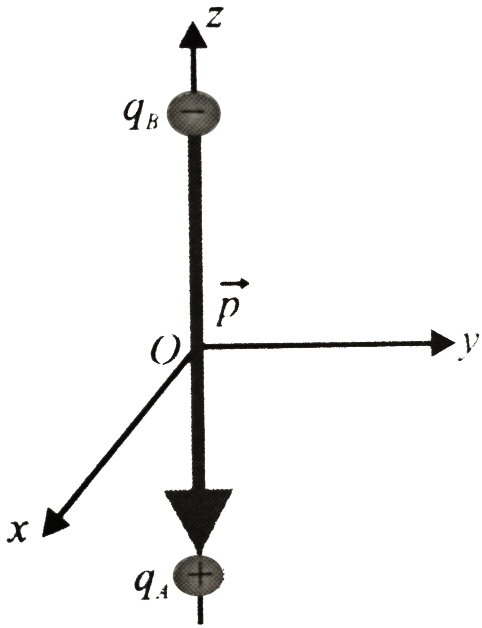
506. A system has two charges $q_A = +2.5 \times 10^{-7}C$ and $q_B = -2.5 \times 10^{-7}C$ located at point A: (0,0,-15 cm)and B: (0,0,+15 cm)`, respectively. What are the total charge and electric dipole moment of the system?



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507. An electrtic dipole with dipole moment $4 \times 10^{-9} Cm$ is aligned at 30° with the direction of a uniform electric field of magnitude $5 \times 10^4 NC^{-1}$. Calculate the magnitude of the torque acting on the dipole .

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508. A polythene piece rubbed will wool is found to have a negative charge of $3.0 \times 10^{-7}C$.

(a) Estimate the number of electrons transferred (from which to which)?

(b) Is there a transfer of mass from wool to polythene?

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509. (a) Two insulated charged copper spheres A and B have their centers speparated by a distance of 50 cm. What is the mutal force of electrostatic repulsion if the charge on each is $6.5 \times 10^{-7}C$? The radill of A and B are negalible compared to the distance of separation.

(b) What is the force of repulsion if each sphere is charged double the above amount, and the distance between them is halved ?

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510. Two insulated identically sized charged copper spheres A and B have their centers separated by a distance of 50 cm. Charges on each sphere is

$q = 6.5 \times 10^{-7} C$

. A third sphere of the same size but uncharged is brought in contact with the first, then in contact with the second and finally removed from both. What is the new force of repulsion between A and B?

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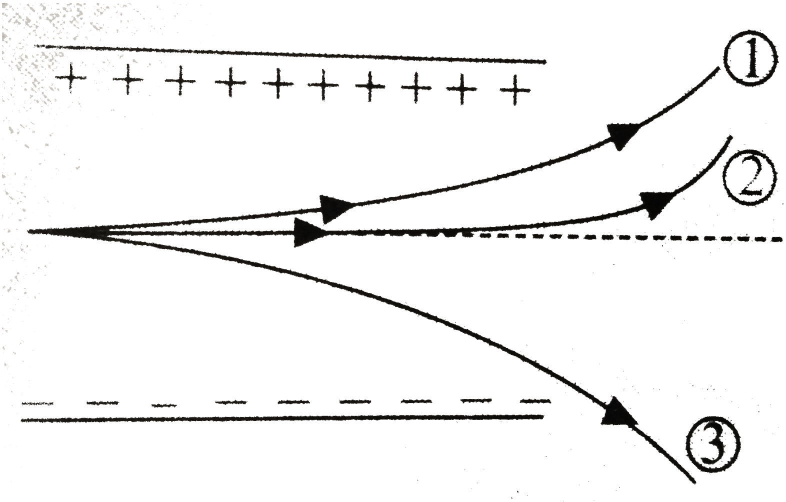
511. Figure shows the tracks of three charged particles in a uniform electrostatic field projected parallel to a plate with the same velocity. Give the signs of the three charges. Which of the three charges. Which of the three particles has the highest charge-to-mass ratio?



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512. Consider a uniform electric field $E = 3 \times 10^3 \hat{i} N/C$. (a) What is the flux of this field through a square of 10 cm on a side whose plane is parallel to the yz plane ? (b) What is the flux through the same square if the normal to its plane makes a 60° angle with the x-axis ?

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513. Careful measurement of the electric field at the surface of a black box inidicates that the net outward flux through the surface of the box is $8.0 \times 10^3 Nm^2/C$ (a) what is the net charge inside the box ? (b) If the net outward flux through the surface of the box were zero, could you conclude that there were no charges inside the box ? Why or why not?

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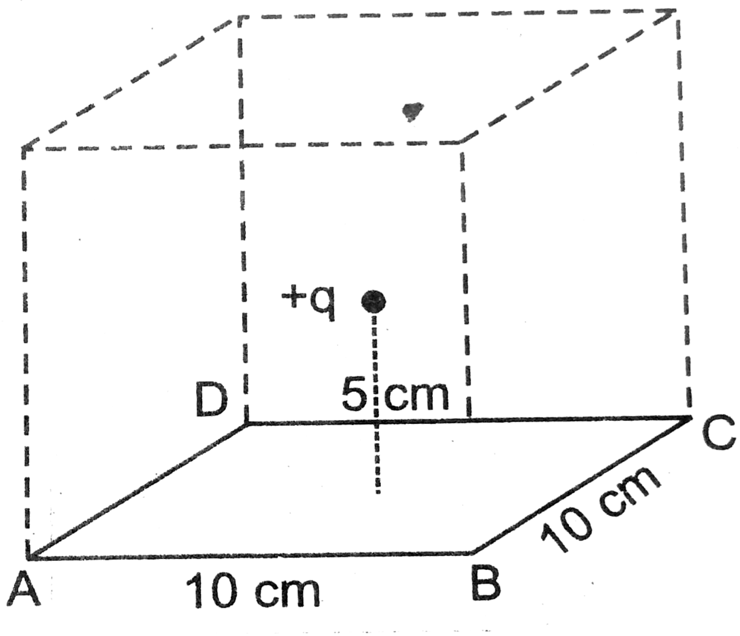
514. A point charge $+10\mu C$ is at distance of 5cm directly above the center of a square of side 10 cm as shown in Fig. What is the magnitude of the electric flux through the square ? (Hint. Think of the square of the square as one face of a cube with edge 10 cm)



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515. A point charge of $2.0\mu C$ is at the centre of a cubic Gaussian surface 9.0 cm on edge. What is the net electric flux through the surface?

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516. A point charge causes an electric flux of $-1.0 \times 10^3 Nm^2/C$ to pass through a spherical Gaussian surface of 10.0 cm radius centred on the charge. (a) If the radius of the Gaussian surface were doubled, how much flux would pass through the surface ? (b) What is the is the value of the point charge ?

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517. A conducting sphere fo radius 10 cm has an unknown charge. If the electric field 20 cm from the center of the sphere is $1.5 \times 10^3 N/C$ and points radilly inwards, what is the net charge on the sphere ?

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518. A uniformly charged conducting sphere of 2.4m diameter has a surface density of $80.0\mu C/m^2$. (a) Find the charge on the sphere (b) What is the total electric flux leaving the surface of the sphere ?

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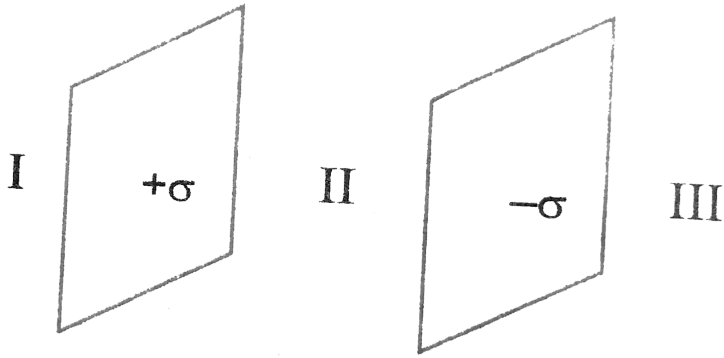
519. An infinite line charge produces a field of $9 \times 10^4 NC$ at a distance of 2cm. Calculate the linear charge density.

Watch Video Solution

520. Two large this metal plates are parallel and close to each other. On their inner faces, the plates have surface charge densities of opposite signs and magnitude $17.0 \times 10^{-22} C/m^2$. What is $\vec{E}$: in the outer region of the first plate. (b) in the outer region of the secound plate, and (c) between the plates ? See Fig.



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521. An oil drop of 12 excess electrons is held stationaty under a constant electric field of $2.55 \times 10^4 NC^{-1}$ in Millikan's oil drop experi,ment. The density of the oil is $1.26 gcm^{-3}$. Estimate the radius of the drop. $\left(g = 9.81 ms^{-2}, e = 1.60 \times 10^{19} C\right)$

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522. Which of the following curves shown below cannot possibly represent electrostatic field lines?

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523. In a certain region of space, electric field is along the z-direction throughout. The magnitude of electric field is , however, not constant but increases uniformly along the positive z-direction. At the rate of $10^5 NC^{-1} m^{-1}$. What are the force and torque experienced by system having a total dipole moment equal to 10^{-7}Cm in the negative z-direction?

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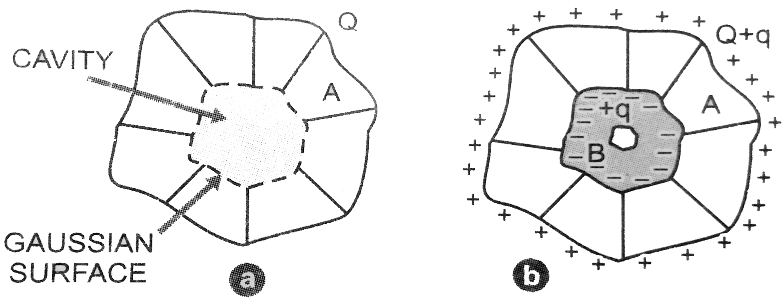
524. (a) A conductor A with a cavity as shown in Fig, is given a charge Q. Show that the entire charge must appear on the outer surface of the conductor.

(b) Another condutor B with charge q is inserted into the cavity keeping B insulated from A. Show that the total charge on the outside surface of A si $(Q + q)$ fig.

(c) A sensitive instument is to be shielded from the strong electrostatic field in its enviroment. Suggest a possibe way.



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525. A hollow charged conductor has a tiny hole cut into its surface. Show that the electric field in the holes is $\left(\sigma/2 \in_{0()} \hat{n}\right.$, where $\hat{n}$ is the unit vector in the outward normal direction, and σ is the surface charge density near ther hole.

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526. Obtain the formula for the electric field due to a long thin wire of uniform linear charge density λ without using Gauss's law. [Hint. use Coulomb's law directly and evaluate the necessary integral].

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527. It is now believed that protons and neutrons (which consitude nuclel of ordinary matter) are themselves built out of more elementary units called quarks. A proton and a neutron consits os three quarks each. Two types of quarks , the so called 'up' quark, (denoted by U) of charge $+(2/3)$ e and the 'down' quark (denoted by d) of charge (- $1/3$) e together with electrons build up ordinary matter. (Quarks of each other types have also been found which

give rise to different unsual varieties of matter). Suggest a possible quark composition of a proton and neutron.

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528. (a) Consider an arbitary electrostatic field configuration. A small test charge is placed at a null point (i.e, where $\vec{E} = 0$) of the configuration. Show that the equillibrium of the test charge is necessarlly unsutable.

(b) Verify this result for the simple configuration of two charges of the same magnitude and sign placed a certain distance apart.

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529. Two charges n $5 \times 10^{-8}C$ and $-3 \times 10^{-8}C$ are located 16 cm apaart. At what points on the line joining the two charges is the electric potential zero ? Take the potential at infinity to be zero.

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530. A regular hexagon of side 10 cm has a charge $5\mu C$ at each of its vertices. Calculate the potential at the center of the hexagon.

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531. Two charges $2\mu C$ and $-2\mu C$ are placed at points A and B 6 cm apart.

(a) Identify an equipotenital surface of the system.

(b) What is the direction of the electric field at every point on this surface ?

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532. A spherical conductor of radius 12 cm has a charge of $1.6 \times 10^{-7} C$ distributed uniformly on its surface. What is the electric field (a) inside the sphere (b) just outside the sphere (c) at a point 18 cm from the center of the sphere ?

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533. A parallel plate capacitor with air between the plates has a capacitance of 8 pF.$\left(1pF = 10^{-12}F\right)$ What will be the capacitance if the distance between the plates is reduced by half and the space between them is filled with a substance of dielectric constant 6 ?

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534. Three capacitors each of capacitane 9 pF are connected in series. (a) What is the total capacitance of the combination ? (b)

What is the potential difference across each capacitor if the combination is connected to a 120V supply.

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535. Three capacitors of capacitance $2pF, 3pF$ and $4pF$ are connected in parallel. (a) what is the total capacitance of the combination ? (b) Determine the charge on each capacitor, If the combination is connected to 100V supply.

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536. In a parallel plate capacitor with air between the plates, each plate has an area of $6 \times 10^{-3} m^2$ and distance between the plates is 3mm. Calculate the capacitance. If this capacitance is connected to a 100V supply, what is the charge on each plate of the capacitor ?

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537. Explain what would happen if in the capacitor in $Q. 8, a3$ mm thick mica sheet of (dielectric constant = 6) were inserted between the plates (a) while the voltage supply remained connected (b) after the supply was disconnected.

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538. A 12 pF capacitor is connected to a 50 V battery. How much electrostatic energy is stored in the capacitor ?

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539. A $600pF$ capacitor is charged by a $200V$ supply. It is then disconnected from the supply and is connected to another uncharged $600pF$ capacitor. What is the common potential in V and energy lost in J afrte reconnection?

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540. A charge of 8 mC is located at the origin. Calculate the work done in taking a small charge of -$2 \times 10^{-9}C$ from a point P (0,0,3 cm) to a point Q (0,4 cm, 0) via a point R (0,6 cm, 9cm).

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541. A cube of side b has a charge q at each of its vertices. Determine the potential and electric field due to this charge array at the center of the cube.

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542. A spherical conducting shell of inner radius r_1 and outer radius r_2 has a charge Q.

(a) A charge q is placed at the center of the shell. What is the surface charge density on the inner and outer surfaces of the shell ?

(b) Is the electric field intensity inside a cavity (with no charge) zero, even if the shell is not spherical, but has any irregular shape ? Explain.

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543. A long charged cylinder of linear charge density λ is surrounded by a hollow co-axial conducting cyclinder. What is the electric field in the space between the two cylinders ?

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544. If one of the two electrons fo a hydrogen molecule is removed, we get a hydrogen molecule ion $\left(H_2^+\right)$. In the ground state of H_2^+, the two protons are separated roughly by 1.5Å and electron is roughly 1Å from each proton. Determine the potential energy of the system. Specify your choice of zero of potential energy.

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545. Two charged conducting spheres of radill a and b are connected to eachother by a wire. What is the ratio of electric fields at the surface of two spheres ? Use the result obtained to explain why charge density on the sharp and pointed ends of a conducter is higher than on its fatter portions ?

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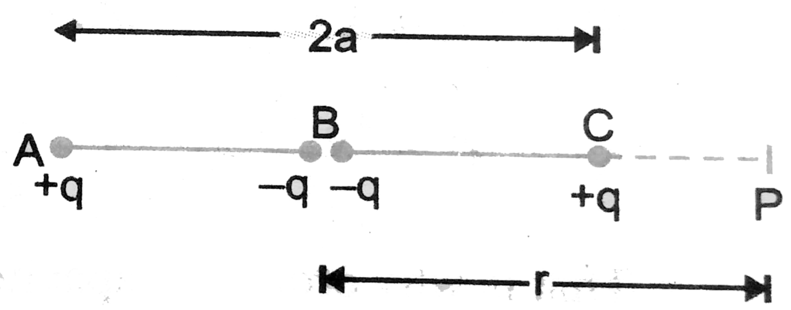
546. Fig shows a charge array known as an 'electric quadrupole'. For a point on the axis of the quadrupole, obtain the dependence of potential on r for $r/a >> 1$, and contract your results with that due to an electric dipole and an electric monopole (i.e, a single charge).



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547. What is the area of the plates of a 2 farad parallel plate air capacitor, given that the separation between the plates is 0.5 cm?

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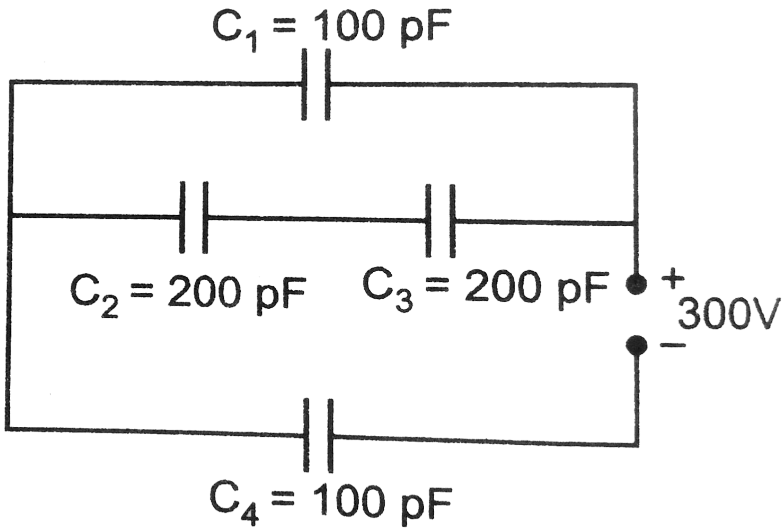
548. Obtain equivalent capacitance of the following net work, Fig. For a 300V supply determine the charge and voltage across each capacitor.



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549. The plates of a paralllel plate capacitor have an area of $90cm^2$ each and are separated by 2.5mm. The capacitane is charged by connecting it to a 400V supply.

(a) How much electrostatic energy is stored by the capacitor ?

(b) View this energy as stored in the electrostatic field between the plates, and obtain the energy per unit volume (u). Hence arrive at a realtion between U and the magnitude of electric field E between the plates.

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550. A $4\mu F$ capacitor is charged by a 200 V supply. It is then disconnected from the supply and is connected to another uncharged $2\mu F$ capacitor. How much electrostatic energy of the first capacitor is disspated in the form of heat and electromagnetic radiation ?

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551. A sperical capacitor consists of two concentric spherical conductors, held in position by suitable insulating supports. Show that the capacitance of this spherical capacitor is given by

$$C = \frac{4\pi \in_0 r_1 r_2}{r_1 - r_2},$$

Where r_1 and r_2 are radill of outer and inner spheres respectively.

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552. A spherical capacitor has an inner sphere of radius 12 cm and an outer sphere of radius 13 cm. The outer sphere si earthed and the inner sphere is given a charge of $2.5\mu C$. The space between the concentric spheres is filled with a liquid of dielectric constant 32.

(a) Determine the capacitance of the capacitor. (b) What is the potential of the inner sphere ?

(c) Compare the capacitance of this capacitor with that of an isolated sphere of radius 12 cm.Explain why the latter is much smaller ?

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553. A cylindrical capacitor has two co-axial cyclinders of length 15 cm and radil 1.5 and 1.4 cm.The outer cylinder is earthed and inner cyclinder is given a charge of $3.5\mu C$. Determine the capacitance of the system and the potential of the inner cylinder. Neglect end effects (i.e., bending of field lines at the ends.)

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554. A parallel plate capacitor is to be designed with a voltage rating 1 KV using a material of dielectrical constant 3 and dielectric strength about $10^7 Vm^{-1}$. [Dielectric strength is the maximum electric field a material can tolerate without break down, i.e, without starting to conduct electrically through partial ionisation. For safety, we should like the field never to exceed say 10% of the dielectric strength]. What minimum area of the plates is required to have a capacitance of 50 pF ?

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555. In a Van de graaf type genertor a sphrical metal shell is to be a 15×10^6 volt electrode. The dielectric strength of the gas surrounding the elctrode is $5 \times 10^7 Vm^{-1}$. What is the minimum radius of the spherical shell required ?

[you will learn form this exercise why one cannot build an electrostatic generator using a very small shell, which requires a small charge to acquire a high potential.]

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556. A small sphere of radius r_1 and charge q_1 is enclosed by a spherical shell of radius r_2 and charge q_2. Show that if q_1 is positive, charge will necessilly flow from the sphere to the shell (when the two are connected by a wire) no matter what the charge q_2 on the shell is [Fig]

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557. An arbitrary surface encloses a dipole. What is the electric flux through this surface ?

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558. A metal spherical shell has an inner radius R_1 and outer radius R_2. A charge Q is placed at the center of the spherical cavity. What will be surface charge density on (i) the inner surface, and (ii) the outer surface ?

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559. The dimensions of an atom are of the order of an Angstrom. Thus there must be large electric fields between the protons and electrons. Why, then is the electronstatic field inside a conductor zero?

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560. If the total charge enclosed by a surface is zero, does it imply that the electric field everywhere on the surface is zero ? Conversely, if the electric field everywhere on a surface is zero, does it imply that net charge inside is zero.

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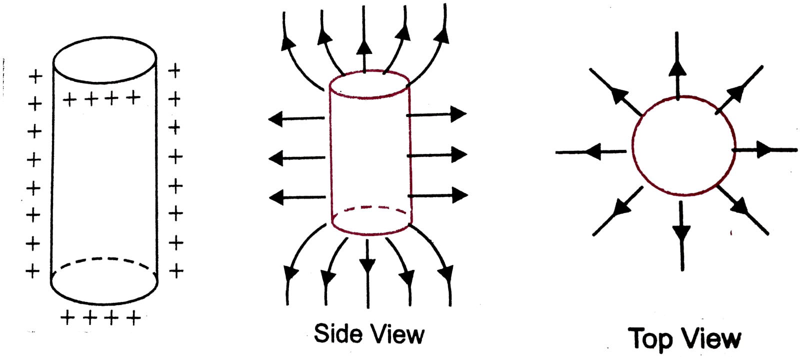
561. Sketch the electric field lines for a unifomly charged hollow cylinder shown in Fig.



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562. What will be the total flux throguh the faces of the cube, Fig with side of length a if a charge q is placed at (a) A : a corner of the cube (b) B : mid-point of an edge of the cube (c) C : center of a face of the cube (d) D : mid-point of B and C.

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563. A paisa coin is made up Al.Mg alloy and weighs 0.75 g. It has a square shape and its diognal measures 17mm. It is electrically neutral and constants equal amounts of positive and negative charges . Treating the paisa coin made up of only Al, find the magnitude of equal number of positive and negative charges. What concluision do you draw from this magnitude ?

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564. Two charges q and $3q$ are placed fixed on x-axis separated by distance 'd'. Where should a third charge 2q be placed such that it will not experience any force ?

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565. Fig shows the electric field lines around three points charges A,B,C.

(a) Which charges are positive ?

(b) Which charge has the largst magnitude ? Why ?

(c) In which region or regions of the picture could be the electric field be zero? Justify your answer.

(i) near A, (ii) near B, (iii) near C, (iv) nowhere.

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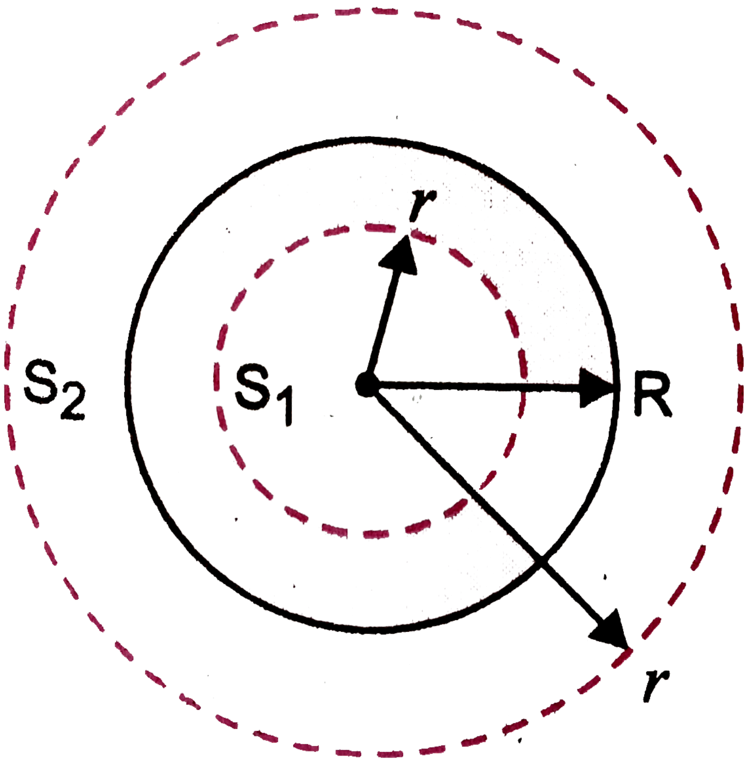
566. Consider a sphere of radius R with charge density distributed as $\rho(R) = kr$ for $r \leq R$ and $= 0$ for $r > R$.

(a) Find the electric field at all points r.

(b) suppose the total charge on the sphere is 2e, where e is the electron charge. Where can two protons be embedded such that the force on each of them is zero. Assume that the introduction of the proton does not alter the negative charge distribution.



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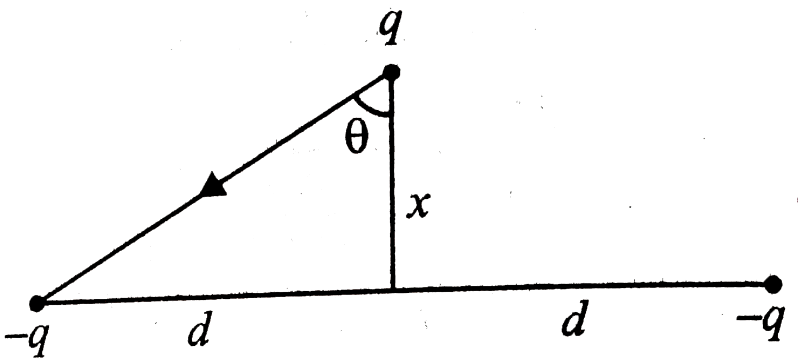
567. Two charges $-q$ each are fixed separated by distance 2d. A third charge q of mass m placed at the mid-point is displaced at the mid-point is placed slightly by $x(x < \ < d)$ perpendicular to the line joining the two fixed charges as shown in Fig. Show that q will perform simple harmonic oscillarion of time period.

$$T = \left[\frac{8\pi^3 \in_0 m d^3}{q^2}\right]^{1/2}$$



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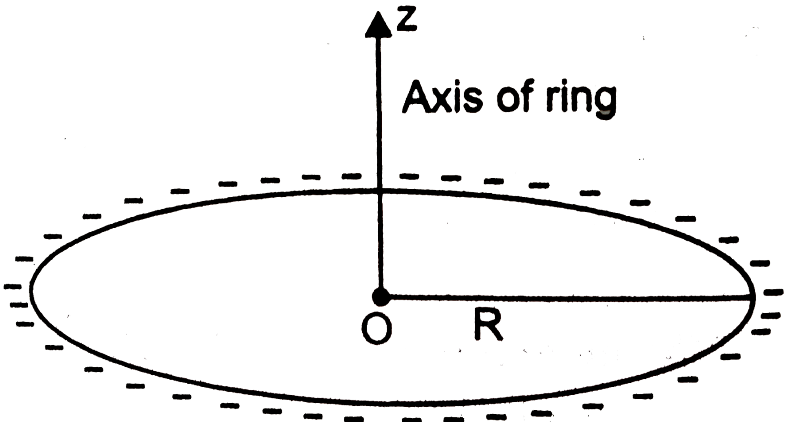
568. Total charge -Q is uniformly spread along length of a ring of radius R. A small test $+q$ of mass m is kept at the center of the ring

.

(a) Show that the particle executes a single harmonic oscillation.

(b) Obtain its time period.



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569. Can there be a potential difference between two adjacent conductors carrying the same charge ?

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570. Can the potential function have a maximum or minimum is free space ?

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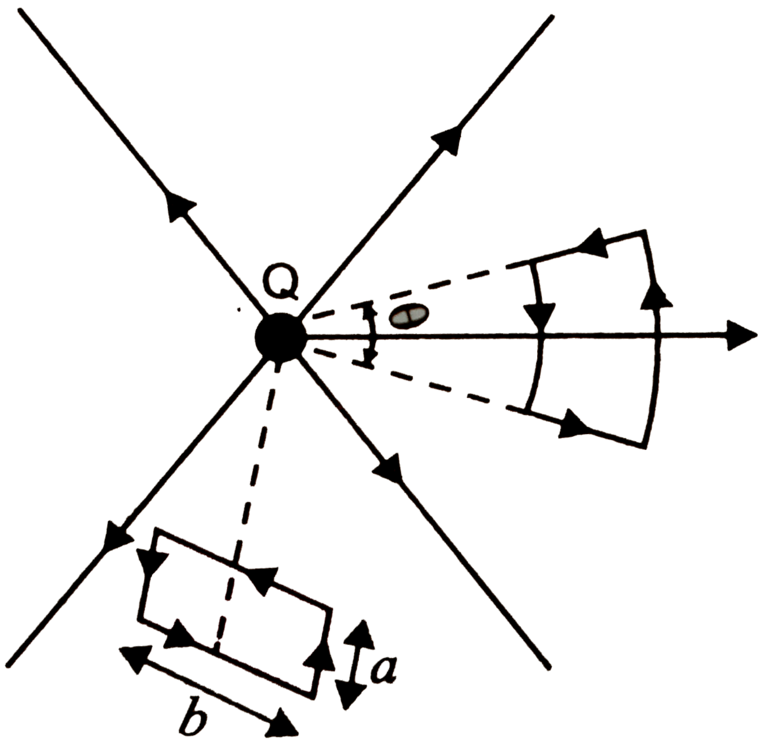
571. A test charge q is made to move in the electric field of a point charge Q along two different closed paths. Fig. First path has sections along and perpendicular loop of the same area as the first loop. How does the work done compare in the two cases?



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572. Prove that a closed equipotenitial surface with no charge within itself must enclose an equipotential volume.

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573. A capacitor has some dielectric between its plates, and the capacitor is connected to a DC source. The battery is now disconnected and then the dielectric is removed. State whether the capacitance, the energy stored in it, electric field, charge stored and the voltage will increase ro remain constant.

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574. Prove that, if an insulated, uncharged conductor is placed near a charged conductor and no other conductors are present, the uncharged body must be intermedicate in potential between that of the charged body and that of infinity.

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575. Calculate potential energy of a point charge $-q$ placed along the axis due to a charge $+Q$ uniformly distributed along a ring of radius R. Skecth P.E. as a function of a axial distance z from the center of the ring, Looking at graph, can you see what happen if $-q$ is displaced slighlty from the centre of the ring (along the axis) ?

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576. Calculate potential on the axis of a ring due to charge Q uniformly distributed along the ring of readius R.

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577. Two point charges of magnitude $+q$ and $-q$ are placed at $(-d/2, 0, 0)$ and $(d/2, 0, 0)$ are respectively. Find the equation of the euipotential surface where the potential is zero.

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578. A parallel palte capacitor is filled by a dielectric whose relative permittively varies with the applied voltage (U) as $\varepsilon = \alpha U$ where alpha $= 2V^{-1}$. A similar capacitor with no dielectric is charged to $U_0 = 78V$. It is then is connected to the uncharged capacitor with the dielectric. Find the final voltage on the capacitors.

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579. A capcitor is made of two circular paltes of radius R each, separated by a distance $d < < R$. The capacitor is connected to a constant voltage. A thin conducting disc of radius $r < < R$ and thickness $t < < r$ is placed at a center of the bottom plate. Find the minimum voltage required to lift the disc if the mass of the disc si m.

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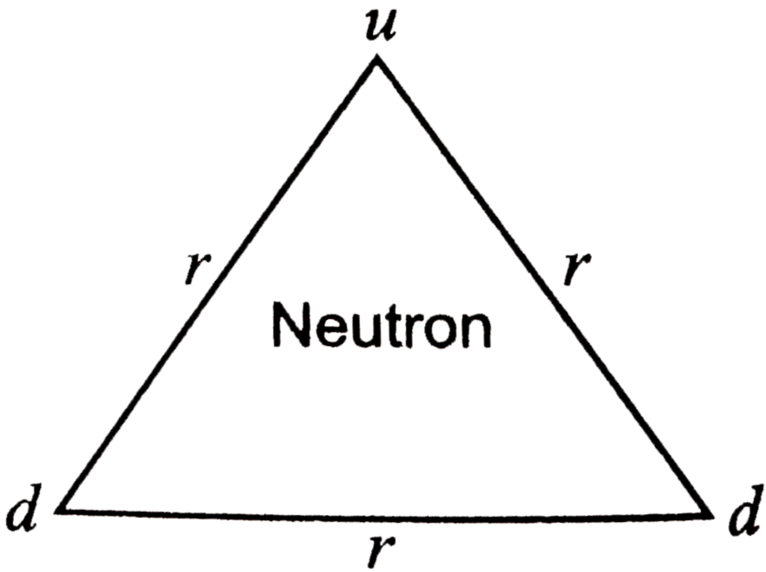
580. (a) In a quark model of elementary particles, a neutron is made of one up quarks [charge $(2/3)$e] and two down quarks [charges -

$(1/3)e \big]. As \sum et\hat{t}heyhavea \triangle configuration with side \leq n > h of the$ or $derof$

10^(-15) m`. Calculate electrostatic potential energy of neutron and compare it with its mass 939 MeV.

(b) Repeat above exercise for a proton which is made of two up and one down quark.



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581. Two metal spheres, one fo radius R and the other of radius 2R, both have same surface charge density s. They are brought in contact and seprated. What will be new surface charge densitites on them ?

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582. In the circuit shown in Fig, instially K_1 is closed and K_2 is open . What are the charges on each capacitor.

Then K_1 was opened and K_2 was closed (order is important). What will be the charge on each capacitor now ? $[C = 1\mu F]$

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583. Calculate potential on the axis of a disc of radius R due to a charge Q uniformly distributed on its surface.

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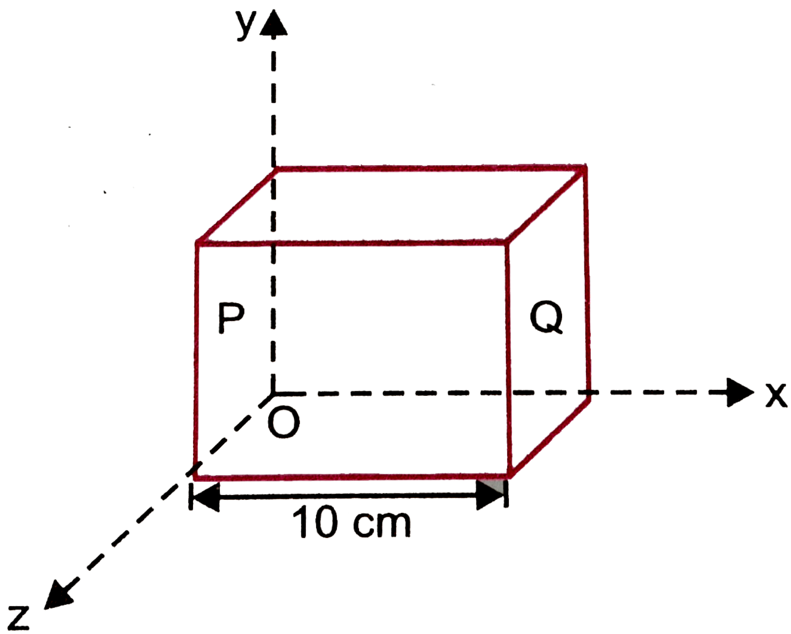
584. In Fig, electric field is dirceted along $+X$ direction and is given by $E_x = 5Ax + 2B$, where E is in NC^{-1} and x is in meter, A and B are constants having dimenstions. Taking $A = 10NC^{-1}m^{-1}$ and $B = 5NC^{-1}$, calculate (i) the electric flux through the cube and (ii) net charge enclosed within the cube.



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585. A radioavtive source in the form of a metal sphere of daimeter 10^{-3} m emits β-particles at a constant rate of 6.25×10^{10} particles per second. If the source is electrically insulated, how long will it take for its potential to rise by $1.0V$, assuming that 80% of the emitted β-particles escape the socurce?

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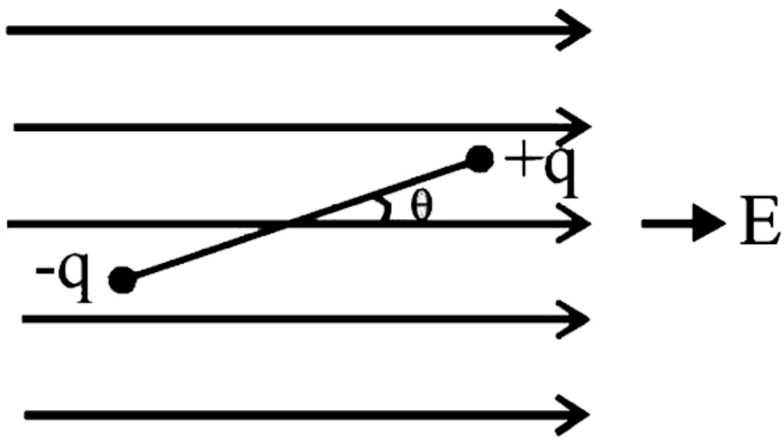
586. A point particle of mass M is attached to one end of a massless rigid non-conducting rod of length L. Another point particle of the same mass is attached to the other end of the rod. The two particles carry charges $+q$ and -q respectively. This arrangement is held in a region of a uniform electric field E such that the rod makes a small angle θ (say of about 5 degree) with the field direction, fig. Find an expression for the minimum time needed for the rod to become parrallel to the field after it is set free.



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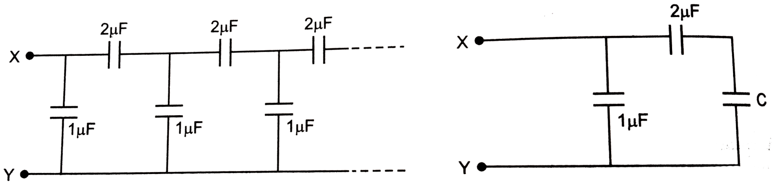
587. Find the capacitance of the infinite ladder between points X and Y, Fig.



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588. Two identical charged spheres are suspended by strings of equal lengths. The strings make an angle of 30° with each other. When suspended in a liquid of density $0.8 gcm^{-3}$, the angle remains the same. If density of the material of the sphere is $1.6 gcm^{-3}$, the dielectric constant of the liquid is

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589. A thin fixed of radius 1 metre has a positive charge 1×10^{-5} coulomb uniformly distributed over it. A particle of mass 0.9 gm and having a negative charge of 1×10^{-6} coulomb is placed on the axis at a distance of 1cm from the centre of the ring. Show that the motion of the negatively charged particle is approaximately simple harmonic. Calculate the time period of oscillations.

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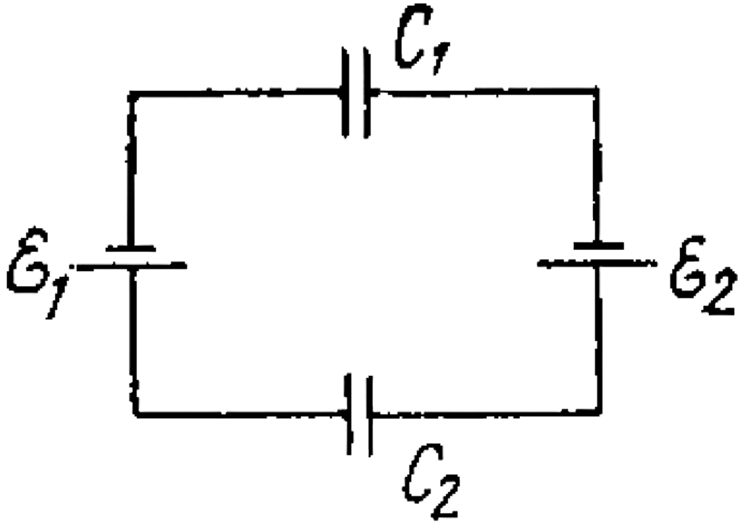
590. In a circuit shown in fig find the potentail difference between the left and right plates of each capacitor.



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591. In the given circuit, Fig, if the points b is connected to earth and a potential of $+1200$ volt is given to the point b is connected to earth and a potential of $+1200$ volt is given to the point a, calculate the charges acquired by each of the capacitors and the potentials of the point C ?

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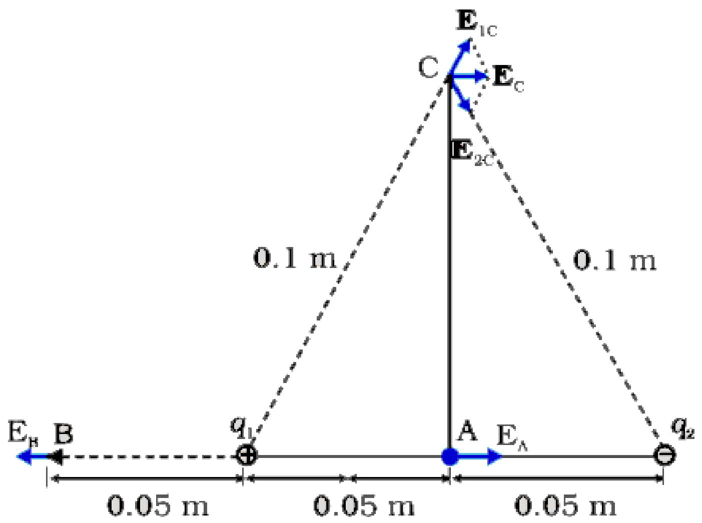
TYPICAL EXAMPLES

1. Two point charges q_1 and q_2, of magnitude $+10^{-8}C$ and $-10^{-8}C$, respectively, are placed 0.1 m apart. Calculate the electric fields at points A, B and C shown in Fig. 1.14.



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CONCEPTUAL PROBLEMS

1. A glass rod rubbed with slik is brought close to two uncharged metallic spheres in contact with each other, inducing charges on them..

Describe what happens when

(i) the spheres are slightly separated and

(ii) the glass rod is subsequently removed and finally

(iii) the spheres are separated far apart.

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2. (a) A comb run through one's dry hair attracts small bits of paper. Why? What happens if the hair is wet or if it is a rainy day? (Remember, a paper does not conduct electricity.)

(b) Ordinary rubber is an insulator. But special rubber tyres of aircraft are made slightly conducting. Why is this necessary?

(c) Vehicles carrying inflammable materials usually have metallic ropes touching the ground during motion. Why?

(d) A bird perches on a bare high power line, and nothing happens to the bird. A man standing on the ground touches the same line and gets a fatal shock. Why?

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3. Plot a graph showing the variation of coulomb force (F) versus $\left(\frac{1}{r^2}\right)$, where r is the distance between the two charges of each pair of charges:

$(1\mu C, 2\mu C)$ and $(2\mu C - 3\mu C)$. Interpet the graphs obtained.

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4. In defining electric field due to a point charge, the test charge, the test charge has to be vanishingly small. How this condition can be justified, when we know that charge less than of electron or a proton is not possible.

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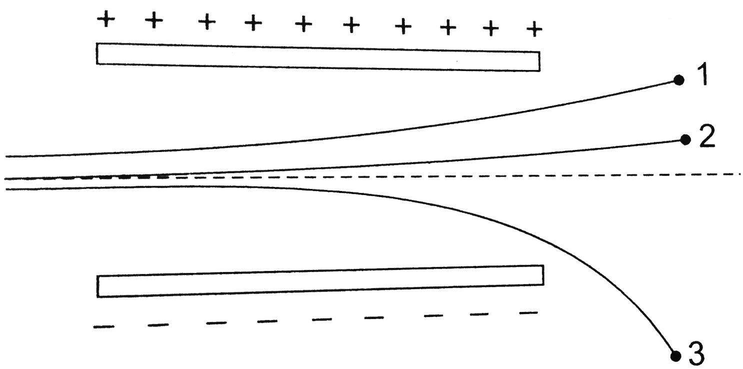
5. Figure shows tracks of three charged particles crossing a uniform electrostatic field with same velocities along horizontal. Give the sign of the three charges. Which particle has the highest charge to mass ratio?



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6. Two small identical electric dipoles AB and CD, each of diople moment p are kept at an angle of 120° as shown in Figure. What is the resultant dipole moment of this combination ?

If this system is subjected to electric field $(\vec{E})$ directed along $+X$ direction, what will be the magnitude and direction of the torque acting on this ?

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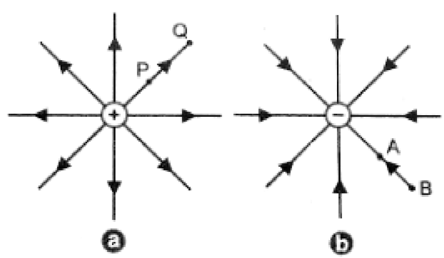
7. Figures (a) and (b) show the field lines of a positive and negative point charge respectively



FIGURE

(a) Give the signs of the potential difference V_P - V_Q, $V_B - V_A$.

(b) Give the sign of the potential energy difference of a small negative charge between the points Q and P, A and B.

(c) Give the sign of the work done by the field in moving a small positive charge from Q to P.

(d) Give the sign of the work done by the external agency in moving a small negative charge from B to A.

(e) Does the kinetic energy of a small negative charge increase or decrease in going from B to A?

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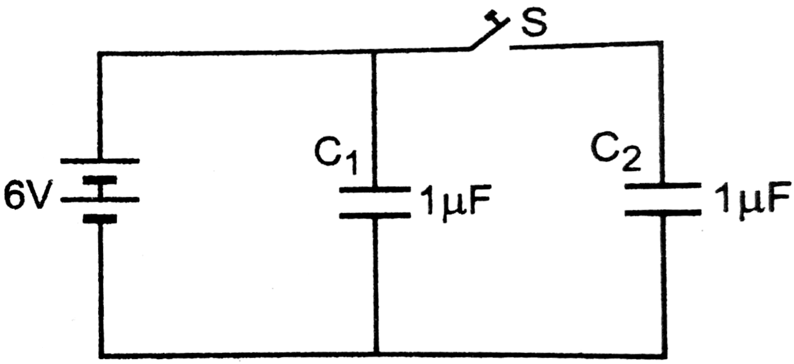
8. Fig. shows two identical capacitors C_1 and C_2 each of $1\mu F$ capacitance, connected to a battery of 6V Initially,swich S is closed. After sometime, S is left open and dielectric slabs of dielectric constant K = 3 are instered to fill compelelty the space between the plates of two capacitors. How will the (i) charge and (ii) potential difference between the plates of the capacitors be affected after teh slabs are inserted ?



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SHORT ANSWER QUESTIONS

1. Define an equipotential surface. Draw equipotential surfaces :

(i) in the case of single point charge and

(ii) in a constant electric field in Z-direction.

Why the equipotential surfaces about a single charge are not equidistant ?

(iii) Can electric field exist tangential to an equipotential surface ? Given reason.

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2. Establish realation between electric field strength and force.

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3. What is an equipotential surface ? Write three properties Sketch equipotential surfaces of

(i) Isolated point charge

(ii) Uniform electric field

(iii) Dipole

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4. Explain electrostatic shiedling with examples.

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5. Show that the electric field at the surface of a charged conductor is given by $\vec{E} = \frac{\sigma}{\varepsilon_0}\hat{n}$, where σ is the surface charge density and $\hat{n}$ is a unit vector normal to the surface in the outward direction .

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6. What is a surface density of charge ? Show that surface density of charge is different at different points of an irregular shaped conductor.

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7. Consider a coin, It is electrically neutral and contains equal amounts of positive and negative charge of magnitude 34.8 kC. Suppose that these equal charges were concentrated in two point charges separated by

(i) 1cm $\left(\sim\frac{1}{2}\times\text{diagonal of the one paisa coin}\right)$

(ii) 100 m (~length of a long building)

(iii) $10^6 m$ (radius of the earth). find the force on each such point charge in each of the three cases. what do you conclude from these results?

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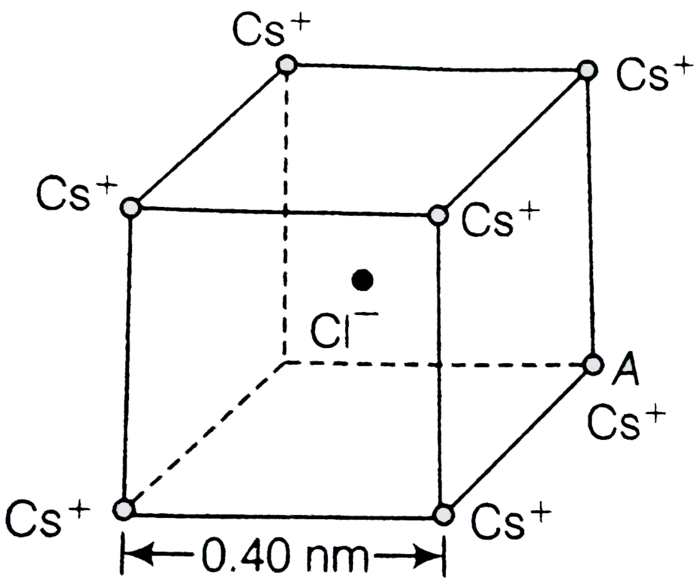
8. Figure represents a crystal unit of cesium chloride, CsCl. The cesium atoms, represented by open circles are situated at the corners of a cube of side 0.40 mm, whereas a Cl atom is situated at the centre of the cube. The Cs atoms are deficient in one electron while the Cl atom carries an excess electron. ltBrgt (i). What is the net electric field on the Cl atom due to eight Cs atoms?

(ii) Suppose that the Cs atom at the corner A is missing. what is the net force now on the Cl atom due to seven remaining Cs atom?



o OCs+ ● Cl−

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9. Five charges, q each are placed at the corners of a regular pentagon of side a. (Refer the adjoining figure)

(a) (i) What will be the electric field at O, if the centre of the pentagon?

(ii) What will be the electric field at O if the charge from one of the corners (say A) is removed?

(iii) What will be the electric field at O if the charge q at A is replaced by -q?

(b) How would your answer to (a) be affected if pentagon is replaced by n-sided regular polygon with charge q at each of its corners?

CURIOSITY QUESTIONS

1. What role does electrostatics play in a xerox copying machine?

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2. When your friend chews a winter green life saver in a dark room, you see a faint flash of blue light from his mouth. How?

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3. What role does electrostatics play in the reproduction of floweres ?

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4. What is a defibrilator ? Explain briefly.

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VERY SHORT ANSWER QUESTIONS

1. What is the net charge on a charged capacitor ?

A. Zero

B. infinite

C. 2q

D. $\frac{q}{2}$

Answer: A

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2. If the plates of a charged capacitor be suddenly connected to each other by a wire, what will happen ?

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3. How many picofarads are there in a farad ?

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4. Consider two conducting spheres of radii R_1 and R_2 with $R_1 > R_2$. If the two are at the same potential, the larger sphere has more charge than the smaller sphere. State whetehr the charge density of the smaller sphere is more or less than that of the larger oe.

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5. Do free electrons travel to region of higher potential or lower potentail ?

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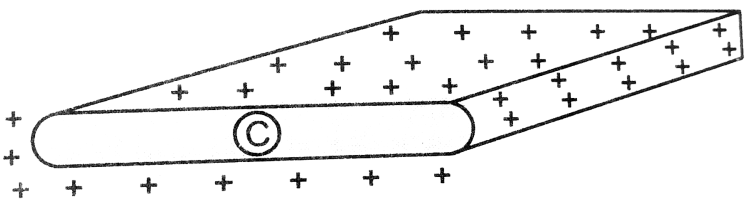
ADVANCED PROBLEMS FOR COMPETITIONS

1. (a) A conductor having cavity C is charged as shown in Fig. What is electricfied inside the cavity ? Does the result depend upon the shape and size of the cavity ?



(b) Can Gauss's law tell us exactly where teh charge is located inside the Gaussian surface ?

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NCERT QUESTIONS

1. The electrostatic force on a small sphere of charge $0.4\mu C$ due to anther small sphere of charge -$0.8\mu C$ in air 0.2 N (i) What is the distance between the two spheres? (ii) What is the force on the second sphere due to the first ?

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2. Check that the ratio ke^2/Gm_em_p is dimensionless, Look up a table of Physical Constants and determine the value of this ratio. What does the ratio signify ?

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3. Check that the ratio $ke^2/Gm_e m_p$ is dimensionless, Look up a table of Physical Constants and determine the value of this ratio. What does the ratio signify ?

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4. What is the net flux of the uniform electric field of Q.15 thorugh a cube of side 20cm oriented so that its faces are parallel to the co-ordinate planes ?

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5. Two tiny spheres carrying charges $1.5\mu C$ and $2.5\mu C$ are located 30 cm apart. Find the potential

(a) at the mid-point of the line joining the two charges and (b). At a point 10 cm from this mid-point in a plane normal to the line and passing through the mid-point.

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6. Show that the normal component of electrostatic field has a discontinuly form one side of a charged. Surface to another given by $\left(\vec{E}_2 - \vec{E}_1\right).\hat{n} = \frac{\sigma}{\in_0}$

where $\hat{n}$ is a unit vector normal to the surface at a point and σ at a point and σ is the surface charge density at that point. (The direction of $\hat{n}$ is from side 1 to side 2). Hence show that justy outside a conductor, the electric field $\sigma\hat{n}/\in_0$.

(b) Show that the tangential componet of electrostatic field is contionous from one side fo a charged surface to another.

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7. In a hydrogen atom, the electron and proton are bound at a distance of about 0.53 Å:

(a) Estimate the potential energy of the system in eV, taking the zero of the potential energy at infinite separation of the electron from proton.

(b) What is the minimum work required to free the electron, given that its kinetic energy in the orbit is half the magnitude of potential energy obtained in (a)?

(c) What are the answers to (a) and (b) above if the zero of potential energy is taken at 1.06 Å separation?

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8. Two charges -q and +q are located at points (0, 0, –a) and (0, 0, a), respectively.

(a) What is the electrostatic potential at the points (0, 0, z) and (x, y, 0) ? (b) Obtain the dependence of potential on the distance r of a point from the origin when $r/a > > 1$.

(c) How much work is done in moving a small test charge from the point (5,0,0) to (–7,0,0) along the x-axis? Does the answer change if the path of the test charge between the same points is not along the x-axis?

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9. An electrical technician requires a capacitance of $2\mu F$ in a circuit across a potential difference of 1 kV. A large number of $1\mu F$ capacitors are available to him each of which can withstand a potential difference of not more than 400 V. Suggest a possible arrangement that requires the minimum number of capacitors.

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10. Show that the force on each plate of a parallel plate capacitor has a magnitude equal to $(½)QE$, where Q is the charge on the capacitor, and E is the magnitude of electric field between the plates. Explain the origin of the factor ½.

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11. Answer carefully : (a) Two large conducting spheres carrying charges Q_1 and Q_2 are brought close to each other. Is the magnitude of electrostatic force between them exactly given by $\frac{Q_1Q_2}{4\pi \in_0 r^2}$ where r is distance between their centers ?

(b) If Coulomb law involved $1/r^3$ dependence (Instead of $1/r^2$). would Gauss's law be still true ?

(c) A small test charge is released at rest at a point in an electrostatic field configuration. Will it travel along the line of force passing through that point ?

(d) What is the work done by the field of a nucleus in a complete circualr orbits of electron ? What if the orbits is elliptical ?

(e) We know that electric field is discontinnous across the surface of a charged conductor conductor. Is electric potential also discontinous there ?

(f) What meaning would you give to the capacity fo a single conductor ?

(g) Guess a possible reason why water has a much greater dielectric constant $K = 80$ than, say mica $(K = 6)$.

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12. Describe schematically the equipotential surfaces corresponding to

(a) a constant electric field in the z-direction,

(b) a field that uniformly increases in magnitude but remains in a constant (say, z) direction,

(c) a single positive charge at the origin, and

(d) a uniform grid consisting of long equally spaced parallel charged wires in a plane.

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13. Answer the following:

(a) The top of the atmosphere is at about 400 kV with respect to the surface of the earth, corresponding to an electric field that decreases with altitude. Near the surface of the earth, the field is about $100 Vm^{-1}$. Why then do we not get an electric shock as we step out of our house into the open? (Assume the house to be a steel cage so there is no field inside!)

(b) A man fixes outside his house one evening a two metre high insulating slab carrying on its top a large aluminium sheet of area $1m^2$. Will he get an electric shock if he touches the metal sheet next morning?

(c) The discharging current in the atmosphere due to the small conductivity of air is known to be 1800 A on an average over the globe. Why then does the atmosphere not discharge itself completely in due course and become electrically neutral? In other words, what keeps the atmosphere charged?

(d) What are the forms of energy into which the electrical energy of the atmosphere is dissipated during a lightning? (Hint: The earth has an electric field of about $100Vm^{-1}$ at its surface in the downward direction, corresponding to a surface charge density $= 10^{-9}Cm^{-2}$. Due to the slight conductivity of the atmosphere up to about 50 km (beyond which it is good conductor), about $+1800C$ is pumped every second into the earth as a whole. The earth, however, does not get discharged since thunderstorms and lightning occurring continually all over the globe pump an equal amount of negative charge on the earth.)

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ADDITIONAL QUESTIONS

1. A paraticale of mass m and charge $(-q)$ enters the region between the two charged plates initially moving along x-axis with speed v_x. The length of plate is L and a uniform electric field E is maintained between the plates. Show that the verticale deflection of the particle at the far edge of the plate is $qEL^2/\left(2mv_x^2\right)$. Compare this motion with motion of a projectille in gravitional field.

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2. Suppose that the particle in Q.33 is an electron projected with velocity $v_x = 2.0 \times 10^6 ms^{-1}$. If E between the plates separated by $0.5 cm is 9.1 \times 10^2 N/C$, where will the electron strike the upper plate ? $\left(|e| = 1.6 \times 10^{-19} C, m_e = 9.1 \times 10^{-31} kg\right)$.

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LONG ANSWER QUESTIONS

1. Derive an expression for electric field intensity at a point due to point charge.

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2. (i) If two similar large plates, each of area A having surface charge densities $+\sigma$ and $-\sigma$ are separated by a distance d in air,find the expression for

(a) field at points between the two plates and on outer side of the plates. Specify the direction of the field in each case.

(b) the potential difference between the plates.

(c) the capacitance of the capacitor so formed.

(ii) Two metallic spheres of radii R and $2R$ are charged so that both of these have same surface charge density σ. If they are connected to each other with a conducting wire, in which direction will the charge flow and why ?

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3. In 1959, Lytteton and Bondi suggest that the expansion of the Universe could be explained fi matter carried a net charge. Suppose that the Universe is made up of hydrogen atoms with a number density N, which is mainted a constant. Let the charge on the proton be , $e_p = -(1+q)$ e where e si the electronic charge.

(a) Find the critical value of y such that expansion may start.

(b) Show that the velocity of expansion is propertional to the distance from the center.

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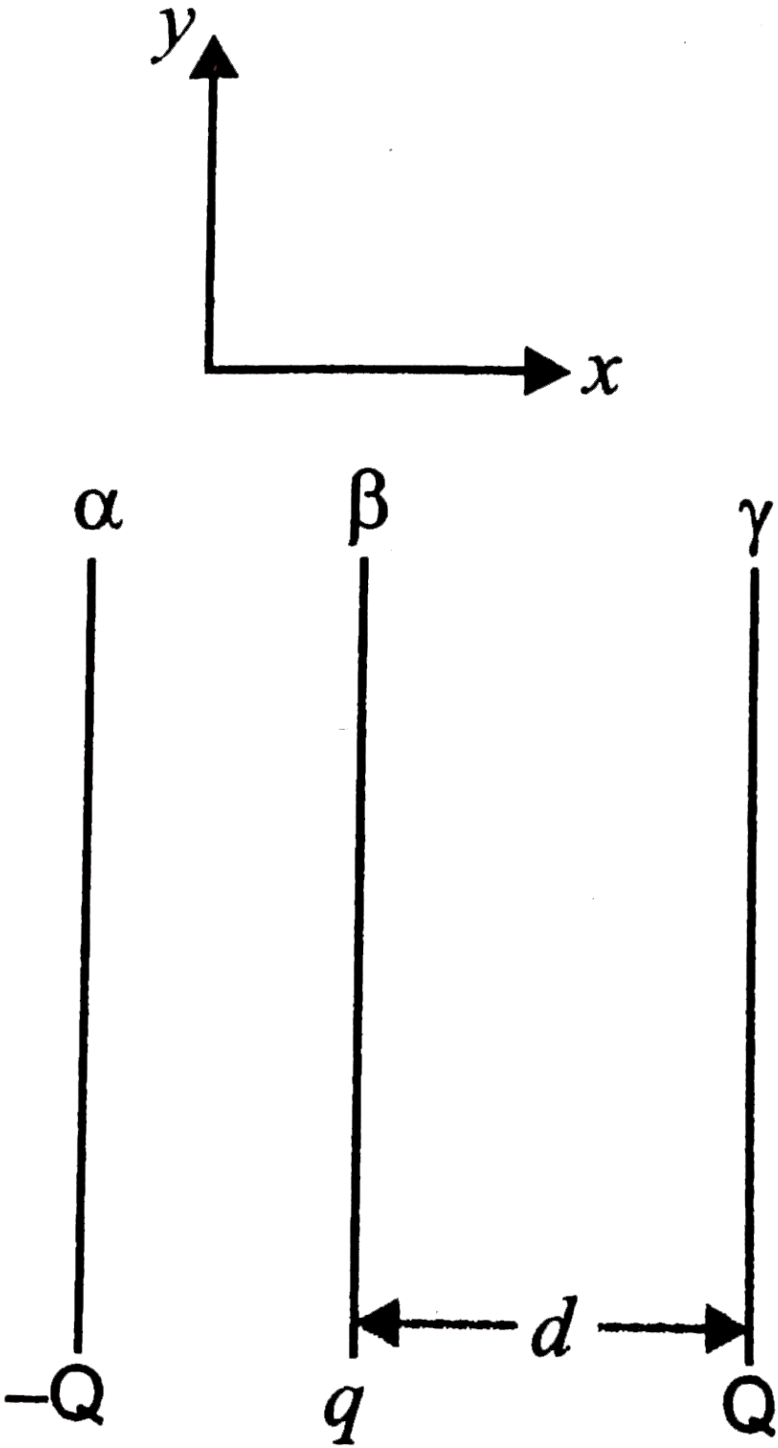
4. Two fixed, identical conducting plates (α and β), each of surface area S are charged to -Q and q, respectively, where $Q > q > 0$. A third indentical plate (γ), free to move is located on the other side of the plate with charge q at a distance d, fig. The third plate is released and collidies with the plate β. Assume the collsion is electric and the time of collision is sufficient to redistribute charge amongst β and γ.

(a) Find the electric field acting on the plate γ before collision.

(b) Find the charge on β and γ after the collision.

(c) Find the velocity of the plate γ after the collision and at a distance d from the plate β.



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5. Three is another useful system of units, besides the SI/mksA system, called the cgs (centimeter-gram -second) system, Coulumb's law is given by $F = \frac{Qq}{r^2}\hat{r}$ where the distance r is measured in cm $\left(= 10^{-2}m\right)$, F in dynes $\left(= 10^{-5}N\right)$ and the charges in electrostatic units (es units), where 1 es unit of charge

$$= \frac{1}{[3]} \times 10^{-9}C$$

The number $[3]$ actually aries from the speed of light in vacumm which is now taken to be exactly given by $c = 2.99792458 \times 10^8 m/s$. An approximate value of c then is $c = [3] \times 10^8 m/s$.

(i) Show that the coulomb law in cgs units yields 1 esu of charge $= 1(dyne)^{1/2}cm$. Obtain the dimensious of units of charge in terms of mass M, length L and time T. Show that it is given in terms of fractional powers of M and L.

(ii) Write 1 esu of charge $= xC$, where x is a dimenionless number.

Show that this gives

$\frac{1}{4\pi \in_0} = \frac{10^{-9}}{x^2}\frac{N.m^2}{C^2} With x = \frac{1}{[3]} \times 10^{-9}$, we have

$\frac{1}{4\pi \in_0} = [3]^2 \times 10^9 \frac{Nm^2}{C^2}$ or $\frac{1}{4\pi \in_0} = (2.99792458)^2 \times 10^9 \frac{Nm^2}{C^2}$

(exactly).

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6. Find the equatio of the equipotentials for an infinite cylinder of radius r_0 carrying charge of linear density λ.

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7. Two charges q_1 and q_2 are placed at (0,0,d) and (0,0,-d) respectively. Find locus of points where the potential is zero.

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8. Two charges -q each are separated by dsitance 2d. A third charge +q is kept at mid-point O. find potential energy of +q as function of small distance x from 0 due to -q charges. Sketch PE Vs/x and convince yourself that the charge at 0 is in an unstable equilibrium.

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VALUE BASED QUESTIONS

1. As is known, all mater is made up of atoms/molecules. Every atom consits of a central of a central core, called the atomic nucleus, around which negatvely charged electrons revole in ciruclar orbits. Every atom is electrically neutral. Containing as many electron as the number of protons in the nucleas.

Thus, even though normally, the materails are electrically neutral, they do contains charges, but thier charges are exactly balanced. The vast amount of charge in an object is usually hidden as the object is usually hidden as the object is said to be electracally neutral charge. With such an equality or balance of charges the object is said to be electrically neutral or uncharged. To electrify or charge a neutral body, actully transfer to the other body. The body which gains electrons become negatively charged and the body which loses electrons becomes positivelyh charged. Further, like charges repel adn unlike charges attract.

Read the above passage and answer the following questions :

(i) Every body, whether a conductor or an insulator is electrically neutral. Is it true ?

(ii) Charging lies in charge imbalance, i.e, excess charge, comment.

(iii) How do you visualize this principle being applied in our daily life ?

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2. Conservatios of charge is the propery by virtue of which total charge of an isolated system always remains constant or conserved. For example, when we rub two inslating bodies, A and B, such that n electrons from A transfer to B, then charge acquired by $A = + \neq$ and charge acquired by $B = - \neq$, where e is magnitude of charge on electron. The net charge on isolated system of bodies A and $B = ne - \neq - 0$, which was the charge before rubbing. Thus, it is not possible to create or destroy net charge carried by any isolated system. It also imples that charges can be created or destroyed in equal and unlike pairs only.

(i) What is the basic cause of conservation of charge ?

(ii) Name any other fundamental property of electric charge.

(iii) At a time, can you create two like charges of magnitude $q = ne$ each ?

(iv) How is the property of conservation of charge reflected in day to day life ?

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3. When an electric dipole of moment $\left|\vec{p}\right| = q \times 2a$ is held at an angle θ, with the direction of uniform external electric field $\vec{E}$, a torque $\tau = pE\sin\theta$ acts on the dipole. This torque tries to align the electric dipole in the direction of the field. When $\vec{p}$ is along $\vec{E}$, $\theta\,°$, $\tau = pE\sin 0\,° = zero$. The dipole is in stabel equilibrium. The energy possessed by the dipole by virtue of its particular position in the electric field is called potential energy of dipole.

$U = W = -pE\left(\cos\theta_2 - \cos\theta_1\right)$

$\theta_1 = 90\,°$ is the position of zero potential energy.

$\therefore U = W = -pE\left(\cos\theta - \cos 90\,°\right) = -pE\cos\theta.$

For stable equillibrium, $\theta 0\,°$, $\therefore U = -pE$ = minimum.

Read the above passage and answer the following questions :

(i) What is the direction of torque acting on electric dipole held at an angle with uniform external electric field ?

(ii) An electric dipole of length 10cm having charges $\pm 6 \times 10^{-3}C$, placed at $30\,°$ with respect to a uniform electric field experiences a torque of magnitude $6\sqrt{3}N$ - m. Calculate.

(a) magnitude of electric field. (b) potential energy of dipole.

(iii) What is the physical significance of this concept in our day to day life ?

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4. The electrostaic potential of a charged body represents the degree of electrification of the body. It detemines the direction of flow of charge between two charged bodies placed in contact with eachother. Charege always flows a body at higher potential to another body at lower potential. The flow of charge stops as soon as the potentials of the two bodies become equal.

Electrostatic potential in electrically corresponds to level in case fo liquids , pressure in case of gases and temperature in case of heat.

Due to a point charge q in air, electrostatic potentials at a distance r from the charge is $V = \frac{q}{4\pi \in_0 r}$ The SI unit of potential is volt.

Read the above passage and answer the follwing questions :

(i) The capacity of a body A is 100 times the capacity of body B and charge on A is 10 times the charge on B. When A and B are put in contact with eachother, will charge flow from A to B to A ? Why ?

(ii) Calcualte the potential in air at a point 1 meter away from charge of $1\mu C$.

(iii) What values of life do yo+-earn from the concept of electric potential ?

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5. The suface integral of electrostatic field $\vec{E}$ produced by any sources over any closed surface S enclosing a volume V in vacumm, i.e., total electric flux over the closed S in vacumm is $1/\in_0$ times the total charge (Q) contained inside S, i.e, $\phi_E = \oint \vec{E}.\vec{ds} = \frac{Q}{\in_0}$

The charge inside S may be point charges or even continous charge distributions.

There is no contribution to total electric flux from the charges outside S. Further, the location at Q inside S does not affect the value of surface integral.

Read the above passage and answer the following questions :

(i) what are the SI unit and dimensions of electric flux ?

(ii) A closed surface in vacumm encloses charge -q, $+3q$ and $+5q$. Another charge $+4q$ lies outside the surface. What is total electric flux over the surface ?

(iii) A point charge q lies inside a spherical of radius r. How will the electric flux be affected if radius of the sphere is doubled ?

(iv) What values of life do you earn from the theorem ?

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6. A capacitor is an arrangement for storing large amounts of electric charge and hence electric energy in a small space.

The electrical capacitance of a capacitor is related to its abillity to store electric charge. We define capacity of a conductor as the ratio of charge Q given to the conductor to the rise in its potential, V i.e., $C = Q/V$. The capacity of an isolted spherical conductor of radius r is $C = 4\pi \in_0 r$. In case of a parallel plate capacitor, $C = \frac{\in_0 A}{d}$ where A is area of insulated metal plate and d is distance between the plates. Clearly, capacity depends on size of capacitor.

When different capacitors are connected in series, capacity, $C_s = \frac{C_1 C_2}{C_1 + C_2}$ and when capacitors are connected in parallel, $C_p = C_1 + C_2$

Read the above passage and answer the following questions :

(i) From $C = \frac{Q}{V}$, we find that C can be increased Q or decresing V. Do you agree ?

(ii) Capacity of a capacitor is fixed depending on its geometry and the medium used. Is it true ?

(iii) Calculate the capacity of a condenser which when connected in series with a conductor of $12\mu F$ gives us a capacitance of $3\mu F$.

(iv) What values of life do yo+-earn from this study ?

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7. While travelling back to his residance in the car, Dr.Pathak was caught up in a thunderstrom. It become very dark. He stopped driving the car and waited for thunderstorm to stop. Suddenly, he noticed a child walking alone on the road. He asked the boy to come inside that Dr. Pathak should meet hsi parents. The parents the boy at his residence. The boy insisted that Dr. Pathak should meet hsi parents. The parents expressed their gratitude to Dr. Patak for his concern for safety of the child.

Answer the following questions based on the above information :

(a) Why is it safer to sit inside a car during thunderstrom ?

(b) Which two values are displayed by Dr. Pathak in his actions ?

(c) Which values are reflected in parent's respone to Dr. Pathak ?

(d) Give an example of a similar action on your part in the past from everyday life.

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Exercise

1. 1 state- Coulomb = ... Coulomb

A. 3×10^{9}

B. 3×10^{-9}

C. $\frac{1}{3} \times 10^{9}$

D. $\frac{1}{3} \times 10^{-9}$

Answer: d

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2. Which of the following is not an insulator ?

A. Glass

B. rubber

C. ebonic

D. human body

Answer: d

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3. An object is charged when it has a charge imbalance, which means the

A. Object contains no electrons

B. object contains no protons

C. object contains equal number of electrons and protons

D. objects contains unequal number of electrons and protons

Answer: d

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4. The cause of charging is

A. actual transfer of protons

B. actual transfer of electrons

C. actual transfer of neutrons

D. none of the above

Answer: b

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5. The cause of quantization of electric charge is

A. transfer of electrons

B. transfer of protons

C. transfer of integral number of electrons

D. none of the above

Answer: c

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6. What is not true

A. It is not possible to create or destroy net charge carried by any isolated system

B. Charges can be created or destroyed in equal and unlike pairs only

C. Proper signs have to be used while adding the charges in a system

D. Excess of electrons over protons in a body is responsible for positive charge of the body.

Answer: d

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7. Charge on a body which carries 200 electrons is

A. $-3.2 \times 10^{-18} C$

B. $3.2 \times 10^{-18} C$

C. $-3.2 \times 10^{-17} C$

D. $3.2 \times 10^{-17} C$

Answer: c

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8. What is the value of absolute permeability of free space? Give its units.

A. $9 \times 10^{9} Nm^2 C^{-2}$

B. $9 \times 10^{-9} Nm^2 C^{-2}$

C. $8.85 \times 10^{-12} C^2 N^{-1} m^{-2}$

D. $8.85 \times 10^{-12} C^2 N m^{-2}$

Answer: c

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9. Value of charge on a body which carries 10 excess electrons is ....

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10. The charges acquired by the objects on rubbing against eachother must be .... and ....

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11. .... was the first to show .... kinds of charges.

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12. Insulators are also called ....

Watch Video Solution

13. The value of electrostatic force constant in free space is ....

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14. A person combs his hair on a dry day. The comb causes 10^{22} electrons to leave the person's hair and stick to the comb. Calculate the charge the comb carries.

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15. Estimate the number of free electrons in 36g of water and the negative charge possessed by them. Given : Avogadro's number $= 6.023 \times 10^{23}$ and molecular weight of water = 18.

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16. What is the total charge on 75.0 kg of electrons ?

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17. How many mega coulombs of positive(or negative) Charge are present in $2.0 mol$ of neutral hydrogen gas.

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18. Calculate the total positive (or negative) charge on a 3.11 g copper penny. Given Avogadro's number $= 6.023 \times 10^{23}\left(g^{-1}\right)mol^{-1}$, , Given Avogadro's number and atomic mass= $63.5g$.

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19. A charge fo magnitude Q is divided into two parts q and $(Q - q)$ such that the two parts exert maximum force on each other. Calculate the ratio Q/q.

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20. Two identical metal spheres A and B have equal and similar charges. They repel each other with a force 103N, when they are placed 10cm apart in a medium of dielectric constant 7. Determine the charge on each sphere.

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21. What is the Coulomb's force between two α-particles separated by a distance of $3.2 \times 10^{-15} m$.

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22. What equal charges would have to be placed on earth and moon to neutralize their gravitational force of attraction?

Given that mass of earth $= 10^{25} kg$ and mass of moon $= 10^{23} kg$

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23. The electrostatics force of repulsion between two positively charged ions carrying equal charge is $3.7 \times 10^{-9} N$ when these are separated by a distance of $5\mathring{A}$. How many electrons are missing from each ion?

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24. Two small spheres each of mass 'm' kg and charge q coulomb are suspended from a point by insulating threads each of 1 metre length, but of negligible mass. If θ is the angle which each string makes with the verticle vertical when equilbrium has been reached, show that

$$q^2 = 4mgl^2\sin^2\theta\tan\theta\left(4\pi \in_0\right)$$

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25. Two particles, each having a mass of 5 g and charge. 1.0×10^{-7} C, stay in limiting equilibrium on a horizontal. table with a separation of 10 cm between them. The coefficient of friction between each particle and the table. is the same. Find the value of this coefficient.

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26. Two small spheres each of mass 10^{-6} kg are suspended from a point by silkk threads 50cm long. They are equally chareged and repel each other to a distance 20cm apart. Calculate charege on each Take $g = 9.8ms^{-2}$.

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27. Two point charge $q_2 = 3 \times 10^{-6}C$ and $q_1 = 5 \times 10^{-6}C$ are located at $(3, 5, 1)$ and $(1, 3, 2)m$. Find $\vec{F}_{12}$ and $\vec{F}_{21}$ using vector form of Coulomb's law. Also, find their magnitude.

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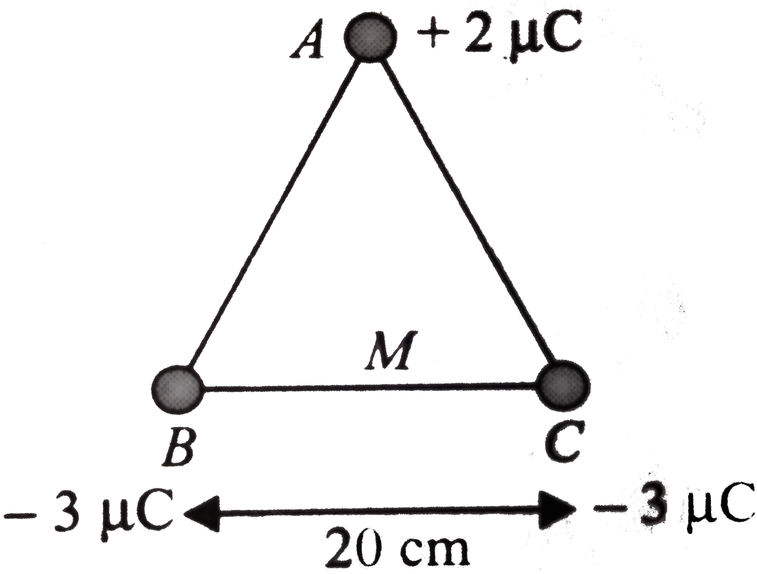
28. Two small charged spheres contain charge $+q_1$ and $+q_2$ respectively. A charge dq is removed from sphere carrying charge q_1 and is transferred to the other. Find charge on each sphere for maximum electric force between them.

Watch Video Solution

29. Three point charges of $+2\mu C$, $-3\mu C$, and $-3\mu C$ are kept at the vertices A, B, and C, respectively of an equilateral triangle of side 20 cm. what should be the sign and magnitude of the charge (q) to be placed at the midpoint (M) of side BC so that the charge at A remains in equilibrium?



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30. A charges Q is placed at each of the two opposite corners of a square. A charge q is placed to each of the other two corners. If the resultant force on each charge q is zero, then

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31. Equal charges each of $20\mu C$ are placed at $x = 0, 2, 4, 8, 16cm$ on X-axis. Find the force experienced by the charge at $x = 2cm$.

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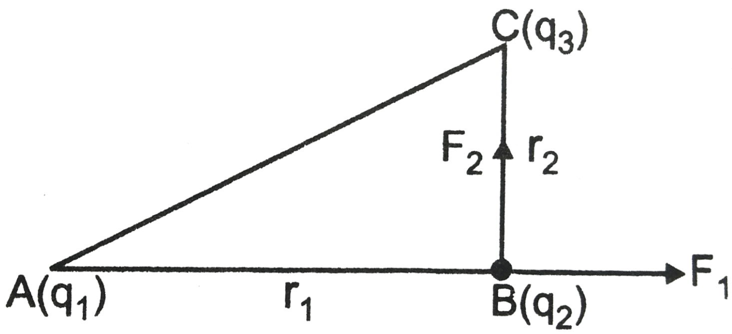
32. Charges $q_1 = 1.5mC, q_2 = 0.2mC$ and $q_3 = -0.5mC$, are placed at points A,B,C respectively as shown in Fig. If $r_1 = 1.2m$ and $r_2 = 0.6m$, calculatae magnitude of resultant force on q_2.



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33. Two similarly and equally charged identical metal spheres A and B repel each other with a force of $2 \times 10^{-5} N$. A third identical uncharged sphere C is touched with A and then placed at the midpoint between A and B. Find the net electric force on C.

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34. Let us assume that charges on Earth and Sum are not neutralised and net charges are of equal magnitude and similar nature. What must be the charge on each so that coulomb force just cancels gravitational force ? This charge corresponds to how many free electrons ?

Mass of sun $= 2 \times 10^{30} kg$

Mass of earth $= 6 \times 10^{24} kg$

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35. In a certain co-ordinate system, charge, $q_1 = -2 \times 10^{-4} C$ is at $x = 0, y = 0$, charge $q_2 = 1 \times 10^{-3} C$ is at $x = 10m$ and $y = 0$ and charge $q_3 = 1 \times 10^{-4} C$ is at $x = 0, y = 5cm$, Find the magnitude of resultantant force on q_1

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36. Two positive charges which are 0.1m apart repel each other with a force of 18N. If the sum of the charges be $9\mu C$, calculate their separate values.

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37. Indenify X in the following nuclear reactions (in the first reaction, n represents a neutron) :

(a) $\_(1)H^1 + {}_4Be^9 \rightarrow X + {}_o n^1$,

(b) $\_ (6)C^{12} + _1H^1 \rightarrow X,$

(c) $\_ (7)N^{15} + _1H^1 \rightarrow _2He^4 + X$

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38. Two equally charged particles, held $3.2 \times 10^{-3}m$ apart, are released from rest. The initial accelerartion of the first particle is observed to be $7.0m/s^2$ and that of the secound to be $9.0m/s^2$. If the mass of the first particle is $6.3 \times 10^{-7}kg$, what are (a) the mass of the secound particle adn (b) teh magnitude of the charge of each particle ?

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39. The SI unit of electric field intensity is

A. N

B. N/C

C. C/m^2

D. N/m^2

Answer: b

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40. Electric field due to a single charge is

A. asmmetric

B. cyclindrically symmetric

C. spherically symmetric

D. none of the above

Answer: c

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41. Electric dipole moment is

A. scaler

B. neither scaler vector

C. a vector directed from $-q \rightarrow +q$

D. a vector directed from $+q \rightarrow -q$

Answer: c

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42. Electric field intensity (E) due to an electric dipole varies with distance (r) of the point from the center of dipole as :

A. $E \propto \frac{1}{r}$

B. $E \propto \frac{1}{r^4}$

C. $E \propto \frac{1}{r^2}$

D. $E \propto \frac{1}{r^3}$

Answer: d

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43. If E_a be the electric field strength of a short dipole at a point on its axial line and E_e that on the equatorial line at the same distance, then

A. 2

B. 3

C. 4

D. 1

Answer: a

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44. Electric field due to an electric dipole is

A. spherically symmetric

B. cylindrical symmetric

C. asymmetric

D. none of the above

Answer: b

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45. When an electric dipole is held at an angle in a uniform electric field, the net force F and torque τ on the dipole are

A. $F = 0, \tau = 0$

B. $F \neq 0, \tau \neq 0$

C. $F = 0, \tau \neq 0$

D. $F \neq 0, \tau = 0$

Answer: c

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46. Potential energy of an electric dipole held at an angle θ in a uniform electric is zero when θ =

A. 0°

B. $90\ ^{\circ}$

C. $180\ ^{\circ}$

D. $360\ ^{\circ}$

Answer: b

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47. Force $\vec{F}$ acting on a test charge q_0 in a uniform electric field $\vec{E}$ is

A. $\vec{F} = q_0\vec{E}$

B. $\vec{F} = \dfrac{\vec{E}}{q_0}$

C. $\vec{F} = \dfrac{q_0}{\vec{E}}$

D. $\vec{F} = q_0^2\vec{E}$

Answer: a

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48. Electric intensity is a ...... quantity and its units are ....

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49. The electric lines of force are .... as against magetic lines of force which are ....

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50. Net charge on an electric dipole is ....

Watch Video Solution

51. Dipole moment is a .... Quanity and its units are ....

Watch Video Solution

52. Field intensity due to a single charge varies inversely as .... of distance and field intensity due to an electric dipole varies inversely as .... of distance of the point.

Watch Video Solution

53. If E_a be the electric field strength of a short dipole at a point on its axial line and E_e that on the equatorial line at the same distance, then

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54. The electric field due to an electric dipole is .... symmetric.

Watch Video Solution

55. The torque acting on an electric dipole of moment p held at an angle θ with an electric field E is ....

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56. A small ball of paper has mass $9 \times 10^{-5} kg$ and carries a charge of $5 \mu C$. When it is held over another charged ball of paper at a distance of 2cm above it, the two balls stay in equilibrium. What is the charge on the second hall ?

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57. A water droplet of radius 1 micron in Milikan oil drop appartus in first held stationary under the influence of an electric field of intensity $5.1 \times 10^4 NC^{-1}$. How many excess electrons does it carry ? Take $e = 1.6 \times 10^{-19}C, g = 9.8ms^{-2}$ and density of water of $= 10^3 kgm^{-3}$.

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58. Two point charges of $+16\mu C$ and $-9\mu C$ are placed 8 cm apart in air. Determine the position of the point at which the resultant electric field is zero.

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59. A particle of mass m and charge q is thrown at a speed u against a uniform electric field E. How much distance will it travel before coming to momentary rest?

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60. A particle of mass m and charge q is released from rest in uniform electric field of intensity E. Calculate the kinetic energy it attains afect moving a distance x between the plates.

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61. A charged ball of mass $8.4 \times 10^{16} kg$ is found to remain suspended in a uniform electric field of $2 \times 10^{4} Vm^{-1}$. Calculate the charge on the ball. Given $g = 10 m/s^{2}$

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62. Two electric $+q$ and $+4q$ are placed at a distance 6a apart on a horizontal plane. Find the position of the point on the line joining the two charges where the electric field is zero.

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63. Calculate the magnitude of the electric field which can just balance a deuteron of mass $3.2 \times 10^{-27} kg$

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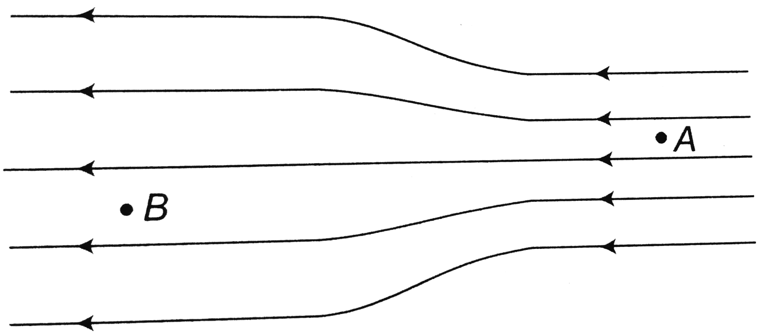
64. In the electric field shown in figure, the electric field lines on the left have twice the separation as that between those on the right. If the magnitudes of the fields at point A is $40NC^{-1}$, calculate the force experienced by a proton placed at point A. Also find the magnitude of electric field at point B



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65. Eight identical point charges of q coulomb each are placed at the corners of a cube side 0.1m. Calculate electric field at the centre of the cube. Calculate the field at the center when one of the corner charges is removed.

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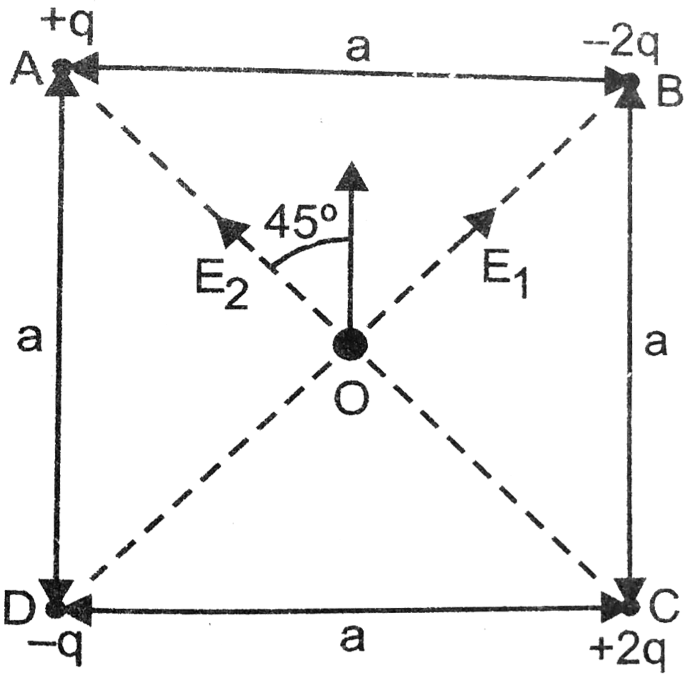
66. What are the magnitude and direction of the electric field at center of the square in Fig, if `q = 1.0xx10^(-8) C and a = 5.0 cm ?



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67. A charge of $4 \times 10^{-9} C$ is distributed uniformly over the circumference of a conducting ring of radius 0.3m. Calculate the field intensity at a point on the axis of the ring at 0.4m from its centre, and also at the centre.

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68. Calculate the magnitude of the force, due to an electric dipole of dipole moment $3.6 \times 10^{-29} C - m$, on an electric 25mm from the center of the dipole , along the dipole axis. Assume that this distance is large relative to the dipole's charge separation.

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69. Charge $q_1 = +6.0nC$ is on y-axis at $y = +3cm$ and charge $q_2 = -6.0nC$ is on y-axis at $y = -3cm$. Calculate force on a test charge $q_0 = 2nC$ placed on X-axis at $x = 4cm$.

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70. ABC is an equillatreal triangle of each side 5cm. Two charges of $\pm \frac{50}{3} \times 10^{-3} \mu C$ are placed at A and B respectively. Calculate magnitude and direction of resultant intensity at C.

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71. (i) Can two equpotential surfaces intersect each other ? Give reason.

(ii) Two charges $+q$ and $-q$ are located at points A $(0, 0, -2)$ and $B(0, 0, 2)$ respectively. How much work will be done in moving a test charge from point P$(4, 0, 0)$ to $(-5, 0, 0)$?

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72. Two charges $+30\mu C$ and $-30\mu C$ are placed 1cm apart. Calculate electric field at a point on the axial line at a distance of 20cm from the centre of dipole.

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73. Two charges $+0.2\mu\mu C$ and $-0.2\mu\mu C$ are placed $10^{-6}cm$ apart. Calculate electric field at an axial point at a distance of 10 cm from their middle point.

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74. An electric dipole of dipole moment 4×10^{-5} Cm is placed in a uniform electric field of $10^{-3}N/C$ making an angle of 30° with the direction of the field. Determine the torque exerted by the electric field on the dipole.

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75. An electric dipole is placed at an angle of 60° with an electric field of magnitude $4 \times 10^5 NC^{-1}$, It experiences a torque of $8\sqrt{3}Nm$. If length of dipole is 2 cm, determine the magnitude of either charge of the dipole.

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76. An electric dipole of length 10cm having charges $\pm 6 \times 10^{-3} C$, placed at 30° with respect to a uniform electric field experiences a torque of magnitude $6\sqrt{3}N - m$. Calculate (i) magnitude of electric field (ii) the potential energy of dipole.

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77. An electric dipole of length 4 cm, when placed with its axis making an angle of 60° with a uniform electric field, experiences a torque of $4\sqrt{3}Nm$. Calculate the

a. magnitude of the electric field, and

b. potential energy of the dipole, if the dipole has charges of $\pm 8nC$

.

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78. An electric dipole consists of two opposite charges of magnitude $q = 1 \times 10^{-6}C$ separated by 2.0cm. The dipole is placed in an external field of $1 \times 10^{5}NC^{-1}$. What maximum torque does the field exert on the dipole ? How much work must an external agent do to rurn the dipole end for end, starting from position of aligment $\left(\theta = 0^{\circ}\right)$?

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79. An electric dipole consists of charges $+2e$ and $-2e$ separated by 0.78mm. It is an electric field of strength $3.4 \times 10^{6}N/C$.

Calculate the magnitude of the torque on the dipole when the dipole moment is (a) parallel to (b) perpendicular to, and (c) antiparallel to the electric field.

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80. Four particles each having a charge q, are placed on the four vertices of a regular pentagon. The distance of each corner from the centre is a. Find the electric field at the centre of the pentagon.

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81. A copper ball of density $8.6g/$ amd 1 cm in diameter is immersed in oil of density $0.8g/$. What is the charge on the ball, if it remains just suspended in oil in electric field of intensity $3600V/m$ acting in the upward direction ?

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82. Two charges of $-4\mu C$ and $+4\mu C$ are placed at the points $A(1, 0, 4)$ and $B(2, -1, 5)$ location in an electric field $\vec{E} = 0.20\hat{i}V/cm$. Calculate the torque acting on the dipole.

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83. An infinite number of charges each equal to q, are placed along the X-axis at $x = 1, x = 2, x = 4, x = 8$,........ and so on.

(i) find the electric field at a point $x = 0$ due to this set up of charges.

(ii) What will be the elctric field if the above setup, the consecutive charges have opposite signs.

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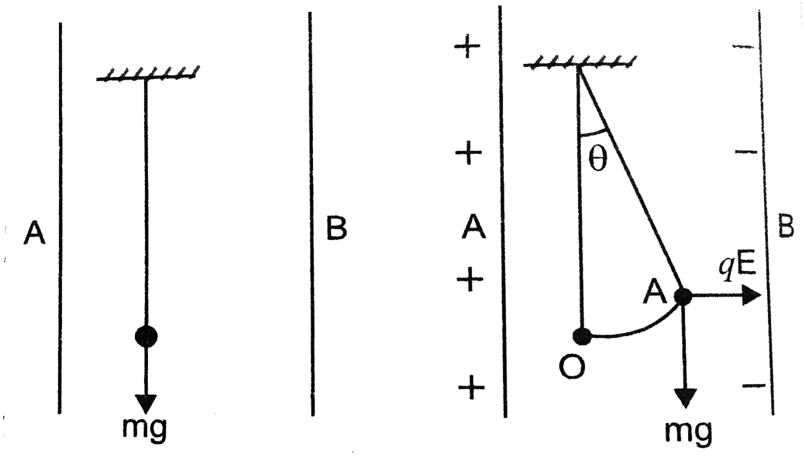
84. A metal ball suspended from a long thread is held between the plates of a capacitor , as shown in Fig, How will the oscillations of this pendulum change, if the ball and the plates of two capacitor are charged ?



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85. Electrostatic potentail V at point, distant r from a charge q varies as

A. q/r^2

B. q^2/r

C. q/r

D. q^2/r^2

Answer: C

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86. Work done in carrying an electron from A to B lying on an equipotential surface of one volt potential is

A. 1 eV

B. 10 eV

C. 1 volt

D. Zero

Answer: D

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87. The correct relation between electric intensity E and electric potential V is

A. $E = -\frac{dV}{dr}$

B. $E = \frac{dV}{dr}$

C. $V = -\frac{dE}{dr}$

D. $V = \frac{dE}{dr}$

Answer: A

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88. I G ev = x eV, where x is

A. 10^6

B. 10^3

C. 10^{12}

D. 10^9

Answer: D

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89. The dimensional formula of electric flux is

A. $\left[M^1L^2T^{-2}A^{-1}\right]$

B. $\left[M^{-1}L^3T^{-3}A\right]$

C. $\left[M^1L^3T^{-3}A^{-1}\right]$

D. $\left[M^1L^{-3}T^{-3}A^{-1}\right]$

Answer: C

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90. A closed surface is vacumm encloses charges $-q$ and $+3q$. Another charge $-2q$ lies outside the surface. Total electric flux over the surface is

A. zero

B. $2q/\in_0$

C. $-\frac{3q}{\in_0}$

D. $4\pi/\in_0$

Answer: B

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91. The number of electric lines of forces rediating from a closed surface in vacumm is 1.13×10^{11}. The charge enclosed by the surface is

A. $1C$

B. $1\mu C$

C. $0.1C$

D. $0.1\mu C$

Answer: A

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92. A charge of $10\mu C$ lies at the centre of a square. Work done in carrying a charge of $2\mu C$ from one corner of square to the diagonally opposite corner is

A. $20J$

B. $5J$

C. Zero

D. $20\mu J$

Answer: C

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93. A Uniform electric field of $10NC^{-1}$ exists in the vertically downward direction. Find the increase in the electric potential as one goes up through a height of 50cm.

A. 20 V

B. 120 V

C. 5 V

D. Zero

Answer: A

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94. Electric potential V and electric flux ϕ are

A. both vectors

B. both scalars

C. V is scalar, ϕ is vector

D. V is vectoe, ϕ is scalar

Answer: B

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95. Work done by an electrostatic field in moving a given charge from one point to another ...... upon the chosen.

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96. Potential difference between any two points B and A in an electrostatic field is the amount of work done in carrying .... from .... to ....

Watch Video Solution

97. Electric potential is a .... Quantity and its units are ....

Watch Video Solution

98. Electrostatic forces are .... forces.

Watch Video Solution

99. Electric potential on dipole axis varies inversely as .... Of distance of point from the center of electric dipole.

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100. Electric potential at any point in equatorial plane of a dipole is ....

Watch Video Solution

101. Electric potential gradient is a .... quantity and is numberically equal to ....

Watch Video Solution

102. Electric flux over an area in an electric field represents the .... crossing this area.

Watch Video Solution

103. Electric flux is a .... quantity and its units are ....

Watch Video Solution

104. Two charges $+q$ and $-q$ are located at points $A(0, 0. -2)$ and $B(0, 0, 2)$ respectively. How much work will be done in moving a test charge from point $P(4, 0, 0) \rightarrow Q(-5, 0, 0)$?

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105. it requires $50\mu J$ of work to carry a $2\mu C$ charge from a paint R to S. What is the potential difference between these points ? Which point is at higher potential ?

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106. If 100 J of work must be done to move electric charge equal tp 4C from a place where potential is -$10V$ to another place where potential si V volt, find the value of V.

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107. If 10 J of work is to be done in moving a charge of `-200C from A to B, which of the two points is at higher potential ? What is the potential difference ?

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108. The electric field at a point due to a point charge is $20NC^{-1}$ and electric potential at that point is $10JC^{-1}$. Calculate the distance of the point from the charge and the magnitude of the charge.

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109. Two point charges q and $-2q$ are kept 'd' distance apart. Find the location of the point relative to charge q at which potential due to the system of charges is zero.

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110. To what potential we must charge an insulate sphere of radius 14 cm, so that the surface charge density is equal to $2\mu Cm^{-2}$?

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111. A charge of $24\mu C$ is given to a hollow metallic sphere of radius 0.2m. Find the potential

(i) at the surface of sphere

(ii) at a distance of 0.1 cm from the center of sphere.

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112. Two charges $+10\mu C$ and $+20\mu C$ are placed at a. separation of 2 cm. Find the electric potential due to the. pair at the middle point of the line joining the two charges.

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113. Two point charges one of $+100\mu C$ and another of $-400\mu C$, are kept 30 cm apart. Find the point of zero potential on the line joining the two charges.

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114. Two point charges $4\mu C$ and $-2\mu C$ are separated by a distance of 1m in air. Calculate at what point on the line joining the two charges is the electric potential zero ?

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115. The electric field at a point due to a point a charge is $30N/C$, and the electric potential at that point is $15J/C$. Calcualte the distance of the point from the charge and the magnitude of the charge.

Watch Video Solution

116. What is the potential at the centre of a square of each side 1.0 meter, when four charges $+1 \times 10^{-8}C$, $-2 \times 10^{-8}C$, $+3 \times 10^{-8}C$ and $+2 \times 10^{-8}C$ are placed at the four corners of the square.

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117. A point charge of $10^{-8}C$ is situated at the origin of co-ordinatges. Find the potential difference between the points $A(4, 4, 2)$ and $B(1, 2, 2)$.

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118. Twenty seven charged water droplets each with a diameter of 2 mm and a charge fo $10^{-12}C$ coalesce to form a single drop. Calculate the potential of the bigger drop.

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119. A charge of $20\mu C$ produces an electric field. Two points are 10 cm and 5 cm from this charge. Find the values of potentials at these points and calculate work done to take an electron from one point to the other.

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120. Calculate the voltage required to balanced an oil drop carrying 10 electrons, when located between plates of a capacitor, which are 5mm apart. Given mass of drop $= 3 \times 10^{-16} kg$, charge on electron $= 1.6 \times 10^{-19} C$ and $g = 9.8 m/s^2$.

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121. An infinite plane sheet of charge density $10^{-8} Cm^{-2}$ is held in air. In this situation how far apart are two equipotenitial surfaces, whose p.d is 5 V ?

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122. An electric field of $20 N/C$ exists along the x-axis in space. Calculate the potential difference $V_B - V_A$ where the points A and B are given by

a. $A = (0, 0), B = (4m, 2m)$

b. $A = (4m, 2m), B = (6m, 5m)$

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123. An electric field $E = \left(20\hat{i} + 30\hat{j}\right)$ N/C exists in the space. If thepotential at the origin is taken be zero, find the potential at $(2m, 2m)$.

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124. What is potential gradient at a distance of $10^{-12}m$ from the centre of the platinum nucleas ? What is the potential gradient at the surface of the nucleas ? Atomic number fo platinum is 78 and radius of platinum nucleas is $5 \times 10^{-15}m$.

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125. A uniform field of $2kN/C$ is the x direction. A point charge $= 3\mu C$ initially at rest at the origin is released. What is K.E. of this charge at x = 4m ? Also, calculate $V(4m) - V(0)$.

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126. If the potentail in the region of space around the point $(-1m, 2m, 3m)$ is given by $V = \left(10x^2 + 5y^2 - 3z^2\right)$, calculate the three components of electric field at this point.

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127. Two charges of magnitude $5nC$ and $-2nC$ are placed at points (2cm,0,0) and (x cm,0,0) in a region of space. Where there is no other external field. If the electrostatic potential energy of the system is $-0.5\mu J$. What is the value of x ?

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128. Two identical particles, each having a charge of $2.0 \times 10^{-4} C$ and then released. What would be the speeds of the particles when the separtion becomes large?

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129. Two point charges A and B of value of $+15\mu C$ and $+9\mu C$ are kept 18 cm apart in air. Calculate the work done when charge B is moved by 3cm towards A.

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130. Two electrons each moving with a velocity of $10^{6} ms^{-1}$ are released towards eachother. What will be the closest distance of approach between them ?

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131. Set up arrangment of three point charges : $q, +2q$ and xq separated by equal finite distances so that electric potential energy of the system is zero. What is x ?

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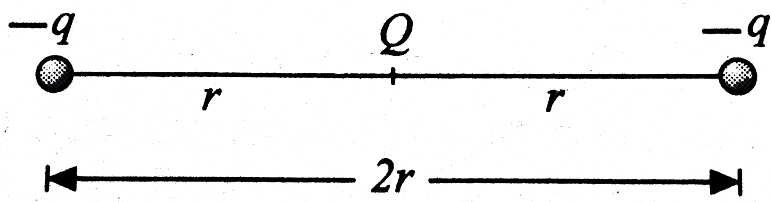
132. Three points charges of $1C, 2C$ and $3C$ are placed at the corners of an equilateral triangle of side 100 cm. Find the work done to move these charges to the corners of a similar equilateral triangle of side 50 cm.

Watch Video Solution

133. Charges-$q, Q,$ and $-q$ are placed at an equal distance on a straight liner. If the total potential energy of the system of three charges is zero, then find the ratio Q/q.



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134. Consider a uniform electric field $E = 3 \times 10^3 \hat{i} N/C$. (a) What is the flux of this field through a square of 10 cm on a side whose plane is parallel to the yz plane ? (b) What is the flux through the same square if the normal to its plane makes a 60° angle with the x-axis ?

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135. A uniform electric field $\vec{E} = -E_x \hat{i} N/C$ for $x < 0$ exists. A right circular cylinder of length lcm and radius rcm has its centre at the origin and its axis along X-axis. Find out the net outward flux. What is the net charge within the cyclinder ?

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136. A circular plane sheet of radius 10 cm is placed in a uniform electric field of $5 \times 10^5 NC^{-1}$, making an angle of $60°$ with the field. Calculate electric flux through the sheet.

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137. If the electric field is given by $\vec{E} = 8\hat{i} + 4\hat{j} + 3\hat{k} NC^{-1}$, calculate the electric flux through a surface of area $100 m^2$ lying in X-Y plane.

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138. A spherical Gaussian surface encloses a charge of $8.85 \times 10^{-8}C$ (i) Calculate the electric flux passing through the surface (ii) If the radius of Gaussian surface is doubled, how would the flux change ?

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139. A rectangular surface of sides $10cm$ and $15cm$ is palaced inside a uniform electric field fo $25Vm^{-1}$, such that normal to the surface makes an angle of 60° with the direction of electric field. Find the flux of electric field through the rectangular surface.

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140. If the electric field is given by $\left(6\hat{i} + 4\hat{j} + 4\hat{k}\right)$, calculate the electric flux through a surface of area 20 units lying in Y - Z plane.

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141. The electric field in a certain region of space is $\left(5\hat{i} + 4\hat{j} - \hat{k}\right) \times 10^5 N/C$. Calculate electric flux due to this field over an area of $\left(2\hat{i} - \hat{j}\right) \times 10^{-2} m^2$.

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142. In the above question, what is the electric flux passing throguh a face of the given cube ?

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143. Five thousand lines of force enter a certain volume of space and three thousand lines emerge from it. What is the total charge in coulomb within this volume ?

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144. A positive charge of $17.7\mu C$ is placed at the centre of a hollow sphere of radius $0.5m$. Calculate the flux density through the surface of the sphere.

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145. An infinite line charge produces a field of $9 \times 10^4 NC^{-1}$ at a distance of $4cm$. Calculate the linear charge density.

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146. A charged particle having a charge of $-2.0 \times 10^{-6} C$ is placed close to a non-conducting plate having a surface charge density $4.0 \times 10^{-6} Cm^{-2}$. Find the force of attraction between the particle and the plate.

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147. A long cylindrical wire carries a positive charge of linear density $2.0 \times 10^{-8} Cm^{-1}$. An electron revolves around it in a circular path under the influence of the attactive electrostatic force. Find the kinetic energy of the electron. Note that it is independent of the radius.

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148. A large plane sheet of charge having surface charge density $5 \times 10^{-16} cm^{-2}$ lies in XY plane. Find electric flux through a circular area of radius 1cm Given normal to the circular area makes an angle of 60° with Z-axis.

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149. Two long straight parallel wires carry charges λ_1 and $lamba_2$ per unit length. The distance between them is d. Calculate the magnitude of force externed on the length of one due to charge on the other.

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150. A particle of mass $9 \times 10^{-5} g$ is kept over a large horizontal sheet of charge density $5 \times 10^{-5} C\ m^{-2}$. What charge should be given to the particle so that it does not fall on release ?

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151. ABCD is a square of side $0.2m$. Charges of $2 \times 10^{-9}C, 4 \times 10^{-9}C$ and $8 \times 10^{-9}C$ are placed at the corners A, B and C respectively. Calculate work required to transfer a charge of $2 \times 10^{-9}C$ from corner D to centre of the square.

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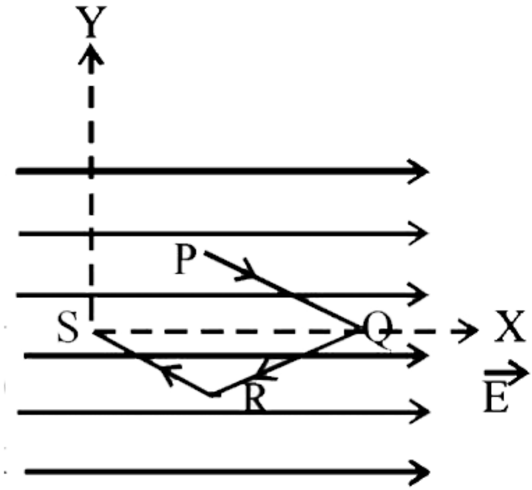
152. A point charge q moves from point P to pont S along the path PQRS (fig.) in a uniform electric field E pointing parallel to the poistive direction of the X-axis. The coordinates of the points P, Q, R and S are(a, b, O), (2a, O, O)(a, -b,$\underline{O}$) and `(O, O, O) respectively. The work done by the field in the above process is given by the expresison............



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153. The electric field outside a charged long straight wire is given by $E = \frac{1000}{r} Vm^{-1}$, and is directed outwards. What is the sign of the charge on the wire ? If two points A and B are situated such that $r_A = 0.2m$ and $r_B = 0.4m$, find the value of $\left(V_B - V_A\right)$.

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154. Electric field inside a conductor is always zero. Is this statement true of false?

A. positive

B. negative

C. constant

D. zero

Answer: D

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155. Charge on a capacitor is doubled. Its capacity becomes k times, where

A. $k = 2$

B. $k = 1$

C. $k = \frac{1}{2}$

D. $k = 4$

Answer: B

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156. Electrical capacity of earth is

A. $1F$

B. $1\mu F$

C. $711\mu F$

D. $9 \times 10^9 \mu F$

Answer: C

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157. When air in between the plates of a capacitor is replaced by mica of dielectric constant 6, its capacity

A. remains unaffected

B. reduced to $1/6th$

C. becomes 6 times

D. none of the above

Answer: C

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158. When a number of capacitor are connected in series between two points, all the capacitors posses same

A. capacity

B. potential

C. charge

D. none of the above

Answer: C

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159. When a number of capacitor are connected in parallel between two points, the equivalent capacitance

A. increases

B. decreases

C. remains the same

D. none of the above

Answer: A

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160. A condenser is charged to double its initial potential. The energy stored in the condenser becomes x times, where x =

A. 2

B. 4

C. 1

D. $1/2$

Answer: B

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161. What is the relation between dielectric constant and electric susceptibility ?

A. $k = \chi$

B. $K = 1 + \chi$

C. $\chi = K + 1$

D. $K^2 = (1 + \chi)(1 - \chi)$

Answer: B

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162. Throughout the volume of the conductor, electric potential is .... And it has the .... As on its surface.

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163. Electrostatic shielding is the phenomenon of .... a certain region of space from ....

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164. A conductor is said to have a capacity of one farad, when a .... Raise its ...... by ....

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165. When plate of a capacitor are separated by a dielectric medium of relative permitively$K$, instead of air, ... becomes .... Times.

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166. When a number of capacitor are connected in series, ... Each capacitor .

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167. Capacity can be increased by connecting different capacitors ....

Watch Video Solution

168. The potential energy of a capacito is obtained of the cost of .... Stored in the .... Used for .... the capacitor.

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169. Total energy stored in series or parallel combination of capacitor is equal to .... stored in ....

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170. When charges are shared between any two bodies, their .... becomes .... Is really lost, but .... does occur.

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171. The maximum .... that a dielectric medium can withstand without breaking down of .... is called its ....

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172. N drops of mercury of equal radii and possessing equal charges combine to from a big drop. Compare the charge, capacitance and potential of bigger drop with the corresponding quantities of individual drops.

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173. 125 drops of water each of radius $2mm$ and carrying charge of $1nC$ are made to form a bigger drop. Find the capacitance and potential of the bigger drop.

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174. 27 drops of same size are charged $220V$ each. They coalesce to form a bigger drop. Calculate the potential of bigger drop.

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175. When electrons equal to Avogadro number are transferred from one conductor to another, a potential difference of $10^6 V$ appears between them. Calculate the capacity of the system of two conductors.

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176. A charged spherical conductor has a surface density of $0.07 Ccm^{-2}$. When the charge is increased by $4.4C$, the surface density changes to `0.084 C cm^(-2). Find the initial charge and capacitance of the spherical conductor.

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177. A charged spherical conductor has a surface density of $0.07Ccm^{-2}$. When the charge is increased by $4.4C$, the surface density changes to $0.084Ccm^{-2}$. Find the initial charge and capacitance of the spherical conductor.

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178. Two metallic conducors have net charge of $+70pC$ and $-70pC$, which result in a potential difference of $20V$ between them. What is the capacitanace of the system ?

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179. Calculate the capacitance of a parallel plate capacitor having circular discs of radii $0.05m$ each. The separation between the discs is $1mm$.

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180. A parallel plate air capacitor consists of two circular plates of diameter $8cm$. At what distance should the plates be held so as to have the same capacitance as that of a sphere of a diameter $20cm$?

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181. Calculate the area of paper required to construct a parallel plate capacitant of $0.004\mu F$, if the dielectric constant of paper be 2.5 and its thickness $0.025mm$.

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182. What distance should be two plates each of area $0.2 \times 0.1 m^2$ of an air capacitor be placed in order to have the same capacitance as a spherical conductor of radius `0.5 m?

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183. The plates of a parallel-plate capacitor in vacuum are $5.00 mm$ apart and $2.00 m^2$ in area. A potential difference of $10, 000 V$ is applied across the capacitor. Compute

(a) the capacitance

(b) the charge on each plate, and

(c) the magnitude of the electric field in the space between them.

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184. A sphere of radius $0.03m$ is suspended within a hollow sphere of radius $0.05m$. If the inner sphere is charged to a potential of 1500 volt and outer sphere is earthed. Find the capacitance and the charge of the inner sphere.

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185. A co-axial cable used in transmission line has inner radius of $0.1mm$ and outer radius of $0.6mm$. Calculate capacitnace per meter of the cable.

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186. The stratosphere acts as a conducting layer for the earth. If the stratosphere exends beyond $50km$ from the surface of earth, then calculate the capacitance of the spherical capacitor formed between strasphere and earth's surface. Take radius of earth of as $6400 km$.

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187. A spherical capacitor has an outer sphere of radius $0.15m$ and the inner sphere of diameter $0.2m$ The outer sphere is earthed and the inner shere is given charge of $6\mu C$. The space between the concentric spheres is filled with a material of dielectric constant 6. Calculate capacitacne and potential of inner sphere.

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188. A cable consisting of a wire $3mm$ thick dielectric of relative permitively 10. Calculate the capacitance of $1km$ length of the cable.

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189. Two capacitors of capacitances $3\mu F$ and $6\mu F$, are charged to potentials 2V and 5V respectively. These two charged capacitors are connected in series. Find the potential across each of the two capacitors now.

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190. In fig. $C_1 = 20\mu F, C_2 = 30\mu F$ and $C_3 = 15\mu F$ and the insulated plate of C_1 is at a potential of 90 V, one plate of C_3 being earthed. What is the potential difference between th plates of C_2 three capacitors being connected in series ?

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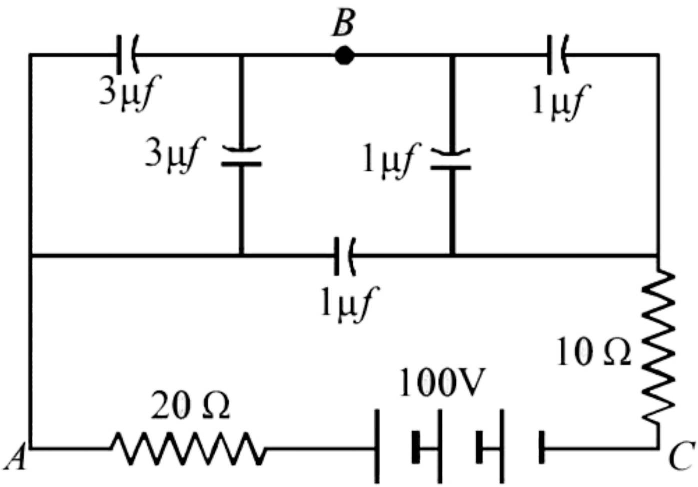
191. In the diagram shown find the potential difference between the points A and B and between the points B and C in the steady state.



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192. Two capacitors have a capacitance of $5\mu F$ when connected in parallel and $1.2\mu F$ when connected in series. Calculate their capacitance.

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193. Connect three capacitors of $3\mu F$, $3\mu F$ and $6\mu F$ such that their equivalent capacitance is $5\mu F$.

A. Series combination of 3 μ F and 6 μ F in parallel with 3 μ F

B. Series combination of 3 μ F and 3 μ F in parallel with 6 μ F

C. both A and B

D. can not be achieved

Answer: A

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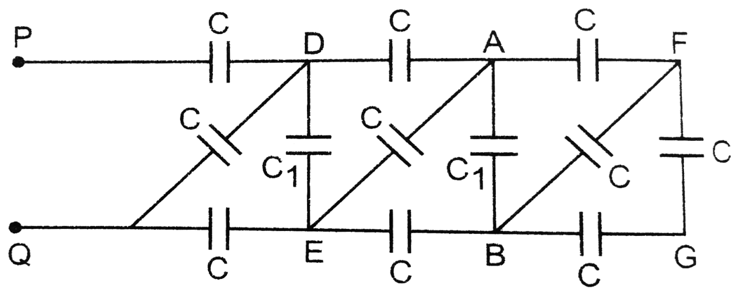
194. Find the equivalent capacitane between the points P and Q as shown in Fig. Given $C = 18\mu F$ and $C_1 = 12\mu F$



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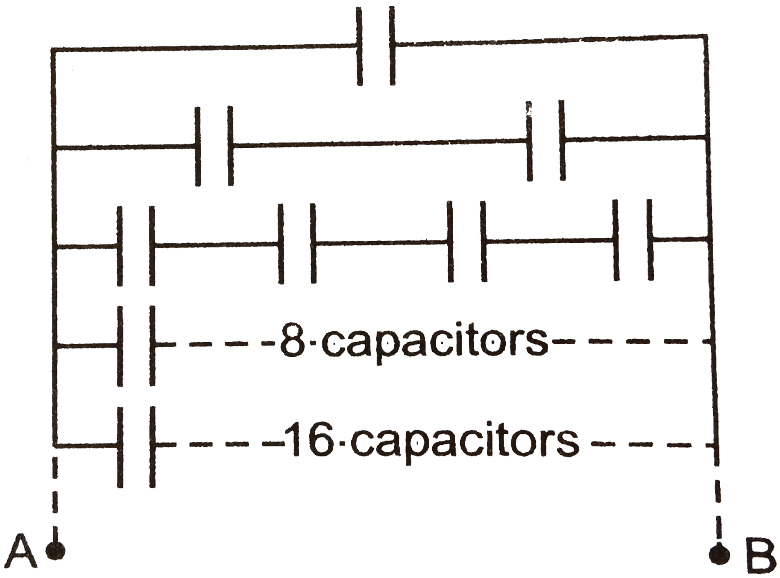
195. An infinite number of identical capacitors each of capacitance $1\mu F$ are connected $1\mu F$ are connected as shown in Fig. Then the equivalent capacitance between A and B is



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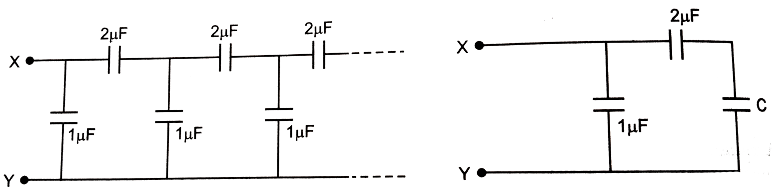
196. Find the capacitance of the infinite ladder between points X and Y, Fig.



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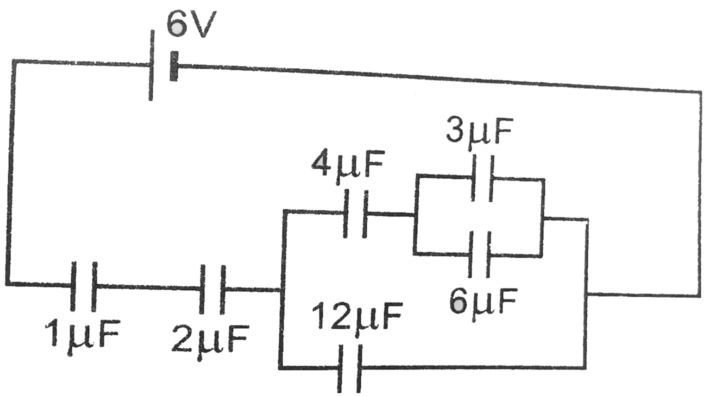
197. Find out the potentail difference across the plates of $1\mu F$ capacitors in Fig.



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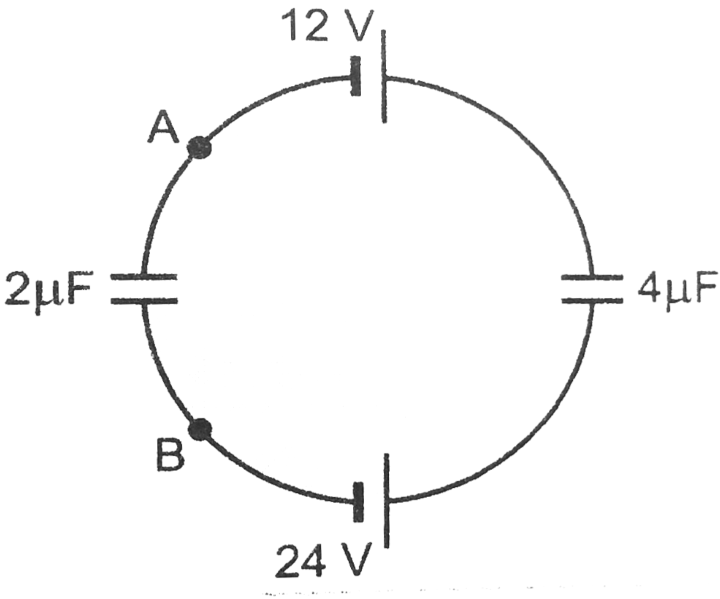
198. Find the $p. d$ between points A and B of ararngement shown in Fig



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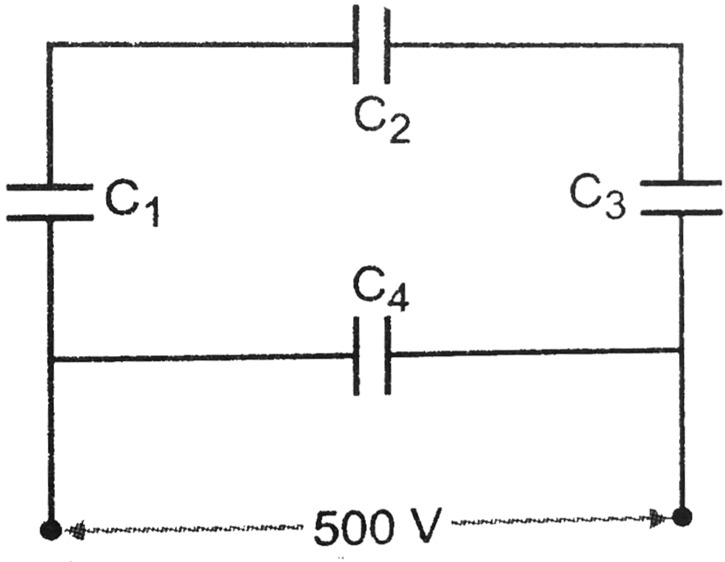
199. A network of four each of $12\mu F$ capacitance is connected to a $500V$ apply as shown in Fig.



(a) Equivalent capacitance of the network.

(b) Charge on each capacitor.

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200. The equivalent capacitance of the combination between A and B in the given Fig.

(i) Calculate capacitance of capacitor C.

(ii) Calculate charge on each capacitor if a $12V$

(iii) What will be the potential drop across each capacitor ?

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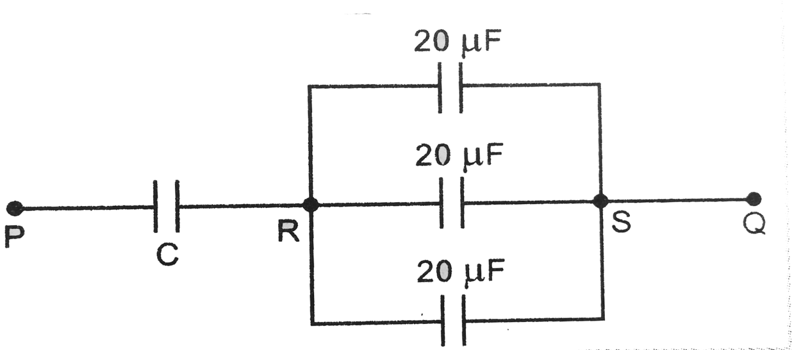
201. Calculate the capacitance of the capacitance of the capacitor C in Fig. The equivalent capacitance of the combination between P and Q is $30\mu F$



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202. The capacities of three capacitors are in the ratio of $1:2:3$. Their equivalent capacity in series is greater than their equivalent capacity in series by $60/11$ pF. Calculate their individual capacitances.

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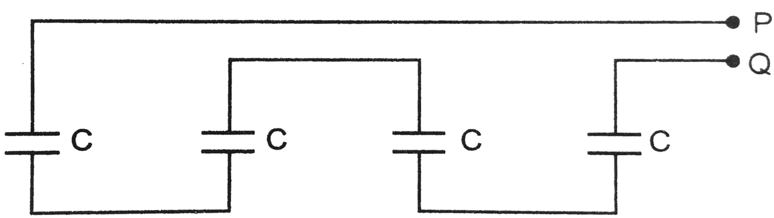
203. A combination of four identical capacitors is shoen in Fig. IF resultatn capacitance of the combination between the points P and Q is $1\mu F$, calculate capacitance of each capacitor.



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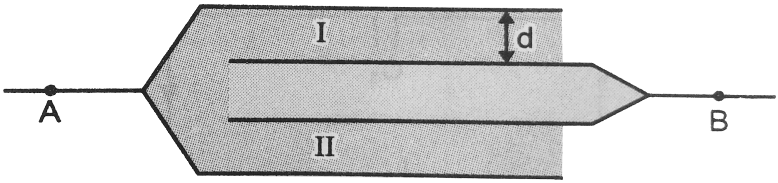
204. What is the capacitance of arrangement of 4 platges each of area A at a distance d in air in Fig.



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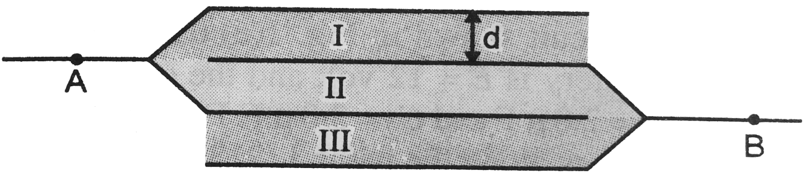
205. What is the capacitance of arrangement of 4 platges each of area A at a distance d in air in Fig.



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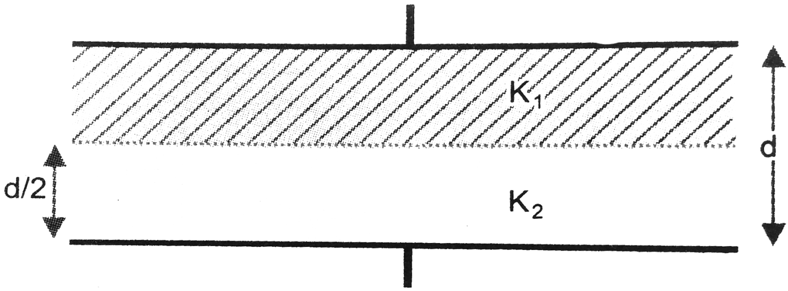
206. A parallel plate capacitor is filled with dielectrics as shown in Fig. What is its capacitance ?



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207. Three capacitors of capacitances $2\mu F$, $3\mu F$ and $6\mu F$ are connected in series with a 12 V battery. All the connecting wire are disconnected, the three positive plates are connected together and the three negative plates are connected together. Find the charges on the three capacitors after the reconnection.

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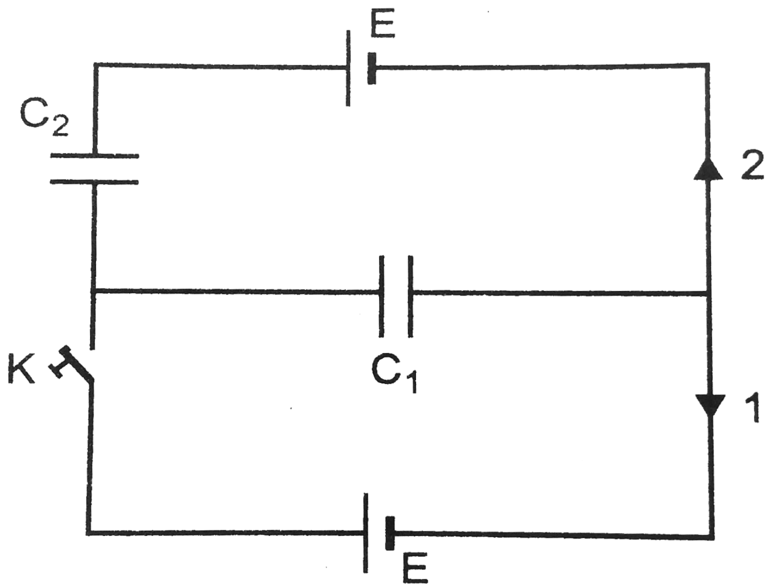
208. Calculate the charges which will flow in sections 1 and 2 in Fig, why key K is pressed.



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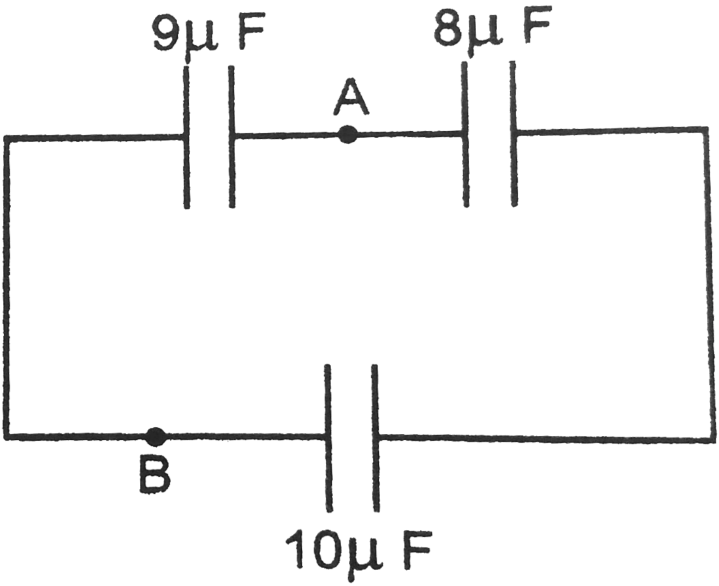
209. Calculate the equuivalent capacitances between the points A and B in the combination shown in Fig.



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210. Two capacitors of $2\mu F$ and $3\mu F$ are joined in series. The outer plate of second capacitor is earthed. Find out the potential and charge of the inner plate of each capacitor.

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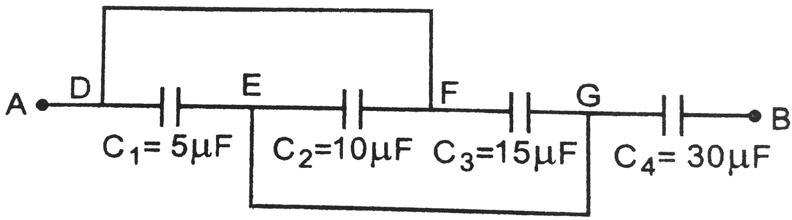
211. Calculate the equivalent capacitance between the points A and B in the combination shown in Fig.



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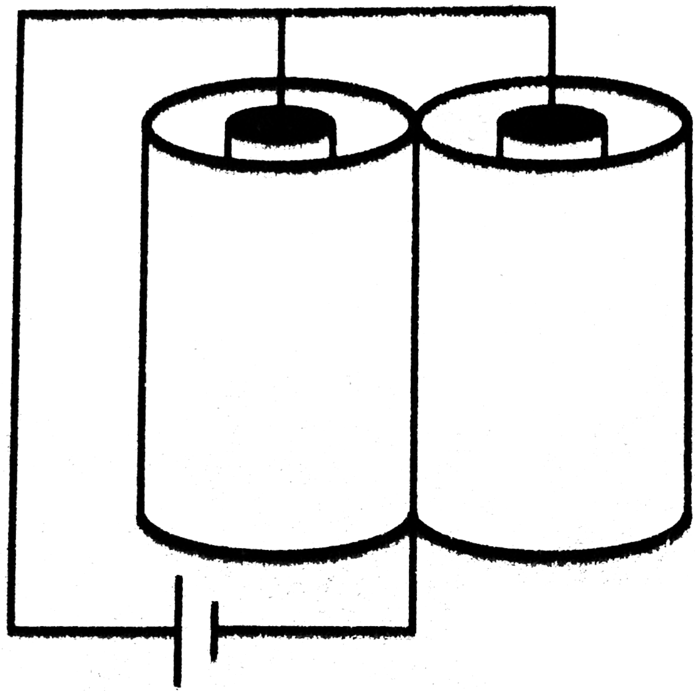
212. The outer cyliunders of two cylindrical capacitors of capacitance 2.2 mu F each , are keot in contact and the inner cylinders are connected through a wire .A bettery of end 10V is connected as shown in figure. Find the totatl charge supplied by the bettery to the inner cylioders.



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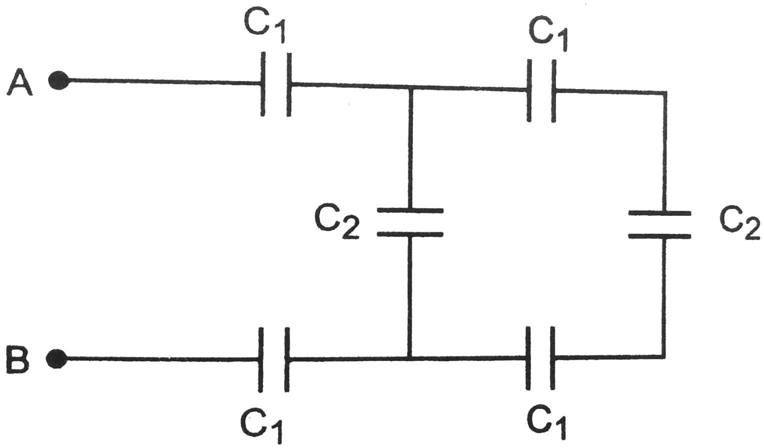
213. If $C_1 = 3pF$ and $C_2 = 2pF$, calculate the equivalent capacitance of the network shown in Fig between points A and B.



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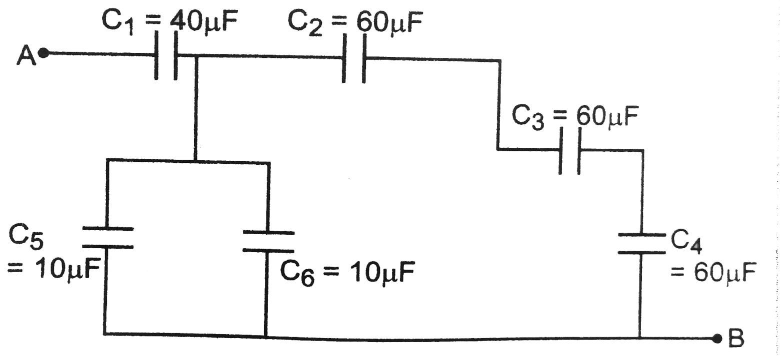
214. Find the equilalent capacitance of the combination of capacitors between the points A and B as shown in Fig. Also calculate the total charge that flows in the circuit, when a $100V$

battery is connected between the points A and B.



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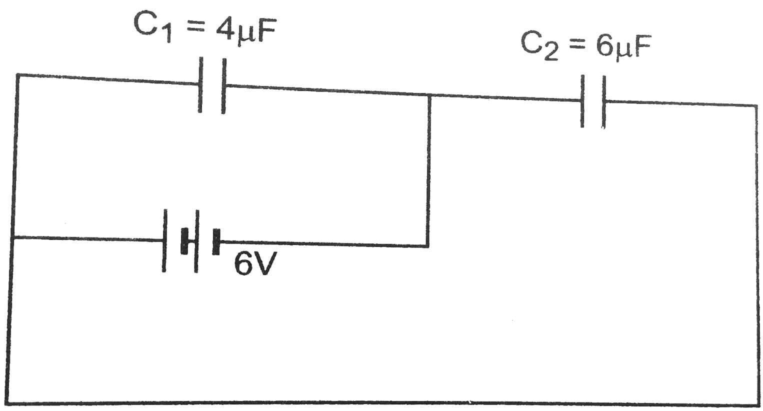
215. Two capacitors C_1 and C_2 are connected to a battery of $6V$ as shown in Fig. Find the charge on each capacitor.



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216. A 800 pF capacitor is charged by a $100V$ battery. After sometime, the battery is disconnected. The capacitor is then connected to another $800pF$ capacitor. What is the electrostatic energy stored ?

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217. Net capacitance of three identical capacitors in series is $1\mu F$. What will be their net capacitance in parallel ? Find the ratio of energy stored in two configurations if they are connected to the same source.

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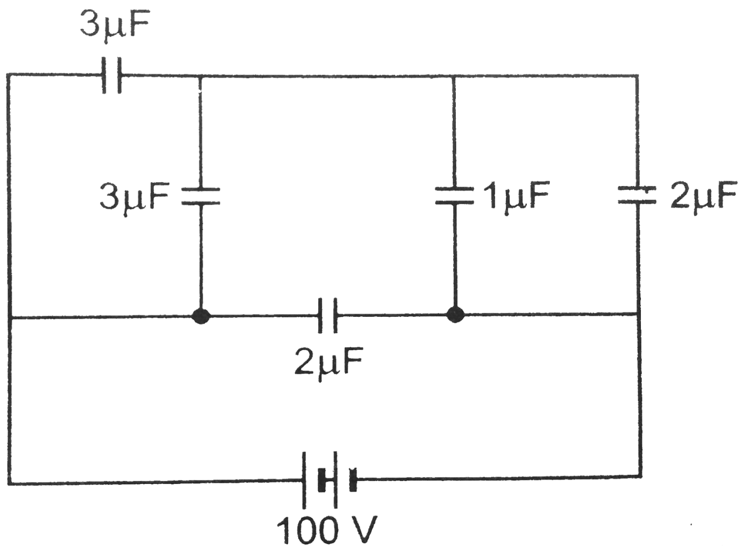
218. Fig, shows a network of five capacitors connected to a $100V$ supply. Calculate the total charge and energy stored in the network.



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219. A parallel plate capacitor of $300\mu F$ is charged to $200V$. If the distance between its plate is halved, what will be the potential difference between the plates and what will be the change in stored energy ?

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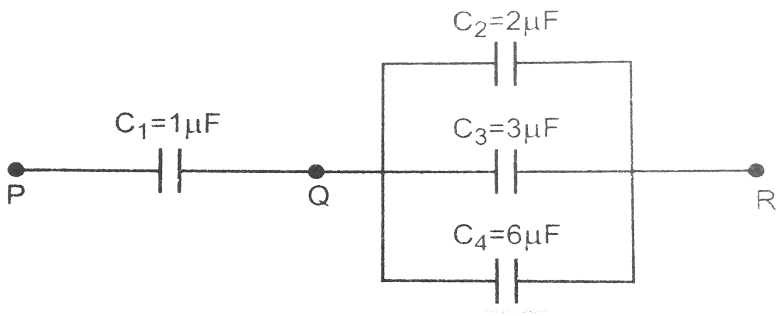
220. In Fig, the energy stored in C_4 is $27J$. Calculate the total energy in the system.



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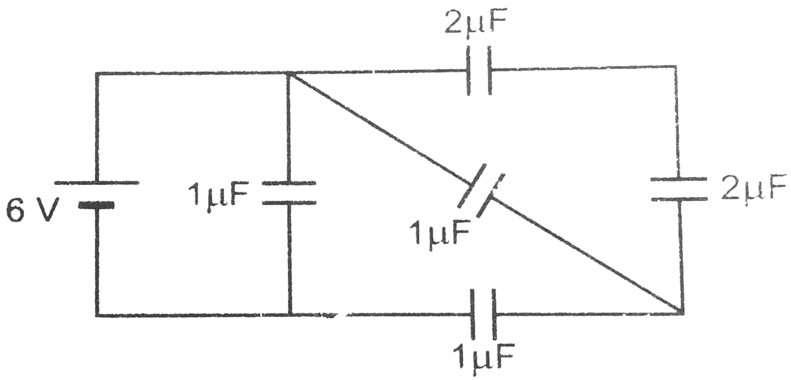
221. Find the total energy stored in capacitors in the network shown in Fig.



A. 3.6 × 10 − 5 J

B. 0.6 × 10 − 5 J

C. 5.6 × 10 − 5 J

D. none of these

Answer: A

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222. Find the ratio of potential difference that must be applied across the parallel and series combination of two capacitors

C_1 and C_2 with their capacitance in the ratio 1:3 so that energy stored in the two cases becomes the same.

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223. Net capacitance of three identical capacitors in series is $1\mu F$. What will be their net capacitance in parallel ? Find the ratio of energy stored in two configurations if they are connected to the same source.

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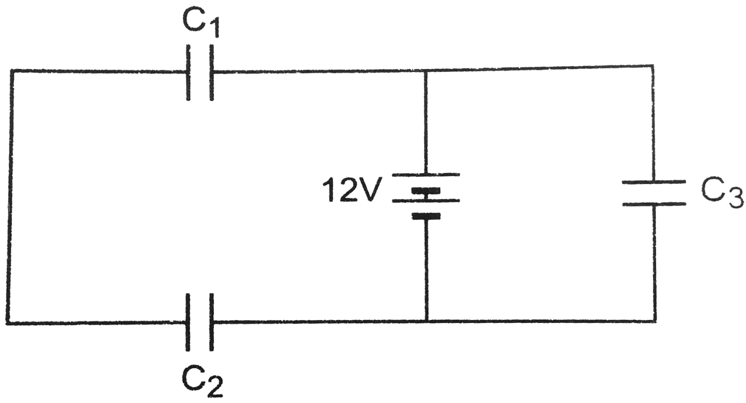
224. Three identical capacitors C_1, C_2 and C_3 of capacitance $6\mu F$ each are connected to a $12V$ battery as shown in Fig. Find



(i) charge on each capacitor

(ii) equivalent capacitance of the network.

(iii) energy stored in the network of capacitors.

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225. A $20\mu F$ capacitors is charged by a $30V$ $d.c$ supply and then connected across an uncharged $50\mu F$ capacitor. Calculate (i) the final potential diff. across the combinition (ii) initial and final energies.

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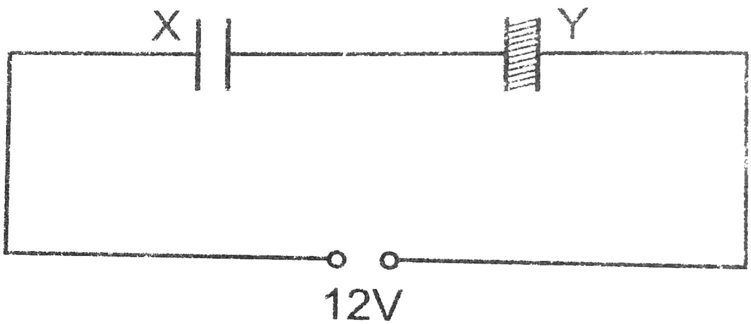
226. Two parallel palate capacitors X and Y have the same area of plates and same separation between then. X has air between the plates and Y contains a dielectric medium of $\in_r = 4$,



Calculate (i) capacitance of X and Y if equivalent capacitance fo combination is $4\mu F$. (ii) pot diff between the plates of X and Y. (iii) What is the ratio of electrostatic energy stored in X and Y ?

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227. Two capacitors of $25\mu F$ and $100\mu F$ are connected in series to a source of $120V$. Keeping their charges uncharged, they are separated and connected in parallel to eachother. Find out

(i) pot. Diff. between the plates of each capacitor

(ii) energy loss in the process.

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228. 1000 similar electrified rain drops merge together into one drop so that their total charge remains uncharged. How is the electric energy affected ?

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229. The two plates of a parallel plate capacitor are $4mm$ apart. A slab of dielectric constant 3 and thickness $3mm$ is introduced between the plates is so adujected that the capacitance of the capacitor becomes $\frac{2}{3}rd$ of its original value. What is the new distance between the plates ?

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230. An electric field $E_0 = 3 \times 10^4 Vm^{-1}$ is established between the plates $0.05m$ apart, of a parallel plate capacitor. After removing the charging battery, an uncharged metal plate of thickness $t = 0.1m$ is inserted between capacitor plates. Find the $p.d.$ across the capacitor, (i) before (ii) after the indroduction of plates (iii) what would be the $p.d$ if a dielectric slab $(K = 2)$ were inroduced of place of metal plate.

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231. The two circular plates of a parallel plate capacitor are 8 cm in diameter each of $15mm$ apart. An ebonite plate $0.5cm$ thick is introduced between the plates. Calculate its capacity. If the plate were of copper, what would be the new capacity ? Take $K = 2.5$.

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232. When a slab of inslulating material $4mm$ thick is inroduced between the plates of a parallel plate capacitor, it is found that the distance between the plates has to be increased by $3.2mm$ to restore the capacity to its original value. Calculate dielectric constant of the material.

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233. The area of parallel plates of an air capacitor is $0.2m^2$ and the distance between them is $0.01m$ The potential difference between the plates, the potential difference between the plates is $3000V$. When a $0.01m$ thick sheet of an insulating material is placed between the plates, the potential difference decrease to 1000 volt. Determine (i) capacitance of capacitance before placing the sheet (ii) charge on each plate (iii) dielectric constant of material (iv) capacitanc after placing the insulator (v) absoulate permittivity of the dielectric.

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234. A parallel plate capacitor has a capacitance of $2\mu F$. A slab of dielectric constant 5 is inserted between the plates and the capacitor is charged to $100V$ and then isolated . (a) What is the new potential diff., if the dielectric slab is removed ? (b) How much work is required to remove teh dielectric slab ?

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235. A parallel plate capacitor is to be designed with a voltage rating 1 KV using a material of dielectrical constant 3 and dielectric strength about $10^7 Vm^{-1}$. [Dielectric strength is the maximum electric field a material can tolerate without break down, i.e, without starting to conduct electrically through partial ionisation. For safety, we should like the field never to exceed say 10% of the dielectric strength]. What minimum area of the plates is required to have a capacitance of 50 pF ?

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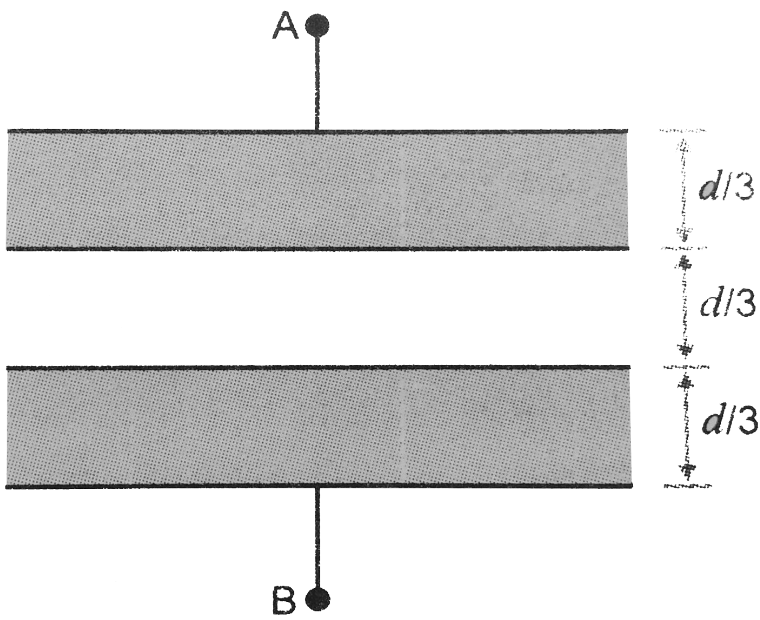
236. Fig shows a parallel plate capacitor of plate area A and plate separation d. Its entire space is filled with three different dielectric slabs of same thickness. Find the equivalent capacitance of the arrangment.



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237. A slab of material of dielectric constant k has the same area as that of the plates of a parallel plate capacitor but has the thickness d/2, when d is the separation between the plates. Find out the expression for its capacitance when the slab is inserted between the plates of the capacitor.

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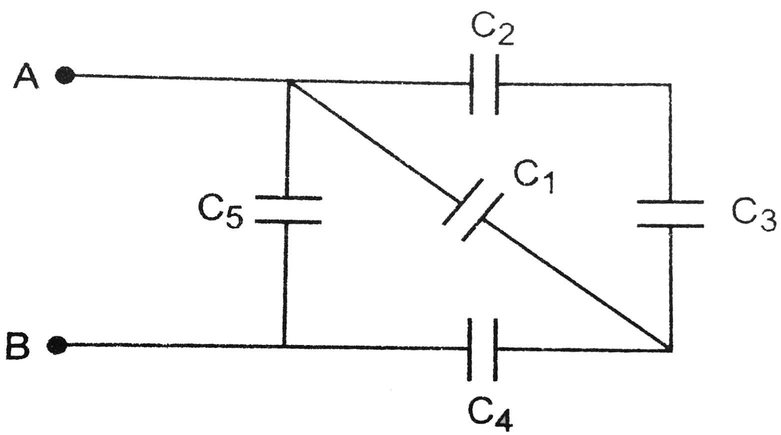
238. Five capacitors of capacitances $C_1 = C_5 = 1\mu F, C_2 = C_3 = C_4 = 2\mu F$ are connectes as shown in Fig. Calculate equivalent capacitance of the system between points A and B.



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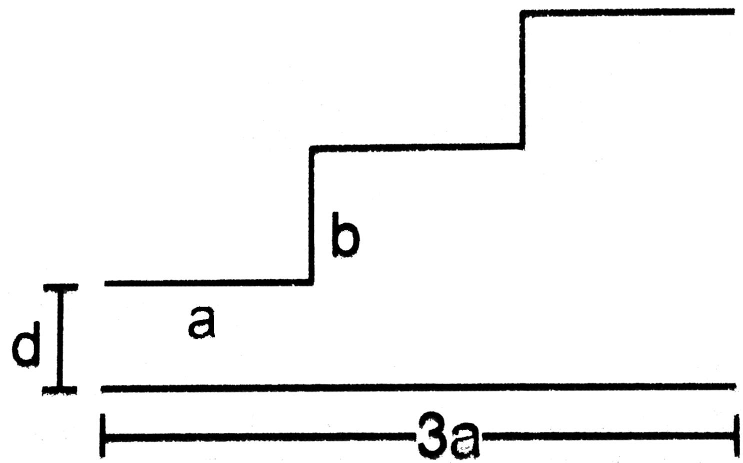
239. A capacitor is made of a flat plate of area A and a second plate having a stair -like structure as shown in figure. The width of each stair is a and the height is b. Find the capacitance of the assembly.



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240. Find the capacitance of a system of three parallel plates, each of area A $metre^2$ separated by distances d_1 and d_2 metre respectively. The space between them is filled with dielectrics of relatives dielectric constants K_1 and K_2. The dielectric constant of free space is $\in_0$.

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241. An uncharged capacitor is connected to a battery. Show that half the energy supplied by the battery is lost as heat while charging the capacitor.

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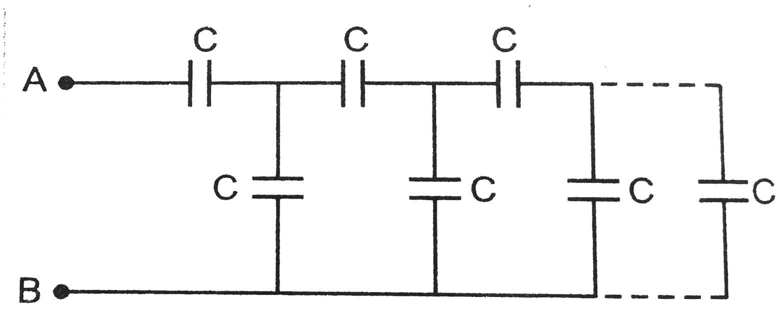
242. Find the equivalent capacitance between the terminals A and B in the given Fig. Take $C = 1\mu F$.



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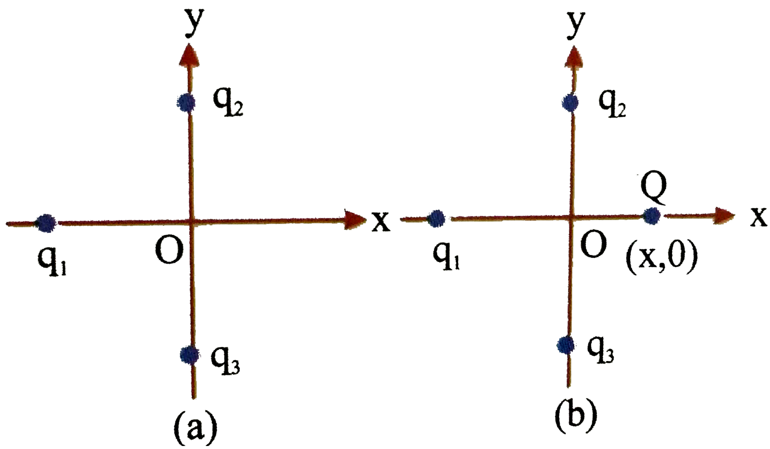
243. In figure two positive charges q_2 and q_3 fixed along the y-axis ,exert a net electric force in the $+x$ direction on a charge q_1 fixed along the x-axis if a positive charge Q is added at $(x, 0)$ the force on q_1



A. shall increase along the positive x-axis

B. shall decrease along the positive x-axis

C. shall point along the negative x-axis

D. shall increase but the direction changes because of the intersection of Q with q_2 and q_3

Answer: A

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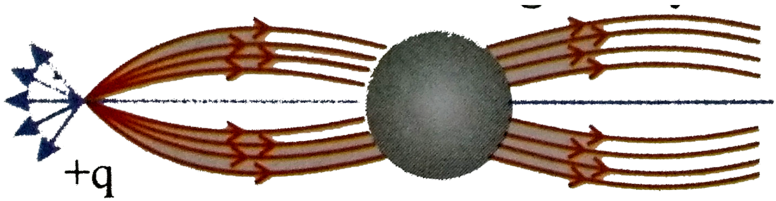
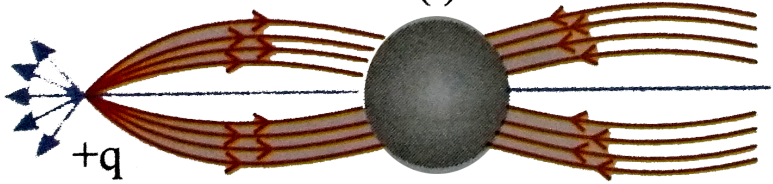
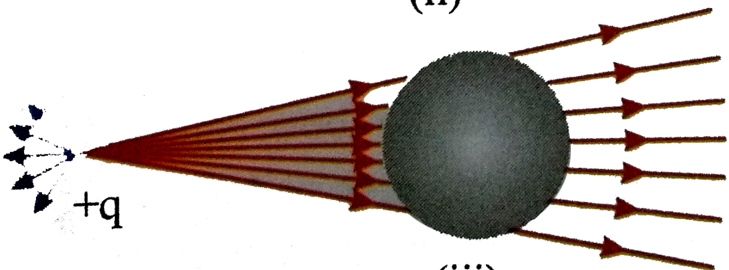
244. A point positive charge is brought near an isolated conducting sphere as shown in figure the electric field is best given by



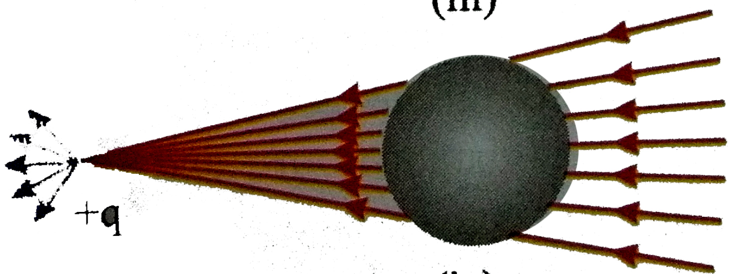
(i)



(ii)



(iii)



(iv)

A. Fig (i)

B. Fig (ii)

C. Fig (iii)

D. Fig (iv)

Answer: A

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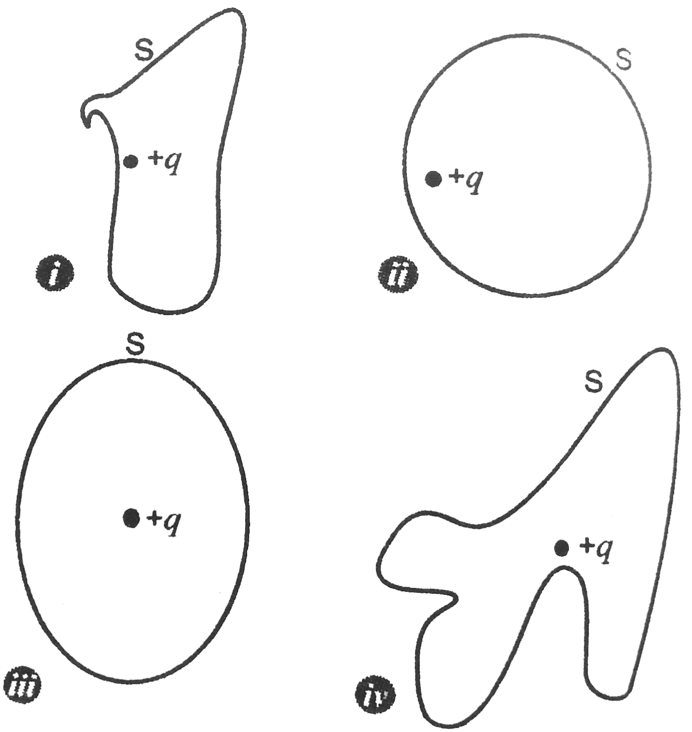
245. The electric flux through the surface



A. in fig, (iv) is the largest

B. in fig, (iii) is the least

C. in fig (ii) is same as a fig (iii) but is smaller than that in Fig (iv).

D. is the same for all the figures.

Answer: D

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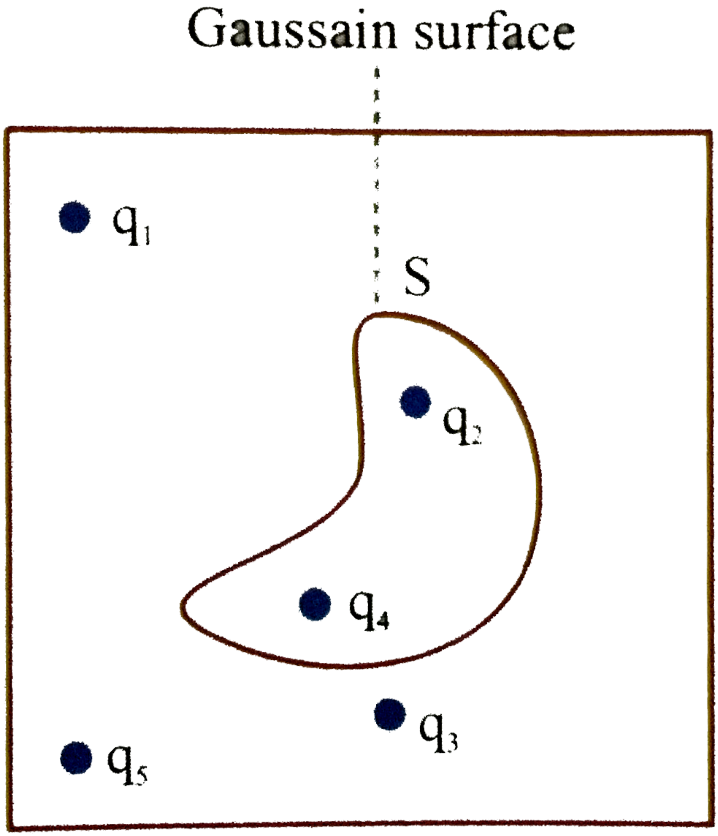
246. five charge $q_1, q_2, q_3, q_4$and q_5 are fixed at their positions as shown in figure .s is Gaussian surface .The Gauss's law is given by

$$\oint \vec{E}. \overrightarrow{ds} = \frac{q}{\varepsilon_0}$$



Which of the following statement is correct?

A. E on the LHS of the above equation will have a contribution from q_1, q_5 and q_3 while q on the RHS will have a contribution from q_2 and q_4 only

B. E on the LHS of the above equation will have a contribution from all charges while q on the RHS will have a contribution from q_2 and q_4 only

C. E on the LHS of the above equation will have a contribution from all charges while q on the RHS will have a contribution from q_1, q_(3) and q_(5)` only

D. Both, E on the LHS and q on the RHS will have contribution from q_(2) and q_(4)` only

Answer: B

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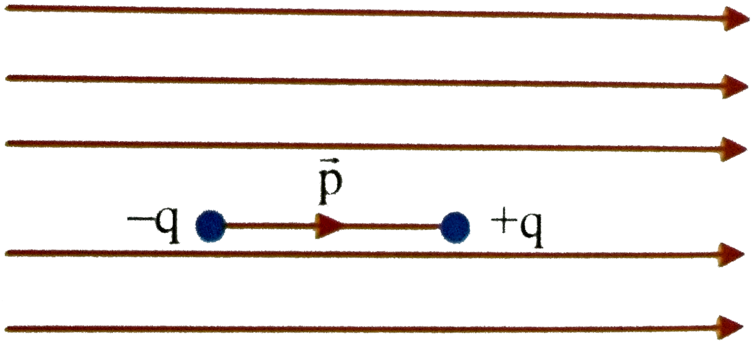
247. Figures shown electric field lines in which as electric dipole $\vec{p}$ is placed as shown .Which of the following statement is correct?



A. The dipole will not not experience any force

B. The dipole will experience a force towards right.

C. The dipole will experience a force towards left.

D. The dipole will experience a force upwards

Answer: C

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248. A point charge $+q$ is placed at a distance d from an isolated conducting plane. The field at a point P on the other side of plane is

A. directed perpendicular to the plane and away from the plane

B. directed perpendicular to the plane but towards the plane

C. directed radially away from the point charge

D. directed radially towards the point charge

Answer: A

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249. A hemispherical shell is uniformly charge positively .the electric field at point on a diameter away from the centre is directed

A. perpendicular to the diameter

B. parallel to the diameter

C. at an angle titled towards the diameter

D. at an angle tilted away from the diameter

Answer: A

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250. If $\oint_s E.\,ds = 0$ Over a surface, then

A. the electric field inside the surface and on it is zero

B. the electric field inside the surface is necessarly uniform

C. the number of flux lines entering the surface must be equal to the number of flux lines leaving it

D. all charges must necessarily be outside the surface

Answer: C::D

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251. The Electric field at a point is

A. always continous

B. continous if there is no charge at that point

C. discontinous only if there is a negative charge at that point

D. discontinous if there is a charge at that point

Answer: B::D

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252. If there were only one type of charge of the universe then

A. $\oint_S \vec{E}.\overrightarrow{ds} \neq 0$ on any surface

B. $\oint_S \vec{E}.\overrightarrow{ds} = 0$ if the charge is outside the surface

C. $\oint_S \vec{E}.\overrightarrow{ds}$ could not be defined

D. $\oint_S \vec{E} . \overrightarrow{ds} = \frac{q}{\epsilon_0}$ if charges of magnitude q were inside the surface

Answer: B::D

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253. Consider a region inside which there are various types of charges but the total charge is zero ,,At points outside the region

A. the electric field is necessarily zero

B. the electric field is due to the dipole moment of the charge distribution only

C. the dominant electric field is $\propto \frac{1}{r^3}$, for large r, where r is the distance from a origin in this region

D. the work done to move a charged particle along a closed path, away from the region, will be zero.

Answer: C::D

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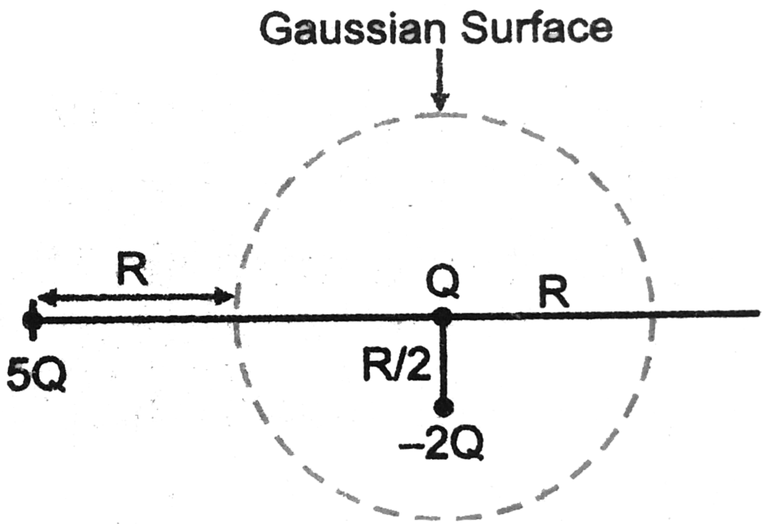
254. Refer to the arrangement of charges in Fig and a Gaussian surface of radius R with Q at the centre. Then



A. total flux through the surface of the sphere is $\frac{-Q}{\in_0}$

B. field on the surface of the sphere si $\frac{-Q}{4\pi \in_0 R^2}$

C. flux through the surface of sphere due to $5Q$ is zero.

D. field on the surface of sphere due to $-2Q$ is same everywhere

Answer: A::C

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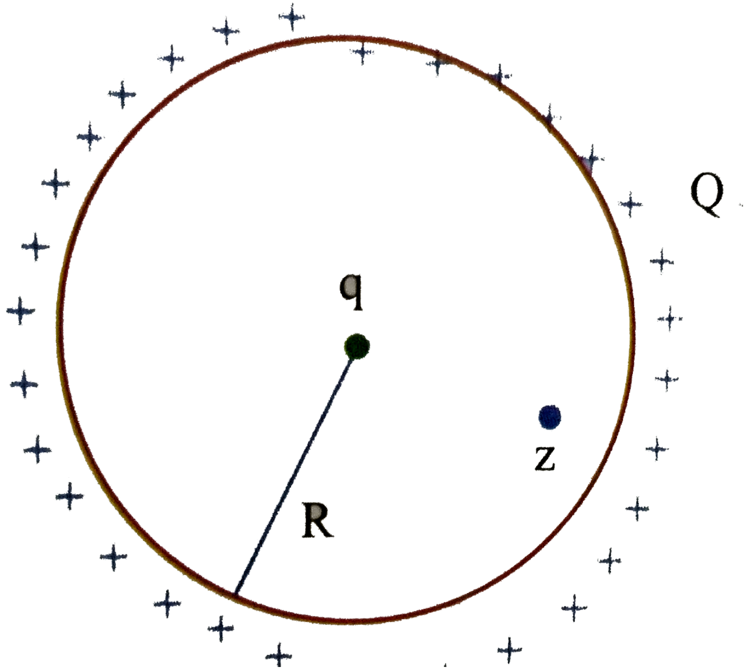
255. A positive charge Q is uniformly distributed along a circular ring of radius R.a small test charge q is placed at the centre of the ring .The



A. If $q > 0$ and is displaced away from the centre in the plane of the ring, it will be pushed back towards the centre,

B. If $q < 0$ and is displaced away from the centre in the plane of the ring, it will, it will never return to the centre and will continue moving till it his the ring.

C. If $q < 0$, it will perform SHM for small displacement along the axis,

D. q at the centre of the ring is an unstable equilibrium within the plane of the ring for $q > 0$.

Answer: A::B::C

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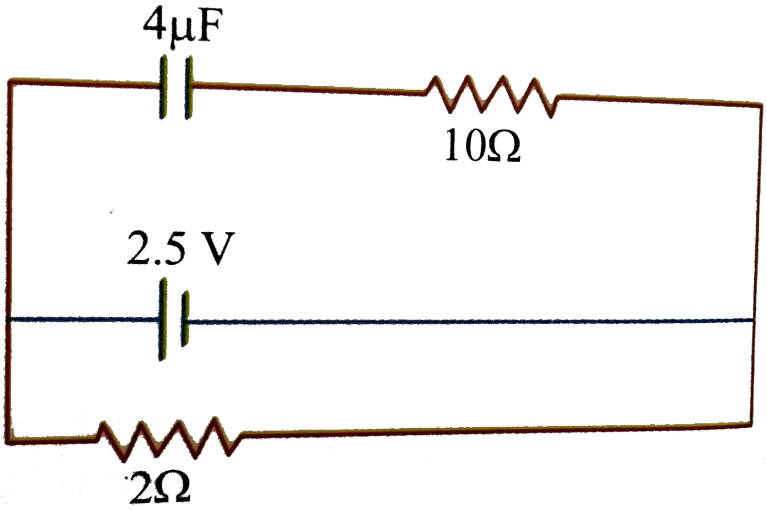
256. A capacitor of $4\mu F$ is connected as shown in the circuit. The internal resistance of the battery is 0.5Ω. The amount of charge on the capacitor plates will be



A. 0

B. $4\mu C$

C. $16\mu C$

D. $8\mu C$

Answer: D

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257. A positively charged particle is released from rest in a uniform electric field. The electric potential energy of the charge.

A. remains a constant because the electric field a uniform

B. increases becauses the charge moves along the electric field

C. decreases because the charge moves along the electric field

D. decreases because the charge moves opposite to the electric field

Answer: C

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258. Figure shows some equipotential lines distributed in space. A charged object is moved from point A to point 5.

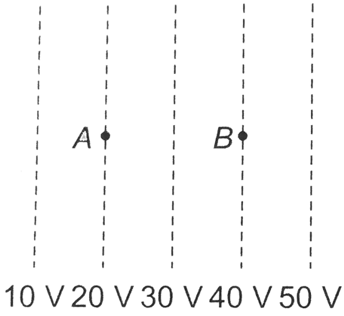

Fig. (i)

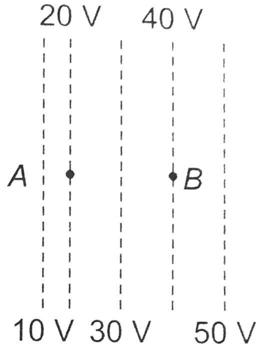

Fig. (ii)

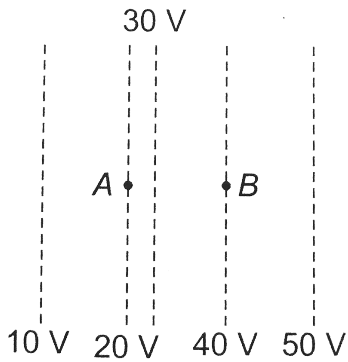

Fig. (iii)

A. The work done in Fig. (i) is the greatest

B. The work done in Fig. (ii) is least.

C. The work doen is the same in Fig. (i), Fig. (ii) and Fig. (iii)

D. The work done in Fig. (iii) is greater than Fig. (ii) but equal to that in Fig. (i)

Answer: C

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259. The electrostatic potential on the surface of a charged concducting sphere is $100V$. Two statements are made in this regard

S_1: at any inside the sphere, electric intensity is zero.

S_2: at any point inside the sphere, the electrostatic potential is $100V$.

A. S_1 is true but S_2 is false

B. Both S_1 and S_2 are false

C. S_1 is true, S_2 is also true and S_1 is the cause of S_2

D. S_1 is true, S_2 is also true but the statement are independent

Answer: C

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260. Equipotentials at a great distance from a collection of charges whose total sum is not zero are approximately

A. spheres

B. planes

C. paraboloids

D. ellipsoids

Answer: A

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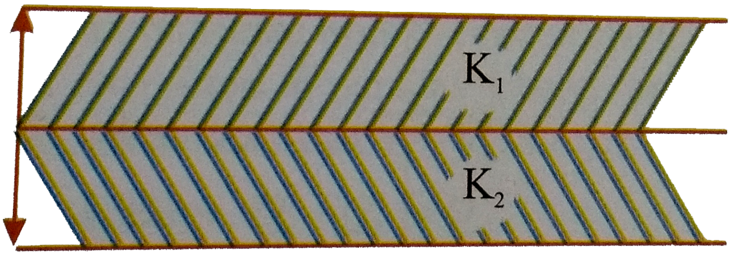
261. A parallel plate capacitor is made of two dielectric blocks in series. One of the blocks has thickness d_1 and dielectric constant

K_1 and the other has thickness d_2 and dielectric constant K_2 as shown in figure. This arrangement can be through as a dielectric slab of thickness $d\left(=d_1+d_2\right)$ and effective dielectric constant K. The K is.



A. $\dfrac{k_1d_1+k_2d_2}{d_1+d_2}$

B. $\dfrac{k_1d_1+k_2d_2}{k_1+k_2}$

C. $\dfrac{k_1k_2\left(d_1+d_2\right)}{\left(k_1d_2+k_2d_1\right)}$

D. $\dfrac{2k_1k_2}{k_1+k_2}$

Answer: C

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262. Consider a uniform electric field in the $\hat{z}$ direction. The potential is a constant.

A. in all space

B. for any x for a given z

C. for any y for a given z

D. on the x - y plane for a given z.

Answer: B::C::D

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263. Equipotential surfaces

A. are closer in regions of large electric fields compared to regions of lower electric fields

B. will be more crowded near sharp edges of a conductor

C. will be more crowded near regions of large charge densities

D. will always be equally spaced

Answer: A::B::C

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264. The work done to move a charge along an equipotential from A to B

A. cannot be defined as $-\int_A^B E.\,dl$

B. must be defined as $-\int_A^B E.\,dl$

C. is zero

D. Both B & C correct

Answer: D

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265. In a region of constant potential

A. the electric field si uniform

B. the electric field is zero

C. there can be no charge inside the region

D. the electric field shall necessarilly change if a charge is placed outside the region

Answer: B::C

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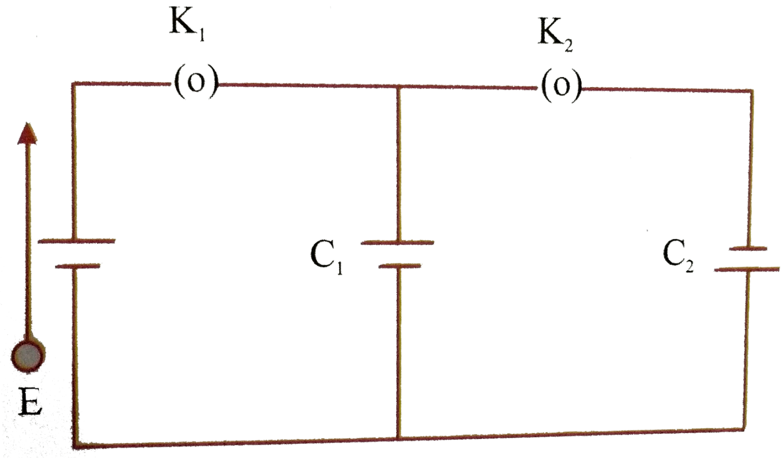
266. In the circuit shown in figure , initially key K_1 is closed and key K_2 is open. Then K_1 is opened and K_2 is closed (order is important). [Take $Q_1^{'}$ and $Q_2^{'}$ as charges on C_1 and C_2 and V_1 and V_2 as voltage respectively].



Then

A. charge on C_1 gets redistributed such that $V_1 = V_2$

B. charge on C_1 gets redistributed such that $Q_1' + Q_2' = Q$

C. charge on C_1 gets redistributed such that

$C_1V_1 + C_2V_2 = C_1E$

D. Both A & B correct

Answer: D

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267. If a conductor has a potential $V \neq 0$ and there are no charges anywhere else outside, then

A. Their must be charges on the surface or inside itself

B. there cannot be any charge in the body of the conductor

C. there must be charges only on the surface

D. there must be charges inside the surface

Answer: A::B

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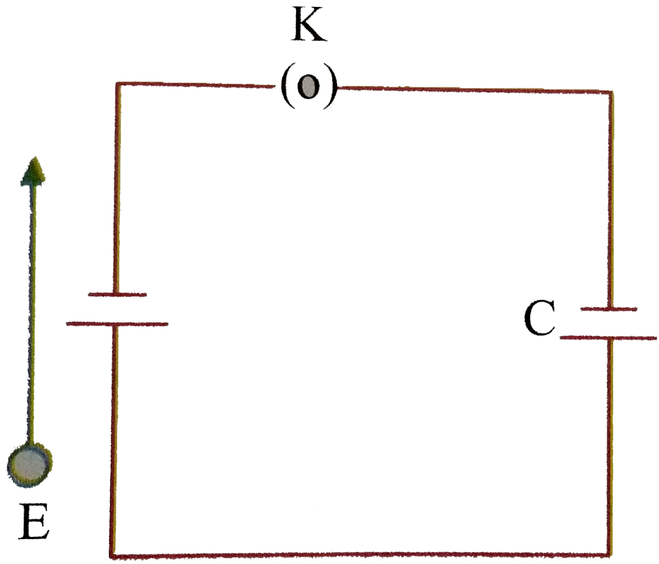
268. A parallel plate capacitor is connected to a battery as shown in figure. Consider two situations :



A : Key K is kept closed and plates of capacitors are moved apart using insulting handle.

B : Key K is opened and plates of capacitors are moved apart using insulting handle. Choose the correct options (s).

A. In A : Q remains same but C changes

B. In B : V remains same but C changes

C. In A : V remains same and hence Q changes

D. In B : Q remains same and hence V changes.

Answer: C::D

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269. Chage Q is distributed to two different metwllic spheres having radii $R$and $2R$ such that both spheres having equal surface charge densityh. Then charge on larger sphere is

A. $\frac{4Q}{5}$

B. $\frac{Q}{5}$

C. $\frac{3Q}{5}$

D. $\frac{5Q}{4}$

Answer: A

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270. Force between two identical charges placed at a distance of r in vacume is F. Now a slab of dielectric constant 4 is inserted between these two charges . If the thickness of the slab is $r/2$, then the force between the charges will becomes

A. F

B. $\frac{3}{5}F$

C. $\frac{4}{9}F$

D. $\frac{F}{4}$

Answer: C

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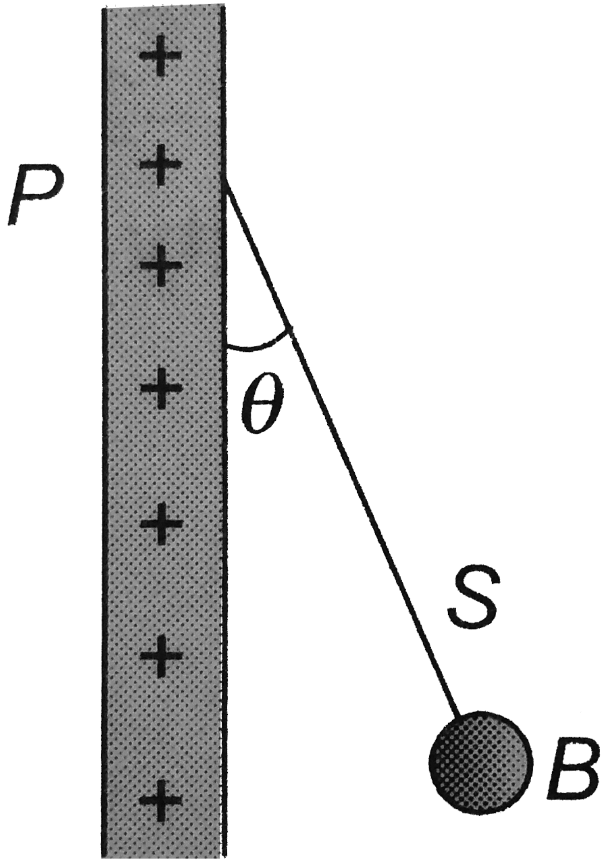
271. A charged ball B hangs from a silk thread S, which makes an angle θ with a large charged conducting sheet P, as shown in the figure. The surface charge density σ of the sheet is proportional to



A. $\tan\theta$

B. $\sin\theta$

C. $\cot\theta$

D. $\cos\theta$

Answer: A

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272. Four charges equal to -Q are placed at the four corners of a square and a charge q is at its center. If the system is in equilibrium the value of q is

A. $-\frac{Q}{4}\left(1+2\sqrt{2}\right)$

B. $\frac{Q}{4}\left(1+2\sqrt{2}\right)$

C. $-\frac{Q}{2}\left(1+2\sqrt{2}\right)$

D. $\frac{Q}{2}\left(1+2\sqrt{2}\right)$

Answer: B

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273. Three identical spheres, each having a charge q and radius R. are kept in such a way that each touches the other two. The magnitude of the electric force on any sphere due to the other two is

A. $\frac{1}{4\pi \in_0}\left(\frac{q}{R}\right)^2$

B. $\frac{1}{4\pi \in_0}\frac{3}{4}\left(\frac{q}{R}\right)^2$

C. $\frac{1}{4\pi \in_0}\frac{\sqrt{3}}{4}\left(\frac{q}{R}\right)^2$

D. $\frac{1}{4\pi \in_0}\frac{3}{2}\left(\frac{q}{R}\right)^2$

Answer: C

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274. A certain charge Q is divided into two parts q and $Q - q$, wheich are then separated by a cetain distance. What must q be in terms of Q to maximum the electrostatic repulsion between the two charges?

A. $q/q' = 2$

B. $q/q' = 1$

C. $q/q' = 4$

D. $q/q' = 3$

Answer: B

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275. An infinite number of charges, each of charge $1\mu C$ are placed on the x-axis with co-ordinates $x = 1, 2, 4, 8\ldots.\infty$ If a charge of $1C$ is kept at the origin, then what is the net force action on $1C$ charge

A. 9000 N

B. 12000 N

C. 24000 N

D. 36000 N

Answer: B

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276. Two identical charged spheres are suspended by strings of equal lengths. The strings make an angle of 30° with each other. When suspended in a liquid of density $0.8 gcm^{-3}$, the angle remains the same. If density of the material of the sphere is $1.6 gcm^{-3}$, the dielectric constant of the liquid is

A. 3

B. 2

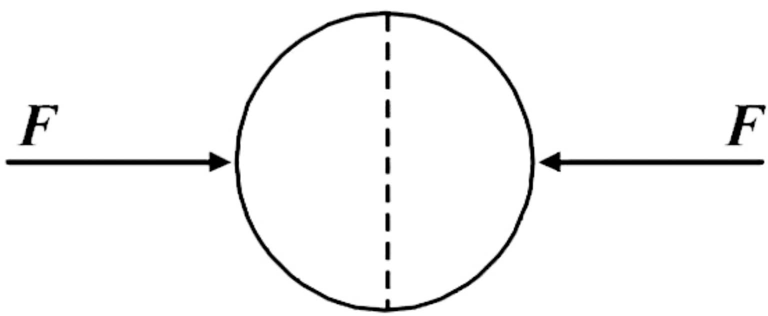
C. 1

D. 4

Answer: B

Watch Video Solution

277. A uniformly charged thin spherical shell of radius R carries uniform surface charge denisty of σ per unit area. It is made of two hemispherical shells, held together by presisng them with force F(see figure). F is proportional to



A. $\frac{1}{\epsilon_0}\sigma^2 R^2$

B. $\frac{1}{\epsilon_0}\sigma^2 R$

C. $\frac{1}{\epsilon_0}\frac{\sigma^2}{R^2}$

D.

Answer: A

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278. A tiny spherical oil drop carrying a net charge q is balanced in still air with a vertical uniform electric field of strength $\frac{81\pi}{7} \times 10^5 Vm^{-1}$. When the field is switched off, the drop is observed to fall with terminal velocity $2 \times 10^{-3} ms^{-1}$. Given $g = 9.8 ms^{-2}$, viscoisty of the air $= 1.8 \times 10^{-5} Nsm^{-2}$ and the denisty of oil $= 900 kgm^{-3}$, the magnitude of q is

A. $1.6 \times 10^{-19} C$

B. $3.2 \times 10^{-19} C$

C. $4.8 \times 10^{-19} C$

D. $8.0 \times 10^{-19} C$

Answer: D

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279. Two small spheres of masses $M_1$and M_2 are suspended by weightless insulating threads of lengths L_1 and L_2. The speres carry charges Q_1 and Q_2 respectively. The spheres are suspended such that they are in level with one another adn the threads are inclined to the verticle at angles θ_1 and $\theta_2$respectively . Which one of the following conditions is essential for $\theta_1 = \theta_2$?

A. $M_1 \neq M_2$, but $Q_1 = Q_2$

B. $Q_1 = Q_2$

C. $L_1 = L_2$

D. $M_1 = M_2$

Answer: D

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280. Two identical charged spheres suspended from a common point by two mass-less strings of length l are initially at a distance d ($d < < l$) apart because of their mutual repulsion . The charge begins to leak from both the spheres at a constant rate. As a result the charge approach each other with a velocity v. Then as a function of distance x between them .

A. $v \propto x$

B. $v \propto x^{-1/2}$

C. $v \propto x^{-1}$

D. $v \propto x^{1/2}$

Answer: B

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281. Two metallic spheres of radii $1cm$ and $2cm$ are given charges $10^{-2}C$ and $5 \times 10^{-2}C$ respectively. If they are connected by a conducting wire, the final charge on the smaller sphere is

A. $2 \times 10^{-2}C$

B. $3 \times 10^{-2}C$

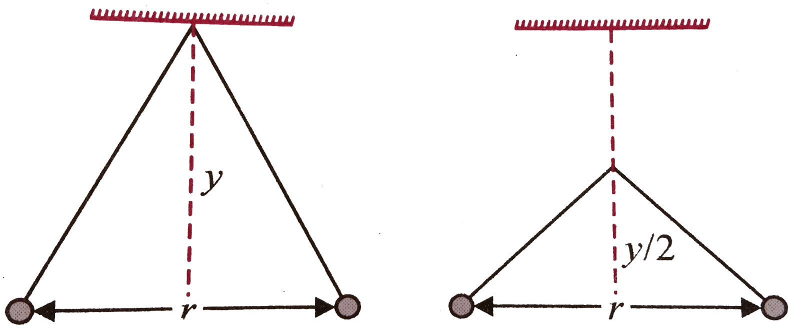
C. $4 \times 10^{-2}C$

D. $1 \times 10^{-2}C$

Answer: B

Watch Video Solution

282. Two path balls carrying eqaul chareges are suspended froom a common point by strings of equal length, the strings are rightly clamped at half the height. The equilibrium separation between the balls, now becomes :



A. $\left(\frac{2r}{3}\right)$

B. $\left(\frac{1}{\sqrt{2}}\right)^2$

C. $\left(\frac{r}{\sqrt[3]{2}}\right)$

D. $\left(\frac{2r}{\sqrt{3}}\right)$

Answer: C

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283. Two charges, each equal to q, aer kept at $x = -a$ and $x = a$ on the x-axis. A particle of mass m and charge $q_0 = \frac{q}{2}$ is placed at the origin. If charge q_0 is given a small displacement (ylt lt a) along the y-axis, the net force acting on the particle is proportional to

A. y

B. $\frac{1}{y}$

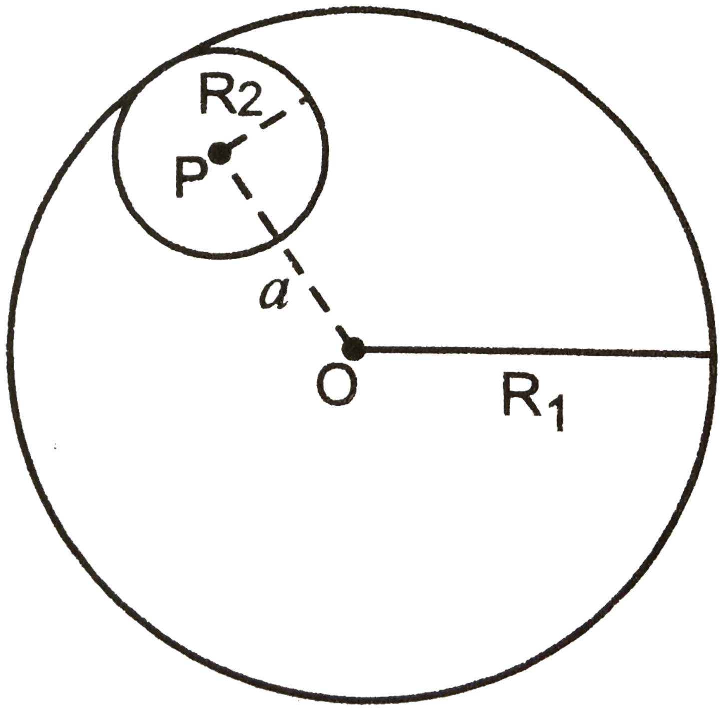
C. $-y$

D. $\frac{1}{y}$

Answer: A

Watch Video Solution

284. Consider a uniform spherical charge distribution of radius R_1 centred at the orgin O. In this distribution a spherical cavity fo radius R_2, centred at P with distance $OP = a = R_1 - R_2$ (fig) is made.If the electric field inside the cavity at position $\vec{r}$, then the correct statement is



A. $\vec{E}$ is uniform,its magnitude is independent of R_2. But its direction depends on $\vec{R}$

B. $\vec{E}$ is uniformly, its magnitude depends on R_2, and its direction depends on $\vec{r}$

C. $\vec{E}$ is uniform,its magnitude is independent of a. But its direction depends on a

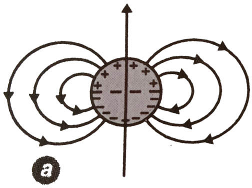
D. $\vec{E}$ is uniform and both its magnitude and direction depend on $\vec{a}$

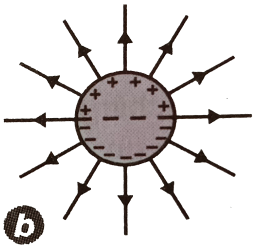
Answer: D

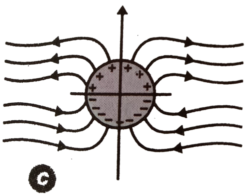
Watch Video Solution

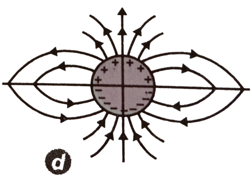
285. A long cylindrical shell carries positive surface charge σ in the upper half and negative surface charge -σ in the lower half. The electric field lines around the cylinder will look like figure given in:

(figures are schematic and not drawn to scale)

A. 

B. 

C. 

D. 

Answer: A

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286. Two point charges $+8q$ and $-2q$ are located at $x = 0$ and $x = L$ respectively. The location of a point on the x axis at which the net electric field due to these two point charges is zero is

A. $2L$

B. $L/4$

C. $8L$

D. $4L$

Answer: A

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287. If potential (in volts) in a region is expressed as $V(x, y, z) = 6xy - y + 2yz$, the electric field (in N/C) at point $(1, 1, 0)$ is

A. $-\left(6\hat{i}+9\hat{j}+\hat{k}\right)$

B. $-\left(3\hat{i}+5\hat{j}+3\hat{k}\right)$

C. $-\left(6\hat{i}+5\hat{j}+2\hat{k}\right)$

D. $-\left(2\hat{i}+3\hat{j}+\hat{k}\right)$

Answer: C

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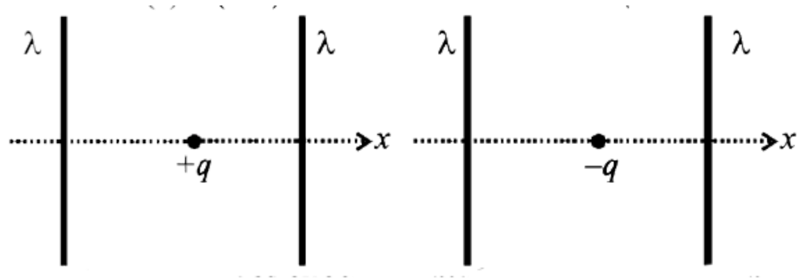
288. The figure below depict two situations in which two infinitely long static line charges of constant positive line charge density λ are kept parallel to each other. In their resulting electric field, point charges q and $-q$ are kept in equilibrium between them. The point charges are confined to move in the x direction only. If they are given a small displacement about their equilibrium positions, then the correct statement(s) is(are)



A. both charges execute simple harmonic motion.

B. both charge will continue moving in the direction of their displacement.

C. charge $+q$ execute simple harmonic motion while charge -q continues moving in the direction of its displacement.

D. charge -q execute simple harmonic motion while charge $+q$ continues moving in the direction of its displacement.

Answer: C

289. Poistive and negative point charges of equal magnitude are kept at $\left(0, 0, \frac{a}{2}\right)$ and $\left(0, 0, \frac{-a}{2}\right)$ respectively. The work done by the electric field when another poistive point charge is moved from $(-a, 0, 0)$ to $(0, a, 0)$ is

A. positive

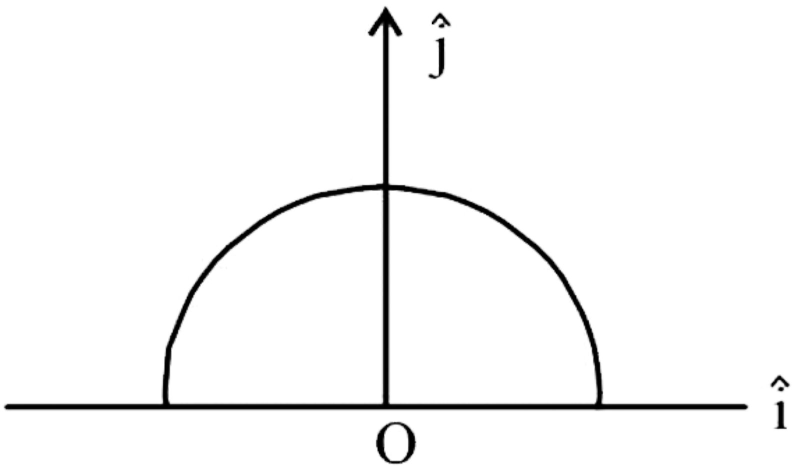
B. negative

C. zero

D. depends on the path connecting the initial and final positions

Answer: C

290. A thin semi-circular ring of radius r has a positive charge q distributed uniformly over it. The net field $\vec{E}$ at the centre O is



A. $\dfrac{\lambda}{2\pi \in_0 a^2}$

B. $\dfrac{\lambda}{4 \in_0 a}$

C. $\dfrac{\lambda^2}{2\pi \in_0 a}$

D. $\dfrac{\lambda}{2\pi \in_0 a}$

Answer: D

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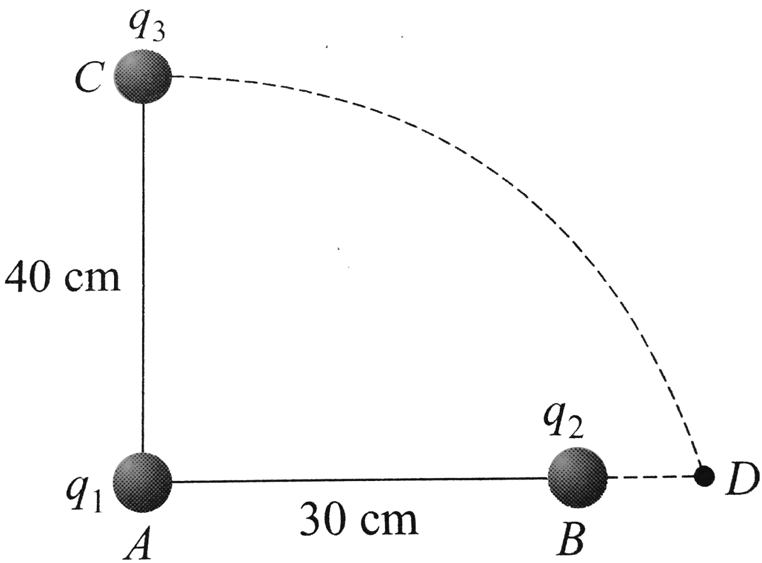
291. Two charges q_1 and q_2 are placed $30cm$ apart, as shown in the figure. A third charge q_3 is moved along the arc of a circle of radius $40cm$ from C to D. The change in the potential energy o fthe system is $\frac{q_3}{4\pi\varepsilon_0}k$., where k is



A. $8q_2$

B. $6q_2$

C. $8q_1$

D. $6q_1$

Answer: A

Watch Video Solution

292. The point charges $+q$, $-2q$ and $+q$ are placed at point $(x=0, y=a, z=0)$, $(x=0, y=0, z=0)$ and $(x=a, y=0, z=0)$, repectively. The magnitude and direction of the electric dipole moment vector of this charge assembly are

A. $\left(\sqrt{2}qa\right)$ along the line joining points $(x=0, y=0, z=0)$ and $(x=a, y=a, z=a)$

B. (qa) along the line joining points $(x=-0, y=0, z=0)$ and $(x=a, y=a, z=a)$

C. $\left(\sqrt{2}qa\right)$ along $+x$ direction.

D. $(\sqrt{2}qa)$ along $+y$ direction.

Answer: A

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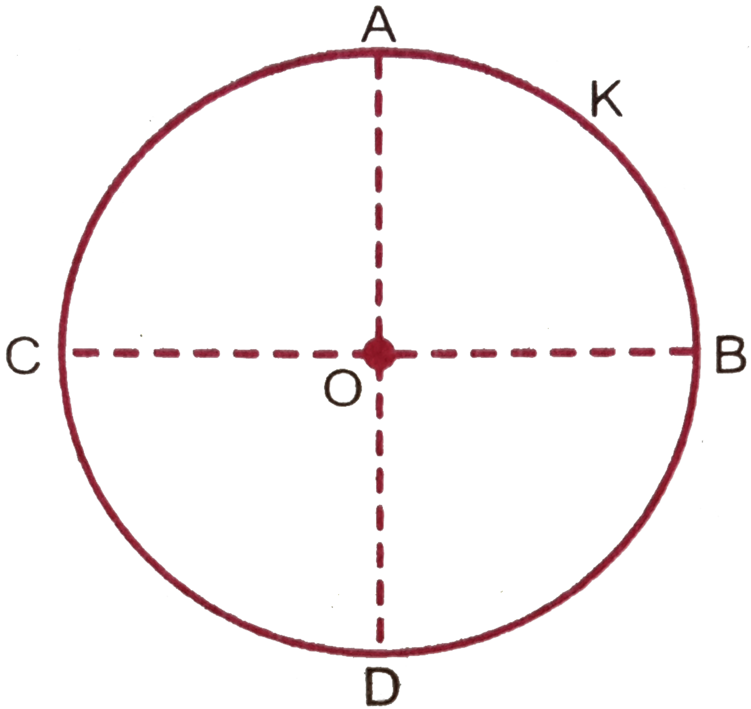
293. A thin conducting ring orf radius R is given a chareg $+Q$, Fig. The electric field at the centre O of the ring due to the charge on the part AKB of the ring is E. The electric field at the centre due to the charge on part $ACDB$ of the ring is



A. $3E$ along KO

B. E along OK

C. E along KO

D. $3E$ along OK

Answer: B

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294. Let there be a spherically symmetric charge distribution with charge density varying as $\rho(r) = \rho\left(\frac{5}{4} - \frac{r}{R}\right)$ upto $r = R$, and $\rho(r) = 0$ for $r > R$, where r is the distance from the origin. The electric field at a distance r(rltR) from the origin is given by

A. $\frac{\rho_0 r}{4 \in_0}\left(\frac{5}{3} - \frac{r}{R}\right)$

B. $\frac{4\rho_0 r}{3 \in_0}\left(\frac{5}{4} - \frac{r}{R}\right)$

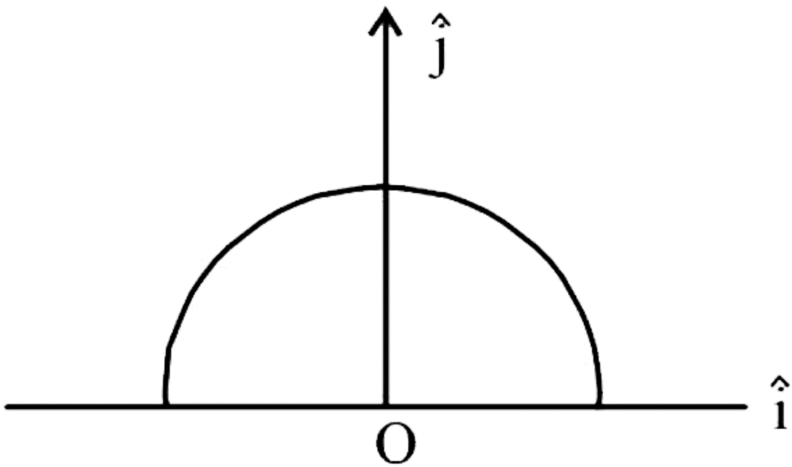
C. $\frac{\rho_0 r}{3 \in_0}\left(\frac{5}{4} - \frac{r}{R}\right)$

D. $\frac{4\pi\rho_0 r}{3 \in_0}\left(\frac{5}{3} - \frac{r}{R}\right)$

Answer: A

Watch Video Solution

295. A thin semi-circular ring of radius r has a positive charge q distributed uniformly over it. The net field $\vec{E}$ at the centre O is



A. $-\dfrac{q}{4\pi^2 \in_0 r^2}\hat{j}$

B. $-\dfrac{q}{2\pi^2 \in_0 r^2}\hat{j}$

C. $\dfrac{q}{2\pi^2 \in_0 r^2}\hat{j}$

D. $\dfrac{q}{4\pi^2 \in_0 r^2}\hat{j}$

Answer: C

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296. Let $P(r) = \frac{Q}{\pi R^4} r$ be the charge density distribution for a solid sphere of radius R and total charge Q. For a point 'p' inside the sphere at distance r_1 from the centre of the sphere, the magnitude of electric field is:

A. $\frac{Q}{4\pi \in_0 r_1^2}$

B. $\frac{Q r_1^2}{4\pi \in_0 R^4}$

C. $\frac{Q r_1^2}{3n\pi \in_0 R^4}$

D. zero

Answer: C

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297. Two positive charges of magnitude q are placed at the ends of a side (side 1) of a square of side $2a$. Two negative charges of the same magnitude are kept at the other corners . Staring from rest , a charge Q moves from the middle of side 1 to the centre of square , its kinetic energy at the centre of square is -.

A. $\frac{1}{4\pi \in_0}\frac{2qQ}{a}\left(1 - \frac{1}{\sqrt{5}}\right)$

B. Zero

C. $\frac{1}{4\pi \in_0}\frac{2qQ}{a}\left(1 + \frac{1}{\sqrt{5}}\right)$

D. $\frac{1}{4\pi \in_0}\frac{2qQ}{a}\left(1 - \frac{2}{\sqrt{5}}\right)$

Answer: A

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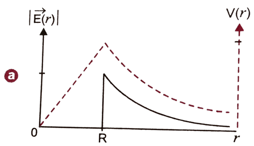
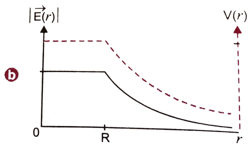
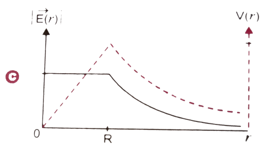
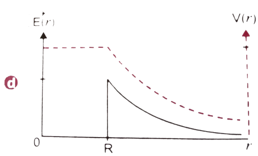
298. Conisder a thin spherical shell of radius R with centre at the origin, carrying uniform poistive surface charge denisty. The variation of the magnitude of the electric field $\left|\vec{E}(r)\right|$ and the electric potential V(r) with the distance r from the centre, is best represented by which graph?

A. 

B. 

C. 

D. 

Answer: D

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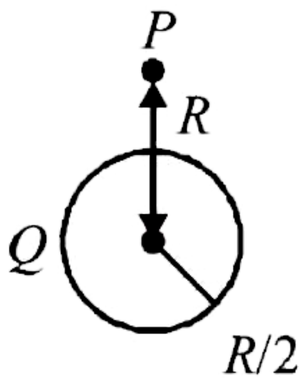
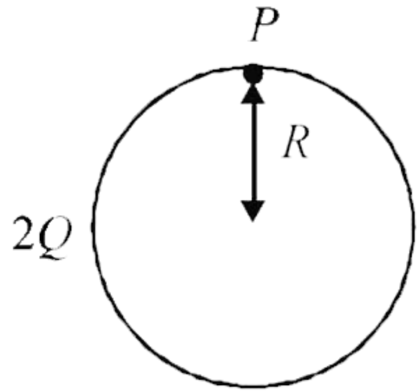
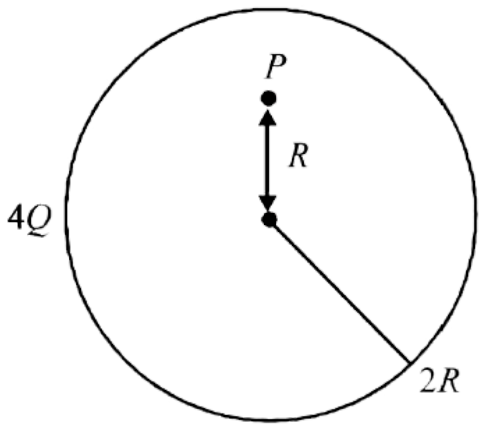
299. Charges Q, 2Q and 4Q are uniformly distributed in three dielectric solid spheres 1, 2 and 3 of radii $R/2$, R and 2R respectively, as shown in figure. If magnitude of the electric fields at point P at a distance R from the centre of sphere 1,2 and 3 are E_1, E_2 and E_3 respectively, then



Sphere 1



Sphere 2



Sphere 3

A. $E_1 > E_2 E_3$

B. $E_3 > E_1 E_2$

C. $E_2 > E_1 E_3$

D. $E_3 > E_2 E_1$

Answer: C

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300. The electric field in a certain region is acting radially outwards and is given by $E = Ar$. A charge contained in a sphere of radius $'a'$ centred at the origin of the field, will given by

A. $A \in_0 a^2$

B. $4\pi \in_0 Aa^3$

C. $\in_0 Aa^3$

D. $4\pi \in_0 Aa^2$

Answer: B

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301. An assmebly of charges $+q, -q, +q, -q....$ are at positions $x = 1m, 2m, 4m, 8m,$ .... And so on from origin. What is the potential at $x = 0$, due to these charges ?

A. $\dfrac{q}{4\pi \in_0}$

B. $\dfrac{-q}{4\pi \in_0}$

C. $\dfrac{q}{6\pi \in_0}$

D. $\dfrac{-q}{6\pi \in_0}$

Answer: C

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302. A point charge q is placed at the centre of a cube. What is the flux linked.

a with all the faces of the cube?

b. with each face of the cube?

c. if charge is not at the centre, then what will be the answer of parts a and b ?

A. $\frac{\pi q}{6(4\pi \in_0)}$

B. $\frac{q}{6(4\pi \in_0)}$

C. $\frac{2\pi q}{6(4\pi \in_0)}$

D. $\frac{4\pi q}{6(4\pi \in_0)}$

Answer: D

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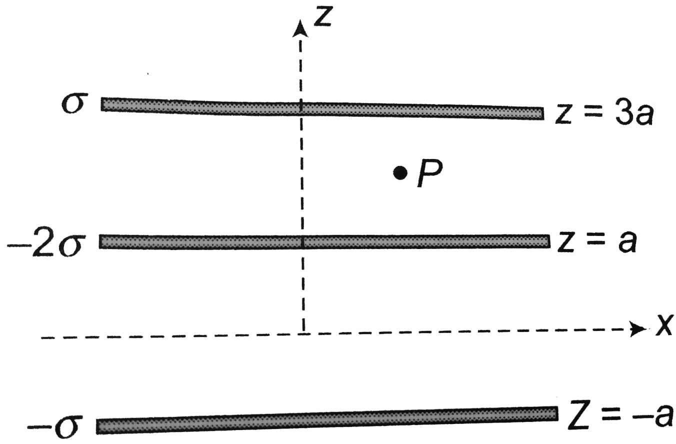
303. Three infinitely long charge sheets are placed as shown in figure. The electric field at point P is



A. $\frac{-4\sigma}{\in_0 \hat{k}}$

B. $\frac{4\sigma}{\in_0 \hat{k}}$

C. $\frac{-2\sigma}{\in_0 \hat{k}}$

D. $\frac{2\sigma}{\in_0 \hat{k}}$

Answer: C

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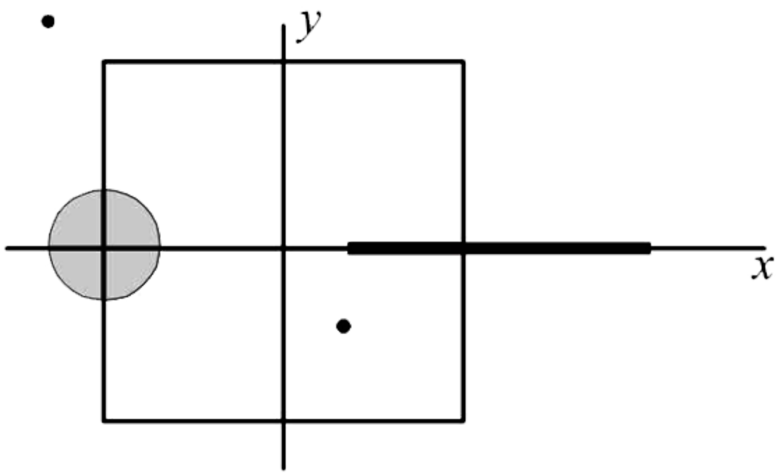
304. A disc of radius $a/4$ having a uniformly distributed charge $6C$ is placed in the x-y plane with its centre at $(-a/2, 0, 0)$. A rod of length a carrying a uniformly distributed charge 8C is placed on the x-axis from $x = a/4$ to $x = 5a/4$. Two point charges $-7C$ and $3C$ are placed at $(a/4, -a/4, 0)$ and $(-3a/4, 3a/4, 0)$, respectively. Conisder a cubical surface formed by isx surfaces $x = \pm a/2$, $y = \pm a/2, z = \pm a/2$. The electric flux through this cubical surface is



A. $-2C/\in_0$

B. $2C/\in_0$

C. $10C/\in_0$

D. $12C/\in_0$

Answer: A

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305. An insulated sphere of radius r haas a uniform volume charge density λ. The electric field at a point A, which is at distance r from its centre is given by $(R > r)$

A. Zero

B. $R\lambda/3\in_0$

C. $\frac{2r\lambda}{3\in_0}$

D. $\frac{r\lambda}{3\in_0}$

Answer: D

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306. A thin spherical conducting shell of radius R has a charge q. Another charge Q is placed at the centre of the shell. The electrostatic potential at a point P a distance $\frac{R}{2}$ from the centre of the shell is

A. $\frac{2Q}{4\pi \in_0 R}$

B. $\left(\frac{2Q}{4\pi \in_0 R}\right)$ - $\left(\frac{2q}{4\pi \in_0 R}\right)$

C. $\frac{2Q}{4\pi \in_0 R} + \frac{q}{4\pi \in_0 R}$

D. $\frac{(q+Q)^2}{4\pi \in_0 R}$

Answer: C

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307. In a region, the potential is respresented by $V(x, y, z) = 6x - 8xy - 8y + 6yz$, where V is in volts and x, y, z are in meters. The electric force experienced by a charge of 2 coulomb situated at point $(1, 1, 1)$ is

A. $6\sqrt{5}N$

B. $30N$

C. $24N$

D. $4\sqrt{35}N$

Answer: D

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308. Assume that an electric field $\vec{E} = 30x^2\hat{i}$ exists in space. Then the potentail differences $V_A - V_0$ where V_0 is the potential at the origin and V_A, the potebntail at $x = 2m$ is

A. $-80V$

B. $80V$

C. $120V$

D. $-120V$

Answer: A

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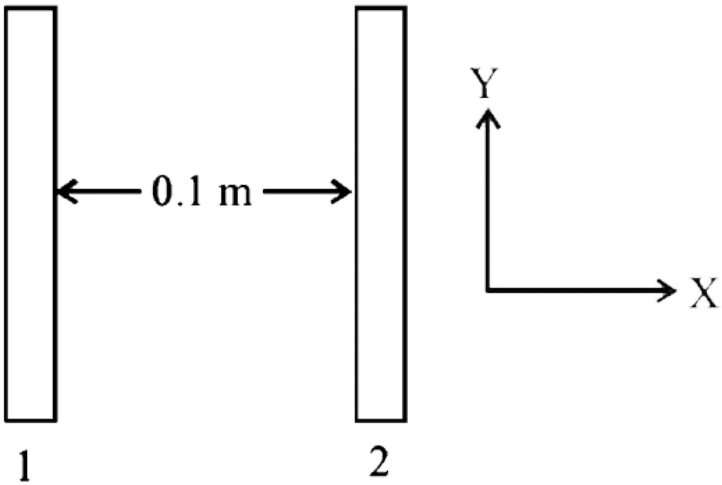
309. Two insulting plates are both uniformly charged in such a way that the potential difference between them is $V_2 - V_1 = 20V$. (i.e., plate 2 is at a higher potential). The plates are separated by $d = 0.1m$ and can be treated as infinity large. An electron is released from rest on the inner surface of plate 1. What is its speed when it hits plate 2? ($e = 1.6 \times 10^{-19}C, m_e = 9.11 \times 10^{-31}kg$)



A. $32 \times 10^{-19} m/s$

B. $2.65 \times 10^{6} m/s$

C. $7.02 \times 10^{12} m/s$

D. $1.87 \times 10^{6} m/s$

Answer: B

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310. Four equal charges Q are placed at the four corners of a square of each side is 'a'. Work done in removing a charge $-Q$ from its centre to infinity is

A. zero

B. $\frac{2q^2}{\pi \in_0 a}$

C. $\frac{\sqrt{2}q^2}{\pi \in_0 a}$

D. $\frac{q^2}{2\pi \in_0 a}$

Answer: C

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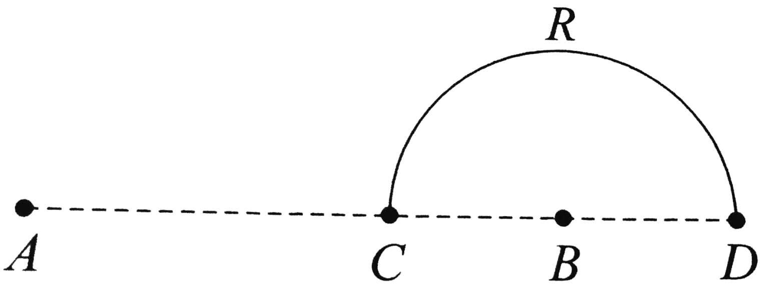
311. Charges $+q$ and $-q$ are placed at points A and B respectively which are a distance $2L$ apart, C is the midpoint between A and B.

The work done in moving a charge $+Q$ along the semicircle CRD is



A. $\dfrac{qQ}{2\pi \in_0 L}$

B. $\dfrac{qQ}{6\pi \in_0 L}$

C. $\dfrac{-qQ}{6\pi \in_0 L}$

D. $\dfrac{qQ}{4\pi \in_0 L}$

Answer: C

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312. The potential at a point x (measured in μ m) due to some

charges situated on the x-axis is given by

$V(x) = 20/\left(x^2 - 4\right) volt$

A. $\frac{5}{3} volt/\mu m$ and in $+x$ direction.

B. $\frac{10}{9} V/\mu m$ and in neg x direction.

C. $\frac{10}{9} V/\mu m$ and in $+x$ direction

D. $\frac{5}{3} V/\mu m$ and inneg. x direction.

Answer: C

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313. An electric charge $10^{-3}\mu C$ is placed at the origin (0, 0) of X-Y co-ordinate system. Two points A and B are situated at $\left(\sqrt{2}, \sqrt{2}\right)$ and (2, 0) respectively. The potential difference between the points A and B will be

A. $4.5V$

B. $9V$

C. zero

D. $2V$

Answer: C

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314. Three concentric spherical shells have radii a, b and $c(a < b < c)$ and have surface charge densities σ, - $sigam$ and σ respectively. If V_A, V_B and V_C denote the potentials of the three shells, then for $c = q + b$, we have

A. $V_C = V_B = V_A$

B. $V_A = V_C \neq V_B$

C. $V_C = V_B \neq V_A$

D. $V_C = V_B \neq V_A$

Answer: B

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315. Which of the following statement(s) is/are correct?

A. If the electric field due to a point charge variesas $r^{-2.5}$ instead fo r^{-2}, then the Gauiss law will still be valid.

B. The Gauss law can be used to calculate the field distributed around on electric dipole.

C. If the electric field between two points charges is zero somewhere , then the sign of the two charges is not the same.

D. The work doen by the external force in moving a unit positive charge from point A at potential $V_A$to point B at potential V_B is $\left(V_B - V_A\right)$.

Answer: D

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316. The electrostatic potential inside a charged spherical ball is given by $\phi = ar^2 + b$ where r is the distance from the centre and a, b are constants. Then the charge density inside the ball is:

A. $-6a \in_0 r$

B. $-24\pi a \in_0 r$

C. $-6a \in_0$

D. $-24\pi a \in_0 r$

Answer: C

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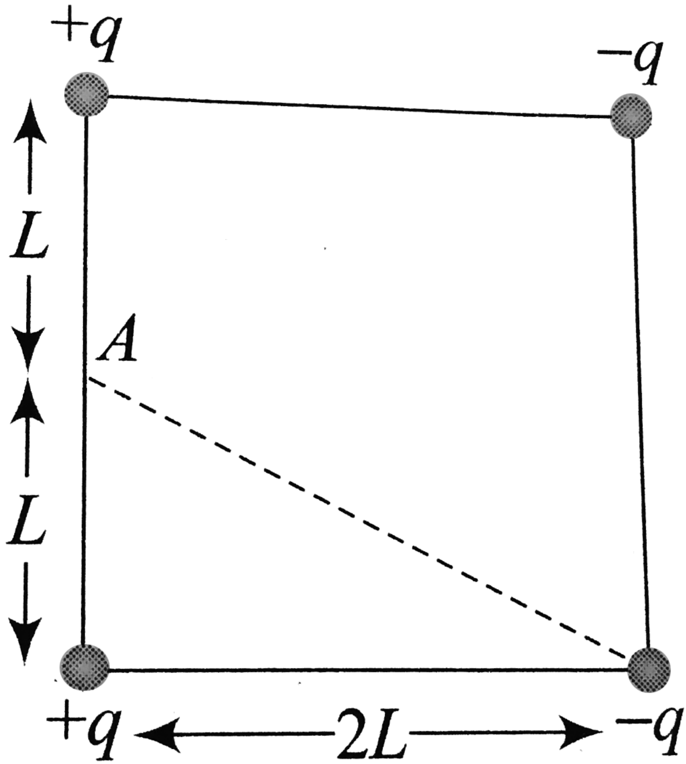
317. Four electric charges $+q$, $+q$, - q and -q are placed at the corners of a square of side 2L (see figure). The electric potential at point A, mid-way between the two charges $+q$ and $+q$, is



A. $\frac{1}{4\pi \in_0} \frac{2q}{L} \left(1 + \sqrt{5}\right)$

B. $\frac{1}{4\pi \in_0} \frac{2q}{L} \left(1 + \frac{1}{\sqrt{5}}\right)$

C. $\frac{1}{4\pi \in_0} \frac{2q}{L} \left(1 - \frac{1}{\sqrt{5}}\right)$

D. Zero

Answer: C

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318. The electric potential V at any point x, y, z (all in meters) in space is given by $V = 4x^2$ volts. The electric field at the point (1m, 0, 2m) is.................V/m.

A. 8 along positive X-axis

B. 16 along negative X-axis

C. 16 along positive X-axis

D. 8 along negative X-axis

Answer: D

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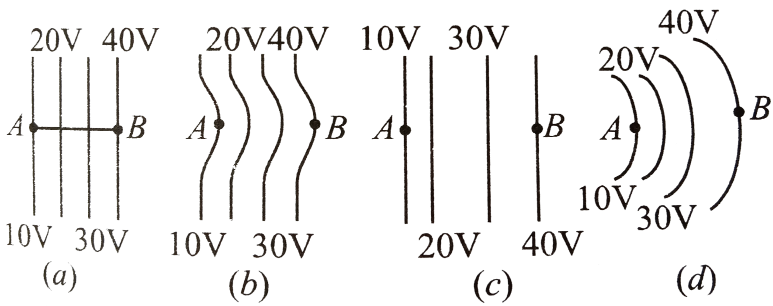
319. The diagrams below show region of equipotentials.



A. Maximum work is required to move q in figurec (c).

B. In all the four cases, the work doen is the same.

C. Minimum work is required to move q in figurec (a).

D. Maximum work is required to move q in figurec (b).

Answer: B

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320. Suppose the charge of a proton and an electron differ slightly. One of them is $-e$, the other is $(e+\Delta e)$. If the net of electrostatic force and gravitational force between two hydrogen atoms placed at a distance d (much greater than atomic size) apart is zero. Then Δe is of the order of [Given mass of hydrogen $m_h = 1.67 \times 10^{-27} kg$]

A. $10^{-20} C$

B. $10^{-23} C$

C. $10^{-37} C$

D. $10^{-47} C$

Answer: C

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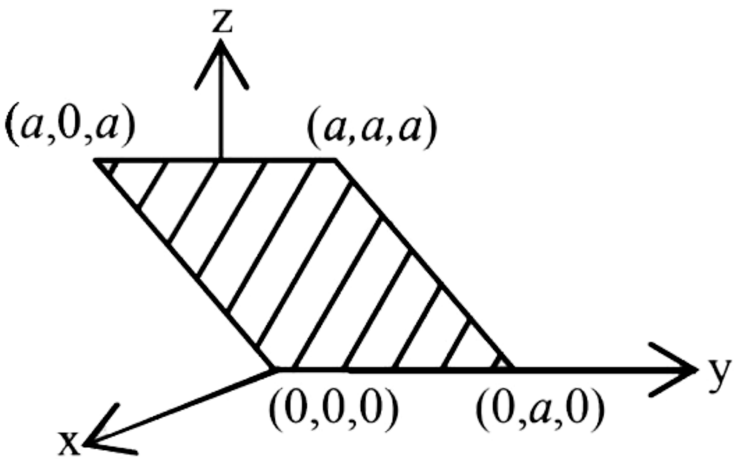
321. Conisder an electric field $\vec{E} = E_0\hat{x}$ where E_0 is a constant .

The flux through the shaded area (as shown in the figure) due to this field is



A. $2E_0a^2$

B. $\sqrt{2}E_0a^2$

C. E_0a^2

D. $\frac{E_0a^2}{\sqrt{2}}$

Answer: C

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322. A charged spherical conductor of radius $10cm$ has potential V at a point distant $5cm$ from its centre. The potential at a point distant $15cm$ from the centre will be

A. $3V$

B. $\frac{3}{2}V$

C. $\frac{2}{3}V$

D. $\frac{1}{3}V$

Answer: C

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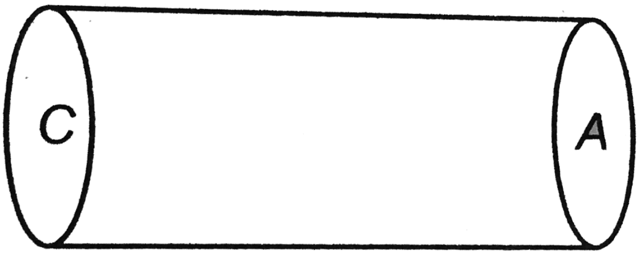
323. A hollow cylinder has a charge qC within it. If ϕ is the electric flux in unit of voltmeter associated with the curved surface B the flux linked with the plance surface A in unit of voltmeter will be



A. $\frac{\phi}{3}$

B. $\frac{q}{2\in_0}$

C. $\frac{1}{2}\left(\frac{q}{\in_0} - \phi\right)$

D. $\frac{q}{\in_0} - \phi$

Answer: C

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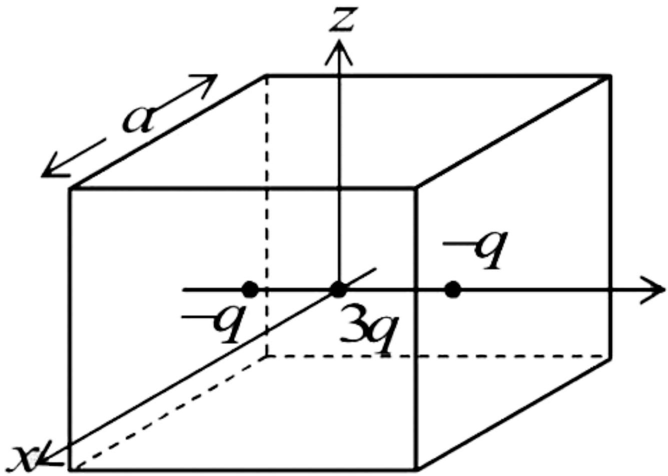
324. A cubical region of side a has its centre at the origin. It encloses three fixed point charges, $-q$ at $(0, -a/4, 0)$, $+3q$ at $(0, 0, 0)$ and $-q$ at $(0, +a/4, 0)$. Choose the correct options(s)



A. The net electric flux crossing the plane $x = +a/2$ is equal to the net electric flux crossing the plane $x = -a/2$

B. The net electric flux crossing the plane $y = +a/2$ is more than the net electric flux crossing the plane $y = -a/2$

C. The net electric flux crossing the entire region is $\frac{q}{\epsilon_0}$

D. The net electric flux crossing the plane $z = +a/2$ is equal to the net electric flux crossing the plane $z = -a/2$

Answer: B

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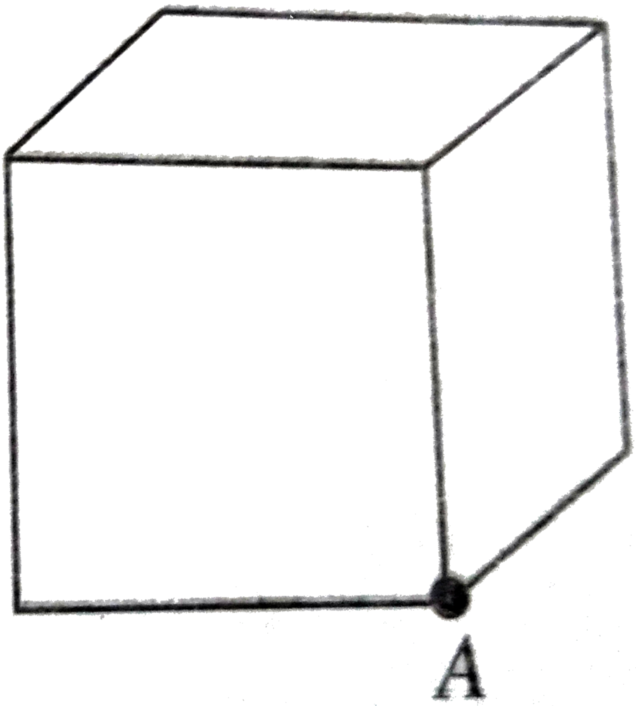
325. The total flux through the faces of the cube with side of length a if a charge q is placed at corner A of the cube is



A. $\frac{2q}{\in_0}$

B. $\frac{q}{8\in_0}$

C. $\frac{q}{\in_0}$

D. $\frac{2q}{2\in_0}6a^2$

Answer: B

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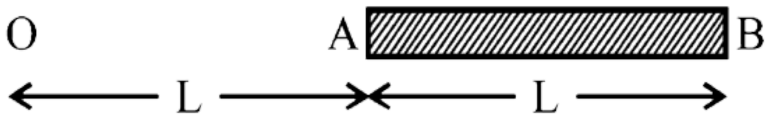
326. A charge Q is uniformly distributed over a long rod AB of length L as shown in the figure. The electric potential at the point O lying at distance L from the end A is



A. $\dfrac{Q}{2\pi \in_0 L}$

B. $\dfrac{3Q}{4\pi \in_0 L}$

C. $\dfrac{3Q}{4\pi \in_0 L \in 2}$

D. $\dfrac{Q \in 2}{4\pi \in_0 L}$

Answer: D

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327. An electric dipole has a fixed dipole moment $\vec{p}$, which makes angle θ with respect to x-aixs. When subjected to an electric field $\vec{E}_1 = E\hat{i}$, it experiences a torque $\vec{T}_1 = \tau\hat{k}$. When subjected to another electric field $\vec{E}_2 = \sqrt{3}E\hat{j}$ it experiences a torque $\vec{T}_2 = -\vec{T}_1$. The angle θ is

A. 60°

B. 90°

C. 30°

D. 45°

Answer: A

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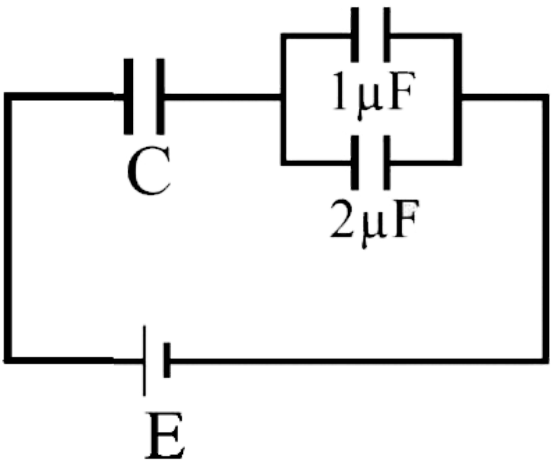
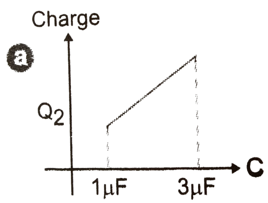
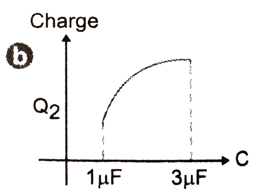
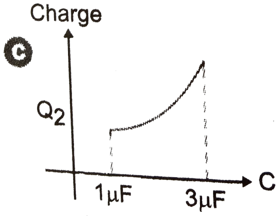
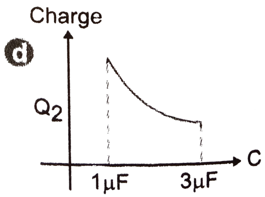
328. In the givven circuit, charge Q_2 on the $2\mu F$ capacitor changes as C is varied from $1\mu F$ to $3\mu F$. Q_2 as a function of 'C' is given properly by: (figures are drawn schematically and are not to scale)



A. 

B. 

C. 

D. 

Answer: B

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329. A capacitance of $2\mu F$ is required in an electrical circuit across a potential difference of $1.0kV$ A large number of $1\mu F$ capacitors are available which can withstand a potential difference of not more than $300v$.

The minimum number of capacitors required to achieve this is

A. 24

B. 32

C. 2

D. 16

Answer: B

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330. A parallel plate air capacitor of capacitance C is connected to a cell of $emFV$ and then disconnected from it. A dielectric slab of dielectric constant K, which can just fill the air gap of the capacitor, is now inserted in it. Which of the following is incorrect ?

A. The energy stored in capacitnce decreases K time.

B. The change in energy stored is

$$\frac{1}{2}CV^2\left(\frac{1}{K} - 1\right)$$

C. The chareg on the capacitor is not conserved

D. The potential difference between te plates decreases K times

Answer: C

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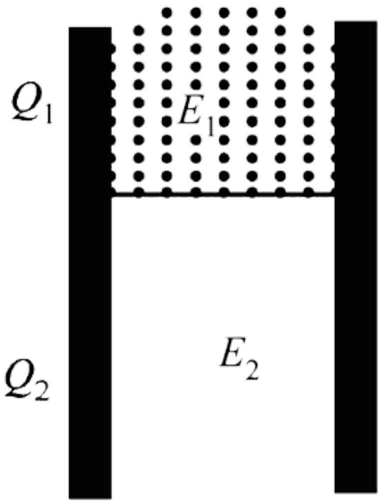
331. A parallel plate capacitor has a dielectric slab of dielectric constant K between its plates that covers $1/3$ of the area of its plates, as shown in the figure. The total capacitance of the capacitor is C while that of the portion with dielectric in between is C_1. When the capacitor is charged, the plate area covered by the dielectric gets charge Q_1 and the rest of the area gets charge Q_2.

The electric field in the dielectric is E_1 and that in the other portion is E_2. Choose the correct option/options, ignoring edge effects.



A. $\frac{E_1}{E_2} = 1$

B. $\frac{E_1}{E_2} = \frac{1}{K}$

C. $\frac{Q_1}{Q_2} = \frac{3}{K}$

D. $\frac{C_1}{C_2} = \frac{3+K}{K}$

Answer: A

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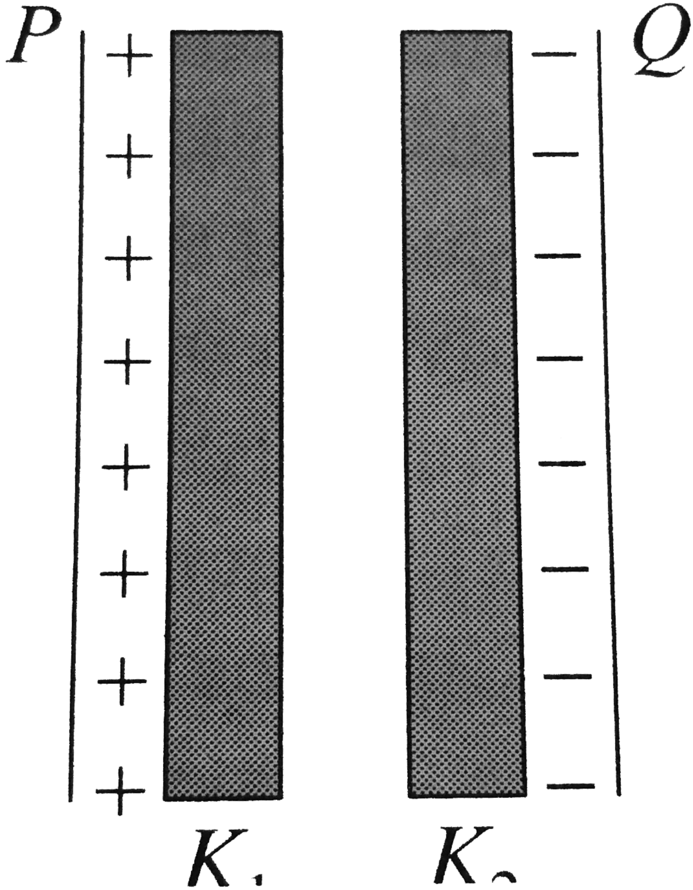
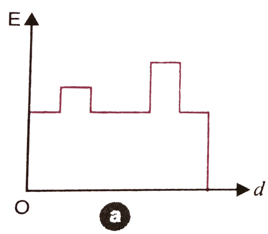
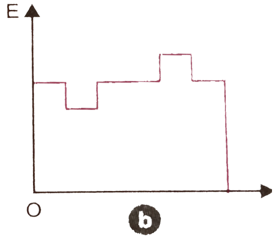
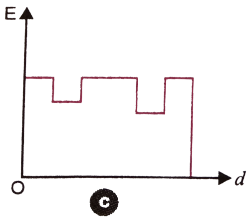
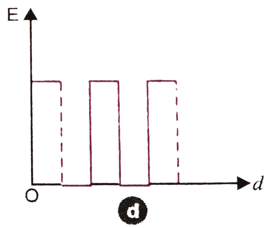
332. Two thin dielectric slabs of dielectric constants K_1 and $K_2\left(K_1 < K_2\right)$ are inserted between plates of a parallel plate capacitor, as shown in the figure. The variation of electric field E between the plates with distance d as measured from plate P is correctly shown by



A. 

B. 

C. 

D. 

Answer: C

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333. A parallel plate condenser with a dielectric of dielectric constant K between the plates has a capacity C and is charged to a potential V volt. The dielectric slab is slowly removed from between the plates and then reinserted. The net work done by the system in this process is

A. zero

B. $\frac{1}{2}(K - 1)CV^2$

C. $\frac{CV^2(K - 1)}{K}$

D. $(K - 1)CV^2$

Answer: A

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334. A parallel plate capacitor is made of two circular plates separated by a distance 5mm and with a dielectric of dielectric constant 2.2 between them. When the electric field in the dielectric is $3 \times 10^4 V/m$ the charge density of the positive plate will be close to:

A. $3 \times 10^4 C/m^2$

B. $6 \times 10^4 C/m^2$

C. $6 \times 10^{-7} C/m^2$

D. $3 \times 10^{-7} C/m^2$

Answer: C

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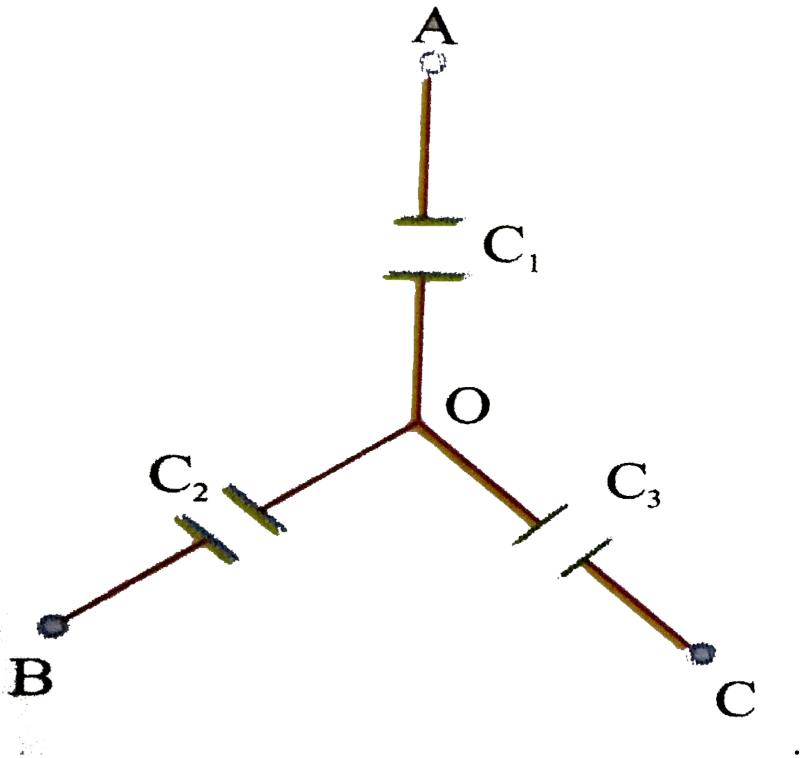
335. Three uncharged capacitors of capacities C_1, C_2 and C_3 are connected as shown in the figure to one another and the potentials V_1, V_2 and V_3 respectively. Then the potential at O will be



A. $\dfrac{V_A + V_B + V_D}{C_1 + C_2 + C_3}$

B. $\dfrac{V_A C_1 + V_B C_2 + V_D C_3}{C_1 + C_2 + C_3}$

C. $\left(V_A V\right)(B) + V_B V_D + \dfrac{V_D V_A}{C_1 + C_2 + C_3}$

D. $\dfrac{V_A V_B V_D}{C_1 C_2 + C_2 C_3 + C_3 C_1}$

Answer: B

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336. A capacitor is charged by a battery. The battery is removed and another identical uncharged capacitor is connected in parallel. The total electrostatic energy of resulting system:

A. increases by a factor of 4

B. decreases by a factor of 2

C. remains the same

D. increases by a factor of 2

Answer: B

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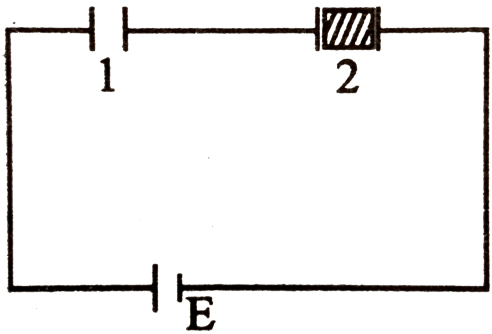
337. Two identical capacitors 1 and 2 are connected in series to a batery as shown in figure. Capacitor 2 contains a dielectric slab of dieletric constant k as shown. Q_1 and Q_2 are the charges stored in the capacitors. Now the dielectirc slab us removed and the corresponding charges are Q'_1 and Q'_2. Then



A. $\dfrac{Q'_1}{Q_1} = \dfrac{K+1}{K}$

B. $\dfrac{Q'_2}{Q_2} = \dfrac{K+1}{2}$

C. $\dfrac{Q'_2}{Q_2} = \dfrac{K+1}{2K}$

D. $\dfrac{Q'_2}{Q_2} = \dfrac{K}{2}$

Answer: C

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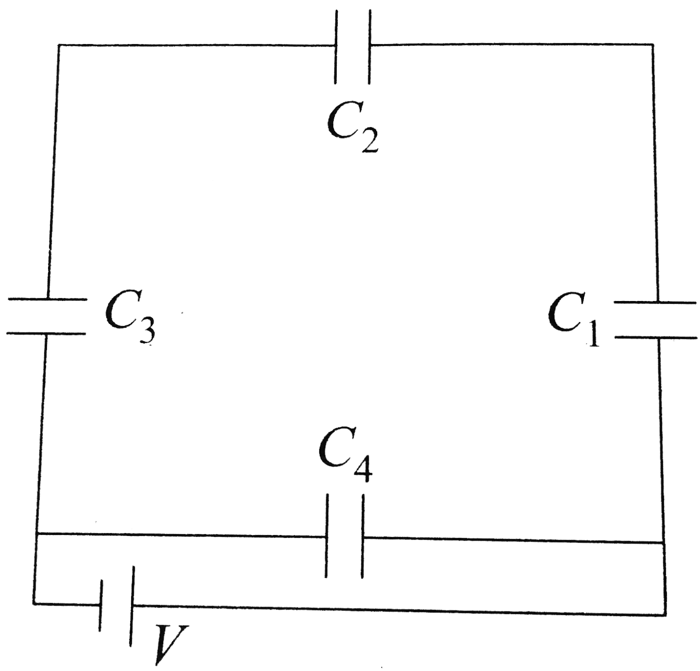
338. A network of four capacitors of capacity equal to $C_1 = C, C_2 = 2C, C_3 = 3C$ and $C_4 = 4C$ are connected to a battery as shown in the figure. The ratio o fthe charges on C_2 an C_4 is



A. $4/7$

B. $3/22$

C. $7/4$

D. $22/3$

Answer: B

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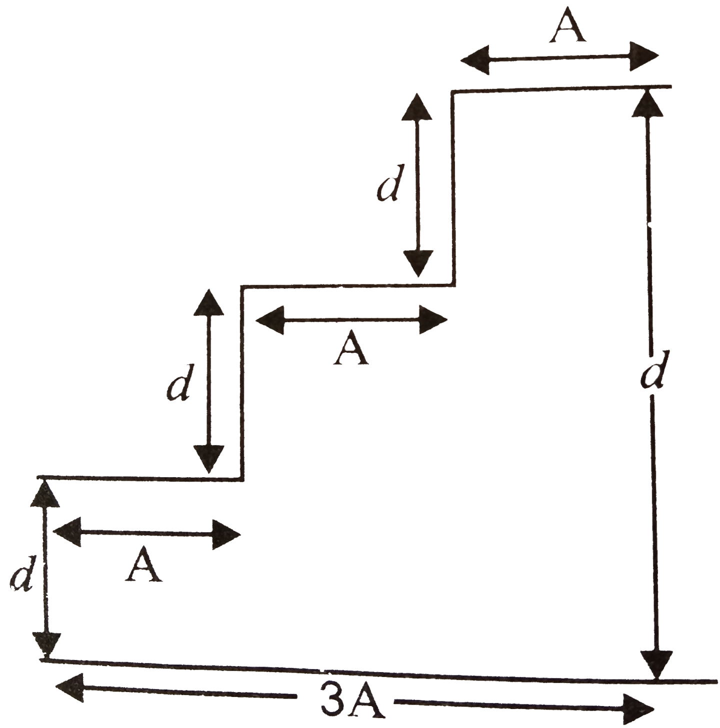
339. The expression for the equivalent capacitance of the system shown in Fig. is (A is the corss-sectional area of one of the planes)

:



A. $\in_0 A/3d$

B. $\frac{3 \in_0 A}{d}$

C. $\in_0 A/6d$

D. none of the above

Answer: D

340. A fully charged capacitor has a capacitance 'C'. It is discharged through a small coil of resistance wire embedded in a thermally insulated block of specific heat capacity 's' and mass 'm'. If the temperature of the block is raised by 'DeltaT', the potential difference 'V' across the capacitance is

A. $\frac{ms\Delta T}{C}$

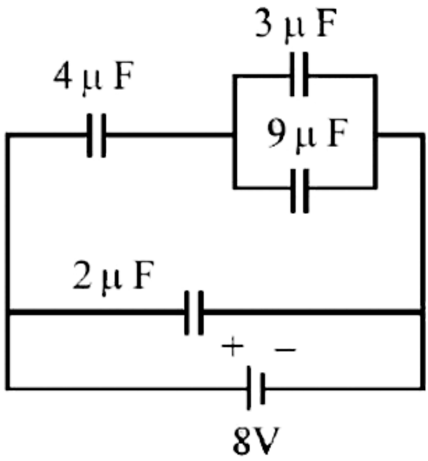
B. $\sqrt{\frac{2ms\Delta T}{C}}$

C. $\sqrt{\frac{2ms\Delta T}{s}}$

D. $\frac{mC\Delta T}{C}$

Answer: B

341. A combination of capacitors is set up as shown in the figure. The magnitude of the electric field, due to a point charge Q (having a charge equal to the sum of the charges on the $4\mu F$ and $9\mu F$ capacitors), at a point distance 30 m from it, would equal:



A. $240N/C$

B. $360N/C$

C. $420N/C$

D. $480N/C$

Answer: C

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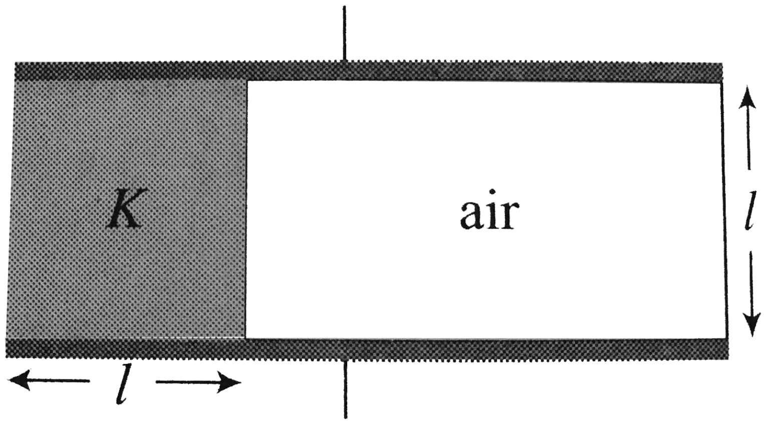
342. parallel plate capacitor has capacitance C when no dielectric between thw plates. Now a slab of dielectric constant K, having same thickness as the separation between the plates is introduced so as to fill one-fourth of the capacitor as shown in the figure. the new capacitance will be



A. $(K+3)\frac{C}{4}$

B. $(K+2)\frac{C}{4}$

C. $(K+1)\frac{C}{4}$

D. $\frac{KC}{4}$

Answer: A

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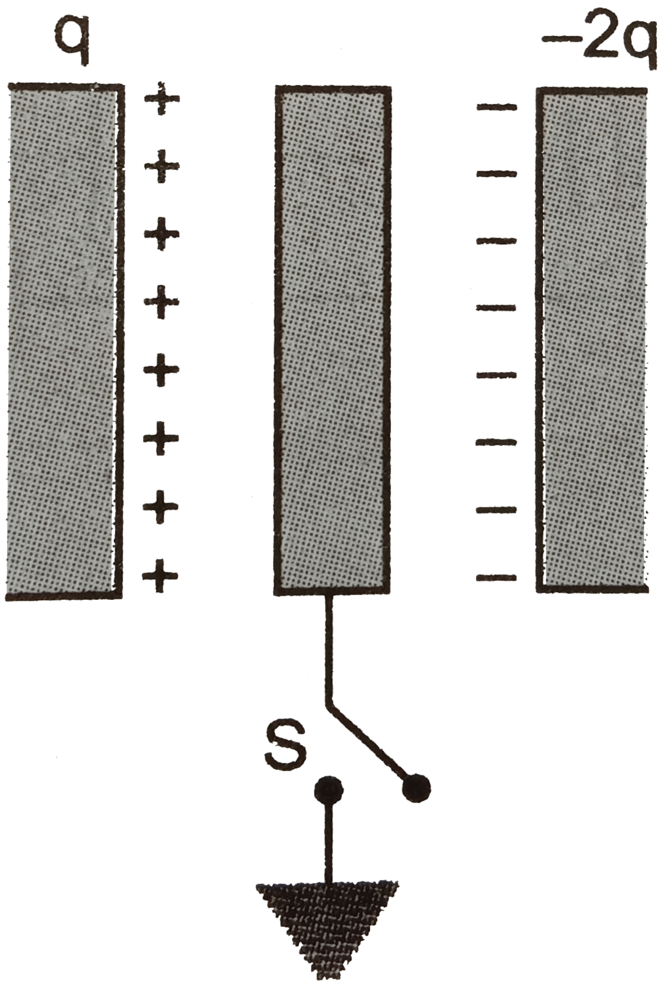
343. The metal plate on the left in Fig, carries a charge $+q$. The metal plate on the right has a charge of $-2q$. What charge will flow through S when it is closed if the central plate is initially neutral ?



A. zero

B. $-q$

C. $+q$

D. -$2q$

Answer: C

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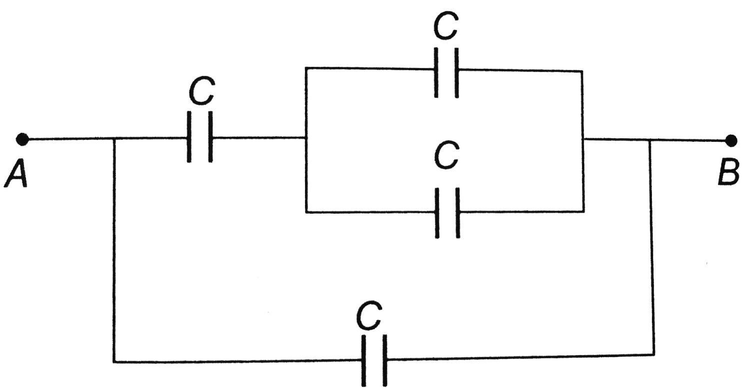
344. Four equal capacitors, each of capacity C, are arranged as shown. The effective capacitance between A and B is



A. $\frac{5}{8}C$

B. $\frac{3}{5}C$

C. $\frac{5}{3}C$

D. C

Answer: C

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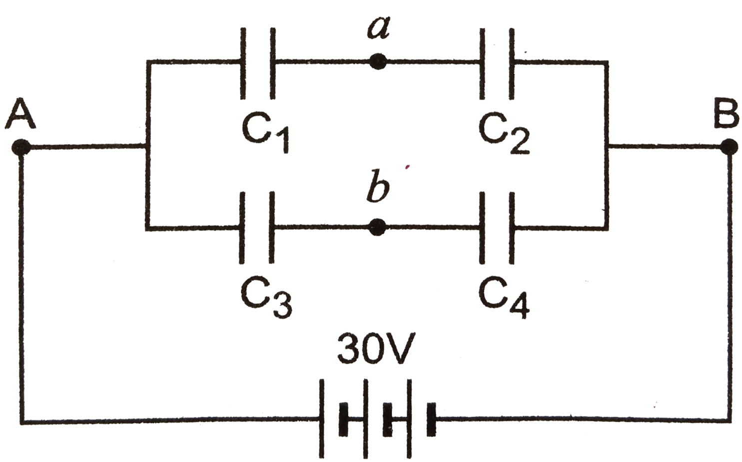
345. Four capacitors with capacitances $C_1 = 1\mu F, C_2 = 1.5\mu F, C_3 = 2.5\mu F$ and $C_4 = 0.5\mu F$ are connected as shown in Fig, to a 30 voltg source. The potentail difference between points a and b is



A. $5V$

B. $9V$

C. $10V$

D. $13V$

Answer: D

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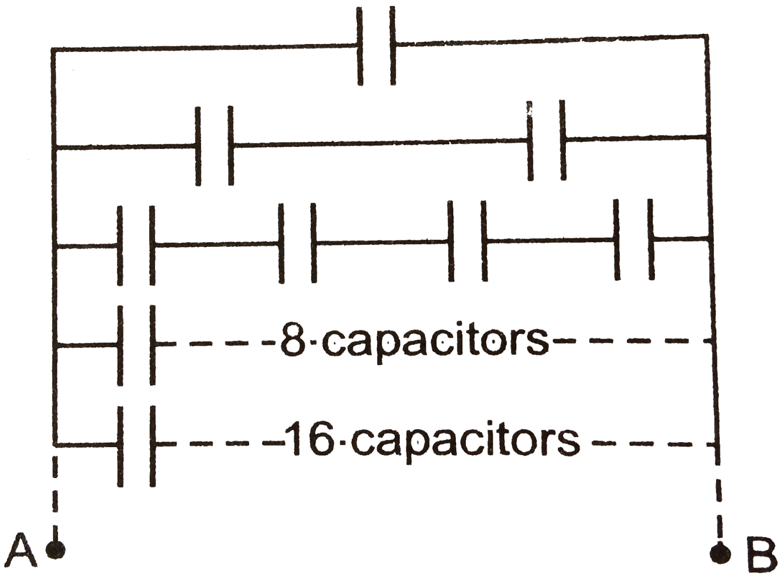
346. An infinite number of identical capacitors each of capacitance $1\mu F$ are connected $1\mu F$ are connected as shown in Fig. Then the equivalent capacitance between A and B is



A. $1\mu F$

B. $2\mu F$

C. $\frac{1}{2}\mu F$

D. ∞

Answer: B

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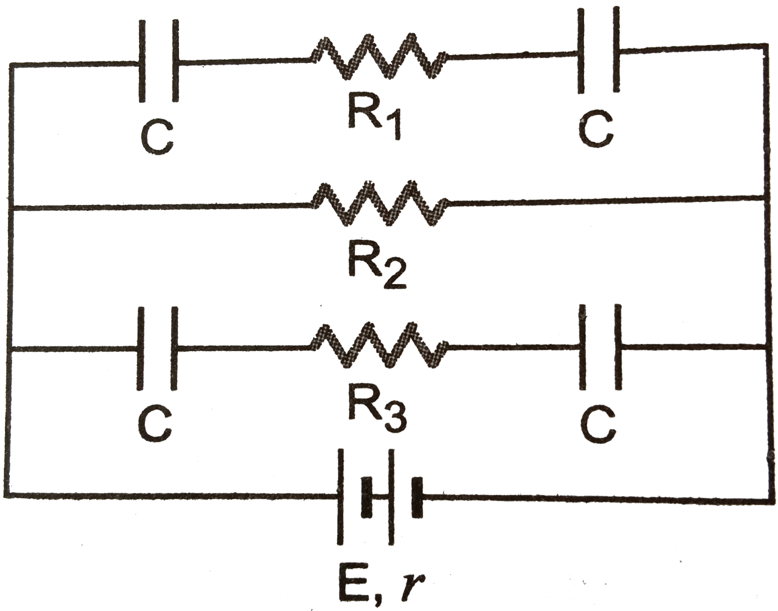
347. In Fig, $E = 5$ volt , $r = 1\Omega, R_2 = 4\Omega, R_1 = R_3 = 1\Omega$ and $C = 3\mu F$.

Then the numbercal value of the charge on each plate of the capacitor is



A. $24\mu C$

B. $12\mu C$

C. $6\mu C$

D. $3\mu C$

Answer: C

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348. The plates of a parallel plate capacitor with air as medium are separated by a distance of $8mm$. A medium of dielectric constant 2 and thickness $4mm$ having the same area is introduced between the plates. For the capacitanace to remain the same, the distance between the plates is

A. $8mm$

B. $6mm$

C. $10mm$

D. $12mm$

Answer: C

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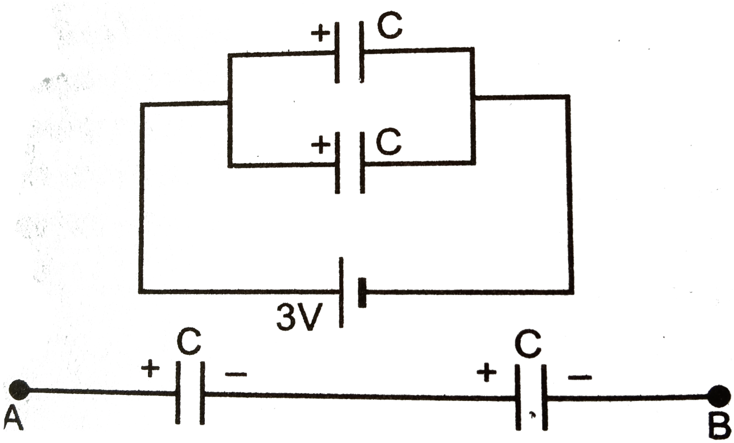
349. Two identical parallel plate capacitors are connected in parallel to a3 volt battery. The battery is disconnected and the two capacitors are joined in series, Fig. What is the potentail difference between A and B ?



A. 6 volt

B. 2 volt

C. 3 volt

D. 12 volt

Answer: D

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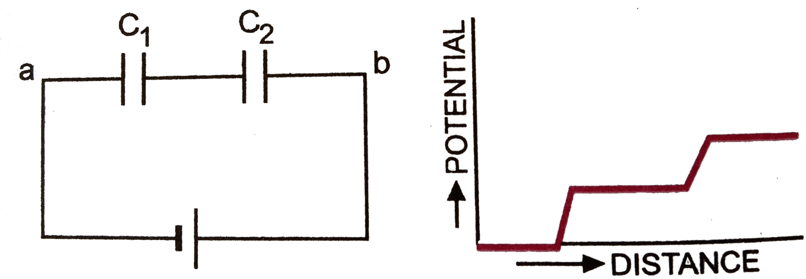
350. Two condensers of capacity C_1 and C_2, are connected in series to a battery as shown in Fig. The adjoining graph shows the variraton of potential in going from a to b. Thereofore.



A. $C_1 > C_2$

B. $C_1 = C_2$

C. $C_1 < C_2$

D. Cannot say

Answer: C

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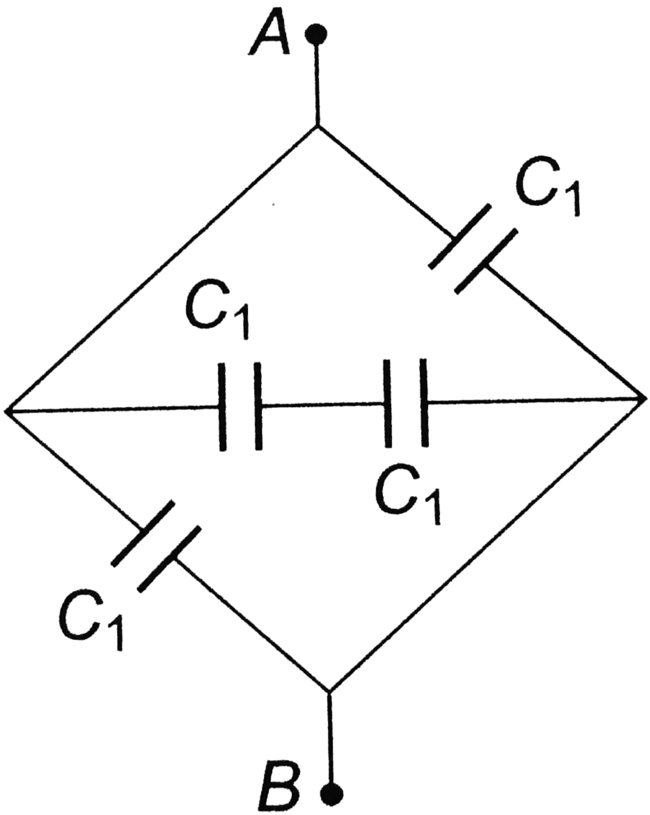
351. Four identical capacitors are connected as shown in diagram.

When a battery of $6V$ is connected between A and B, the charges stored is found to be $1.5 \mu C$. The value of C_1 is



A. $2.5 \mu F$

B. $15 \mu F$

C. $1.5 \mu F$

D. $0.1 \mu F$

Answer: D

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352. A parallel plate capacitor with air between the plates has capacitance of $9pF$. The separation between its plates is 'd'. The space between the plates is now filled with two dielectrics. One of the dielectrics has dielectric constant $k_1 = 3$ and thickness $\frac{d}{3}$ while the other one has dielectric constant $k_2 = 6$ and thickness $\frac{2d}{3}$. Capacitance of the capacitor is now

A. $1.8pF$

B. $45pF$

C. $40.5pF$

D. $20.25pF$

Answer: C

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353. A condenser of capacity C is charged to a potential difference of V_1. The plates of the condenser are then connected to an ideal inductor of inductance L. The current through the inductor wehnn the potential difference across the condenser reduces to V_2 is

A. $\left(\dfrac{C\left(V_1 - V_2\right)^2}{L}\right)^{\frac{1}{2}}$

B. $\dfrac{C\left(V_1^2 - V_2^2\right)}{L}$

C. $\dfrac{C\left(V_1^2 + V_2^2\right)}{L}$

D. $\left(\dfrac{C\left(V_1^2 - V_2^2\right)}{L}\right)^{\frac{1}{2}}$

Answer: D

Watch Video Solution

354. A series combination of n_1 capacitors, each of value C_1, is charged by a source of potential difference $4V$. When another parallel combination of n_2 capacitors, each of value C_2, is charged by a source of potential difference V, it has same (total) energy stored in it, as the first combination has. the value of C_2, in terms of C_1, is then

A. $\frac{2C_1}{n_1 n_2}$

B. $16\frac{n_2}{n_1}C_1$

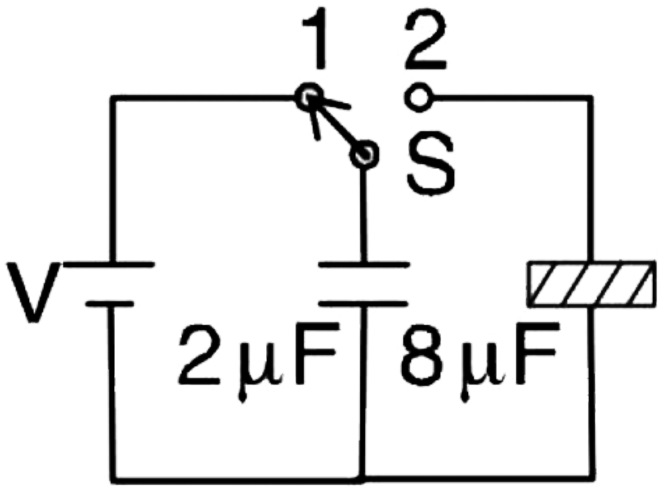
C. $2\frac{n_2}{n_1}C_1$

D. $\frac{16C_1}{n_1 n_2}$

Answer: D

Watch Video Solution

355. A $2\mu F$ capacitor is charged as shown in the figure. The percentage of its stored energy disispated after the switch S is turned to poistion 2 is



A. $0\ \%$

B. $20\ \%$

C. $75\ \%$

D. $80\ \%$

Answer: D

Watch Video Solution

356. A resistor 'R' and $2(\mu)F$ capacitor in series is connected through a switch to 200 V direct supply. A cross the capacitor is a neon bulb that lights up at 120 V. Calculate the value of R to make the bulb light up 5 s after the switch has been closed. ($\log_{10}2.5 = 0.4$)

A. $1.7 \times 10^5 \Omega$

B. $2.7 \times 10^6 \Omega$

C. $3.3 \times 10^7 \Omega$

D. $1.3 \times 10^4 \Omega$

Answer: B

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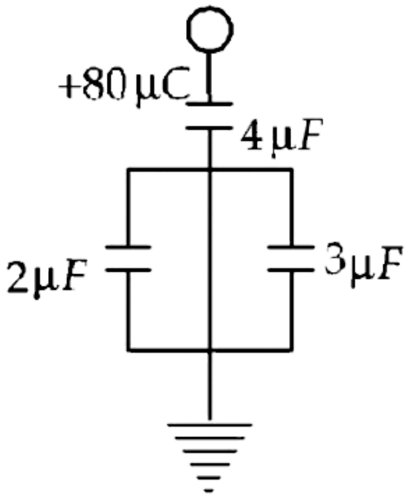
357. In the given circuit, a charge of $+80\mu C$ is given to the upper plate of the $4\mu F$ capacitor. Then in the steady state, the charge on the upper plate of the $3\mu F$ capacitor is



A. $+32\mu C$

B. $+40\mu C$

C. $+48\mu C$

D. $+80\mu C$

Answer: C

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358. Two capacitors C_1 and C_2 are charged to 120V and 200V respectively. It is found that connecting them together the potential on each one can be made zero. Then

A. $5C_1 = 3C_2$

B. $3C_1 = 5C_2$

C. $3C_1 + 5C_2 = 0$

D. $9C_1 = 4C_2$

Answer: B

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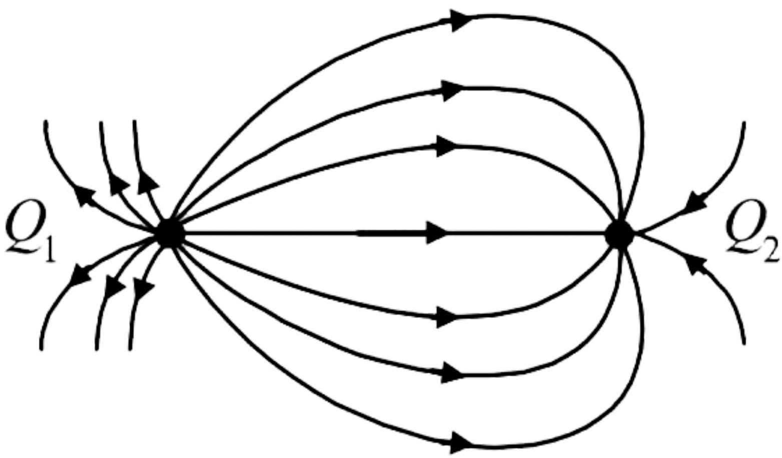
359. A few electric field lines for a system of two charges Q_1 and Q_2 fixed at two different points on the x-axis are shown in the figure. These lines suggest that



A. $|Q_1| > |Q_2|$

B. $|Q_1| < |Q_2|$

C. at finite distnance to the left of Q_1, the electric field is zero

D. at a finitie distance to the right of Q_2, the electric field is zero

Answer: A::D

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360. Three charged particles are collinear and are in equilibrium, then

A. all the charged particles have the same polarity

B. the equilibrium in unstable

C. all the charged particles cannot have the same polarity

D. both (a) and (c) are correct

Answer: B::C

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361. A spherical metal shell A of radius R_A and a solid metal sphere B of radius $R_B\left(< R_A\right)$ are kept far apart and each is given charge $' + Q'$. Now they are connected by a thin metal wire. Then

A. $E_{A_{\in side}} = 0$

B. $Q_A > Q_B$

C. $\frac{\sigma_A}{\sigma_B} = \frac{R_B}{R_A}$

D. E_A on the surface $< E_B$ on surface

Answer: A::B::C::D

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362. A proton and an electron are placed in a uniform electric field.

A. The magnitude of the electric forces acting on them will be equal

B. The electric forces acting on them will be unequal

C. The magnitude of their accelerations will be equal

D. Their accelrations will be equal

Answer: A

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363. A point charge is brought in an electric field. The electric field at a nearby point

(i) will increase if the charge is $+ve$

(ii) will decrease if the charge is -ve

(iii) may increase if the charge is $+ve$

(iv) may decrease if the charge is -ve

A. will increase if charge is positive

B. may increase if charge is positive

C. will increase if charge is negative

D. may increase if charge is negative

Answer: B::D

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364. A uniformly charged solid shpere fo radius R has potential V_0 (measured with respect to ∞) on its surface. For this sphere the equipotentail surfaces with potentials $\frac{3V_0}{2}, \frac{5V_0}{4}, \frac{3V_0}{4}$ and $\frac{V_0}{4}$ have radius R_1, R_2, R_3 and R_4 respecatively. Then

A. $R_1 = 0$ and $R_2 > (R_4 - R_3)$

B. $R_1 \neq 0$ and $R_2 > (R_4 - R_3)$

C. $R_1 = 0$ and $R_2 < \left(R_4 - R_3\right)$

D. $2R < R_4$

Answer: C::D

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365. A positively charged thin metal ring of radius R is fixed in the xy plane with its centre at the origin O. A negatively charged particle P is released from rest at the point $\left(0, 0, z_0\right)$ where $z_0 > 0$. Then the motion of P is

A. Periodic for all the values of Z_0, satisfying $0 < Z_0 < \infty$

B. Simple harmonic for all the values of Z_0, satisfying $0 < Z_0 \leq R$

C. appoximately simple harmonic provided $Z_0 < \, < R$

D. such that P crosses O and continues to move along the negative Z-axis towards $Z = -\infty$

Answer: A::C

Watch Video Solution

366. A non-conducting solid sphere of radius R is uniformly charged. The magnitude of the electric filed due to the sphere at a distance r from its centre

A. increases as r increases for $r < R$

B. decreases as r increases for $0 < r < \infty$

C. decreases as r increases for $R < r < \infty$

D. is discontiues at $r = R$

Answer: A::C

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367. Which of the following quantites do not depend on the choice of zero potential or zero potential energy?

A. Potential at a point

B. Potential difference between two point

C. Change is potential energy of a system of two charges

D. Potential energy of a system of two charges

Answer: B::C::D

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368. A charge $+q$ is fixed at each of the points $x = x_0$, $x = 3x_0$, $x = 5x_0$,............$x = \infty$ on the x axis, and a charge -q is fixed at each of the points $x = 2x_0$, $x = 4x_0$, $x = 6x_0$, ...$x = \infty$. Here x_0 is a positive constant. Take the electric potential at a point due to a charge Q at a distance r from it to be $Q/\left(4\pi\varepsilon_0 r\right)$.Then, the potential at the origin due to the above system of

A. 0

B. ∞

C. $\dfrac{q}{4\pi \in_0 x_0 \in 2}$

D. $\dfrac{qIN2}{4\pi \in_0 x_0 \in 2}$

Answer: D

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369. A parallel plate air capacitor is connected to a battery. The quantities charge, voltage, electric field and energy associated with this capacitor are given by Q_0 , V_0, E_0 and U_0 respectively. A dielectric slab is now introduced to fill the space between the plates with battery still in connection. The corresponding quantities now given by Q, V, E and U are related to the previous one as

A. $Q > Q_0$

B. $V > V_0$

C. $E > E_0$

D. $U > U_0$

Answer: A::D

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370. A parallel plate capacitor of plate area A and plate separation d is charged to potential difference V and then the battery is disconnected. A slab of dielectric constant K is then inserted between the plates of the capacitor so as to fill the space between the plates. If Q, E and W denote respectively, the magnitude of charge on each plate, the electric field between the plates (after the slab is inserted), and work done on the system, in question, in the process of inserting the slab, then

A. $Q = \frac{\in_0 AV}{d}$

B. $Q = \frac{\in_0 KAV}{d}$

C. $E = \frac{V}{Kd}$

D. $W = \frac{\in_0 AV^2}{2d}\left(1 - \frac{1}{K}\right)$

Answer: A::C::D

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371. Which of the following statement(s) is/are correct?

A. If the electric field due to a point charge variesas $r^{-2.5}$ instead fo r^{-2}, then the Gauiss law will still be valid.

B. The Gauss law can be used to calculate the field distributed around on electric dipole.

C. If the electric field between two points charges is zero somewhere , then the sign of the two charges is not the same.

D. Work done in moving a unit positive charge by the external force from point A at potential V_A to point B at potential V_B is $\left(V_B - V_A\right)$

Answer: C::D

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372. A parallel plate capacitor is charged and the charging battery is then disconnected. If the plates of the capacitor are moved farther apart by means of insulating handles:

A. the stored energy of the capacitor increases

B. charge on capacitor increases

C. voltage of the capacitor increasess

D. the capacitance increases

Answer: A::C

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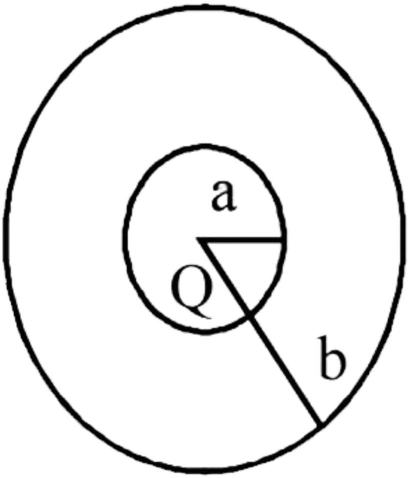
373. The region between two concentric spheres of radii 'a' and 'b', respectively (see figure), have volume charge density $\rho = \frac{A}{r}$, where A is a constant and r is the distance from the centre. At the centre of the spheres is a point charge Q. The value of A such that the electric field in the region between the spheres will be constant, is:



A. $\frac{Q}{2\pi a^2}$

B. $\frac{Q}{2\pi\left(b^2 - a^2\right)}$

C. $\frac{2Q}{\pi\left(a^2 - b^2\right)}$

D. $\frac{2Q}{\pi a^2}$

Answer: A

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374. Let $E_1(r), E_2(r)$ and $E_3(r)$ be the respectively electric field at a distance r from a point charge Q, an infinitely long wire with constant linear charge density λ, and an infinite plane with uniform surface charge density σ. If $E_1\left(r_0\right) = E_2\left(r_0\right) = E_3\left(r_0\right)$ at a given distance r_0, then

A. $Q = 4\sigma\pi r_0^2$

B. $r_0 = \lambda/2\pi\sigma$

C. $E_1\left(r_0/2\right) = 2E_2/\left(r_0/2\right)$

D. $E_2\left(r_0/2\right) = 4E_0\left(r_0/2\right)$

Answer: C

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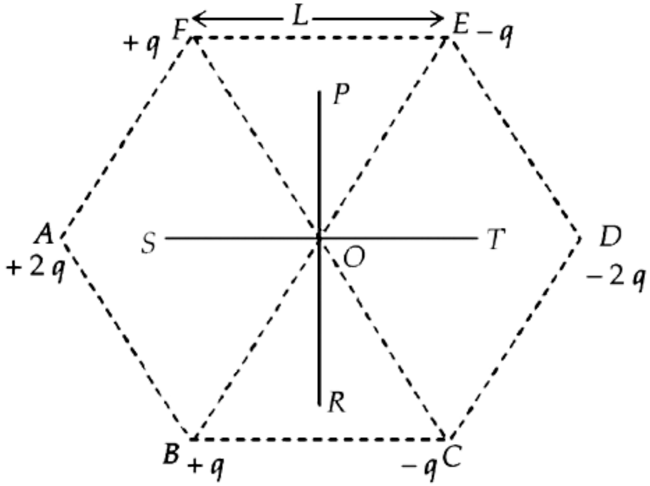
375. Six point charges are kept at the vertices of a regular hexagon of side L and centre O, as shown in the figure. Given that $K = \frac{1}{4\pi\varepsilon_0}\frac{q}{L^2}$, which of the following statements(s) is (are) correct?



A. The electric field at O is $6K$ along OD

B. The potentail at O is zero

C. The potentail at all points on the line PR is same

D. The potential at all points on the line ST is same

Answer: A::B::C

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376. What is the potential at the centre of a square of each side 1.0 meter, when four charges $+1 \times 10^{-8}C$, $-2 \times 10^{-8}C$, $+3 \times 10^{-8}C$ and $+2 \times 10^{-8}C$ are placed at the four corners of the square.

A. $5.09 \times 10^{2}V$

B. $5.09 \times 10^{3}V$

C. $5.09V$

D. $8.23 \times 10^{2}V$

Answer: A

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377. The capacity of a condenser increases both, when a conducting slab or an insulating slab is introduced between the plates of the condenser. In the former case, electric field $E = 0$ inside the conductor and in the latter case, $E < E_0$, inside the insulator. Thus, potentai difference $V = E \times d$ decreases and hence capacity $C = Q/V$ increases.

It should be clearly understood that when a dielectric slab is introduced inbetween the plates of a charged capacitor with battery connected across the plates,

(i) Capacity C increases, (ii) Potential V remains constant, (iii) Charge $Q = CV$, increases, (iv) Electric field E decreases,

(v) Energy stored $U = \frac{1}{2}CV^2$ increases.

However, when battery across the plates of charged capacitor is put off and dielectric slab is introduced inbetween th plates of the capacitor, (i) Capacity C increases,

(ii) charge Q remains constant,

(iii) Potential $V = \frac{Q}{C}$ decreases, (iv) Electric field. $E = V \times d$ decreases, (v) Energy stored $U = \frac{Q^2}{2C}$ decreases.

Consider a parallel plate air capacitor with area of each plate $= 150 cm^2$ and distance between its plates $= 0.8 mm$. With the help of the passage given above, choose the most appropriate for each of the following questions :

Energy stored in the capacitor, when charged to a potential difference of $1200V$ is

A. $1.2 \times 10^{-4} J$

B. $1.2 \times 10^{4} J$

C. $3.6 \times 10^{-4} J$

D. $3.6 \times 10^{4} J$

Answer: A

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378. The capacity of a condenser increases both, when a conducting slab or an insulating slab is introduced between the plates of the condenser. In the former case, electric field $E = 0$ inside the conductor and in the latter case, $E < E_0$, inside the insulator. Thus, potentai difference $V = E \times d$ decreases and hence capacity $C = Q/V$ increases.

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(ii) charge Q remains constant,

(iii) Potential $V = \frac{Q}{C}$ decreases, (iv) Electric field. $E = V \times d$

decreases, (v) Energy stored $U = \frac{Q^2}{2C}$ decreases.

Consider a parallel plate air capacitor with area of each plate $= 150cm^2$ and distance between its plates $= 0.8mm$. With the help of the passage given above, choose the most appropriate for each of the following questions :

If the air capacitor is filled with a medium of $K = 3$ and then charged to the same potentail, the energy stored will be

A. $1.2 \times 10^{-4}J$

B. $3.6 \times 10^{-4}J$

C. $3.6 \times 10^{4}J$

D. $1.2 \times 10^{4}J$

Answer: B

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379. The capacity of a condenser increases both, when a conducting slab or an insulating slab is introduced between the plates of the condenser. In the former case, electric field $E = 0$ inside the conductor and in the latter case, $E < E_0$, inside the insulator. Thus, potentai difference $V = E \times d$ decreases and hence capacity $C = Q/V$ increases.

It should be clearly understood that when a dielectric slab is introduced inbetween the plates of a charged capacitor with battery connected across the plates,

(i) Capacity C increases, (ii) Potential V remains constant, (iii) Charge $Q = CV$, increases, (iv) Electric field E decreases,

(v) Energy stored $U = \frac{1}{2}CV^2$ increases.

However, when battery across the plates of charged capacitor is put off and dielectric slab is introduced inbetween th plates of the capacitor, (i) Capacity C increases,

(ii) charge Q remains constant,

(iii) Potential $V = \frac{Q}{C}$ decreases, (iv) Electric field. $E = V \times d$ decreases, (v) Energy stored $U = \frac{Q^2}{2C}$ decreases.

Consider a parallel plate air capacitor with area of each plate $= 150cm^2$ and distance between its plates $= 0.8mm$. With the help of the passage given above, choose the most appropriate for each of the following questions :

If the capacitor is charged first as an air capacitor and then filled with this dielectric energy storred will be

A. $3.6 \times 10^{-4}J$

B. $1.2 \times 10^{-4}J$

C. $4 \times 10^{-5}J$

D. $4 \times 10^{5}J$

Answer: C

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380. The capacity of a condenser increases both, when a conducting slab or an insulating slab is introduced between the plates of the condenser. In the former case, electric field $E = 0$ inside the conductor and in the latter case, $E < E_0$, inside the insulator. Thus, potentai difference $V = E \times d$ decreases and hence capacity $C = Q/V$ increases.

It should be clearly understood that when a dielectric slab is introduced inbetween the plates of a charged capacitor with battery connected across the plates,

(i) Capacity C increases, (ii) Potential V remains constant, (iii) Charge $Q = CV$, increases, (iv) Electric field E decreases,

(v) Energy stored $U = \frac{1}{2}CV^2$ increases.

However, when battery across the plates of charged capacitor is put off and dielectric slab is introduced inbetween th plates of the capacitor, (i) Capacity C increases,

(ii) charge Q remains constant,

(iii) Potential $V = \frac{Q}{C}$ decreases, (iv) Electric field. $E = V \times d$

decreases, (v) Energy stored $U = \frac{Q^2}{2C}$ decreases.

Consider a parallel plate air capacitor with area of each plate $= 150 cm^2$ and distance between its plates $= 0.8 mm$. With the help of the passage given above, choose the most appropriate for each of the following questions :

What will be the potential of the capacitor when filled with dielectric after charging as air capacitor ?

A. $1200V$

B. $400V$

C. $3600V$

D. $300V$

Answer: B

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381. The capacity of a condenser increases both, when a conducting slab or an insulating slab is introduced between the plates of the condenser. In the former case, electric field $E = 0$ inside the conductor and in the latter case, $E < E_0$, inside the insulator. Thus, potentai difference $V = E \times d$ decreases and hence capacity $C = Q/V$ increases.

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However, when battery across the plates of charged capacitor is put off and dielectric slab is introduced inbetween th plates of the capacitor, (i) Capacity C increases,

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(iii) Potential $V = \frac{Q}{C}$ decreases, (iv) Electric field. $E = V \times d$ decreases, (v) Energy stored $U = \frac{Q^2}{2C}$ decreases.

Consider a parallel plate air capacitor with area of each plate $= 150cm^2$ and distance between its plates $= 0.8mm$. With the help of the passage given above, choose the most appropriate for each of the following questions :

The air capacitor is charged to $1200V$ and then filled with dielectric of $K = 3$. The charge on the plates will be

A. $1.66 \times 10^2 C$

B. $1.66 \times 10^{-10} C$

C. $1.99 \times 10^7 C$

D. $1.99 \times 10^{-7} C$

Answer: D

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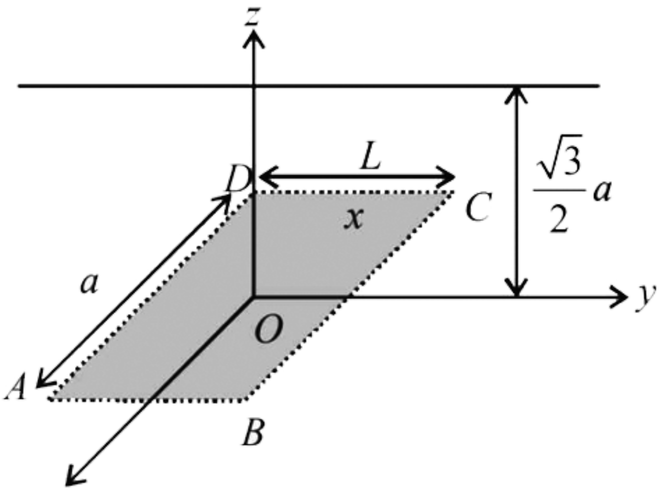
382. An infinity long uniform line charge distribution of charge per unit length λ lies parallel to the y-axis in the y - z plane at $z = \frac{\sqrt{3}}{2}$ a (see figure). If the magnitude of the flux of the electric field through the rectangular surface ABCD lying in the x - y plane with its centre at the origin is $\frac{\lambda L}{n\varepsilon_0}$ ($\varepsilon_0 =$ permittivity of free space), then the value of n is



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383. Two metal spheres A and B of different sizes are charged such that the electric potential is the same at the surface of each. Sphere A has a radius three times that of sphere B. If E_A and E_B be the electric field magnitudes at the surface of each sphere, then E_B/E_A is

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384. Two charges of values $2\mu C$ and -$50\mu C$ are placed at a distance of 6 cm from each other. The distance of the point (in cm) from the bigger charge where the electric intensity will be zero is :

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385. A point charge $q = 1C$ and mass $1kg$ is projected with speed $10m/s$ in the perpendicular direction of unifrom electric field

$E = 100V/m$. The value of latus rectum of the path followed by charged particle (in meter) is :

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386. An electric dipole consists of two opposite charges each of magnitude $1\mu C$ separated by $2cm$. The dipole is placed in an external uniform field of $10^5 NC^{-1}$ intensity. Find the

a. maximum torque exterted by the field on the dipole, and

b. work done in rotating the dipole through 180° starting from the position $\theta = 0^\circ$.

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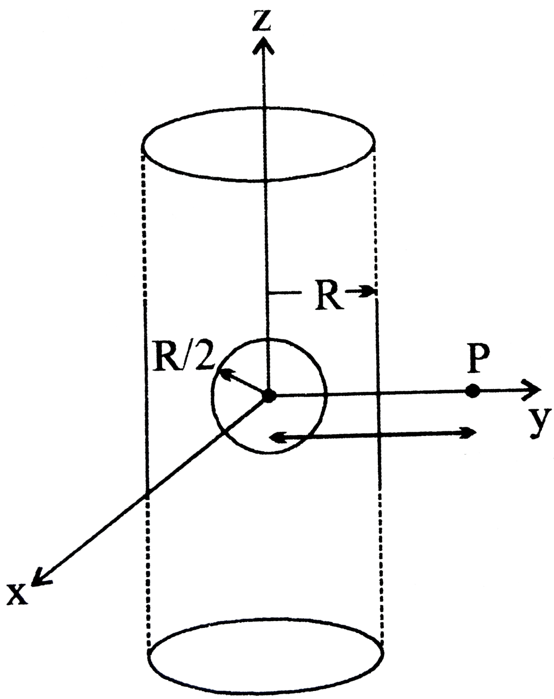
387. An infinitely long solid cylinder of radius R has a uniform volume charge density ρ. It has a spherical cavity of radius $R/2$ with its centre on the axis of cylinder, as shown in the figure. The magnitude of the electric field at the point P, which is at a distance $2R$ form the axis of the cylinder, is given by the expression $\frac{23rR}{16ke_0}$. The value of k is .



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388. Eight drops fo water each having a charge of $3 \times 10^{-9} C$ having surface potential $2V$ coalesce to from a single drop. What is the surface potentail (in volt) of new drop ?

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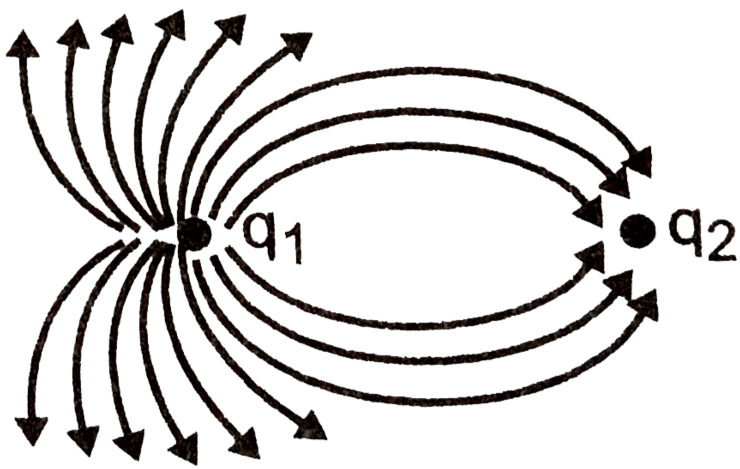
389. The electric lines of force of two point charges are shown in fig. What is the value of the ratio q_1 / q_2 ?



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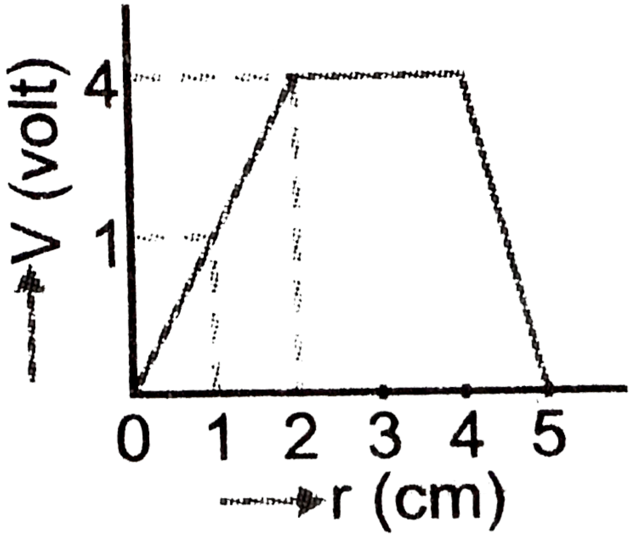
390. The variation of potential V with distance r from dixed point is shown in Fig. The magnitude of electric field at, $r = 2cm$ (in volt/cm) is :



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391. An electric field is described as $\vec{E} = \hat{i}x + \hat{k}z$.

The potential difference V_{AB} (in volt) between $A(0, 0, 0)$ and $B(2, 2, 0)$ is :

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392. Two balls with charges $5\mu C$ and $10mC$ are at a distance of $90m$ from each other. In order to reduce the distance between them to $45m$, the amount of work to be performed in joule is :

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393. Assertion. Delectric polaristion means formation of positive and negative charges inside the dielectric.

Reason. Free electrons are formed in this process.

A. both, Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. both, Assertion and Reason are true, but Reason is not the correct explanation of the Asserrtion.

C. Assertion is true, but the Reason is false.

D. both, Assertion and Reason are false.

Answer: c

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394. Assertion. When charges are shared between any two bodies, no charge is really lost but some loss of energy does occur.

Reason. Some energy disappears in the from of heat, sparking etc.

A. both, Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. both, Assertion and Reason are true, but Reason is not the correct explanation of the Asserrtion.

C. Assertion is true, but the Reason is false.

D. both, Assertion and Reason are false.

Answer: a

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395. Assertion : Insulators do no allow flow of current through them.

Reason: Insulators have no free charge carrier

A. both, Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. both, Assertion and Reason are true, but Reason is not the correct explanation of the Asserrtion.

C. Assertion is true, but the Reason is false.

D. both, Assertion and Reason are false.

Answer: a

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396. Assertion. During charging by rubbing, the insulating material with lower work function becomes positively charged.

Reason. Electrons are negatively charged.

A. both, Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. both, Assertion and Reason are true, but Reason is not the correct explanation of the Asserrtion.

C. Assertion is true, but the Reason is false.

D. both, Assertion and Reason are false.

Answer: b

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397. Assertion. If a point charge q is placed in front of an infinite grounded condcuting plane surface, the point charge will experience a force.

Reason. This force is due to the induced charge on the conducting surface which is at zero potential

A. both, Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. both, Assertion and Reason are true, but Reason is not the correct explanation of the Asserrtion.

C. Assertion is true, but the Reason is false.

D. both, Assertion and Reason are false.

Answer: a

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398. Assertion: Electrons move away from a low potential to high potential region.

Reason: Because electrons have negative charges

A. both, Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. both, Assertion and Reason are true, but Reason is not the correct explanation of the Asserrtion.

C. Assertion is true, but the Reason is false.

D. both, Assertion and Reason are false.

Answer: a

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399. Assertion. Work done in moving any charge through any distance on an equipotential surface is zero.

Reason. An equipotential surface is very smooth.

A. both, Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. both, Assertion and Reason are true, but Reason is not the correct explanation of the Asserrtion.

C. Assertion is true, but the Reason is false.

D. both, Assertion and Reason are false.

Answer: c

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400. Assertion: Work done in moving a charge between any two points in a unifrom electric field is independent of the path followed by the charge, between these points.

Reason: Electrostatic forces are non-conservative.

A. both, Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. both, Assertion and Reason are true, but Reason is not the correct explanation of the Asserrtion.

C. Assertion is true, but the Reason is false.

D. both, Assertion and Reason are false.

Answer: c

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401. Assertion. A metallic shield in the form of a hollow shell, can be built to block an electric field.

Reason. In a hollow spherical shell, the electric field inside is not zero at every point.

A. both, Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. both, Assertion and Reason are true, but Reason is not the correct explanation of the Asserrtion.

C. Assertion is true, but the Reason is false.

D. both, Assertion and Reason are false.

Answer: c

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402. Assertion. Farad is too big a unit of capacity.

Reason. Capacity of earth-which is the largest sphere is in microfarad.

A. both, Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. both, Assertion and Reason are true, but Reason is not the correct explanation of the Asserrtion.

C. Assertion is true, but the Reason is false.

D. both, Assertion and Reason are false.

Answer: a

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403. Assertion. Capacity of a parllel plate condenser remains unaffected on introduced a conducting or insulating slab between the plates.

Reason. In both the cases, electric field intensity between the plates increases.

A. both, Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. both, Assertion and Reason are true, but Reason is not the correct explanation of the Asserrtion.

C. Assertion is true, but the Reason is false.

D. both, Assertion and Reason are false.

Answer: d

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404. Statement-1. Charge is quantized because only intergal number of electrons can be transferred.

Statement-2. There is no possibility of transfer of transfer of some fraction of electron.

A. Statement-1. is true , Statement-2 is true , Statement-2 is correct explanation of Statement-1.

B. Statement-1. is true , Statement-2 is true , Statement-2 is not a correct explanation of Statement-1.

C. Statement-1. is correct and Statement-2 is false.

D. Statement-1. is false and Statement -2 is true.

Answer: a

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405. Statement-1. Force between two charges increases, when air separating the charges is replaced by water.

Statement-2. Medium intervenning between the charges has dielectric constant $K > 1$.

A. Statement-1. is true , Statement-2 is true , Statement-2 is correct explanation of Statement-1.

B. Statement-1. is true , Statement-2 is true , Statement-2 is not a correct explanation of Statement-1.

C. Statement-1. is correct and Statement-2 is false.

D. Statement-1. is false and Statement -2 is true.

Answer: d

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406. Statement-1. Force between two charges is quadupled when distance between them is halved

Statement-2. $F = \frac{1}{r^2}$, as per coulomb's law.

A. Statement-1. is true , Statement-2 is true , Statement-2 is correct explanation of Statement-1.

B. Statement-1. is true , Statement-2 is true , Statement-2 is not a correct explanation of Statement-1.

C. Statement-1. is correct and Statement-2 is false.

D. Statement-1. is false and Statement -2 is true.

Answer: a

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407. Statement-1. The whole charge of a body can be transferred to another body.

Statement-2. Charge cannot be transferred partially.

A. Statement-1. is true , Statement-2 is true , Statement-2 is correct explanation of Statement-1.

B. Statement-1. is true , Statement-2 is true , Statement-2 is not a correct explanation of Statement-1.

C. Statement-1. is correct and Statement-2 is false.

D. Statement-1. is false and Statement -2 is true.

Answer: c

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408. Statement-1. The number of electrons in one coulomb is 6.25×10^{18}.

Statement-2. $q = ne$, where symbols have their usual meaning.

A. Statement-1. is true , Statement-2 is true , Statement-2 is correct explanation of Statement-1.

B. Statement-1. is true , Statement-2 is true , Statement-2 is not a correct explanation of Statement-1.

C. Statement-1. is correct and Statement-2 is false.

D. Statement-1. is false and Statement -2 is true.

Answer: a

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409. Statement-1. Units of electric dipole moment are C - m and unints of torque are N - m

Statement-2. $p = q(2a)$ and $\tau = force \times distance$

A. Statement-1. is true , Statement-2 is true , Statement-2 is correct explanation of Statement-1.

B. Statement-1. is true , Statement-2 is true , Statement-2 is not a correct explanation of Statement-1.

C. Statement-1. is correct and Statement-2 is false.

D. Statement-1. is false and Statement -2 is true.

Answer: a

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410. Assertion. When charges are shared between any two bodies, no charge is really lost but some loss of energy does occur.

Reason. Some energy disappears in the from of heat, sparking etc.

A. Statement-1. is true , Statement-2 is true , Statement-2 is correct explanation of Statement-1.

B. Statement-1. is true , Statement-2 is true , Statement-2 is not a correct explanation of Statement-1.

C. Statement-1. is correct and Statement-2 is false.

D. Statement-1. is false and Statement -2 is true.

Answer: a

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411. Statement-1. The number of electric lins of force emanting from $1\mu C$ charge in vacumm is 1.13×10^6.

Statement-2. This follows from Gauss's theorem in electrostatics.

A. Statement-1. is true , Statement-2 is true , Statement-2 is correct explanation of Statement-1.

B. Statement-1. is true , Statement-2 is true , Statement-2 is not a correct explanation of Statement-1.

C. Statement-1. is correct and Statement-2 is false.

D. Statement-1. is false and Statement -2 is true.

Answer: a

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412. Statement-1. In a series combination of capacitors, charge on each capacitor is same.

Statement-2. In such a combination, charge cannot move only along one route.

A. Statement-1. is true , Statement-2 is true , Statement-2 is correct explanation of Statement-1.

B. Statement-1. is true , Statement-2 is true , Statement-2 is not a correct explanation of Statement-1.

C. Statement-1. is correct and Statement-2 is false.

D. Statement-1. is false and Statement -2 is true.

Answer: a

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413. Statement-1. For a charged particle moving from pont P to point Q, the net work done by an electrostatic field on the particle is independent of the path connecting point P to point Q

Statement-2. The net work done by a conservatie force on an object moving along a closed loop is zero.

A. Statement-1. is true , Statement-2 is true , Statement-2 is correct explanation of Statement-1.

B. Statement-1. is true , Statement-2 is true , Statement-2 is not a correct explanation of Statement-1.

C. Statement-1. is correct and Statement-2 is false.

D. Statement-1. is false and Statement -2 is true.

Answer: b

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414. STATEMENT-1: For practical purposes, the earth is used as a reference at zero potencial in electrical circuits. and

STATEMENT-2: The electrical potential of a sphere of radius R with charge Q uniformly distributed on the surface is given by $\frac{Q}{4\pi\varepsilon_0 R}$.

A. Statement-1. is true , Statement-2 is true , Statement-2 is correct explanation of Statement-1.

B. Statement-1. is true , Statement-2 is true , Statement-2 is not a correct explanation of Statement-1.

C. Statement-1. is correct and Statement-2 is false.

D. Statement-1. is false and Statement -2 is true.

Answer: a

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FILL IN THE BLANKS

1. Lightning is a common example of ....

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2. Like charge .... each other and unlike charges .... eachother.

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3. The cause of charging is .... of electrons from .... To ....

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4. Electrons are transferred from the material whose .... Is ...... to the material whose .... Is ....

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5. Charges can be created or destroyed in .... and .... Pairs only.

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6. Electric field intensity at any point is the .... Experienced by .... placed at that point.

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7. Electric field due to a single charge is

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8. Electric potential due to a single charge is........... .

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PROBLEMS FOR PRACTICE

1. Four equal charges each $16\mu C$ are placed on four corners of a square of side 0.4m. Calculate force on q is zero, how are Q and q related ?

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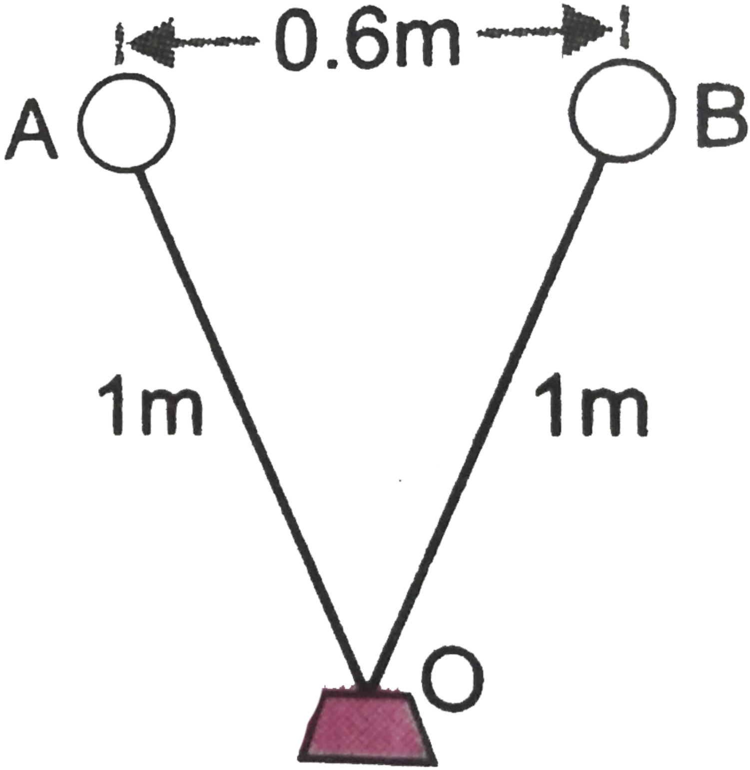
2. Two identical helium filled ballons A and B fastended to a weight of 5 gram by threads float in equilibrium as shown in fig. Calculate the charge on each ballon, assuming that they carry equal charges.



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3. Two charges, each of $5\mu C$ but opposite in sign, are placed 4 cm apart. Calculate the electric field intensity of a point that is a distance 4 cm from the mid point on the axial line of the dipole.

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4. Two small sphres of radius 'a' each carryig charges $+q$ and $-q$ and placed at points A and B, distance 'd' apart. Calculate the potential difference point A and B.

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5. A spark passes in air when the potential gradient at the surface of charged conductor is $4 \times 10^6 Vm^{-1}$. What must be the radius of an insulated metal sphere which can be charged to a potential of $4 \times 10^6 V$ before sparking into air ?

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6. A charge of $2 \times 10^{-9}C$ is placed on a corner of a cube of side 1m. Find the electric flux passing throguh a face of the given cube ?

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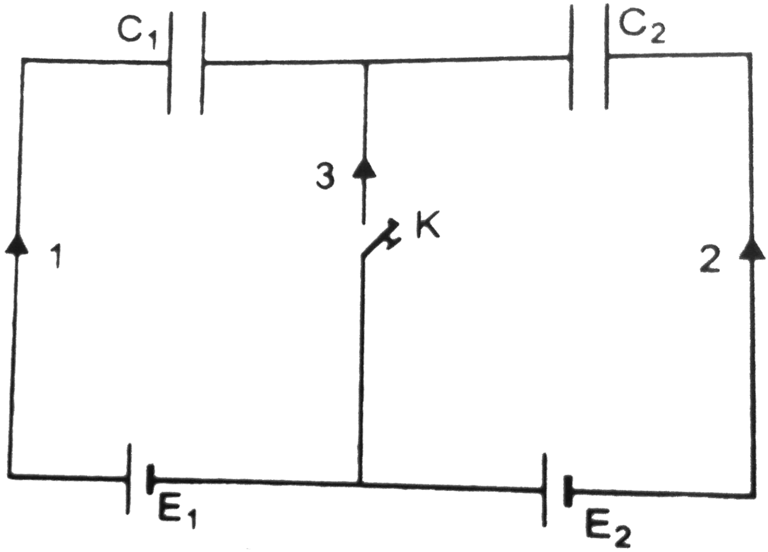
7. In the circuit shown in Fig, the enf of each battery is $E = 12$ votl and the capacitances are $C_1 = 2.0\mu F$ and $C_2 = 3.0\mu F$. Find the charges which flow along the paths 1,2,3 when K is pressed.



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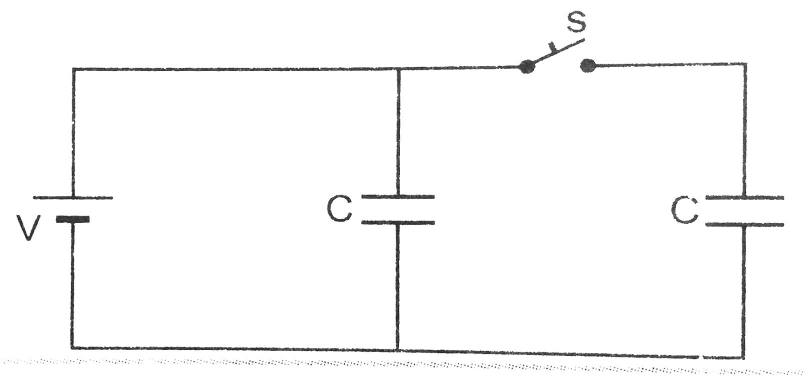
8. In the circuit shown in fig, the energy stored in both capacitors is U_1. If swich S is opened and a dielectric slab of constant 5 is put in free spaces of the capacitors, the energy stored is found to be U_2. Calcualte `U_(1)//U_(2).



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MULTIPLE CHOICE QUESTIONS

1. When a plastic comb is passed through dry hair, the charge acquired by the comb is

A. always negative

B. always positive

C. sometimes negative

D. none of the above

Answer: a

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2. Out of glass (rod) and silk (cloth), work function of glass is

A. smaller

B. larger

C. equal

D. none of the above

Answer: a

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3. At a particular point, electric field depends upon

A. source charge Q only

B. test charge q_0 only

C. both Q and q_0

D. neither Q nor q_0

Answer: a

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4. When two capacitors charged to different potentials are connected by a conducting wire, what is not true ?

A. charge lost by one is equal to charge gained by the other

B. potentail lost by one is equal to potentail gained by the other

C. some energy is lost

D. both the capacitor acquire a common potential

Answer: B

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5. In polar molecules, the centres of positive and negative charges of the molecule do not coincide. The statement is always

A. 1

B.

C. NA

D. NA

Answer: A

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COMPREHENSION

1. We may define electrostatic potential at a point in an electrostatic field as the amount of work done in moving a unit positive test charge from infinity to that point against the electrostatic forces, along any path. Due to a single charge q, potential at a point distant r from the charge is $V = \frac{q}{4\pi \in_0 r}$. The potential can be positive or negative. However, it is scalar quantity. The total amount of work done in bringing various charges to their respective postions from infinelty large mutual separations gives us the electric potential energy of the system of charges. Whereas electric potentail is measured in volt, electric potential energy is measured in joule. You are given a square of each side 1.0 metre with four charges $+1 \times 10^{-8} C$, $-2 \times 10^{-8} C$, $+3 \times 10^{-8} C$ and $+2 \times 10^{-8} C$ placed at the four corners of the square. With the help of the passage given above, choose the most approprite alternative for each of the following questions :

Electric potentail and electric potential energy

A. both are scalars

B. both are vectors

C. electric potential is scalar and electric potential energy is vector,

D. electric potentail is vector and electric potential energy is scalar.

Answer: A

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2. We may define electrostatic potential at a point in an electrostatic field as the amount of work done in moving a unit positive test charge from infinity to that point against the electrostatic forces, along any path. Due to a single charge q, potential at a point distant r from the charge is $V = \frac{q}{4\pi \in_0 r}$. The potential can be positive or negative. However, it is scalar quantity. The total amount of work done in bringing various charges to their respective postions from infinelty large mutual separations gives us the electric potential energy of the system of charges. Whereas electric potentail is measured in volt, electric potential energy is measured in joule. You are given a square of each side 1.0 metre with four charges $+1 \times 10^{-8} C$, $-2 \times 10^{-8} C$, $+3 \times 10^{-8} C$ and $+2 \times 10^{-8} C$ placed at the four corners of the square. With the help of the passage given above, choose the most approprite alternative for each of the following questions :

Potential energy fo the system of four system of four charges is

A. $12.73 \times 10^{7} J$

B. $-6.4 \times 10^{7} J$

C. $12.73 \times 10^{-9} J$

D. $-12.73 \times 10^{-9} J$

Answer: B

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ASSERTION-REASON TYPE QUESTIONS

1. Assertion. A sphrical equipotential surface is not possible for a point charge.

Reason. A spherical equipotential surface is possible inside a spherical capacitor.

A. both, Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. both, Assertion and Reason are true, but Reason is not the correct explanation of the Asserrtion.

C. Assertion is true, but the Reason is false.

D. both, Assertion and Reason are false.

Answer: d

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2. Assertion (A) A charge q is placed on a height h/4 above the centre of a square of side b . The fluk associated with the square is independent of side length.

Reason (R) Gauss 's law is independent of size of the Gaussian surface.

A. both, Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. both, Assertion and Reason are true, but Reason is not the correct explanation of the Asserrtion.

C. Assertion is true, but the Reason is false.

D. both, Assertion and Reason are false.

Answer: a

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