PHYSICS

BOOKS - CBSE COMPLEMENTARY MATERIAL PHYSICS (HINGLISH)

ELECTROSTATICS AND CURRENT ELECTRICITY

Very Short Answer Questions

1. Draw schematically an equipotential surface of a uniform electrostatic field along x - axis

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2. Sketch field lines due to (i) two equal positive charges near each other (ii) a dipole.

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3. Name the physical quantity whose SI unit is volt/meter. Is it a scalar or a vector quantity ?

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4. Two point charges repel each other with a force F when placed in water of dielectric constant 81. What will be the force between them when placed the same distance apart in air ?

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5. Electric dipole moment of $CuSO_4$ molecule is $3.2 \times 10^{-28} Cm$. Find the separation between copper and sulphate ions.

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6. Net capacitance of three identical capacitors connected in parallel is 12 microfarad. What will be the net capacitance when two of them are connected in (i) parallel (ii) series ?

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7. A charge q is placed at the centre of an imaginary spherical surface. What will be the electric flux due to this charge through any half of the sphere.

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8. Draw the electric field vs distance (from the centre) graph for (i) a long charged rod

having linear charge density $\lambda > 0$ (ii) spherical shell of radius R and charge $Q > 0$.

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

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10. A charge Q is distribution over a metal sphere of radius R. What is the electric field and electric potential at the centre ?

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11. If a body contains n_1 electrons and n_2 protons then what is the total charge on the body ?

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12. How much positive and negative charge is there in a water molecule ?

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13. How does the energy of dipole change when it is rotated from unstable equilibrium to stable equilibrium in a uniform electric field.

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14. What is the ratio of electric field intensity at a point on the equatorial line to the field at a point on axial line when the points are at the same distance from the centre of the dipole ?

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15. Draw equipotential surface for a dipole.

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16. 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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17. A point charge Q is placed at point O shown in Fig. Is the potential difference $V_A - V_B$ positive, negative or zero, if Q is (i) positive (ii) negative charge.

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18. A proton and an electron are placed in a uniform electric field. Which of the following is correct?

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19. In an uniform electric field of strength E, a charge particle Q moves point A to point B in the direction of the field and back from B to A. Calculate the ratio of the work done by the

electric field in taking the charge particle from A to B and from B to A.

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20. If a dipole having charge $\pm 2\mu C$ is placed inside a sphere of radius 2m , what is the net flux linked with the surface.

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21. Four charges $+q, -q, +q, -q$ are placed as shown in the figure. What is the work done in bringing a test charge from ∞ to point 0.

Here, OA = OB = OC = OD & q_0 = Test charge

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22. Calculate electric flux linked with a sphere of radius 1 m and charge of 1C at its centre.

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23. If the metallic conductor shown in the figure is continuously charged from which of the points A, B, C or D does the charge leak first. Justify.

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24. What is dielectric strength ? Write the value of dielectric strength of air.

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25. Two charges $-q$ and $+q$ are located at points $A(0, 0, -a)$ and $B(0, 0+a)$. How much work is done in moving a test charge from point $(b, 0, 0)$ to $Q(-b, 0, 0)$?

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26. If an electron is accelerated by a Potential difference of 1 Volt, Calculate the gain in

energy in Joule and electron volt.

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27. Describe schematically the equipotential surfaces corresponding to

A field that uniformly increases in magnitude but remains in the same (say Z) direction

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28. Figure shows six charged lumps of plastic coin. The cross - section of a Guassian surface S is indicated. What is the net electric flux through the surface ?

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29. Without referring to the formula $C = \in_0$ A/d. Explain why the capacitance of a parallel

plate capacitor reduces on increasig the separation between the plates?

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30. Draw field lines to show the position of null point for two charges $+Q_1$ and $-Q_2$ when magnetic of $Q_1 > Q_2$ and mark the position of null point.

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31. How does the relaxation time of electron in the conductor change when temperature of the conductor decreases.

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32. Sketch a graph showing variation of resistivity with temperature of (i) Copper (ii) Carbon.

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33. The emf of the driver cell in the potentiometer experiment should be greater than the emf of the cell to be determined. Why?

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34. You are required to select a carbon resistor of resistance $47k\Omega \pm 10\,\%$ from a large collection. What should be the sequence of color bands used to code it ?

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35. Find the value of i in the given circuit :

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36. Two wires of equal length one of copper and other of manganin have the same resistance. Which wire is thicker?

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37. Three copper wires of length and cross-sectional areas are (L,A) $\left(2L, \frac{A}{2}\right), (L/2, 2A)$, resistance is

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38. V - I graph for a metallic wire at two different temperatures, T_1 and T_2 is as shown in the figure. Which of the two temperature is higher and why ?

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39. Out of $V - I$ graph for parallel and series combination of two metallic resistors, which one represents parallel combination of resistors ? Justify your answer.

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40. Why is the potentiometer preferred to a voltmeter for measuring emf of a cell ?

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41. How can a given 4 wires potentiometer be made more sensitive ?

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42. Can we use copper wire as potentiometer wire ? Explain.

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43. In the figure, what is the potential difference between A and B ?

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44. A copper wire of resistance R_0 is strerched till its length is increased to n times of its original length. What will be its new resistance?

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45. Two resistance 5Ω and 7Ω are joined as shown to two batteries of emf 2V and 3V. If the 3V battery is short circuited. What will be the current through 5Ω

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46. Calculate the equivalent resistance between points A and B in the figure given

below.

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47. What is the largest voltage you can safely put across a resistor marked $196\Omega - 1W$?

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48. When does the terminal voltage of a cell become (i) greater than its emf (ii) less than

its emf ?

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49. A car battery is of 12V. Eight dry cells of 1.5 V connected in series also give 12V, but such a combination is not used to start a car. Why ?

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50. Two electric lamps A and B marked 220 V, 100 W and 220 V, 60 W respectively. Which of

the two lamps has higher resistance ?

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51. Resistors of high value are made up of carbon. Why ?

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52. Draw graph showing the variation of electronic field & electronic potential with distance 'r' due to point change.

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53. 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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54. A parallel plate capacitor of capacitance C is charged to a potential V. It is then connected to another uncharged capacitor having the same capacitance. Find out the ratio of the energy stored in the combined system to that stored initially in the single capacitor.

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55. A proton and a alpha particle are accelerated from rest through a potential difference of 100 volt. Find (i) Their KE in eV and Joule (ii) which particle will move faster.

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56. An electron starting from rest takes 14×10^{-9} sec to reach from one plate to other of a capacitor placed 2 cm apart. If charge to mass ratio of electron is

$1.8 \times 10^{11} CIkg.$ Then find the potential difference between the plates.

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57. An alpha particle of charge $3.2 \times 10^{-19} C$ and mass $6.8 \times 10^{-27} Kg$ is initially moving at speed $10^7 \frac{m}{s}$ when it is at far distance from another fixed point charge $112 \times 10^{-19} C.$ Find the distance of closest approach.

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58. If the electric field strength of air is $3 \times 10^6 V/m$, what will be the maximum potential at the surface of a metal sphere of radius 1m.

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59. Two point charge each +3 μC are placed along the diameter of a circle of radius 15 cm. Calculate the ectric potential at the ends of perpendicular diameter

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60. An electric dipole of dipole moment $40 \times 10^{-6} C - m$ is enclosed by a closed surface. What is the net flux coming out of the surface?

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61. Does the charge given to a metallic sphere depend on whether it is hollow or solid ? Give reason for your answer.

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62. A and B are two conducting spheres of the same radius, A being solid and B hollow. Both have same field on their surface. What will be the relation between the charges on the two spheres?

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63. How does the electric flux due to a point charge enclosed by a spherical Gaussian

surface get a affected when its radius is increased ?

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64. How does the Coulomb force between two point charges depend upon the dielectric constant of the intervening medium?

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65. The distance of the field point, on the equatorial plane of a small electric dipole, is halved. By what factor will the electric field, due to the dipole, change?

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66. Two plane sheets of charge densities $+\sigma$ and $-\sigma$ are kept in air as shown in figure.What are the electric field intensities at

points A and B?

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

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68. A charge Q is uniformly distributed over a ring of radius a.Obtain an expression for electric field intensity at a point on the axis of ring. show that at far point ring behaves as a point charge.

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69. Figure shows electric lines of force due to two point charges q_1 and q_2 placed at points A and B respectively. Write the nature of

charge on them.

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70. Two points charges q_1 and q_2 are placed close to each other. What is the nature of force between the charges when $q_1 < 0, q_2 > 0, q_1 < 0, q_2 < 0$

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71. A metal rod of square cross-section area A having length l has current I flowing through it, when a potential difference of V volt is applied across its ends (figure I). Now the rod is cut parallel to its length in two Identical pieces and joined as shown in (figure-II). What potential difference must be maintained across the length $2l$ so that the current in the rod is still remains I ?

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72. State the condition under which the terminal potential difference across a battery and its emf are equal.

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73. State the condition for maximum current to be drawn from the cell.

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Short Answer Questions 2 Marks

1. An oil drop of mass m carrying charge - Q is to be held stationary in the gravitational field of the earth. What is the magnitude and direction of the electrostatic field required for this purpose ?

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2. Draw E and V versus r on the same graph for a point charge.

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3. Find position around dipole at which electric potential due to dipole is zero but has non zero electric field intensity

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4. Derive an expression for the work done in rotating an electric dipole from its equilibrium position to an angle θ with the uniform electrostatic field.

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5. An electrostatic field line cannot be discontinsous. Why ?

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6. A thin long conductor has linear charge density of 20 $\mu C/m$. Calculate the electric field intensity at a point 5 cm from it. Draw a graph to show variation of electric field intensity with distance from the conductor.

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7. What is the ratio of electric field intensity at a point on the equatorial line to the field at a point on axial line when the points are at the same distance from the centre of the dipole ?

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8. Show that the electric field intensity at a point can be given as negative of potential

gradient.

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9. A charged metallic sphere A having charge q_A is brought in contact with an uncharged metallic sphere of same radius and then separated by a distance d. What is the electrostatic force between them

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10. An electron and a proton travel through equal distances in the same uniform electric field E. Compare their time of travel. (Neglect gravity)

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11. The electric potential V at any point in space is given $V = 20x^3$ volt, where x is in meter. Calculate the electric intensity at point P (1, 0, 2).

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12. Justify why two equipotential surfaces cannot intersect.

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13. Find equivalent capacitance between A and B in the combination given below : each capacitor is of 2 μF.

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14. What is the electric field at O in Figures (i), (ii) and (iii), ABCD is a square of side r.

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15. What should be the charge on a sphere of radius 4 cm, so that when it is brought in contact with another sphere of radius 2 cm

carrying charge of 10 μC, there is no transfer of charge from one sphere to other ?

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16. For an isolated parallel plate capacitor of capacitance C and potential difference V, what will be change in (i) charge on the plates (ii) potential difference across the plates (iii) electric field between the plates (iv) energy stored in the capacitor, when the distance between the plates is increased ?

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17. Does the charge given to a metallic sphere depend on whether it is hollow or solid ? Give reason for your answer.

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18. Two charges Q_1 and Q_2 are separated by distance r. Under what conditions will the electric field be zero on the line joining them

(i) between the charges (ii) outside the charge?

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19. Obtain an expression for the electric field intenstiy at a point on the equatorial line of an electric dipole.

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20. The electric field component in the figure are $\overrightarrow{E}_x = 2x\hat{i}, \overrightarrow{E}_y = E_z = 0$. Calculate the electric flux through, (1, 2, 3) the square surfaces of side 5 m

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21. Calculate the work required to separate two charges $5\mu c \text{ and } -2\mu c$ placed at (- 3 cm,

0, 0) and (+ 3 cm, 0, 0) infinitely away from each other

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22. What is electric field between the plates with the separation of 2 cm and (i) with air (ii) dielectric medium of dielectric constant K. Electric potential of each plate is marked in the following figure.

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23. A RAM (Random access Memory) chip a storage device like parallel plate capacitor has a capacity of 55pF. If the capacitor is charged to 5.3V, how may excess electrons are on its negative plate ?

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24. The figure shows the Q (charge) versus V (potential) graph for a combination of two capacitors. identify the graph representing the

parallel combination.

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25. Calculate the work done in taking a charge of 1 μC in a uniform electric field of 10 N/C from B to C given AB = 5 cm along the field and AC = 10 cm perpendicular to electric field

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26. (i) Can two equaipotential surfaces intersect each other ? Give reasons

(ii) Two charges $-q$ and $+q$ are located at point A (0, 0 -a) and B(0, 0, +a) respectively. How much work is done in moving a test charge from point $P(7, 0, 0)$ to $Q(-3, 0, 0)$?

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27. The potential at a point A is – 500 V and that at another point B is + 500 V. What is the

work done by external agent to take 2 units (S.I.) of negative charge from B to A.

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28. In charging a capacitor of capacitance C by a source of emf V, energy supplied by the sources QV and the energy stored in the capacitor is $1/2QV$. Justify the difference.

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29. An electric dipole of dipole moment p, is held perpendicular to an electric field. If the dipole is released does it have (a) only rotational motion (b) only translatory motion (c) both translatory and rotatory motion explain?

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30. The net charge of a system is zero. Will the electric field intensity due to this system also

be zero.

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31. A point charge Q is kept at the intersection of (i) face diagonals (ii) diagonals of a cube of side a. What is the electric flux linked with the cube in (i) & (ii) ?

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32. There are two large parallel metallic plates S_1 and S_2 carrying surface charge densities σ_1 and σ_2 respectively $(\sigma_1 > \sigma_2)$ placed at a distance d apart in vacuum. Find the work done by the electric field in moving a point charge q at distance $a(a < d)$ from S_1 towards S_2 along a line making an angle $\pi/4$ with the normal to the plates.

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33. Explain how electron mobility changes for a good conductor, when (i) the temperature of the conductor is decrased at constant potential difference and (ii) applied potential difference is doubled at constant temperature.

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34. On what factors, does the potential gradient of the potentimeter wire depend?

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35. What are super-conductors? Write their two applications.

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36. Two copper wires with their lengths in the ratio 1 : 2 and resistances in the ratio 1 : 2 are connected (i) in series (ii) in parallel with a battery. What will be the ratio of drift velocities of free electrons in two wires in (i) and (ii) ?

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37. The current through a wire depends on time as $i = i_0 + at$ where $i_0 = 4A$ and $a = 2As^{-1}$. Find the charge crossing a section of wire in 10 seconds.

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38. In the arrangement of resistors shown, what fraction of current I will pass through 5Ω

resistor ?

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39. A 100W and a 200 W domestic bulbs joined in parallel are connected to the mains. Which bulb will glow more brightly ? Justify.

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40. A battery has an emf of 12V and an internal resistance of 2Ω. Calculate the potential difference between the terminal of cell if (a) current is drawn from the battery (b) battery is charged by an external source.

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41. In a potentiometer arrangment, a cell of emf 1.25 V gives a balance point at 35.0 cm length of the wire. If the cell is replaced by

another cell and the balance point shifts to 63.0 cm`, what is the emf of the second cell ?

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42. In a meter bridge, the balance point is found to be 39.5 cm from end A. The known resistance Y is 12.5Ω. Determine unknown resistance X.

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43. A meterbridge is in balance condition. Now if galvanometer and cell are interchanged, the galvanometer shows no deflection. Give reason.

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44. If the emf of the driving cell be decreased, what will be effect on the position of zero deflection in a potentiometer ? Explain .

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45. Why should the area of cross-section of the meter-bridge wire be uniform ? Explian

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46. Given any two limitations of Ohm's law.

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47. Which one of the two, an ammeter or a milliammeter, has a higher resistance and

why?

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48. Name two factors on which the resistivity of a given material depends ? A carbon resistor has a value of $62k\Omega$ with a tolerance of 5%. Give the colour code for the resistor.

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49. If the electron drift speed is so small $\left(\sim 10^{-3} m/s\right)$ and the electron's charge is very small, how can we still obtain a large amount of current in a conductor.

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50. A battery of emf 2.0 volts and internal resistance 0.1Ω is being charged with a current of 5.0 A. What is the potential difference between the terminals of the

battery ?

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51. Why should the jockey be not rubbed against potentiometer wire ?

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52. What is meant by the sensitivity of a potentiometer of any given length ?

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53. Five identical cells, each of emf E and internal resistance r, are connected in series to form (a) an open (b) closed circuit. If an ideal voltmeter is connected across three cells, what will be its reading ?

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54. An electron in a hydrogen atom is considered to be revolving around a proton with a velocity $\frac{e^2}{n}$ in a circular orbit of radius $\frac{n^2}{me^2}$. If I is the equivalent current, express it in terms of m, e, n.

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55. In the given circuit, with steady current, calculate the potential drop across the

capacitor in terms of V.

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56. .A cell of emf E and internal resistance r is connected across a variable resistor. Plot a graph showing variation of terminal voltage V of cell versus the current.

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57. Winding of rheostat wire are quite close to each other why do not they get short circuted ?

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58. Why is it necessary to obtain the balance point in the middle of bridge wire ? Explain.

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59. What are the possible cause of one side deflection in Galvanometer while performing potentiometer experiment ?

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Short Answer Questions 3 Marks

1. Calculate the electrostatic potential energy for a system of three point charges q placed at

the corners of an equilateral triangle of side ‘a’.

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2. Using Gauss’s theorem in electrostatics, deduce an expression for electric field intensity due to a charged spherical shell at a point (i) inside (ii) on its surface (iii) outside it. Graphically show the variation of electric field intensity with distance from the centre of shell.

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3. Three capacitors are connected first in series and then in parallel. Find the equivalent capacitance for each type of combination

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4. A charge Q is distributed over two concentric hollow spheres of radii r and $R(>r)$ such that the surface charge

densities are equal. Find the potential at the common centre.

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5. Derive an expression for energy density of a parallel plate capacitor.

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6. You are given an air filled parallel plate capacitor. Two slabs of dielectric constants

K_1 and K_2 having been filled in between the two plates of the capacitor as shown in Fig. What will be the capacitance of the capacitor of initial area was A distance between plates d ?

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7. In the figure shown, calculate the total flux of the electrostatic field through the sphere S_1 and S_2 The wire AB shown of length l has

a liner charge density λ given $\lambda = kx$ where x is the distance measured along the wire from end A.

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8. A conducting slab of thickness 't' is introduced between the plates of a parallel plate capacitor, separated by a distance d $(t < d)$. Derive an expression for the

capacitance of the capacitor. What will be its capacitance when t = d ?

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9. If a dielectric slab is introduced between the plates of a parallel plate capacitor after the battery is disconnected, then how do the following quantities change.

(i) Charge

(ii) Potential

(iii) Capacitance (iv) Energy.

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

(i) Isolated point charge

(ii) Uniform electric field

(iii) Dipole If charge Q is given to a parallel plate capacitor and E is the electric field between the plates of the capacitor the force on each plate is 1/2 QE and if charge Q is placed between the plates experiences a force equal to QE. Give reason to explain the above.

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12. Two metal spheres A and B of radius r and 2r whose centres are separated by a distance of 6r are given charge Q, are at potential V_1 and V_2. Find theratio of V_1/V_2 . These spheres are connected to each other with the help of a connecting wire keeping the separation unchanged, what is the amount of charge that will flow through the wire ?

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13. Define specific resistance. Write its SI unit. Derive an expression for resistivity of a wire in terms of its material's parameters, number density of free electrons and relaxation time

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14. A potential difference V is applied across a conductor of length L and diameter D. How are the electric field E and the resistance R of the

conductor affected when (i) V is halved (ii) L is halved (iii) D is doubled. Justify your answer

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15. Define drift velocity. A conductor of length L is connected to a dc source of emf E. If the length of conductor is tripled by stretching it, keeping E constant, explain how do the following factors would vary in the conductor ?

(i) Drift speed of electrons (ii) Resistance and (iii) Resistivity

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16. Define conductivity of a substance. Give its SI units. How does it vary with temperature for (i) Copper (ii) Silicon ?

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17. Two cells of emf E_1 and E_2 having internal resistance r_1 and r_2 are connected in parallel. Calculate Eeq and req for the combination.

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18. Electron drift speed is estimated to be only a few mm/s for currents in the range of few amperes ? How then is current established almost the instant a circuit is closed.

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19. Give three differences between e.m.f. and terminal potential difference of a cell.

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20. Define the terms resistivity and conductivity and state their S. I. units. Draw a graph showing the variation of resistivity with temperature for a typical semiconductor.

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21. The current flowing through a conductor is 2 mA at 50V and 3 mA at 60V. Is it an ohmic or nonohmic conductor ?

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22. Nichrome and copper wires of same length and area of cross-section are connected in sereis, current is passed through them. Why does the nichrome wire get heated first ?

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23. Under what is the heat produced in an electric circuit: (i) directly proportional (ii) inversely proportional to the resistance of the circuit ?

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Long Answer Questions

1. Derive an expression for the strength of electric field intensity at a point on the axis of

a uniformly charged circular coil of radius R carrying charge Q.

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2. 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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3. Is current density a vector or a scalar quantity ? Deduce the relation between current density and potential difference across a current carrying conductor of length l, area of cross-section A, and number density of free electrons n. How does the current density, in a conductor vary with (a) increases in potential gradient ? (b) increase in temperature? (c) increase in length? (d) increase in area of cross-section? (Assume that the other factors remain constant in each case).

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4. Write any four important results regarding electro statics of conductors.

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5. Derive an expression for drift velocity of electrons in a conductor. Hence deduce ohm's law.

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6. Explain how does the conductivity of a :

(i) Metallic conductor

(ii) Semi conductor and

(iii) Insulator varies with the rise of temperature.

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Numericals

1. What should be the position of charge $q = 5\mu C$ for it to be in equilibrium on the line joining two charges $q_1 = -4\mu C$ and $q_2 = 16\mu C$ separated by 9 cm. Will the position change for any other value of charge q ? (9 cm from - 4 μC)

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2. Two point charges 4e and e each, at a separation r in air, exert force of magnitude F.

They are immersed in a medium of dielectric constant 16. What should be the separation between the charges so that the force between them remains unchanged.

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3. Two capacitors of capacitance $10\mu F$ and $20\mu F$ are connected in series with a 6 V battery. If E is the energy stored in $20\mu F$ capacitor what will be the total energy supplied by the battery in terms of E.

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4. Two point charges $6\mu C$ and $2\mu C$ are separated by 3 cm in free space. Calculate the work done in separating them to infinity.

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5. ABC is an equilateral triangle of side 10 cm. D is the mid point of BC charge 100 μC, $-100\mu C$ and $75\mu C$ are placed at B, C and D respectively. What is the force

experienced by a $1\mu C$ positive charge placed at A ?

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6. A point charge of $2\mu C$ is kept fixed at the origin. Another point charge of $4\mu C$ is brought from a far point to a distance of 50cm from origin. (a) Calculate the electrostatic potential energy of the two charge system. Another charge of $11\mu C$ is brought to a point

100 cm from each of the two charges. What is the work done ?

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7. A $5MeV\alpha$ particle is projected towards a stationary nucleus of atomic number 40. Calculate distance of closest approach.

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8. To what potential must a insulated sphere of radius 10 cm be charged so that the surface density of charge is equal of $1\mu C/m^2$.

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9. 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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10. A point charge developes an electric field of 40 N/C and a potential difference of 10 J/C at a point. Calculate the magnitude of the charge and the distance from the point charge.

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11. Figure shows three circuits, each consisting of a switch and two capacitors initially charged as indicated. After the switch has been closed, in which circuit (if any) will the charges on the left hand capacitor (i) increase (ii) decrease (iii) remain same ?

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12. For what value of C does the equivalent capacitance between A and B is $1\mu F$ in the given circuit.

All capacitance given in micro farad.

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13. A pendulum bob of mass 80 mg and carrying charge of $3 \times 10^{-8} C$ is placed in an horizontal electric field. It comes to

equilibrium position at an angle of 37° with the vertical. Calculate the intensity of electric field. (g = $10m/s^2$)

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14. Eight chraged water drops, each with a radius of $1mm$ and a charge of $10^{10}C$, coalesce to from a single drop. The potential of the big is

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15. What potential difference must be applied to produce an electric field that can accelerate an electron to 1/10 of velocity of light.

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16. A $10\mu F$ capacitor can withstand a maximum voltage of 100 V across it,whereas another $20\mu F$ capacitor can withstand a maximum voltage of only 25 V. What is the maximum voltage that can be put across their series combination ?

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17. Three concentric spherical metallic shells A, B and C of radii a, b and c (a lt b ltc) have surface charge densities σ, $-\sigma$ and σ respectively.

`(i) Find the potential of the three shells A, B and C.

(ii) If the shells A and C are at the same potential, obtain the relation between the radii a, b and c.

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18. Four point charges are placed at the corners of the square of edge a as shown in the figure. Find the work done in disassembling the system of charges.

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19. Find the potential at A and C in the following circuit :

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20. Fig. shows two parallel plate capacitors X and Y having same area of plates and same separation between them : X has air while Y has dielectric of constant 4 as medium between plates

(a) calculate capacitance of each capacitor, if equivalent capacitance of combination is $4\mu F$

(b) calculate potential difference between plate X and Y (c) what is the ratio of electrostatic energy stored in X & Y.

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21.

In the following arrangement of capacitors, the energy stored in the $6\mu F$ capacitor is E.

Find :

(i) Energy stored in $12\mu F$ capacitors.

(ii) Energy stored in $3\mu F$ capacitor.

(iii) Total energy drawn from the battery.

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22. The charge passing through a conductor in a function of time and given as $q = 2t^2 - 4t + 3$ coulomb. Calculate (i) current though the conductor (ii) potential difference across it at $t = 4$ second. Given resistance of conductor is 4 ohm.

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23. The resistance of a platinum wire at a point 0° C is 5.00 ohm and its resistance at steam point is 5.40 Ω. When the wire is immersed in a hot oil bath, the resistance becomes 5.80Ω. Calculate the temperature of the oil bath and temperature coefficient of resistance of platinum.

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24. Three identical cells, each of emf 2V and internal resistance 0.2 ohm, are connected in series to an external resistor of 7.4 ohm. Calculate the current in the circuit and the terminal potential difference across an equivalent.

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25. Calculate the equivalent resistance and current shown by the ammeter in the circuit

diagram given.

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26. A storage battery of emf 12V and internal resistance of 1.5Ω is being charged by a 12 V supply. How much resistance is to be put in series for charging the battery safely, be maintaining a constant charging current of 6 A.

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27. Three cells are connected in parallel, with their like poles connected together, with wires of negligible resistance. If the emf of the cell are 2V, 1V and 4V and if their internal resistance are $4\Omega, 3\Omega$ and 2Ω respectively, find the current through each cell.

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28. A 16 ohm resistance wire is bent to form a square. A source of emf 9 volt is connected

across one of its sides. Calculate the potential difference across any one of its diagonals.

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29. A length of uniform 'heating wire' made of nichrome has a resistance 72 Ω. At what rate is the energy dissipated if a potential difference of 120V is applied across (a) full length of wire (b) half the length of wire (wire is cut into two). Why is it not advisable to use the half length of wire ?

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30. With a certain unknown resistance X in the left gap and a resistance of 8Ω in the right gap, null point is obtained on the metre bridge wire. On putting another 8Ω in parallel with 8Ω resistance in the right gap, the null point is found to shift by 15 cm. Find the value of X from these observations.

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31. Figure show a potentiometer circuit for comparison of two resistances. The balance point with a standard resistance R = 10Ω is found to be 160 cm. While that with the unknown resistance X is 134.4 cm. Determine the value of X.

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32. In a potentiometer, a standard cell of emf 5V of negligible internal resistance maintains a steady current through Potentiometer wire of length 5m. Two primary cells of emf E_1 and E_2 are joined in series with (i) same polarity (ii) opposite polarity. The balancing point are found at length 350 cm and 50 cm in two cases respectively.

(i) Draw necessary circuit diagram.

(ii) Find the value of emf E_1 and E_2 of the two cells (if $E_1 > E_2$)

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33. Potential difference across terminals of a cell are measured (in volt) against different current (in ampere) flowing through the cell. A graph was drawn which was a straight line ABC. Using the data given in the graph. Determine (i) the emf. (ii) The internal resistance of the cell.

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34. Four cells each of internal resistance 0.8Ω and emf 1.4 V, d are connected (i) in series (ii) in parallel. The terminals of the battery are joined to the lamp of resistance 10Ω. Find the current through the lamp and each cell in both the cases.

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35. In the figure, an ammeter A and a resistor of resistance $R = 4\Omega$ have been connected to the terminals of the source to form a

complete circuit. The emf of the source is 12V having an internal resistance of 2Ω. Calculate voltmeter and ammeter reading.

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36. In the circuit shown, the reading of voltmeter is 20V. Calculate resistance of voltmeter. What will be the reading of voltmeter if this is put across 200Ω resistance

?

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37. (i) Calculate Equivalent Resistance of the given electrical network b/w points A and B.

(ii) Also calculate the current through CD & ACB if a 10V d.c. source is connected b/w points A and B and the value of R = 2Ω

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38. A potentiometer wire AB of length 1m is connected to a driver cell of emf 3V as shown in figure. When a cell of emf 1.5V is used in the secondary circuit, the balance point is found to be 60 cm. On replacing this cell by a cell of unknown emf, the balance point shifts to 80 cm. :

(i) Calculate unknown emf of ε' the cell.

(ii) Explain with reason, whether the circuit works if the driver cell is replaced with another

a cell of emf 1V.

(iii) Does the high resistance R, used in the secondary circuit affect the balance point ? Justify your answer.

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39. A battery of emf 10 v and internal resistane 3Ω is connected to a resistor. If the current in the circuit is 0.5 A, what is the resistane of the resistors ? What is the terminal voltage of the battery when the circuit is closed ?

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40. A network of resistance is connected to a 16V battery with internal resistance of 1Ω as shown in Fig. on next page.

(i) Compute the equivalent resistance of the network.

(ii) Obtain the current in each resistor.

(iii) Obtain the voltage drop $V_{AB}, V_{BC} \& V_{CD}$.

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41. The number density of free electrons in a copper conductor is estimated at $8.5 \times 10^{28} m^{-3}$. How long does an electron take to drift from one end of a wire 3.0 m long to its other end? The area of cross-section of the wire is $2.0 \times 10^{-6} m^2$ and it is carrying a current of 3.0A.

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42. A voltmeter of resistance 400Ω is used to measure the potential difference across the

100Ω resistor in the circuit shown in figure. What will be the reading of voltmeter.

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43. Find magnitude of current supplied by battery. Also find potential difference between points P and Q in the given fig.

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44. A copper wire of length 3 m and radius r is nickel plated till its radius becomes 2r. What would be the effective resistance of the wire, if specific resistance of copper and nickel are ρ_c and ρ_n respectively.

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45. Given two resistors X and Y whose resistances are to be determined using an ammeter of resistance 0.5Ω and a voltmeter of resistance $20k\Omega$. It is known that X is in the

range of a few ohms, while Y is in the range of several thousand ohm. In each case, which of the two connection shown should be chosen for resistance measurement ?

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46. When resistance of 2Ω is connected across the terminals of a battery, the current is 0.5A. When the resistance across the terminal is 5Ω, the current is 0.25A. (i) Determine the emf of

the battery (ii) What will be current drawn from the cell when it is short circuited.

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47. A part of a circuit in steady state, along with the currents flowing in the branches and the resistances, is shown in the figure. Calculate energy stored in the capacitor of $4\mu F$ capacitance.

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48. With two resistance R_1 and $R_2(>R_1)$ in the two gaps of a metre bridge the balance was found to be 1/3 m from the zero end. When a 6Ωresistance is connected in series with the smaller of the two resistance, the point is shifted to 2/3 m from the same end, then R_1 and R_2 are

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49. A voltmeter with resistance 500Ω is used to measure the emf of a cell of internal resistance 4Ω. The percentage error in the reading of the voltmeter will be

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