



PHYSICS

BOOKS - JEEVITH PUBLICATIONS

PHYSICS (KANNADA ENGLISH)

**ELECTROSTATIC POTENTIAL AND
CAPACITANCE**

One Mark Questions With Answers

1. Define potential energy of charge at a point.



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2. Represent work done in bringing a test charge from one point to another in an electric field with the help of a mathematical expression.



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3. Define potential energy difference between any two points.





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4. What is the reference potential energy taken at infinity ?



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5. Give an expression for the electric potential at a point due to a point charge.



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6. Give an expression for P.E. between any two points due to a given point charge.



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7. How does electric potential depend on 'r' and θ due to an electric dipole ?



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8. Represent $p \cos \theta$ ($|p| =$ dipolemoment $=p$) vectorally



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9. Write the expression for electric field at a point on the axis of a short electric dipole.



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10. Give the expression for electric potential at a point, due to a system of discrete point charges.



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11. What is angle between the electric field at a point and the equipotential surface passing through the point ?



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12. What is the shape of equipotential surface around the point charge ?



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13. What does the term $E = - \frac{dV}{dx}$ signify ?



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14. Express electrostatic potential energy in terms of electric potential.



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15. Give the expression for the potential energy of a dipole in an external electric field with the help of a neat diagram.



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16. Electric potential on the surface of a spherical shell is 1000 V. What will be the electric potential at any point inside the shell ?



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17. What is the electric field inside a conductor ?



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18. What is the direction of electric field intensity on a Gaussain surface around a point charge ?



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19. What is the electric field inside a conductor ?



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20. What is the effect of induced dipole moment on the external electric field ?



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21. Define electric polarization.



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22. What are linear isotropic dielectrics ?



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23. Define capacitance of a conductor.



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24. What is meant by an electrical capacitor ?



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25. How does electrical capacitance depend on the area of the plate ?



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26. How does electrical capacitance of a parallel plate capacitor depend on the distance between the plates ?



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27. What is the net electric field intensity outside the plates of a capacitor ?



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28. What is the net electric field intensity in between the oppositely charged plates capacitor ?



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29. Compare the capacitance of a parallel plate capacitor with and without the dielectric medium.



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30. Write the equivalent capacitance of a number of identical capacitors connected in series.



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31. Write the equivalent capacitance of a number of identical capacitors connected in parallel.



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32. Give the expression for equivalent capacitance of a number of capacitors of different capacitances in series combination.



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33. Give the expression for equivalent capacitance of a number of capacitors of different capacitances in parallel combination.



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34. Give different expressions to find the energy stores in a capacitor.



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35. What is the amount of energy stored per unit volume in a capacitor called ?



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36. What is Van de Graaff generator?



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37. What is the value of electric potential due to a charge at its own location ?



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38. What is the amount of work done to move a point charge from one point to another on an equipotential surface ?



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39. What is angle between the electric field at a point and the equipotential surface passing through the point ?



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40. What is a neutral point in a combined electric field?



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41. A closed surface has an electric dipole. What will be the flux passing through the surface?



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42. What will be electric potential at any point on the perpendicular bisector of an electric dipole?



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43. What is the condition for a system of charges to be at equilibrium ?



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44. Write the expression for work done by the force acting on an electric dipole to deflect it through a certain angle with respect to the uniform electric field.



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45. Define capacitance of a conductor.



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46. Compare the electrical capacitance of a spherical capacitor with and without the presence of dielectric medium.



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47. Define one farad of electrical capacitance



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48. Define SIU of electric charge.



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49. What is the effect of temperature on the dielectric constant of a dielectrical medium ?



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50. Name the type of capacitors that are used as back up voltage sources for computers.



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51. Define one farad of electrical capacitance



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52. What happens to the electrical capacitance of a capacitor, when a dielectric medium is

introduced?



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53. What is the effect of dielectric medium on the electric potential of a capacitor ?



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54. What happens to the electrical capacitance of a conductor when it is brought closer to an earthed conductor?



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55. What is the direction of induced electric field in a dielectric medium ?



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56. Write the unit of energy density ?



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57. What is the a.c. resistance of the capacitor called ?



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58. What is the value of capacitive reactance of capacitor for a D.C. Voltage ?



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59. Define dielectric constant.



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60. Give an example for a polar molecule.



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61. Give an example for a non-polar molecule.



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62. What is the magnitude of electric potential of the Earth ?



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Two Marks Questions With Answers

1. Define potential energy difference between any two points.



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Three Marks Question With Answer

1. Draw a neat labelled diagram of van de graaff generator. Give the principle of its working.



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2. Give any three applications of Van der Graaff generator.



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3. Derive a relation between electric field and potential



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4. Give the expression for the potential energy of a dipole in an external electric field with the help of a neat diagram.



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1. How is the electric potential at a point due to a given charge measured? Obtain an expression for the electric potential at a point due to an isolated point charge.



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2. Derive an expression for the electric potential energy of a system of two point charges in the absence of an external electric field.



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3. Derive an expression for electric potential energy of a system of charges in an electric field.



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Numericals With Solutions

1. A spherical hollow conductor is charged to -250V . If the radius of the conductor is 0.15m , then calculate

(i) Charge on the conductor.

(ii) Electric field intensity on the surface

(iii) Electric field intensity at the centre.

(iv) Electric potential difference between A and B at distances of 0.20 m & 0.25m from the centre respectively.



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2. Three point charges $+10nC$, $-15nC$ and $+20nC$ are placed at the corners A,B and C respectively of a square, ABCD of side 0.1m. Calculate the amount of work done to transfer $-100nC$ from the point 'D' to the point 'O'.



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3. Calculate the amount of work done by a uniform electric field of 200 Vm^{-1} on an electric dipole of length 0.05m and charge

40nC in order that the angle between the axis and the field is equal to 180° , what is the amount of torque required to maintain that position?



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4. Calculate the number of electrons to be transferred from a material body in order to charge it to +5.5 nC.



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5. The effective capacitances of two condensers are $3\mu F$ and $16\mu F$, when they are connected in series and parallel respectively. Compute the capacitance of each condenser.



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6. A parallel plate capacitor consists of two circular plates of radius 0.05 m each, which are separated by a distance of $1.2 \times 10^{-3} m$. Calculate its capacitance. If the difference

between the two plates is reduced to half the initial value, then calculate its capacitance.



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7. When two capacitors are connected in series across a 2kV line, the energy stored in the system is $5\left(\frac{5}{11}\right)$ J and when connected in parallel to the same voltage line, the energy stored in the system is (22)J. find the capacitances of the individual capacitors.



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8. Two capacitors $3\mu F$ and $5\mu F$ are charged to 18V and 25V respectively. These are then connected in series. Calculate the net voltage and net charge. Find the loss of energy after connecting them in series.



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9. Two capacitors $1\mu F$ and $3\mu F$ are charged individually to voltages of 100V and 200V respectively. These are then connected in a

parallel combination. Find the loss in the energy stored in the capacitors.



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10. Three concentric metallic spheres A, B and C of radii 1m, 2m and 3m respectively are charged to 0.56 nC, 2.12 nC and 5.0 nC. Calculate the potentials of the spheres.



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11. A parallel capacitor collects a charge of $3\mu\text{C}$ when connected to a 1.5 V battery with air as dielectric. On replacing the air with a dielectric material the capacitor collects $9\mu\text{C}$ of charge. Find the dielectric constant of the material and also the energy stored in it with the material as dielectric.



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12. You are provided with 3 capacitors, each capacitance $2\mu F$. In how many possible ways can you connect these capacitors. Calculate the capacitance of each of the combinations.



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13. Two charges $5 \times 10^{-8} C$ and $-3 \times 10^{-8} C$ are located 0.16 m apart. At what point(s) on the line

joining the two charges is the electric potential zero?



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14. A spherical conductor of radius 0.12 m has a charge of $1.6 \times 10^{-7} \text{ C}$ distributed uniformly on its surface, what is the electric potential?

(a) inside the sphere?

(b) Just outside the sphere?

(c) At a point 0.18 m from the centre of the sphere?



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15. A parallel plate capacitor with only air between the plates has a capacitance of 8pF . 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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16. Three capacitors each of capacitance $9\mu\text{F}$ are connected in series.

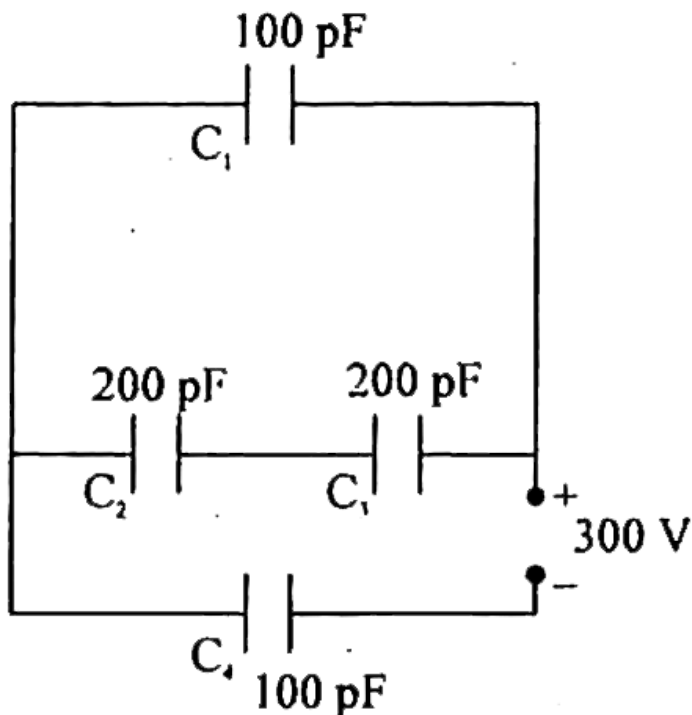
(a) What is the total capacitance of the combination?

(b) What is the potential difference across each capacitor if the combination is connected to a 120 V supply?



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17. Obtain the equivalent capacitance of the network in the figure given below. For a 300V supply, determine the charge and voltage across each capacitor.



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18. A parallel plate capacitor is to be designed with a voltage rating 1kV, using a material of dielectric constant 3 and dielectric strength about 10^7Vm^{-1} . 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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19. A molecule of a substance has a permanent electric moment of magnitude $10^{-29} Cm$. A mole of this substance is polarised by applying a strong electrostatic 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 dipoles along the new direction of the field. For simplicity, assume 100% polarisation of the sample.



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20. The area of a parallel plate capacitor is $6 \times 10^{-3} m^2$. The distance of separation of two plates is $3 \times 10^{-3} m$. Calculate the capacitance of the above capacitor. If the capacitor is charged to potential of 100 V then calculate the charge on each plate.



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