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UDUPI

CET25P2 ELECTROSTATIC POTENTIAL AND CAPACITANCE

Class 12 - Physics

Time Allowed: 1 hour and 30 minutes **Maximum Marks: 75**

1. Capacitance of a parallel plate capacitor can be increased by **[1]**

   a) decreasing the area of plates.
   b) decreasing the distance between the plates.
   c) increasing the thickness of the plates.
   d) increasing the distance between the plates.

2. The amount of charge a capacitor can store when a potential diffrence of 1V is applied across it is called its **[1]**

   a) resistance
   b) capacitance
   c) reactance
   d) inductance

3. The potential on the hollow sphere of radius 1 m is 1000 V, then the potential at $\frac{1}{4}$ m from the centre of the sphere is: **[1]**

   a) Zero V
   b) 500 V
   c) 1000 V
   d) 250 V

4. If an electron is brought towards another electron, the electric potential energy of the system **[1]**

   a) decreases
   b) increases
   c) remains the same
   d) becomes zero

5. If the potential of a capacitor having capacity 8 pF is increased from 10 V to 20 V, then increase in its energy will be: **[1]**

   a) 12×10^{-4} J
   b) 4×10^{-6} J
   c) 12×10^{-6} J
   d) 4×10^{-4} J

6. At point A, there is an electric field of 500 V/m and a potential difference of 3000 V. The distance between the point charge and A is: **[1]**

   a) 6m
   b) 144m
   c) 12m
   d) 36m

7. A $2\mu F$ capacitor C_1 is charged to a voltage 100 V and a 4 μF capacitor C_2 is charged to a voltage 50 V. The capacitors are then connected in parallel. What is the loss of energy due to parallel connection? **[1]**

   a) 1.7×10^{-2}J
   b) 0.17×10^{-2}J
   c) 1.7 J
   d) 1.7×10^{-4}J

8. The dimension of $\frac{1}{2}\varepsilon_0 E^2$ where ε_0 is the permittivity of free space and E is the electric field, is **[1]**

   a) $ML^{-1}T^{-2}$
   b) MLT^{-1}
   c)
   d)

ML^2T^{-2} ML^2T^{-1}

9. Electric potential V at any point x, y, z in space is given by $V = 6z^2$. The value of the electric field at the point (2, -1, 3) is **[1]**

a) -36 b) 24

c) -12 d) 12

10. If a dielectric plate of thickness t is placed between the plates of a parallel plate capacitor of plate distance d, the capacitance becomes half of the original value. The dielectric constant of the plate will be **[1]**

a) $\frac{2t}{2d+t}$ b) $\frac{t}{d-t}$

c) $\frac{t}{d+t}$ d) $\frac{2t}{2d-t}$

11. Two spherical conductors each of capacity C are charged to potential V and -V. These are then connected by means of a fine wire. The loss of energy is: **[1]**

a) Zero b) $2CV^2$

c) $\frac{1}{2}CV^2$ d) CV^2

12. An electrolytic capacitor is marked 8 μF, 220 V. It can be used in a circuit where the p.d. across the capacitor may be **[1]**

a) 200 V b) 300 V

c) 1000 V d) 500 V

13. The work done in carrying a charge Q once round a circle of radius r with charge q at the centre of the circle is **[1]**

a) $\frac{1}{4\pi\varepsilon_0} \cdot \frac{Q}{r}$ b) $\frac{Q \cdot q}{2r}$

c) $\frac{Q \cdot q}{4\pi\varepsilon_0 r}$ d) zero

14. Two capacitors of capacitances C_1 and C_2 are connected in parallel. If a charge Q is given to the combination, the ratio of the charge on the capacitor C_1 to the charge on C_2 will be **[1]**

a) $\sqrt{\frac{C_1}{C_2}}$ b) $\frac{C_2}{C_1}$

c) $\frac{C_1}{C_2}$ d) $\sqrt{\frac{C_2}{C_1}}$

15. Two capacitors of capacitances 3 μF and 6 μF are charged to a potential of 12 V each. They are now connected to each other, with the positive plate of each joined to the negative plate of the other. The potential difference across each will be **[1]**

a) 3 V b) 4 V

c) 6 V d) zero

16. Can two equipotential surfaces intersect each other? **[1]**

a) Yes b) Only when surfaces intersect at 90^o

c) Sometimes d) No

17. To make a condenser of 16μF, 1000 volts, how many condensers are needed which have written on them "8μF,, 250 volts"? **[1]**

a) 8 b) 32

c) 40 d) 2

18. The work done to move a charge along an equipotential surface from A to B **[1]**

a) is a negative quantity. b) is a positive quantity.

c) cannot be defined. d) is zero.

19. Equipotential surface at a great distance from a collection of charges whose total sum is not zero are approximately **[1]**

a) spheres b) ellipsoids

c) planes d) paraboloids

20. The ratio of charge to potential of a body is known as **[1]**

a) capacitance b) inductance

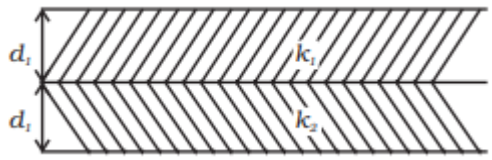
c) conductance d) resistance

21. A parallel plate capacitor is charged by connecting it to a battery. Which of the following will remain constant if the distance between the plates of the capacitor is increased in this situation? **[1]**

a) Energy stored b) Capacitance

c) Electric field d) Potential difference

22. 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 Fig. This arrangement can be thought of as a dielectric slab of thickness d (= d_1+d_2) and effective dielectric constant k. Then k is **[1]**



a) $\frac{k_1d_1+k_2d_2}{d_1+d_2}$ b) $\frac{k_1d_1+k_2d_2}{k_1+k_2}$

c) $\frac{k_1k_2(d_1+d_2)}{(k_1d_1+k_2d_2)}$ d) $\frac{2k_1k_2}{k_1+k_2}$

23. How many 1μF capacitors must be connected in parallel to store a charge of 1C with a potential of 110 V across the capacitors? **[1]**

a) 9090 b) 909

c) 990 d) 900

24. Equal charges are given to two conducting spheres of different radii. The potential will **[1]**

a) be more on the bigger sphere b) be equal on both the spheres

c) be less on the smaller sphere d) depend on the radii of the sphere

25. The action of the dielectric to increase the capacitance is due to **[1]**

a) neutralization of charges b) electric polarization

c) movement of charges to the sides of dielectric d) dipole orienting parallel to the plates

26. A capacitor of capacitance C_1 is charged upto potential V and then connected in parallel to an uncharged **[1]**

capacitor of capacitance C_2. The final potential difference across each capacitor will be:

a) $\left(1+\frac{C_2}{C_1}\right)V$ b) $\left(1-\frac{C_2}{C_1}\right)V$

c) $\frac{C_1V}{C_1+C_2}$ d) $\frac{C_2V}{C_1+C_2}$

27. In a region, the potential is represented by V(x, y, z) = 6x - 8xy - 8y + 6yz, where V is N volts and x, y, z are in metres. The electric force experienced by a charge of 2 coulomb situated at point (1, 1, 1) is: **[1]**

a) $4\sqrt{35}$ N b) $6\sqrt{5}$ N

c) 24 N d) 30 N

28. When a dielectric material is introduced between the plates of a charged condenser, then electric field between the plates: **[1]**

a) decreases b) first increases then remains constant

c) increases d) remains constant

29. The surface charge density (in C/m^2) of the earth is about: **[1]**

a) 10^9 b) -10^9

c) 10^{-9} d) -10^{-9}

30. The effective capacitance of two capacitors of capacitances C_1 and C_2 (with $C_2 > C_1$) connected in parallel is $\frac{25}{6}$ times the effective capacitance when they are connected in series. The ratio $\frac{C_2}{C_1}$ is **[1]**

a) $\frac{25}{6}$ b) $\frac{5}{3}$

c) $\frac{4}{3}$ d) $\frac{3}{2}$

31. A parallel plate capacitor of value $1.77\mu F$ is to be designed using a dielectric material (dielectric constant 200, breakdown strength of $3\times10^{-6}Vm^{-1}$). In order to make such a capacitor, which can withstand a potential difference of 20 V across the plates, the separation d between the plates and the area A of the plates should be **[1]**

a) $d = 10^{-5}$ m, $A = 10^{-2}$ m^2 b) $d = 10^{-4}$ m, $A = 10^{-4}$ m^2

c) $d = 10^{-4}$ m, $A = 10^{-5}$ m^2 d) $d = 10^{-6}$ m and $A = 10^{-4}$ m^2

32. Two capacitors of $10\mu F$ and $20\mu F$ are connected in series with a 30 V battery. The charges on the capacitors will be respectively: **[1]**

a) 200 μC, 100μC b) 200μC, 200μC

c) 100 μC, 100μC d) 100 μC, 200 μC

33. A 4 μF capacitor is charged to 400 V. If its plates are joined through a resistance, then heat produced in the resistance is: **[1]**

a) 1.28 J b) 0.32 J

c) 0.64 J d) 0.16 J

34. An uncharged capacitor with a solid dielectric is connected to a similar air capacitor charged to a potential of V_0. If the common potential after sharing of charges becomes V, then the dielectric constant of the dielectric must be: **[1]**

a) $\frac{V}{V_0}$ b) $\frac{V_0}{V}$

c) $\frac{(V_0-V)}{V}$

d) $\frac{(V_0-V)}{V_0}$

35. A capacitor of 20 μF is charged up to 500 V is connected in parallel with another capacitor of 10 μF which is charged up to 200 V. The common potential is: **[1]**

a) 500 V

b) 400 V

c) 300 V

d) 200 V

36. Two points charges of +10 μC and -10 μC are placed at points A and B. If P and Q are the two points lying on the perpendicular bisector of the line AB, then work done in taking a charge of 5 μC from P to Q will be equal to: **[1]**

a) distance between A & B

b) zero and distance between A & B

c) zero

d) distance between P and Q

37. A 40 F capacitor in a defibrillator is charged to 3000 V. The energy stored in the capacitor is sent through the patient during a pulse of duration 2 ms. The power delivered to the patient is **[1]**

a) 90 kW

b) 180 kW

c) 45 kW

d) 360 kW

38. Three capacitors of 2.0, 3.0 and 6.0 μF are connected in series to a 10 V source. The charge on the 3.0 μF: **[1]**

a) 5μC

b) 10μC

c) 12μC

d) 15μC

39. For a charged conductor of arbitrary shape, inside the conductor **[1]**

a) V= 0 and $\mathrm{E} \neq 0$

b) E and V are zero

c) E = 0, but V is same as on the surface and non-zero

d) E is non-uniform but V is zero everywhere

40. Work done in moving a unit positive charge through a distance of x metre on an equipotential surface is: **[1]**

a) $\frac{1}{x}$ joule

b) zero

c) x^2 joule

d) x joule

41. Top of the stratosphere has an electric field E (in units of V/m) nearly equal to: **[1]**

a) 0

b) 10

c) 100

d) 1000

42. With the rise in temperature, the dielectric constant K of a liquid: **[1]**

a) increases

b) decreases

c) changes erratically

d) remains unchanged

43. The potential at a point, due to a positive charge of 100 μC at a distance of 9 m, is **[1]**

a) 10^5 V

b) 10^7 V

c) 10^4 V

d) 10^6 V

44. If P.D. across a capacitor is changed from 15 V to 30 V, work done is W. What will be the work done when P.D. is changed from 30 V to 60 V? **[1]**

a) 3W

b) 2W

c) W

d) 4 W

45. The electric potential at a point (x, y, z) is given by V = -x^2y - xz^3 + 4. The electric field $\vec{E}$ at that point is: **[1]**

a) $\vec{E} = \hat{i}2xy + \hat{j}\left(x^2 + y^2\right) + \hat{k}\left(3xz - y^2\right)$

b) $\vec{E} = \hat{i}z^3 + \hat{j}xyz + \hat{k}z^2$

c) $\vec{E} = \hat{i}\left(2xy - z^3\right) + \hat{j}xu^2 + \hat{k}3z^2x$

d) $\vec{E} = \hat{i}\left(2xy + z^3\right) + \hat{j}x^2 + \hat{k}3xz^2$

46. A proton is about 1840 times heavier than an electron. When it is accelerated by a potential difference of 1 kV, its kinetic energy will be: **[1]**

a) 920 keV

b) $\frac{1}{1840}$keV

c) 1 keV

d) 1840 keV

47. Two identical capacitors, have the same capacitance C. One of them is charged to potential V_1 and the other to V_2. The negative ends of the capacitors are connected together. When the positive ends are also connected, the decrease in energy of the combined system is - **[1]**

a) $\frac{1}{4}C(V_1 - V_2)^2$

b) $\frac{1}{4}C\left({V_1}^2 + {V_2}^2\right)$

c) $\frac{1}{4}C\left({V_1}^2 - {V_2}^2\right)$

d) $\frac{1}{4}C(V_1 + V_2)^2$

48. n identical capacitors joined in parallel are changed to a common potential V. The battery is disconnected. Now, the capacitors are separated and joined in series. For the new combination: **[1]**

a) energy and potential difference both will remain unchanged

b) energy will become n times, potential difference will remain V.

c) energy will remain same, potential difference will become nV

d) energy and potential both will become n times

49. The capacity of an isolated conducting sphere of radius R is proportional to: **[1]**

a) R^2

b) $\frac{1}{R}$

c) R

d) $\frac{1}{R^2}$

50. A point charge q_0 is moving along a circular path of radius a, with a point charge -Q at the centre of the circle. The kinetic energy of q_0 is **[1]**

a) $\frac{q_0 Q}{4\pi\epsilon_0 a}$

b) $\frac{q_0 Q}{4\pi\epsilon_0 a^2}$

c) $\frac{q_0 Q}{8\pi\epsilon_0 a}$

d) $\frac{q_0 Q}{8\pi\epsilon_0 a^2}$

51. The plates of a parallel plate capacitor are 10 cm apart and have area equal to $2m^2$. If the charge on each plate is $8.85 \times 10^{-10} C$, the electric field at a point **[1]**

a) between the plates will be zero

b) outside the plates will be zero

c) between the plates will be $25 NC^{-1}$

d) between the plates will change from point to point

52. The capacity of a pure capacitor is 1 farad. In DC circuit, its effective resistance will be **[1]**

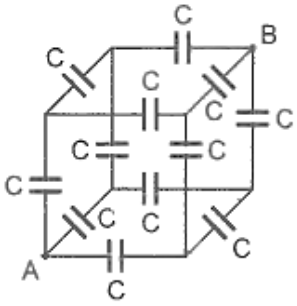
a) infinite

b) zero

c) 1 ohm

d) 2 ohm

53. The equivalent capacity between points A and B shown in the figure is: **[1]**



a) $(\frac{5}{6})C$

b) C

c) 30 C

d) $(\frac{6}{5})C$

54. The equivalent capacity of two capacitors in series is 3 μF and in parallel is 16 μF. Their individual capacities are **[1]**

a) 12, 2

b) 12, 4

c) 8, 8

d) 10, 16

55. The mean free path of electrons in a metal is 4×10^{-8} m. The electric field which can give on an average 2 eV energy to an electron in the metal will be in units of V/m: **[1]**

a) 8×10^{7}

b) 5×10^{11}

c) 5×10^{7}

d) 8×10^{-11}

56. A charged particle is placed between the two plates of a charged parallel plate capacitor. It experiences a force F. If one plate is removed, then the force on the particle will be **[1]**

a) 2F

b) $\frac{F}{2}$

c) Zero

d) F

57. A parallel plate capacitor of capacity 100 μF is charged by a battery of 50 volts. The battery remains connected and if the plates of the capacitor are brought closer so that the distance between them becomes half the original distance, the additional energy given by the battery to the capacitor in joules is: **[1]**

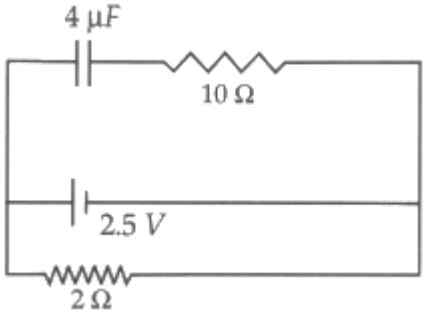
a) 1.25×10^{-3}

b) 0.125×10^{-3}

c) 12.5×10^{-3}

d) 125×10^{-3}

58. A capacitor of 4 μF is connected as shown in the circuit Figure. The internal resistance of the battery is 0.5 Ω. The amount of charge on the capacitor plates will be : **[1]**



a) 8μC

b) 16μC

c) 4μC

d) 0

59. In a parallel plate capacitor, the distance between the plates is d and potential difference across plates is V. **[1]**

Energy stored per unit volume between the plates of capacitor is

a) $\frac{1}{2}\varepsilon_0\frac{V^2}{d^2}$

b) $\frac{1}{2}\frac{V^2}{\varepsilon_0 d^2}$

c) $\frac{1}{2}\varepsilon_0\frac{V^2}{d}$

d) $\frac{Q^2}{2V^2}$

60. The capacitors, each of $4\mu F$ are to be connected in such a way that the effective capacitance of the combination is $6\mu F$. This can be achieved by connecting **[1]**

a) Two of them connected in parallel and the combination in series to the third.

b) Two of them connected in series and the combination in parallel to the third.

c) All three in series

d) All three in parallel

61. Electric potential inside a conducting sphere **[1]**

a) increases from centre to surface.

b) remains constant.

c) decreases from centre to surface.

d) is zero.

62. If we carry a charge once around an equipotential path, then work done by the charge is **[1]**

a) infinity

b) negative

c) zero

d) positive

63. A capacitor is charged by connecting a battery across its plates. It stores energy U. Now the battery is disconnected and another identical capacitor is connected across it. Then the energy stored by both capacitors of the system will be: **[1]**

a) $\frac{U}{4}$

b) U

c) $\frac{3U}{2}$

d) $\frac{U}{2}$

64. If a unit positive charge is taken from one point to another over an equipotential surface, then: **[1]**

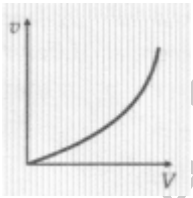
a) no work is done

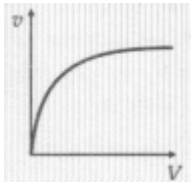
b) work is done on the charge

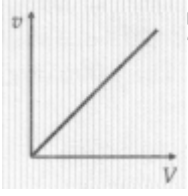
c) work done is constant

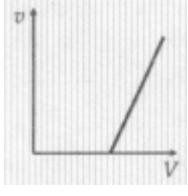
d) work is done by the charge

65. The velocity v acquired by an electron starting from rest and moving through potential difference V is shown by which of the following graphs? **[1]**

a) 

b) 

c) 

d) 

66. The capacitance of a parallel plate capacitor is 5 μF . When a glass slab of thickness equal to the separation between the plates is introduced between the plates, the potential difference reduces to $\frac{1}{8}$ of the original value. The dielectric constant of glass is **[1]**

a) 8

b) 5

c) 1.6

d) 40

67. The dielectric constant K of an insulator will be - **[1]**

a) 0.4 b) 4

c) - 4 d) 0

68. The energy stored in a capacitor of capacitance C and potential V is given by: **[1]**

a) $\frac{1}{2}C^2V$ b) $\frac{1}{2}\mathrm{CV}$

c) $\frac{1}{2}C^2V^2$ d) $\frac{1}{2}CV^2$

69. A parallel plate capacitor of capacitance C is connected to a battery and is charged to a potential difference V. Another capacitor of capacitance 2C is similarly charged to a potential difference 2V. The charging battery is then disconnected and the capacitors are connected in parallel to each other in such a way that the positive terminal of one is connected to the negative terminal of the other. The final energy of the configuration is - **[1]**

a) $\frac{25}{6}\mathrm{CV}^2$ b) $\frac{3}{2}\mathrm{CV}^2$

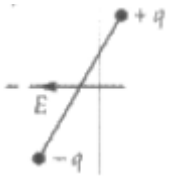
c) $\frac{9}{2}\mathrm{CV}^2$ d) zero

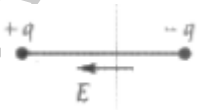
70. A2 μF capacitor is charged to 200 volt and then the battery is disconnected. When it is connected in parallel to another uncharged capacitor, the potential difference between the plates of both is 40 volt. The capacitance of the other capacitor is **[1]**

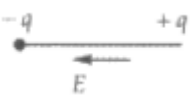
a) $4\mu F$ b) $2\mu F$

c) $8\mu F$ d) $16\mu F$

71. In which of the states shown in the figure, is potential energy of an electric dipole maximum? **[1]**

a) 

b) 

c) 

d) 

72. The capacity of a condenser is 4×10^{-6} farad and its potential is 100 volts. The energy released on discharging it fully will be: **[1]**

a) 0.025 J b) 0.05 J

c) 0.04 J d) 0.02 J

73. 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 the same (total) energy stored in it, as the first combination has. The value of C_2, in terms of C_1, is then: **[1]**

a) $\frac{2C_1}{n_1n_2}$ b) $2\frac{n_2}{n_1}C_1$

c) $16\frac{n_2}{n_1}C_1$ d) $\frac{16C_1}{n_1n_2}$

74. A parallel plate capacitor is charged to V volt by a battery. The battery is disconnected and the separation between the plates is halved. The new potential difference across the capacitor will be **[1]**

a) $\frac{V}{2}$

b) 2V

c) V

d) $\frac{V}{4}$

75. Which of the following is not the property of equipotential surfaces? **[1]**

a) They are concentric spheres for uniform electric fields.

b) They can be imaginary spheres.

c) They do not cross each other.

d) Rate of change of potential with distance on them is zero.