Exam Time : 00:50:00 Hrs

Total Marks : 100

50 x 2 = 100

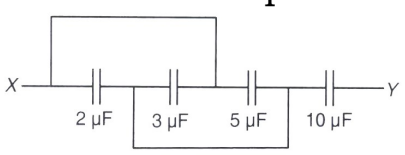
1) Three capacitors each of capacitance 9 pF are connected in series.
(a) What is the total capacitance of the combination?
(b) What is the potential difference across each capacitor, if the combination is connected to a 120 volt supply?

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

3) Two charged conducting spheres of radii a and b are connected to each other by a wire. What is the ratio of electric fields at the surface of the two spheres? Use the result obtained to explain why charge density on the sharp and pointed ends of a conductor is higher than on its flattened portions?

4) Two charges 2 μC and –2 μC are placed at points A and B 6 cm apart.
(a) Identify an equipotential surface of the system.
(b) What is the direction of the electric field at every point on this surface?

5) Four capacitors are connected as shown in the figure given below:
Calculate the equivalent capacitance between the points X and Y.



6) What is the cause of charging?

7) Name any two basic properties of electric charge.

8) What is the value of charge on an electron? Is a charge less than this value possible?

9) Define electric dipole moment. Write its SI unit.

10) In which orientation, a dipole placed in a uniform field is in (i) stable (ii) unstable equilibrium?

11) What is the electrostatic potential due to electric dipole at an equatorial point?

12) A hollow metal sphere of radius 5cm is charged such that potential on its surface is 10 V. What is the potential at the centre of the sphere?

13) Can two equipotential surface intersect each other? Justify your answer.

14) If the radius of the Gaussian surface enclosing a charge q is halved, how does the electric flux through the Gaussian surface change?

15) Two concentric spherical shells of radii R and 2R are given charges Q_1 and Q_2 respectively. The surface charge densities of the outer surfaces are equal. Determine the ratio $Q_1 : Q_2$

16) Why electrostatic field be normal to the surface at every point of a charged conductor?

17) A proton is placed in a uniform electric field directed along a positive X-axis. In which direction will it tend to move?

18) Why should electrostatic field be zero inside a conductor?

19) Two charges of magnitudes - 2Q and + Q are located at points (a, 0) and (4a, 0) respectively. What is the electric flux due to these charges through a sphere of radius 3a with its centre at the origin?

20) why do the electric field lines not form closed loops?

21) Quarks are the building blocks of nucleons and possess fractional electronic charge. Does this discovery violate the principle of quantization of charge?

22) Two insulated charged copper spheres A and B of identical size have charges q_A and q_B , respectively. A third sphere C of the same size but uncharged is brought in contact with the first and then in contact with the second and finally removed from both. What are the new charges on A and B?

23) Is it correct to write the unit of electric dipole moment as mC?

24) If an electric dipole is placed in a uniform electric field, then state whether it always experience a torque or not?

25) Two equal balls having equal positive charge q coulombs are suspended by two insulating string of equal length.what would be the effect on the force when a plastic sheet is inserted between the two?

26) What will be the electric field intensity at the centre of a uniformly charged circular wire of linear charge density?

27) A point charge of 2.0 μC is at the centre of a cubic Gaussian surface 9.0 cm on edge. What is the net electric flux through the surface?

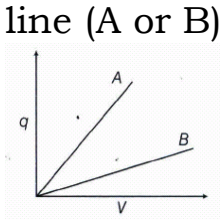
28) plot a graph showing the variation of coulomb's force(F) versus 1 / r^2, where r is the distance between the two charges of each pair of charges(1 μC, 2 μC) and (1μC - 3μC). Interpret the graphs obtained.

29) An uncharged, metallic ball is suspended in the region between two vertical metal plates. If the two plates are charged, one positively and one negatively, then describe the motion of the ball after it is brought into contact with one of the plates.

30) 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.

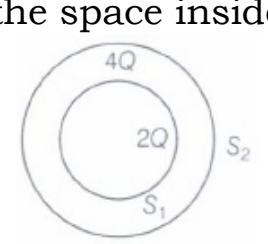
31) Why is the potential inside a hollow spherical charged conductor, constant and has the same value as on its surface?

32) The given graph shows the variation of charge q versus potential difference V for two capacitors C_1 and C_2. Both the capacitors have same plate separation but plate area of C_2 is greater than that C_1 . Which line (A or B) corresponds to C_1 and why?



33) Deduce Coulomb's law from Gauss' law.

34) Consider two hollow concentric spheres, S_1 and S_2 enclosing charges 2Q and 4Q respectively as shown in the figure.
(i) Find out the ratio of the electric flux through them.
(ii) How will the electric flux through the sphere S_1 change, if a medium of dielectric constant ε_r is introduced in the space inside S_1 in place of air? Deduce the necessary expression.

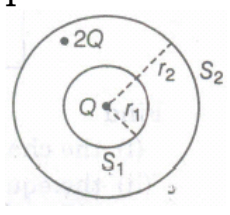


35) A dipole with its charges, -q and +q, located at the points(0, -b,0) and (0, +b, 0) is present in a uniform electric field E. The equipotential surfaces of this field are planes parallel to the YZ- planes
(i) What is the direction of the electric field E?
(ii) How much torque would the dipole experience in this field?

36) Two dipoles, made from charges $\pm$q and $\pm$Q respectively, have equal dipole moments. Give the
(i) ratio between the 'seperations' of these two pairs of charges,
(ii) angle between the dipole axis of these two dipoles.

37) Two closely spaced equipotential surfaces A and B with potentials V and V +δV, (where δ V is the charge in V), are kept δl distance apart as shown in the figure. Deduce the relation between the electric field and the potential gradient between them. Write the two important conclusions concerning the relation between the electric field and electric potentials.

38) A sphere S_1 of radius r_1 encloses a net charge Q. If there is another concentric sphere S_2 of radius r_2 ($r_2 > r_1$) enclosing charge 2Q, find the ratio of the electric flux through $S_1$and S_2. How will 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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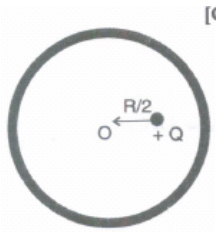
39) A particle of mass 10^{-3} kg and charge 5 μCenters into a uniform electric field of 2 x 10^5 NC^{-1}, moving with a velocity of 20 ms^{-1} in a direction opposite to that of the field. Calculate the distance it would travel before coming to rest.

40) Represent graphically the variation of electric field with distance, for a uniformly charged plane sheet.

41) Show on a plot the nature of variation of the
(i) Electric field (E) and (ii) potential (V), of a(small) electric dipole with the distance (r) of the field point from the centre of the dipole

42) Figure shows a point charge + Q, located at a distance R/2 from the centre of a spherical metal shell. Draw the electric field lines for the given system.



43) Two insulated charged copper spheres A and B of identical size have charges q_A and q_B respectively. A third sphere C of the same size but uncharged is brought in contact with the first and then in contact with the second and finally removed from both. What are the new charges on A and B?

44) A metallic spherical shell has an inner radius R_1 and outer radius R_2. A charge Q is placed at the centre of the spherical cavity. What will be surface charge density on
(i) the inner surface and
(ii) the outer surface

45) Two point charges having equal charges separated by 1m distance experience a force of 8 N. What will be the force experienced by . them, if they are held in water, at the same distance? (Given, $K_{water} = 80$)

46) Does the strength of electric field due to an infinite plane sheet of charge depend upon the distance of the observation point from the sheet of charge?

47) A thin straight infinitely long conducting wire having charge density λ is enclosed by a cylindrical surface of radius r and length l, its axis coinciding with the length of the wire. Find the expression for the electric flux through the surface of the cylinder.

48) A charge q is placed at the centre of a cube of side I. What is the electric flux passing through each face of the cube.

49) Define the dielectric constant of a medium. What is its unit?

50) Sketch the electric field lines for two point charges q_1 and q_2 for $q_1 = q_2$ and $q_1 > q_2$ separated by distance d.

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