Transweb Educational Services Pvt Ltd
B -147, Sector -6 Noida, UP - 201301,
www.askiitians.com
Email: info@askiitians.com
Tel: 1800-2000-838

askIITians
ENGINEERING | MEDICAL | FOUNDATION

Class: 12
Subject: Physics
Topic: Electric charges and fields
No. of Questions: 40

Q1. Explain the meaning of the statement 'electric charge of a body is quantized'.
Why can one ignore quantization of electric charge when dealing with macroscopic i.e. large scale charges?

Q2. When a glass rod is rubbed with a silk cloth, charges appear on both. A similar phenomenon is observed with many other of bodies. Explain how this observation is consistent with the law of conservation of charge.

Q3. Four point charges $q_A = 2\ _{u}C$, $q_B = -5\ _{u}C$ are located at the corners of a square ABCD of side 10 cm. What is the force on a charge of 1 $_{u}C$ placed at the centre of the square?

Q4. An electrostatic field line is a continuous curve. That is, a field line cannot have sudden breaks. Why not?

Q5. Explain why two field line never cross each other at any point?

Q6. What is the relevance of large value of K ( =81) for water?

Q7. A system has two charges $q_A = 2.5 \times 10^{-7}$ C and $q_B = -2.5 \times 10^{-7}$ C located at points A: (0, 0, −15 cm) and B: (0, 0, + 15 cm), respectively. What are the total charge and electric dipole moment of the system?

Q8. A polythene piece rubbed with wool is found to have a negative charge of $3 \times 10^{-7}$ C.
Estimate the number of electrons transferred (from which to which?)
Is there a transfer of mass from wool to polythene?

Q9. Suppose the spheres A and B in Exercise 1.12 have identical sizes. A third sphere of the same size but uncharged is brought in contact with the first, then brought in contact with the second, and finally removed from both. What is the new force of repulsion between A and B?

Q10. A hemispherical body is placed in uniform electric field E. What is the flux linked with the curved surface, if field is
(a) Parallel to the base
(b) Perpendicular to the base entering the plane surface

Transweb Educational Services Pvt Ltd
B -147, Sector -6 Noida, UP - 201301,
www.askiitians.com
Email: info@askiitians.com
Tel: 1800-2000-838

Q11. Two equal negative charges – q are fixed at points (0, a) and (0, – a) on the y-axis. A positive charge Q is released from rest at a point (2a, 0) on the x-axis. The charge Q will

A. execute simple harmonic motion about the origin
B. move to the origin and remain at rest there
C. move to infinity
D. execute oscillatory but not simple harmonic motion

Q12. Three point charges 4q, Q and q are placed in a straight line of length l at points distant 0, l/2 and l respectively. The net force on charge q is zero. The value of Q is

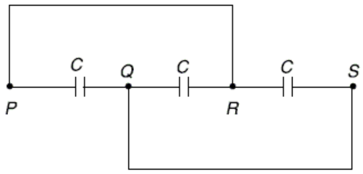
A. q
B. 2q
C. $-\frac{1}{2}q$
D. 4q

Q13. The work done in carrying a charge q, once round a circle of radius r with a charge Q at the centre is

A. $\frac{qQ}{4\pi\varepsilon_0 r}$
B. $\frac{qQ}{4\pi\varepsilon_0}\frac{1}{\pi r}$
C. $\frac{qQ}{4\pi\varepsilon_0}\left(\frac{1}{2\pi r}\right)$
D. Zero

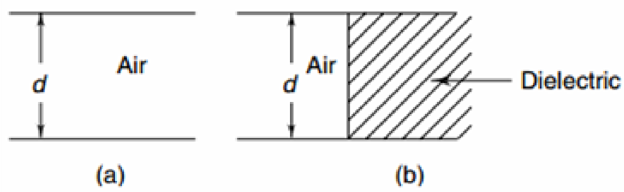
Transweb Educational Services Pvt Ltd
B -147, Sector -6 Noida, UP - 201301,
www.askiitians.com
Email: info@askiitians.com
Tel: 1800-2000-838

Q14. Three capacitors, each of capacitance C = 3 $\mu F$, are connected as shown in the figure. The equivalent capacitance between points P and S is




A. 1 $\mu F$
B. 3 $\mu F$
C. 6 $\mu F$
D. 9 $\mu F$

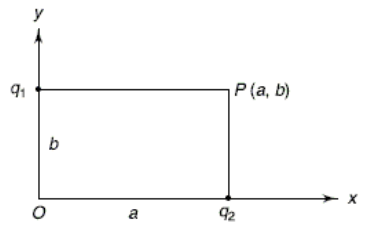
Q15. A parallel plate air-filled capacitor has a capacitance of 2 $\mu F$. When it is half-filled with a dielectric of dielectric constant k = 3, its capacitance becomes




A. 4 $\mu F$
B. 3 $\mu F$
C. 1.5 $\mu F$
D. 0.5 $\mu F$

Transweb Educational Services Pvt Ltd
B -147, Sector -6 Noida, UP - 201301,
www.askiitians.com
Email: info@askiitians.com
Tel: 1800-2000-838

Q16. Two point charges q1 = 2 $\mu C$ and q2 = 1 $\mu C$ are placed at distances b = 1 cm and a = 2 cm from the origin on the y and x axes as shown in figure. The electric field vector at point P (a, b) will subtend an angle q with the x-axis given by




A. $\tan\theta = 1$
B. $\tan\theta = 2$
C. $\tan\theta = 3$
D. $\tan\theta = 4$

Q17. An electric dipole placed with its axis inclined at an angle to the direction of a uniform electric field experiences

A. a force but no torque
B. a torque but no force
C. a force as well as a torque
D. neither a force nor a torque

Q18. Four point charges + q, + q, – q and – q are placed respectively at the corners A, B, C and D of a square of side a. The electric potential at the centre O of the square is

A. $\frac{1}{4\pi\varepsilon_0}\cdot\frac{q}{a}$
B. $\frac{1}{4\pi\varepsilon_0}\cdot\frac{2q}{a}$
C. $\frac{1}{4\pi\varepsilon_0}\cdot\frac{4q}{a}$
D. Zero

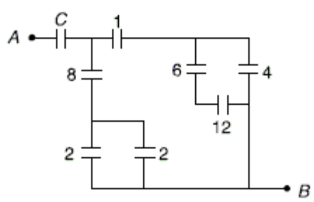
Transweb Educational Services Pvt Ltd
B -147, Sector -6 Noida, UP - 201301,
www.askiitians.com
Email: info@askiitians.com
Tel: 1800-2000-838



Q19. A neutral hydrogen molecule has two protons and two electrons. If one of the electrons is removed, we get a hydrogen molecular ion ($H_2^+$). In the ground state of $H_2^+$, the two protons are separated by roughly 1.5 $\mathring{A}$ and the electron is roughly 1 $\mathring{A}$ from each proton. What is the potential energy of the system?

A. 38.4 eV
B. 19.2 eV
C. 9.6 eV
D. Zero

Q20. Figure shows a network of capacitors where the numbers indicate capacitances in microfarad. What must be the value of capacitance C, if the equivalent capacitance between points A and B is to be 1 $\mu F$?




A. $\frac{31}{23}\mu F$
B. $\frac{32}{23}\mu F$
C. $\frac{33}{23}\mu F$
D. $\frac{34}{23}\mu F$

Q21. The magnitude of the electric field on the surface of a sphere of radius r having a uniform surface charge density $\sigma$ is

A. $\frac{\sigma}{\varepsilon_0}$
B. $\frac{\sigma}{2\varepsilon_0}$
C. $\frac{\sigma}{\varepsilon_0 r}$
D. $\frac{\sigma}{2\varepsilon_0 r}$

Transweb Educational Services Pvt Ltd
B -147, Sector -6 Noida, UP - 201301,
www.askiitians.com
Email: info@askiitians.com
Tel: 1800-2000-838

Q22. The electric potential due to an extremely short dipole at a distance r from it, is proportional to

A. $\frac{1}{r}$
B. $\frac{1}{r^2}$
C. $\frac{1}{r^3}$
D. $\frac{1}{r^4}$

Q23.If n drops, each of capacitance C, coalesce to form a single big drop, the capacitance of the big drop will be

A. $n^3C$
B. $nC$
C. $n^{1/2}C$
D. $n^{1/3}C$

Q24. A capacitor of capacitance C is fully charged by a 200 V supply. It is then discharged through a small coil of resistance wire embedded in a thermally insulated block of specific heat 2.5 $\times$ $10^2$ J $kg^{-1}$ $K^{-1}$ and of mass 0.1 kg. If the temperature of the block rises by 0.4 K, what is the value of C?

A. 500 $\mu$F
B. 400 $\mu$F
C. 300 $\mu$F
D. 200 $\mu$F

Q25. Eight dipoles of charges of magnitude q are placed inside a cube. The total electric flux through the cube will be

A. $\frac{8q}{\varepsilon_0}$
B. $\frac{16q}{\varepsilon_0}$
C. $\frac{q}{\varepsilon_0}$
D. zero

Transweb Educational Services Pvt Ltd
B -147, Sector -6 Noida, UP - 201301,
www.askiitians.com
Email: info@askiitians.com
Tel: 1800-2000-838

Q26. The introduction of a metal plate between the plates of a parallel plate capacitor increases its capacitance by 4.5 times. If d is the separation of the two plates of the capacitor, then the thickness of the metal plate introduced is

A. $\frac{d}{3}$
B. $\frac{5d}{9}$
C. $\frac{7d}{9}$
D. d

Q27. An electron of mass $m_e$, initially at rest, move through a certain distance in a uniform electric field in time $t_1$. A proton of mass $m_p$, also initially at rest, takes time $t_2$ to move through an equal distance in this uniform electric field. Neglecting the effect of gravity, the ratio $t_2/t_1$ is nearly equal to

A. 1
B. $\left(\frac{m_p}{m_e}\right)^{1/2}$
C. $\left(\frac{m_e}{m_p}\right)^{1/2}$
D. 1836



Q28. A dielectric slab of thickness d is inserted in a parallel plate capacitor whose negative plate is at x 0 and positive plate is at x = 3d. The slab is equidistant from the plates. The capacitor is given some charge. As x goes from 0 to 3d,

A. the magnitude of the electric field remains the same
B. the direction of the electric field changes continuously
C. the electric potential increases continuously
D. the electric potential increases at first, then decreases and again increases

Transweb Educational Services Pvt Ltd
B -147, Sector -6 Noida, UP - 201301,
www.askiitians.com
Email: info@askiitians.com
Tel: 1800-2000-838

Q29. The flux of electric field E = 200 $\hat{i}$ $NC^{-1}$ through a cube of side 10 cm, oriented so that its faces are parallel to the co – ordinate axes is

A. zero
B. 2 $NC^{-1}$ $m^2$
C. 6 $NC^{-1}$ $m^2$
D. 12 $NC^{-1}$ $m^2$

30. The magnitude of electric field at a distance x from a charge q is E. An identical charge is placed at a distance 2x from it. The magnitude of the force experienced by it is

A. pE
B. 2 pE
C. $\frac{qE}{2}$
D. $\frac{qE}{4}$

Q31. Three capacitors of capacitances 2 pF, 3 pF and 4 pF are connected in parallel.
What is the total capacitance of the combination?
Determine the charge on each capacitor if the combination is connected to a 100 V supply.

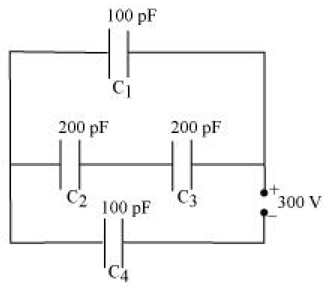
Q32. A charge of 8 mC is located at the origin. Calculate the work done in taking a small charge of $-2 \times 10^{-10}$ C from a point P (0, 0, 3 cm) to a point Q (0, 4 cm,) Via a point R (0, 6 cm, 9cm)

Q33. A cube of side $d$ has a charge $q$ at each of its vertices. Determine the potential and electric field due to this charge array at the centre of the cube.

Q34. What is the area of the plates of a 2 F parallel plate capacitor, given that the separation between the plates is 0.5 cm? [You will realize from your answer why ordinary capacitors are in the range of $\mu F$ or less. However, electrolytic capacitors do have a much large capacitance (0.1 F) because of very minute separation between the conductors.

Q35. Obtain the equivalent capacitance of the network in Fig. 2.35. For a 300 V supply, determine the charge and voltage across each capacitor.

Transweb Educational Services Pvt Ltd
B -147, Sector -6 Noida, UP - 201301,
www.askiitians.com
Email: info@askiitians.com
Tel: 1800-2000-838




Capacitance of capacitor $C_4$ is 100 pF.

Q36. Two large conducting spheres carrying charges $Q_1$ and $Q_2$ are brought close to each other.

Is the magnitude of electrostatic force between them exactly given by $Q_1Q_2/4\pi\epsilon_0 r^2$, where r is the distance between their centres?

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

What is the work done by the field of a nucleus in a complete circular orbit of the electric potential also discontinuous there?

What meaning would you give to the capacitance of a single conductor?

Guess a possible reason why water has a much greater dielectric constant (=80) than say, mica (=60)

Q37. If Coulomb's law involved $1/r^3$ dependence (instead of $1/r^2$), would Gauss's law be still true?

Q38. Describe schematically the equipotential surfaces corresponding to

A constant electric field in the z=direction,

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

A single positive charge at the origin, and

A uniform grid consisting of long equally spaced parallel charged wires in a plane.

Q39. In a Van de Graaff type generator a spherical metal shell is to be a $15 \times 10^6$ V electrode. The dielectric strength of the gas surrounding the electrode is $5 \times 10^7$ $Vm^{-1}$. What is the minimum radius of the spherical shell required? (You will learn from this exercise why one cannot build an electrostatic generator using a very small shell which requires a small

Q40. A small sphere of radius $r_1$ and charge $q_1$ is enclosed by a spherical shell of radius $r_2$ and charge $q_2$. Show that if $q_1$ is positive, charge will necessarily flow from the sphere to the shell (when the two are connected by a wire) no matter what the charge $q_2$ on the shell is.