PH 102 QUIZ

[Total 20 questions; Each question carries 1 mark; Only one correct answer for each question]

1. Three charges –q, +q, +q are placed at points (a,0,0), (0,a,0) and (0,0,-a) respectively. The Electric field at the origin is:

   (a) $\frac{q}{4\pi\varepsilon_o a}$ **(b)** zero **(c)** $\frac{-q}{4\pi\varepsilon_o a}$ **(d)** None of the above

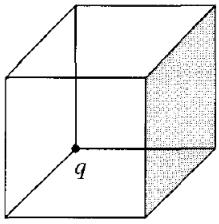
2. The Electric field at the surface and centre of a spherical shell of radius 'r' and carrying a uniformly distributed charge 'Q' is respectively:

   (a) 0, 0 **(b)** $\frac{Q}{4\pi\varepsilon_o r^2}\hat{r}, \frac{Q}{4\pi\varepsilon_o r^2}\hat{r}$ **(c)** $\frac{Q}{4\pi\varepsilon_o r^2}\hat{r}, 0$ **(d)** None of the above

3. The Electric potential at the surface and centre of the above configuration is:

   (a) 0, 0 **(b)** $\frac{Q}{4\pi\varepsilon_o r}, \frac{Q}{4\pi\varepsilon_o r}$ **(c)** $\frac{Q}{4\pi\varepsilon_o r}, 0$ **(d)** None of the above

4. A charge 'q' sits on the back corner of a cube as shown in the figure below. What is the Electric flux through the shaded region?



   (a) zero **(b)** $\frac{q}{6\varepsilon_o}$ **(c)** $\frac{q}{12\varepsilon_o}$ **(d)** $\frac{q}{24\varepsilon_o}$

5. Assume a Gaussian surface of radius 'r' within a metallic spherical shell of inner and outer radii 'R_1' and 'R_2' respectively ($R_1<r<R_2$). A charge 'q' is placed at the centre of the spherical shell. The normal component of Electric flux at the Gaussian surface will be:

   (a) Zero **(b)** $\frac{q}{4\pi R_1^2}$ **(c)** $\frac{q}{4\pi R_2^2}$ **(d)** $\frac{q}{4\pi(R_1 - R_2)^2}$

6. A conducting spherical shell of radius ‘r’ carries a charge ‘Q’. Another uncharged conducting spherical shell of radius ‘2r’ is connected to the first shell with a conducting wire. The charge on the first shell (of radius ‘r’) will now be:

(a) Q **(b)** Q/2 **(c)** 2Q/3 **(d)** Q/3

7. The Electric field between the two plates of a parallel plate capacitor varies sinusoidally with a frequency ‘ω’. Then the force between the two plates varies sinusoidally with a frequency:

(a) ω **(b)** 2 ω **(c)** ω/2 **(d)** Force does not vary with ω

8. Which of these cannot be a possible electrostatic field? (k is a constant)

(a) $\vec{E} = k[yz\,\hat{a}_x + xz\,\hat{a}_y + xy\,\hat{a}_z]$ **(b)** $\vec{E} = k[y^2\,\hat{a}_x + (2xy + z^2)\,\hat{a}_y + 2yz\,\hat{a}_z]$

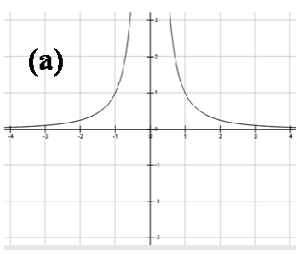
(c) $\vec{E} = k[xy\,\hat{a}_x + 2yz\,\hat{a}_y + 3xz\,\hat{a}_z]$ **(d)** $\vec{E} = k[x^2\,\hat{a}_x]$

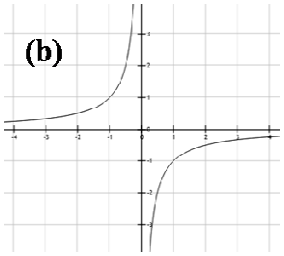
9. An Electric dipole is placed in a uniform electric field. The equilibrium position of the dipole is:

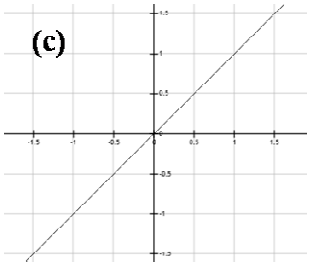
(a) Perpendicular to the field (90^o) **(b)** Along the field (0^o)

(c) at 45^o to the field **(d)** Opposite to the field (180^o)

10. A charge ‘q’ is placed at a certain distance‘d’ from an infinite grounded sheet (XZ plane). The charge is free to move from -∞ to +∞ along the y-axis. The plot of force F (Y-axis) acting on the charge with respect to the distance ‘d’(X-axis) from the plate is:







(d) None

11. The Electric flux density $\vec{D}$ is _____ to the electric flux lines.

(a) Normal **(b)** Tangential **(c)** Opposite **(d)** Unrelated

12. The Electric field $\vec{E}$ is _____ to the electric equipotential lines.

(a) Normal **(b)** Tangential **(c)** Opposite **(d)** Unrelated

13. The polarization '$\vec{P}$' in a dielectric material (homogenous and isotropic) expressed in terms of the Electric displacement '$\vec{D}$' and dielectric constant 'ε_r' is given by:

(a) $\left(\frac{\varepsilon_r - 1}{\varepsilon_r}\right)\vec{D}$ **(b)** $(\varepsilon_r - 1)\vec{D}$ **(c)** $\left(\frac{1-\varepsilon_r}{\varepsilon_r}\right)\vec{D}$ **(d)** $\varepsilon_r \vec{D}$

14. The capacitance between two spherical shells of radius 'a' separated by a distance 'd' (d>>a) is:

(a) $4\pi\varepsilon_o a$ **(b)** $2\pi\varepsilon_o a$ **(c)** $4\pi\varepsilon_o d$ **(d)** None of the above

15. The work done to assemble four charges of charge +q, each at the corner of a square of side 'a' is:

(a) $\frac{2q^2}{4\pi\varepsilon_o a}[2+\frac{1}{\sqrt{2}}]$ **(b)** $\frac{q^2}{4\pi\varepsilon_o a}[2+\frac{1}{\sqrt{2}}]$ **(c)** $\frac{q^2}{4\pi\varepsilon_o a}$ **(d)** $\frac{2q^2}{4\pi\varepsilon_o a}[2-\frac{1}{\sqrt{2}}]$

16. The energy stored in a uniformly charged solid sphere of radius 'R' and charge 'q' is:

(a) $\frac{q^2}{4\pi\varepsilon_o R}$ **(b)** $\frac{3q^2}{4\pi\varepsilon_o R}$ **(c)** $\frac{q^2}{8\pi\varepsilon_o R}$ **(d)** $\frac{3q^2}{20\pi\varepsilon_o R}$

17. A laser source emitting ordinary light (unpolarized light) of intensity 'I' is incident onto a polarizer. The output beam of light is then incident onto another polarizer, whose polarizing angle is kept at 45^o with respect to the first polarizer. The intensity of the output beam is:

(a) I **(b)** I/2 **(c)** I/4 **(d)** Cannot be determined

18. Let a point in spherical and cylindrical co-ordinates be represented as (r,θ,ϕ) and (ρ,ϕ,z) respectively. The radial component 'r' in spherical co-ordinates is related to components in cylindrical components as:-

(a) ρ **(b)** $\rho\cos\phi$ **(c)** $z\tan^{-1}\phi$ **(d)** $(\rho^2+z^2)^{1/2}$

19. If $\vec{r} = x\hat{a}_x + y\hat{a}_y + z\hat{a}_z$ and $r = \left|\vec{r}\right|$, the divergence of $\vec{A} = r^n \vec{r}$ is:

(a) $(n+1)r^{n-1}$ **(b)** $(n+3)r^n$ **(c)** $(3n+1)r^n$ **(d)** None of the above

20. The value of the integral $\int_{-\infty}^{a} \delta(x-b)dx$ for a>b and a<b are respectively:

(a) 1, 0 **(b)** 0, 1 **(c)** 0, 0 **(d)** 1, 1