Test Your fiziks concepts!

Topic: Electromagnetic Theory

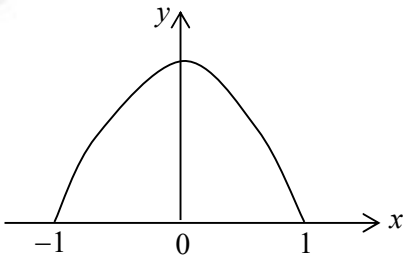
(For CSIR NET-JRF, GATE, JEST and TIFR Aspirants)

Q. The shape of a dielectric lamina is defined by the two curves $y=0$ and $y=1-x^2$. If the charge density of the lamina $\sigma = 15y\,C/m^2$, then the total charge on the lamina is:

(a) $2C$ (b) $4C$ (c) $6C$ (d) $8C$

Ans.: (d)

Solution.: Total charge on the lamina is



$$Q=\int_S \sigma da=\int_{-1}^{1}\int_{0}^{1-x^2} 15y\,dx\,dy=\frac{15}{2}\int_{-1}^{1}\left(1-x^2\right)^2 dx$$

$$\Rightarrow Q=\frac{15}{2}\int_{-1}^{1}\left(1+x^4-2x^2\right)dx=\frac{15}{2}\left[x+\frac{x^5}{5}-2\frac{x^3}{3}\right]_{-1}^{1}$$

$$\Rightarrow Q=\frac{15}{2}\left[1+\frac{1}{5}-\frac{2}{3}-\left(-1-\frac{1}{5}+\frac{2}{3}\right)\right]=\frac{15}{2}\left[2+\frac{2}{5}-\frac{4}{3}\right]\Rightarrow Q=\frac{15}{2}\times\frac{16}{15}=8C$$

Note:

For detailed solutions, visit the *Free Download* section at www.physicsbyfiziks.com

Test Your fiziks concepts!

Topic: Solid State Physics

(For IIT-JAM, JEST, TIFR and CUET Aspirants)

Q. The number of atoms in the *basis* of a primitive cell of hexagonal closed packed structure is:

(a) 1 (b) 2 (c) 3 (d) 4

Ans.: (b)

Solution.:

The HCP lattice is described by a primitive cell with a basis of 2 atoms.

Thus, the correct option is (b).

Note:

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Test Your fiziks concepts!

Topic: Mechanices

(For PGT: KVS, NVS, DSSSB, State Education Boards, etc.)

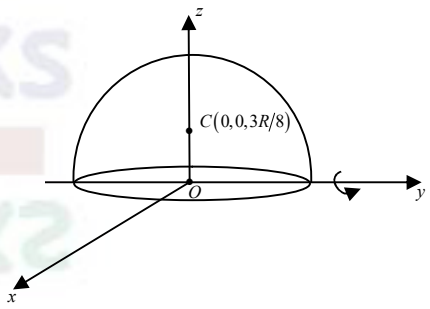
Q. The moment of inertia of a solid hemisphere (mass M and radius R) about the axis passing through the hemisphere and parallel to its flat surface is $\frac{2}{5}MR^2$. The distance of the axis from the center of mass of the hemisphere (in units of R) is

(a) 0.28 (b) 0.38 (c) 0.58 (d) 0.68

Ans.: (b)

Solution.:

Coordinate of COM = $(0,0,3R/8)$



$I_x = \frac{2}{5}MR^2$,

$OC = \frac{3R}{8} = 0.375R = 0.38$

Note:

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Test Your fiziks concepts!

Topic: Electromagnetic Theory

(For CSIR NET-JRF, GATE, JEST and TIFR Aspirants)

Q. A static charge distribution gives rise to an electric field of the form $\vec{E} = \alpha\left(1 - e^{-r/R}\right)\frac{\hat{r}}{r^2}$, where α and R are positive constants. The charge contained within a sphere of radius R, centered at the origin is

(a) $\pi\alpha\varepsilon_0 \frac{e}{R^2}$ (b) $\pi\alpha\varepsilon_0 \frac{e^2}{R^2}$ (c) $4\pi\alpha\varepsilon_0\left(1-\frac{1}{e}\right)$ (d) $\pi\alpha\varepsilon_0 \frac{R^2}{e}$

Ans.: (c)

Solution.: $Q_{enc} = \varepsilon_0 \oint \vec{E}\cdot d\vec{a} = \alpha\varepsilon_0 \int \left(1-e^{-r/R}\right)\frac{\hat{r}}{r^2}\cdot\left(r^2 \sin\theta d\theta d\phi \hat{r}\right) = \alpha\varepsilon_0 \times \int_0^{\pi}\int_0^{2\pi}\left(1-e^{-r/R}\right)\sin\theta d\theta d\phi$

at $r = R$, $Q_{enc} = 4\pi\alpha\varepsilon_0\left(1-\frac{1}{e}\right)$.

Note:

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Test Your fiziks concepts!

Topic: Solid State Physics

(For IIT-JAM, JEST, TIFR and CUET Aspirants)

Q. The Fermi energy of a system is 5.5 eV. At 500 K, the energy of a level for which the probability of occupancy is 0.2, is (Boltzmann constant $k_B = 8.62\times10^{-5}$ eV/K)

(a) $3.56\,eV$ (b) $4.56\,eV$ (c) $5.56\,eV$ (d) $6.56\,eV$

Ans.: (c)

Solution.: $f(E) = \dfrac{1}{1+\exp\left(\dfrac{E-E_F}{k_BT}\right)} = 0.2 \Rightarrow 1+\exp\left(\dfrac{E-E_F}{k_BT}\right) = \dfrac{10}{2} = 5 \Rightarrow \exp\left(\dfrac{E-E_F}{k_BT}\right) = 4$

$$\Rightarrow \frac{E-E_F}{k_BT} = \ln 4 = 2\ln 2 \Rightarrow E = E_F + 2k_BT\ln 2 \Rightarrow E = 5.5eV + 2\times8.62\times10^{-5}\times500\times0.693$$

$$\Rightarrow E = 5.5eV + 0.0597eV = 5.5eV + 0.06eV = 5.56\,eV$$

Note:

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Test Your fiziks concepts!

Topic: Mechanices

(For PGT: KVS, NVS, DSSSB, State Education Boards, etc.)

Q. A satellite moves around a planet in a circular orbit at a distance R from its center. The time period of revolution of the satellite is T. If the same satellite is taken to an orbit of radius $4R$ around the same planet, the time period would be

(a) $8T$ (b) $4T$ (c) $\frac{T}{4}$ (d) $\frac{T}{8}$

Ans.: (a)

Solution.: $T^2 \propto R^3 \Rightarrow \frac{T_2}{T} = \left(\frac{4R}{R}\right)^{\frac{3}{2}} = 8 \Rightarrow T_2 = 8T$

Note:

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