Sample Questions for

Admission test of M.Phil admission test 2015

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1.Two infinite non-conducting sheets of charge are parallel to each other. Each sheet has positive uniform charge density 'σ '. Calculate the value of the electric field to the right of the two sheets

A) 0
B) $\sigma/2\varepsilon_o$ x
C) - $\sigma/2\varepsilon_o$ x
D) - σ/ε_o x
E) σ/ε_o x

2.The electric field of a plane EM wave traveling along the z-axis is
E = (E_{ox} x + E_{oy} y) Sin (ωt –kz + φ). Find the magnetic field B.

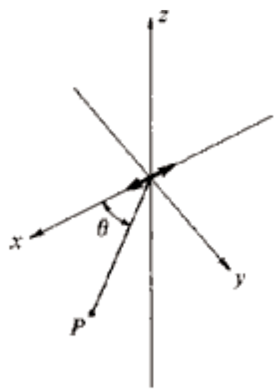
A) (-E_{oy} x + E_{ox} y) Cos (ωt –kz + φ)/c
B) (E_{ox} x + E_{oy} y) Sin (ωt –kz + φ)/c
C) (-E_{oy} x + E_{ox} y) Sin (ωt –kz + φ)/c
D) (E_{ox} x + E_{oy} y) Cos (ωt –kz + φ)/c
E) (-E_{oy} x - E_{ox} y) Sin (ωt –kz + φ)/c

3. As is well known, Maxwell's equations imply the existence of electromagnetic waves. Determine the appropriate wave equation for a magnetic field

B = B_z *(x,y,z)* $\hat{z}$

A) $\partial^2 B_z/\partial x^2 = \partial^2 B_z/\partial t^2$
B) $\partial^2 B_z/\partial z^2 = \partial^2 B_z/\partial t^2$
C) $(\partial^2/\partial x^2 + \partial^2/\partial y^2 + \partial^2/\partial z^2)\, B_z = \mu_o\varepsilon_o\, (\partial^2 B_z/\partial t^2)$
D) $\partial^2 B_z/\partial y^2 = \partial^2 B_z/\partial t^2$
E) $(\partial^2/\partial x^2 + \partial^2/\partial y^2 + \partial^2/\partial z^2)\, B_z = \mu_o\varepsilon_o\, (\partial^2 E_y/\partial t^2)$

4. A charged particle oscillates harmonically along the x-axis as shown above. The radiation from the particle is detected at a distance P, which lies in the xy-plane. The electric field at P is in the



A) ± z direction and has a maximum amplitude at $\theta = 90^o$
B) ± z direction and has a minimum amplitude at $\theta = 90^o$
C) xy-plane and has a maximum amplitude at $\theta = 90^o$
D) xy-plane and has a minimum amplitude at $\theta = 90^o$
E) xy-plane and has a maximum amplitude at $\theta = 45^o$

5. The complex refractive index of germanium at 400 nm is given by n= 4.141 –*i*(2.215). What will be the reflectivity of the at 400nm?

A) 30%
B) 47%
C) 70%
D) 80%
E) 100%

6. Which of the following Maxell equations imply that there are no magnetic monopoles?

A) $\nabla \bullet E = \rho/\varepsilon_o$
B) $\nabla \bullet B = 0$
C) $\nabla \times E = - \partial B/\partial t$
D) $\nabla \times B = \mu_o J + \mu_o \varepsilon_o \partial E/\partial t$
E) magnetic monopoles have recently been found

7. Two equal masses $m_1 = m_2 = m$ are connected by a spring having Hooke's constant *k*. If the equilibrium is ' l_o' and the spring rests on a frictionless horizontal surface, then derive ω_o the angular frequency.

A) $\sqrt{k/m}$
B) $\sqrt{2k/m}$

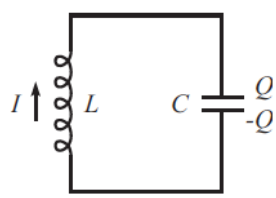
C) $\sqrt{3k/m}$

D) $2\sqrt{k/m}$

E) $\sqrt{g/l_o}$

8. The potential energy of a particle moving in one dimension is given by $U(x) = \frac{1}{2} kx^2 + \frac{1}{4} bx^4$. Determine the force.

A) $-kx - bx^3$
B) $kx + bx^3$
C) $1/6\ kx^3 + 1/20\ bx^5$
D) $-1/6\ kx^3 - 1/20\ kx^5$
E) $-kx - bx^2$



9.Consider the LC circuit shown in the figure above. What will be the frequency of oscillation of charges in the circuit?

A) $\omega = (1/2LC)^{1/2}$
B) $\omega = (1/LC)^{½}$
C) $\omega = (LC)^{½}$
D) $\omega = (2LC)^{½}$
E) $\omega = (1/LC)$

10. A particle is constrained to move along the x-axis under the influence of the net force F = -*k*x with amplitude *A* and frequency *f*, where k is a positive constant. When x = A/2, the particle's speed is

A) $2\pi fA$
B) $\sqrt{3}\ \pi fA$
C) $\sqrt{2}\ \pi fA$
D) πfA
E) $(1/3)\pi fA$

11. On a planet with an unknown value of g, the period of a 0.75m long pendulum is 1.8s. What is g for this planet?

A) $10 m/s^2$
B) $9.8 m/s^2$
C) $9.1 m/s^2$
D) $9.5 m/s^2$
E) $9.0 m/s^2$

12. Consider N interacting bosons in an infinite potential box of width 'a'. What is the ground state energy?

A) $h^2 \pi^2 N/ ma^2$
B) $h^2 \pi^2 / 2ma^2$
C) $h^2 \pi^2 / ma^2$
D) $h^2 \pi^2 N/ 4ma^2$
E) $h^2 \pi^2 N/ 2ma^2$

13. According to Bose-Einstein statistics, there exists a Bose condensate for collection of bosons. What does this mean?

A) as $T \to \infty$ all particles reside in excited states
B) for $T < T_c$ all particles reside in the ground state
C) bosons are not physically meaningful particles
D) bosons are like fermions
E) for $T < T_c$ bosons dissolve into quarks and gluons.

14. The particle in a box has a ground state function given by

$\phi (x) = 1/\sqrt{a} \, Cos (\pi x/2a)$. Calculate the expectation value of x^2.

A) $a^2/3$
B) $a^2(1/3 - 2/\pi^2)$
C) $a^2 (2/3 - 4/\pi^2)$
D) $2a^2/\pi^2$
E) $a^2/4$

15. A bead is constrained to slide on a frictionless rod that is fixed at angle θ with a vertical axis and is rotating with angular frequency ω about the axis. Taking the distance 's' along the rod as the variable, the Lagrangian for the bead is equal to

A) $½ ms'^2 - mgs \cos \theta$
B) $½ ms'^2 - mgs + 1/2m (\omega s)^2$
C) $½ ms'^2 + 1/2m (\omega s \cos \theta)^2 + mgs \cos \theta$

D) $\frac{1}{2} m (s' \sin\theta)^2 - mgs \cos\theta$

E) $\frac{1}{2} m s'^2 + \frac{1}{2} m' (\omega s \sin\theta)^2 - mgs \cos\theta$