Surprise Test
PH11003

Full marks=10 **Time=1 hr**

Problem 1

Suppose the yz-plane forms chargeless boundary between two media of permittivities ϵ_{left} and ϵ_{right}, where ϵ_{left}:ϵ_{right}=1:2, if the uniform electric field on the left is $\vec{E}_{left} = c(\hat{i} + \hat{j} + \hat{k})$ (where c is a constant), then the electric field on the right $\vec{E}_{right}$ is

2 marks
(Hint: Use boundary condition of parallel and perpendicular component of electric field at the interface between two different media)

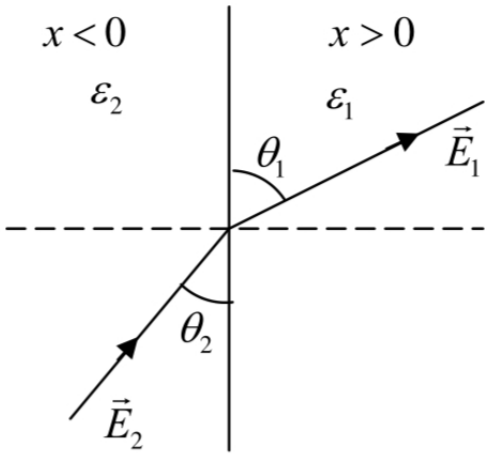
(a) $c\left(2\hat{i} + \hat{j} + \hat{k}\right)$

(b) $c\left(\hat{i} + 2\hat{j} + 2\hat{k}\right)$

(c) $c\left(\frac{1}{2}\hat{i} + \hat{j} + \hat{k}\right)$

(d) $c\left(\hat{i} + \frac{1}{2}\hat{j} + \frac{1}{2}\hat{k}\right)$

Problem 2



The half space region $x > 0$ and $x < 0$ are filled with dielectric media of dielectric constants ϵ_1 and ϵ_2 respectively. There is a uniform electric field in each part. In the right half, the electric field makes an angle θ_1 to the interface. The corresponding angle θ_2 in the left half satisfies

2 marks
(Hint: Use boundary condition of parallel and perpendicular component of electric field at the interface between two different media)

(a) $\varepsilon_1 \sin\theta_2 = \varepsilon_2 \sin\theta_1$ (b) $\varepsilon_1 \tan\theta_2 = \varepsilon_2 \tan\theta_1$

(c) $\varepsilon_1 \tan\theta_1 = \varepsilon_2 \tan\theta_2$ (d) $\varepsilon_1 \sin\theta_1 = \varepsilon_2 \sin\theta_2$

Problem 3

The x and z components of a static magnetic field in a region are $B_x = B_0(x^2 - y^2)$ and $B_z = 0$, respectively. Which of the following solutions for its y-component is consistent with the Maxwell equations?

2 marks

(a) $B_y = B_0 xy$ (b)$B_y = -2B_0 xy$

(c)$B_y = -B_0(x^2 - y^2)$ (d)$B_y = B_0(\frac{1}{3}x^3 - xy^2)$

Problem 4

Three sinusoidal electric field represented by the equations $E_1 = 10\cos(20\pi t + \frac{\pi}{4})$, $E_2 = 10\cos(20\pi t + \frac{3\pi}{4})$, $E_3 = 10\cos(20\pi t - \frac{3\pi}{4})$ respectively. Using, phasor addition method, find out the resultant electric field.

2 marks

(a)$E = 10\sqrt{2}\cos(20\pi t + \pi)$ (b)$E = 10\sqrt{3}\cos(20\pi t + \pi)$

(c)$E = 10\sqrt{2}\cos(20\pi t + \frac{3\pi}{4})$ (d)$E = 10\sqrt{3}\cos(20\pi t + \frac{3\pi}{4})$

Problem 5

A plane electromagnetic wave with the B field amplitude 3×10^{-6} T travelling in vacuum falls normally on a surface and is totally reflected. Calculate the pressure exerted on the surface.

2 marks

(a) 0.42×10^{-5} Pa. (b) 0.72×10^{-5} Pa.

(c)0.69×10^{-6} Pa.

(d)0.90×10^{-6} Pa