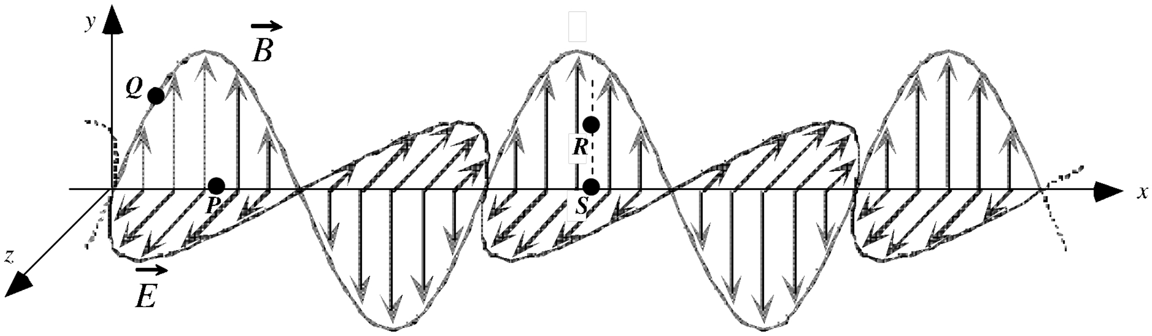
Name: ___________________Sec. _______ **P212: Quiz 9A Week 12**

Shown below are mathematical and pictorial representations of an electromagnetic plane wave propagating through empty space. The electric field is parallel to the *z*-axis.

$$\vec{E}(x, y, z, t) = E_o \sin(kx + \omega t)\,\hat{z}$$



The points *R,* and *S* in the diagram above lie in the *x–y* plane, the points P and Q also lie in the *x–y* plane. Each of the questions relates to the instant shown.

1. Which statement below correctly relates the magnitude of the *magnetic field* at points *P* and *Q?* **[3]**

   a) $B_P > B_Q > 0$ b) $B_P > B_Q = 0$ c) $B_P = B_Q > 0$
   d) $B_P = B_Q = 0$ e) $B_Q > B_P > 0$ f) $B_Q > B_P = 0$

2. Explain your reasoning. **[2]**

3. Which statement below correctly relates the magnitude of the *magnetic field* at points *S* and *R?* **[3]**

   a) $B_S > B_R > 0$ b) $B_S > B_R = 0$ c) $B_S = B_R > 0$
   d) $B_S = B_R = 0$ e) $B_R > B_S > 0$ f) $B_R > B_S = 0$

4. Explain your reasoning. **[2]**

5. Write an expression for the magnetic field **B**(x,y,z,t). (Remember to express the amplitude of the magnetic field in terms of the amplitude of the electric field.) **[4]**

6. In which direction is the wave traveling? **[3]**

7. Suppose that the diagram above represents a radio wave. In order to obtain the best reception with a radio, how would you orient the antenna? Remember, the optimal orientation to maximize reception is with the antenna parallel (or antiparallel) to the electric field. **[3]**

   a) parallel to the *x*-axis
   b) parallel to the *y*-axis
   c) parallel to the *z*-axis
   d) parallel to the *y*-*z* plane and at an angle of 45° with respect to the *y*-axis
   e) any orientation parallel to the *y*-*z* plane.

W12 Quiz1

Q9A

1) Only the x position matters. P is closer to the max than Q is, so $B_P > B_Q$. Neither = 0. (3)
$B_P > B_Q$ (2)
Neither = 0. (1)
No explanation required. (That's question 2.)

2) Give the reasoning above (2)

3) Only the x position matters. R and S are at the same x, so $B_S = B_R$. Neither = 0. (3)
$B_S = B_R$ (2)
Neither = 0. (1)
No explanation required. (That's question 4.)

4) Give the reasoning above (2)

5) $\vec{B}(x,y,z,t) = \frac{E_0}{c}\sin(kx+\omega t)\hat{y}$ (4)
$B_o = E_o/c$ (1)
Direction of B (1)
$\sin(kx+\omega t)$ (2)

6) (Assuming that k and ω are positive), the wave travels in the $-x$ direction. (3)
$v = k\omega$, or something similar (2)
Correct answer (1)
Any direction other than $\pm x$ (0)

7) This is probably a give-away. Antenna should pont along z. (3)
No part credit.