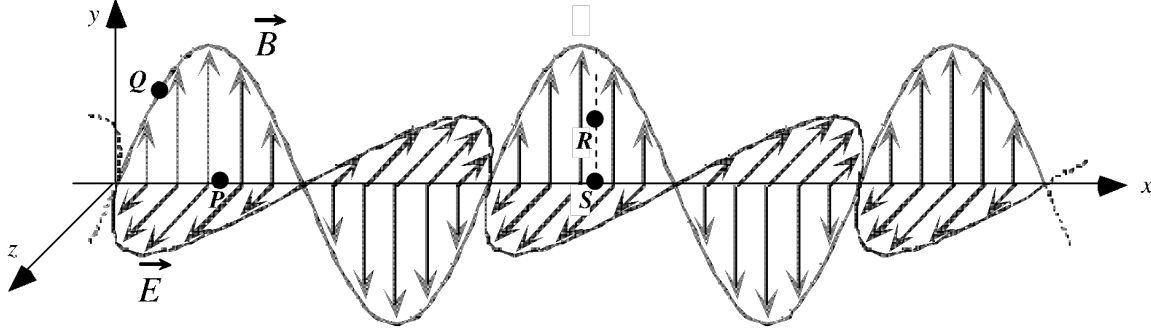


Shown below are mathematical and pictorial representations of an electromagnetic plane wave propagating through empty space. The electric field is parallel to the  $z$ -axis.

$$\vec{E}(x, y, z, t) = E_0 \sin(kx + \omega t) \hat{z}$$



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]

Initials: \_\_\_\_\_ Sec. \_\_\_\_\_

**P212: Quiz 9A Week 12**

5. Write an expression for the magnetic field  $\mathbf{B}(x,y,z,t)$ . (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  $45^\circ$  with respect to the  $y$ -axis
  - e) any orientation parallel to the  $y$ - $z$  plane.