Warm-up set 8

Question

1. HRW6 29.TB.01. [119924] Units of a magnetic field might be:
   (a) N/C · m
   (b) kg/C · s
   (c) C · m/s
   (d) C · s/m
   (e) C/kg

Answer:

(b) kg/C · s

An electric field is the force per unit charge. Correspondingly, a magnetic field is the force per unit moving charge.

$$\frac{N}{C \cdot m/s} = kg \cdot \frac{m}{s^2} \cdot \frac{1}{C} \cdot \frac{s}{m} = \frac{kg}{C \cdot s}$$

Question

2. HRW6 29.TB.06. [119929] A magnetic field exerts a force on a charged particle:
   (a) never
   (b) if the particle is moving along the field lines
   (c) always
   (d) if the particle is at rest
   (e) if the particle is moving across the field lines

Answer:

(e) If the particle is moving across the field lines

A magnetic field only exerts a force on a moving charge. However, since

$$F = q\vec{v} \times \vec{B}$$

The force is the cross product of the velocity and magnetic field vectors, when the two are in the same direction, the force is 0.

Question

3. HRW6 29.TB.09. [119932] A magnetic field CANNOT:
   (a) change the kinetic energy of a charge
   (b) change the momentum of a charge
   (c) exert a force on a charge
   (d) accelerate a charge
   (e) exist

Answer:

(a) Change the kinetic energy of a charge

$$F = q\vec{v} \times \vec{B}$$

The force exerted by a magnetic field on a moving charge is always perpendicular to the velocity of the particle. Thus the force affects the direction but not the magnitude of the velocity. Since kinetic energy is a function of the magnitude of velocity, the kinetic energy is unaffected by magnetic force.