2020 Sec 4 AP2 Electric and Magnetic Fields

Answers to Examples

Example 1

(a) Upwards

(b) $E = F / q$

$5.0 = F / (1.0 \times 10^{-3})$

$F = 5.0 \times 10^{-3}$ N

Example 2

Let left be positive.

$F_{12} - F_{23}$

$= \left|\frac{kq_1Q_2}{r_{12}^2}\right| - \left|\frac{kQ_2q_3}{r_{23}^2}\right|$

$= \left|\frac{8.99 \times 10^9(4.0 \times 10^{-6})(2.0 \times 10^{-6})}{(4.0 \times 10^{-2})^2}\right| - \left|\frac{8.99 \times 10^9(3.0 \times 10^{-6})(2.0 \times 10^{-6})}{(6.0 \times 10^{-2})^2}\right|$

$= 29.96$ N

$= 30$ N (2 sf)

Example 3

Let the unknown distance be x

$$E_1 = E_2$$

$$\left|\frac{kQ_1}{r_1^2}\right| = \left|\frac{kQ_2}{r_2^2}\right|$$

$$\left|\frac{Q_1}{r_1^2}\right| = \left|\frac{Q_2}{r_2^2}\right|$$

$$\left|\frac{3.0 \times 10^{-15}}{x^2}\right| = \left|\frac{5.0 \times 10^{-15}}{(0.050 - x)^2}\right|$$

$3(0.050 - x)^2 = 5x^2$

$0 = 2x^2 + 0.30x - 0.0075$

$x = 0.02182$ or -0.1718 (reject)

$x = 0.022$ m (2 sf)

Example 4

$F = BIL$

$= (2.0)(10)(0.500)$

$= 10$ N

Direction of force: upwards

Example 5

$F = BIL$
$= B (q / t) L$
$= B q (L / t)$
$= Bqv$

Example 6

$E = F / q$
$E = ma / q$
$a = Eq / m$

$s = ut + 0.5at^2$
$s = 0.5 (Eq / m) t^2$
$1.0 = (0.5)[(500)(1.60 \times 10^{-19}) / (9.11 \times 10^{-31})] t^2$
$t = 1.509 \times 10^{-7}$
$= 1.5 \times 10^{-7}$ s (2 sf)

Example 7

(a) $s = ut + 0.5at^2$
$s = ut$
$12.0 / 100 = (9.00 \times 10^6) t$
$t = 1.333 \times 10^{-8}$
$t = 1.33 \times 10^{-8}$ s (3 sf)

(b) $E = F / q$
$E = ma / q$
$a = Eq / m$
$= (1.60 \times 10^3)(1.60 \times 10^{-19}) / (9.11 \times 10^{-31})$
$= 2.810 \times 10^{14}$
$= 2.81 \times 10^{14}$ m s^{-2}

(c) $s = ut + 0.5at^2$
$= 0.5at^2$
$= (0.5)(2.810 \times 10^{14})(1.333 \times 10^{-8})^2$
$= 0.02496$
$= 0.0250$ m (3 sf)

Example 8

(a) Anticlockwise

(b) $F_B = F_C$
$Bqv = mv^2 / r$
$v = Bqr / m$
$= (0.020)(1.6 \times 10^{-19})(0.010) / (9.11 \times 10^{-31})$
$= 3.512 \times 10^7$
$= 3.5 \times 10^7$ m s^{-1}

Example 9

$F_B = F_C$

$Bqv = mv^2 / r$

$v = Bqr / m$

$v = E / B$

$Bqr / m = E / B$

$B^2 = Em / qr$

$B = (Em / qr)^{1/2}$

$= [(40)(9.11 \times 10^{-31}) / (1.6 \times 10^{-19})(5.0 / 100)]^{1/2}$

$= 6.749 \times 10^{-5}$

$= 6.7 \times 10^{-5}$ T (2 sf)