12rev 2
Answer Section

SHORT ANSWER

1. ANS:
   The vectors must be perpendicular to each other.

   PTS: 1 DIF: I OBJ: 3-2.2
2. ANS:
   The baby's resultant displacement will be oriented counterclockwise at angle θ from the $-x$-axis, which is west.

   PTS: 1 DIF: II OBJ: 3-2.2
3. ANS:
   resolving the vector

   PTS: 1 DIF: I OBJ: 3-2.3
4. ANS:
   the x-axis

   PTS: 1 DIF: I OBJ: 3-2.3
5. ANS:
   zero

   PTS: 1 DIF: II OBJ: 3-2.3
6. ANS:
   projectile motion

   PTS: 1 DIF: I OBJ: 3-3.1

PROBLEM

7. ANS:
   16.2 m

   Solution
   Students should use graphical techniques. Their answers can be checked using the techniques presented in Section 2.

   $$d = \sqrt{(16.0\ \text{m})^2 + (2.4\ \text{m})^2}$$

   $$d = \sqrt{256\ \text{m}^2 + 5.8\ \text{m}^2}$$

   $$d = \sqrt{262\ \text{m}^2}$$

   $$d = 16.2\ \text{m}$$

PTS: 1 DIF: IIIA OBJ: 3-1.2

8. ANS:

$\frac{2}{3}\mathbf{v}_{\mathbf{plane}}$

Given

$\mathbf{v}_{\mathbf{plane}}$ = 180 km/h west = –180 km/h

$\mathbf{v}_{\mathbf{wind}}$ = 60 km/h east = +60 km/h

Solution

$$v_R = v_{plane} + v_{wind} = -180\ \text{km/h} + (60\ \text{km/h}) = -120\ \text{km/h}$$

$$\frac{v_R}{v_{plane}} = \frac{-120\ \text{km/h}}{-180\ \text{km/h}} = \frac{2}{3}$$

$$\mathbf{v_R} = \frac{2}{3}\mathbf{v_{plane}}$$

PTS: 1 DIF: IIIA OBJ: 3-1.3

9. ANS:

62.0 m

Given

$\Delta x_1 = -1.9 \times 10^1$ m

$\Delta y_1 = 17$ m

$\Delta x_2 = +7.8 \times 10^1$ m

Solution

$$\Delta x_{tot} = \Delta x_1 + \Delta x_2 = (-1.9 \times 10^1\ \text{m}) + (7.8 \times 10^1\ \text{m}) = 5.9 \times 10^1\ \text{m}$$

$$\Delta y_{tot} = \Delta y_1 = 17\ \text{m}$$

$$d^2 = (\Delta x_{tot})^2 + (\Delta y_{tot})^2$$

$$d = \sqrt{(\Delta x_{tot})^2 + (\Delta y_{tot})^2} = \sqrt{(5.9 \times 10^1\ \text{m})^2 + (1.7 \times 10^1\ \text{m})^2}$$

$$d = \sqrt{3.5 \times 10^3\ \text{m}^2 + 2.9 \times 10^2\ \text{m}^2}$$

$$d = \sqrt{3.8 \times 10^3\ \text{m}^2}$$

$$d = 6.2 \times 10^1\ \text{m}$$

PTS: 1 DIF: IIIA OBJ: 3-2.2

10. ANS:

2.5 km

Given

$\mathbf{d_1}$ = 3.3 km at 45.0° north of west = 3.3 km at (180.0° – 45.0°) north of east

$= 3.3$ km at 135.0° north of east
$\mathbf{d}_2 = 3.4$ km south = –3.4 km

Solution

$$\Delta x_1 = d_1 \cos\theta = (3.3\text{ km})(\cos 135.0°)$$

$$\Delta x_1 = (3.3\text{ km})(-0.707)$$

$$\Delta x_1 = -2.3\text{ km}$$

$$\Delta y_1 = d_1 \sin\theta = (3.3\text{ km})(\sin 135.0°)$$

$$\Delta y_1 = (3.3\text{ km})(0.707)$$

$$\Delta y_1 = 2.3\text{ km}$$

$$\Delta x_2 = 0.0\text{ km}$$

$$\Delta y_2 = -3.4\text{ km}$$

$$\Delta x_{tot} = \Delta x_1 + \Delta x_2 = -2.3\text{ km} + 0.0\text{ km} = -2.3\text{ km}$$

$$\Delta y_{tot} = \Delta y_1 + \Delta y_2 = 2.3\text{ km} + (-3.4\text{ km}) = -1.1\text{ km}$$

$$d^2 = (\Delta x_{tot})^2 + (\Delta y_{tot})^2$$

$$d = \sqrt{(\Delta x_{tot})^2 + (\Delta y_{tot})^2} = \sqrt{(-2.3\text{ km})^2 + (-1.1\text{ km})^2}$$

$$d = \sqrt{5.3\text{ km}^2 + 1.2\text{ km}^2}$$

$$d = 2.5\text{ km}$$

PTS: 1 DIF: IIIB OBJ: 3-2.4

11. ANS:
148 m

Given
$\mathbf{v}_i = 15$ m/s at 30.0° above the horizontal
$\Delta t = 6.30$ s
$g = 9.81\text{ m/s}^2$

Solution

$$v_{i,y} = v_i \sin\theta = (15\text{ m/s})(\sin 30.0°) = 7.5\text{ m/s}$$

$$\Delta y = v_{i,y}\Delta t + \frac{1}{2}a_y(\Delta t)^2 = (7.5\text{ m/s})(6.30\text{ s}) + \frac{1}{2}(-9.81\text{ m/s}^2)(6.30\text{ s})^2$$

$$\Delta y = 47\text{ m} - 195\text{ m} = -148\text{ m}$$

$$h = 148\text{ m}$$

PTS: 1 DIF: IIIB OBJ: 3-3.3

12. ANS:
0.77

Given
$F_{applied} = 177\text{ N}$
$F_g = 230\text{ N}$

Solution
$\Sigma F_y = F_n - F_g = 0$

$F_n = F_g$

$\Sigma F_x = F_{applied} - F_{s,max} = 0$

$F_{s,max} = F_{applied}$

$$\mu_k = \frac{F_{s,max}}{F_n} = \frac{F_{applied}}{F_g} = \frac{177\text{N}}{230\text{ N}} = 0.77$$

PTS: 1 DIF: IIIB OBJ: 4-4.4

13. ANS:
3.9 N

Given
$m = 0.86\text{ kg}$
$\mu_k = 0.46$
$g = 9.81\text{ m/s}^2$

Solution
$F_{net,y} = F_n - F_g = 0$

$F_n = F_g$

$F_{net,x} = F_{applied} - F_f = 0$

$F_{applied} = F_f$

$$F_f = \mu_k F_n = \mu_k F_g = \mu_k mg = (0.46)(0.86\text{ kg})(9.81\text{ m/s}^2) = 3.9\text{ N}$$

$F_{applied} = F_f = 3.9\text{ N}$

PTS: 1 DIF: IIIA OBJ: 4-4.4

14. ANS:
6.2 m/s

Given

$v_i = 0$ m/s

$F_g = 43.0$ N

$\theta = 30.0°$

$d = 7.6$ m

$F_k = -5.0$ N

$g = 9.81$ m/s^2

Solution

$W_{net} = \Delta KE$

$W_{net} = F_{net}d = \left(F_g \sin\theta - F_k\right)d$

$\Delta KE = KE_f - KE_i = \frac{1}{2}mv_f^{\,2} - 0 = \frac{1}{2}mv_f^{\,2}$

$F_g = mg$

$$m = \frac{F_g}{g}$$

$$\left(F_g \sin\theta + F_k\right)d = \frac{1}{2}mv_f^{\,2} = \frac{1}{2}\left(\frac{F_g}{g}\right)v_f^{\,2}$$

$$v_f = \sqrt{\frac{2dg\left(F_g \sin\theta + F_k\right)}{F_g}}$$

$$v_f = \sqrt{\frac{(2)(5.0\text{ m})(9.81\text{ m/s}^2)\left[(43.0\text{ N})(\sin 30.0°) + (-5.0)\right]}{43.0\text{ N}}}$$

$$v_f = \sqrt{\frac{(2)(5.0\text{ m})(9.81\text{ m/s}^2)[16.5\text{ N}]}{43.0\text{ N}}}$$

$$v_f = \sqrt{38\text{ m}^2/\text{s}^2}$$

$v_f = 6.2$ m/s

PTS: 1 DIF: IIIC OBJ: 5-2.3

15. ANS:
11.2 m/s

Given

$h = 6.41$ m

$g = 9.81$ m/s^2

Solution

$KE_f = PE_{g,i}$

$\frac{1}{2}mv_f{}^2 = mgh$

$v_f = \sqrt{2gh} = \sqrt{(2)\left(9.81 \text{ m/s}^2\right)(6.41 \text{ m})}$

$v_f = \sqrt{126 \text{ m}^2/\text{s}^2}$

$v_f = 11.2 \text{ m/s}$

PTS: 1 DIF: IIIB OBJ: 5-3.3

16. ANS:
708 kg • m/s downward

Given
$m = 56.0 \text{ kg}$

$\Delta t = 1.29 \text{ s}$

$\mathbf{p_i} = 0 \text{ kg} \bullet \text{m/s upward}$

$\mathbf{g} = 9.81 \text{ m/s}^2 \text{ downward} = -9.81 \text{ m/s}^2$

Solution
$\mathbf{F} = m\mathbf{g} = \left(56.0 \text{ kg}\right)\left(-9.81 \text{ m/s}^2\right) = -549 \text{ N} = 549 \text{ N downward}$

$\mathbf{F}\Delta t = \Delta\mathbf{p} = \mathbf{p_f} - \mathbf{p_i}$

$\mathbf{p_f} = \mathbf{F}\Delta t + \mathbf{p_i} = (-549 \text{ N})(1.29 \text{ s}) + \left(0 \text{ kg} \bullet \text{m/s}\right) = -708 \text{ kg} \bullet \text{m/s}$

$\mathbf{p_f} = 708 \text{ kg} \bullet \text{m/s downward}$

PTS: 1 DIF: IIIC OBJ: 6-1.4

17. ANS:
1.2×10^3 N upward

Given
$m = 56.0 \text{ kg}$

$\mathbf{v_i} = 13.9 \text{ m/s downward}; v_i = -13.9 \text{ m/s}$

$\mathbf{v_f} = 0 \text{ m/s}$

$\Delta t = 0.65 \text{ s}$

Solution
$$F = \frac{\Delta p}{\Delta t} = \frac{m\left(v_f - v_i\right)}{\Delta t} = \frac{\left(56.0 \text{ kg}\right)\left[(0 \text{ m/s}) - (-13.9 \text{ m/s})\right]}{0.65 \text{ s}} = 1.2 \times 10^3 \text{ N}$$

$\mathbf{F} = 1.2 \times 10^3 \text{ N upward}$

PTS: 1 DIF: IIIB OBJ: 6-1.4