

Solutions

PHYS-205A (Midterm Exam 01) 2018 Spring

Prob. 1

Since h^2 and $(r_2 - r_1)^2$ are added together, they must have the same dimension.

$$[h^2] = [(r_2 - r_1)^2]$$
$$= L^2$$

$$\Rightarrow [h] = L$$

Prob. 2

$$x = 2.75 t^2 - 2.00 t + 3.00$$

$$v = \frac{dx}{dt} = 5.50 t - 2.00$$

$$a = \frac{dv}{dt} = 5.50$$

Answer

$$a = 5.50 \frac{m}{s^2}$$

Prob. 3

$$\Delta y =$$

$$\Delta t = 2.90 s$$

$$v_i = ?$$

$$v_f = 0$$

$$a = -9.8 \frac{m}{s^2}$$

$$v_f = v_i + a \Delta t$$

$$0 = v_i + (-9.8)(2.90)$$

$$v_i = (9.8)(2.90) = 28 \frac{m}{s}$$

Prob. 4

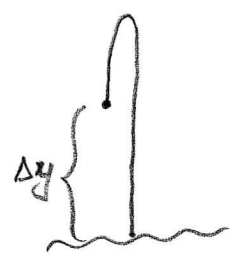
$$\Delta y = -30.0 \text{ m}$$

$$\Delta t =$$

$$v_i = +4.0 \frac{\text{m}}{\text{s}}$$

$$v_f =$$

$$a = -9.8 \frac{\text{m}}{\text{s}^2}$$



$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$-30.0 = 4.0 \Delta t + \frac{1}{2} (-9.8) \Delta t^2$$

$$4.9 \Delta t^2 - 4.0 \Delta t - 30.0 = 0$$

$$\Delta t = \frac{+4.0 \pm \sqrt{4.0^2 - 4(4.9)(-30.0)}}{2(4.9)}$$

$$= \frac{+4.0 \pm 24.6}{9.8} = +2.9 \text{ s (or)} -2.1 \text{ s}$$

↙ correct solution.

Prob. 5

$$3 \vec{A} + 4 \vec{B} = \vec{C}$$

$$2 \vec{A} + 3 \vec{B} = 2 \vec{C}$$

$$\vec{A} = \frac{\begin{vmatrix} 1 & 4 \\ 2 & 3 \end{vmatrix} \vec{C}}{\begin{vmatrix} 3 & 4 \\ 2 & 3 \end{vmatrix}} = -5 \vec{C} = -5(3\hat{i} + 4\hat{j}) = -15\hat{i} - 20\hat{j}$$

$$\vec{B} = \frac{\begin{vmatrix} 3 & 1 \\ 2 & 2 \end{vmatrix} \vec{C}}{\begin{vmatrix} 3 & 4 \\ 2 & 3 \end{vmatrix}} = 4 \vec{C} = 4(3\hat{i} + 4\hat{j}) = 12\hat{i} + 16\hat{j}$$

Prob. 6

$\Delta x = 36.0 \text{ m}$

$\Delta t = 2.35 \text{ s}$

$V_{xi} = 20.0 \cos 40^\circ$
 $= 15.3 \frac{\text{m}}{\text{s}}$

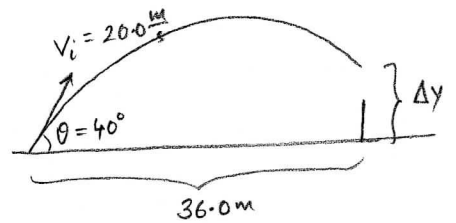
$\Delta y = ?$

$\Delta t = 2.35 \text{ s}$

$V_{yi} = 20.0 \sin 40^\circ$
 $= 12.9 \frac{\text{m}}{\text{s}}$

$a_y = -9.8 \frac{\text{m}}{\text{s}^2}$

$V_{yf} =$



$\frac{\Delta x}{\Delta t} = V_{xi}$

$\frac{36.0}{\Delta t} = 15.3$

$\Delta t = 2.35 \text{ s}$

$\Delta y = V_{yi} \Delta t + \frac{1}{2} a_y \Delta t^2$
 $= (12.9)(2.35) + \frac{1}{2}(-9.8)(2.35)^2$
 $= 30.32 - 27.06$
 $= 3.26 \text{ m}$

The football clears the crossbar by $3.26 - 3.05 = 0.20 \text{ m}$.

Prob. 7

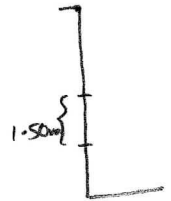
$\Delta y = -1.50 \text{ m}$

$\Delta t = 0.125 \text{ s}$

$V_i = ?$

$V_f =$

$a = -9.8 \frac{\text{m}}{\text{s}^2}$



$\Delta y = V_i \Delta t + \frac{1}{2} a \Delta t^2$
 $-1.50 = V_i(0.125) + \frac{1}{2}(-9.8)(0.125)^2$
 $\Rightarrow V_i = -11.39 \frac{\text{m}}{\text{s}}$

$\Delta y = ?$

$\Delta t =$

$V_i = 0$

$V_f = -11.39 \frac{\text{m}}{\text{s}}$

$a = -9.8 \frac{\text{m}}{\text{s}^2}$

$2a \Delta y = V_f^2 - V_i^2$

$2(-9.8) \Delta y = (-11.39)^2 - 0^2$

$\Delta y = -6.6 \text{ m}$

→ height between window top and roof is 6.6 m.