Solutions

PHYS-205A, Fall 2016, Midterm Exam 1

Prob. 1

Given $[r_1] = [r_2] = L$

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

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

$\Rightarrow [h] = L$

$[K] = [(r_1 - r_2)] \left[\sqrt{h^2 + (r_2 - r_1)^2}\right]$

$= [r_1][h]$

$= L^2$

Thus, the variable K has the dimensions of area.

Prob. 2

$x = 54t - 2.0t^3$

stopping means $\frac{dx}{dt} = 0$.

$\frac{dx}{dt} = 54 - 6.0t^2$

$\frac{dx}{dt} = 0 \Rightarrow 54 - 6.0t^2 = 0$

$\Rightarrow t = \pm 3.0$ s

Thus, the objects stops at $t = +3.0$ seconds after start.

Prob. 3

$\Delta x = 37.5\ m$ $\qquad V_i =$ $\qquad a = -3.00\ \frac{m}{s^2}$.

$\Delta t = ?$ $\qquad V_f = 0$

$$\Delta x = V_f \Delta t - \frac{1}{2} a \Delta t^2$$

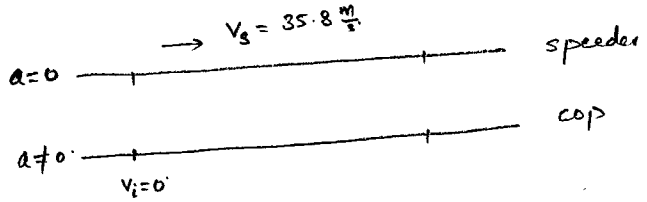
($V_f = 0$)

$$37.5 = 0 - \frac{1}{2}(-3.00)\Delta t^2.$$

$$\Delta t = \pm 5.00 \text{ seconds}$$

Answer: $\Delta t = +5.00\ s$.

Prob. 4



cop $\qquad$ speeder

$x_p = \frac{1}{2} a t^2$ $\qquad x_s = V_s t$

$$x_p = x_s$$

$$\frac{1}{2} a t^2 = V_s t$$

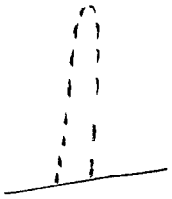
$$t = \frac{2V_s}{a} = \frac{2 \times 35.8}{3.00}$$

$$= 23.9 \text{ seconds}$$

Prob. 5

$\Delta y =$ $\quad V_i = ?$ $\quad a = -9.8 \frac{m}{s^2}$.

$\Delta t = 2.80\,s$ $\quad V_f = 0$



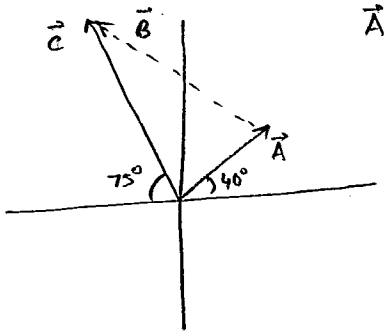
$$V_f = V_i + a\,\Delta t$$

$$0 = V_i - 9.8 \times 2.80$$

$$V_i = 27.44 \ \frac{m}{s}$$

Prob. 6

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



$$\vec{B} = \vec{C} - \vec{A}$$

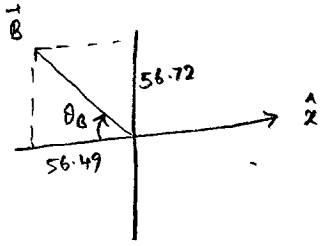
$$\vec{C} = -88\cos 75\,\hat{i} + 88\sin 75\,\hat{j}$$

$$= -22.78\,\hat{i} + 85.00\,\hat{j}$$

$$\vec{A} = 44\cos 40\,\hat{i} + 44\sin 40\,\hat{j}$$

$$= +33.71\,\hat{i} + 28.28\,\hat{j}$$

$$\vec{B} = \vec{C} - \vec{A} = -56.49\,\hat{i} + 56.72\,\hat{j}$$



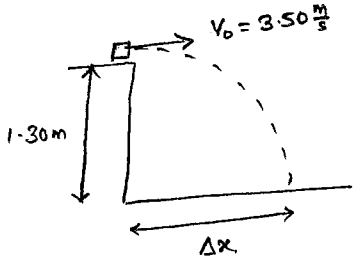
magnitude: $|\vec{B}| = \sqrt{(56.49)^2 + (56.72)^2}$

$= 80.1\ m$

direction: $\theta_B = \tan^{-1}\left(\frac{56.72}{56.49}\right)$

$= 45.1^\circ$ clockwise w.r.t $-\hat{x}$

Prob. 7



x-dir

$\Delta x = ?$

$\Delta t =$

$V_{ix} = 3.50 \frac{m}{s}$

y-dir

$\Delta y = -1.30\ m$

$\Delta t =$

$V_{iy} = 0$

$V_{fy} =$

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

Find Δt using y-motion:

$$\Delta y = \cancel{V_{iy}}^{=0} \Delta t + \frac{1}{2} a_y \Delta t^2$$

$$-1.30 = -\frac{1}{2} 9.8\, \Delta t^2 \Rightarrow \Delta t = 0.515 \text{ seconds}$$

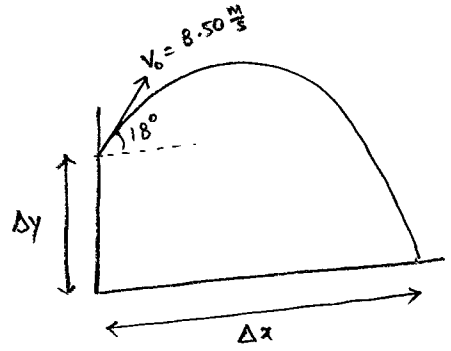
Find Δx using x-motion:

$$\Delta x = V_{ix} \Delta t$$

$$= \left(3.50 \frac{m}{s}\right) \times (0.515\ s)$$

$$= 1.8\ m$$

Prob. 8



x-dir

$\Delta x =$

$\Delta t =$

$V_{ix} = 8.5 \cos 18$

$= 8.08 \frac{m}{s}$

y-dir

$\Delta y = ?$

$\Delta t = 6.00\ s$

$V_{iy} = 8.50 \sin 18$

$= 2.63 \frac{m}{s}$

$V_{fy} =$

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

Find Δy using y-motion:

$$\Delta y = V_{iy} \Delta t + \frac{1}{2} a_y \Delta t^2$$

$$= 2.63 \times 6.00 + \frac{1}{2}(-9.8)(6.00)^2$$

$$= 15.78 - 176.4$$

$$= -160.6\ m$$