

Solutions

PHYS-205A-002

(Fall 2017)

Midterm Exam 1

①

Prob. 1

$$[D \Lambda] = \left[\frac{8\pi G}{c^4} \epsilon \right]$$

$$[\Lambda] = \frac{[G]}{[c]^4} \frac{[\epsilon]}{[D]}$$

$$= \frac{L^3}{M T^2} \frac{T^4}{L^4} \frac{M}{L T^2} = \frac{1}{L^2}$$

Prob. 2

$$x(t) = 75t - 1.0t^3$$

$$v(t) = \frac{dx}{dt} = 75 - 3.0t^2$$

$$a(t) = \frac{dv}{dt} = -6.0t$$

When it stops, $v = 0 \Rightarrow 75 - 3.0t^2 = 0$
 $\Rightarrow t^2 = 25$
 $\Rightarrow t = \pm 5.0 \text{ s}$

$$a(+5.0 \text{ s}) = -6.0(+5.0) = -30. \frac{\text{m}}{\text{s}^2}$$

$$a(-5.0 \text{ s}) = -6.0(-5.0) = +30. \frac{\text{m}}{\text{s}^2}$$

Prob. 3

$$\Delta x = 44.0 \text{ m}$$

$$\Delta t = 8.20 \text{ s}$$

$$a = ?$$

$$v_i =$$

$$v_f = 2.50 \frac{\text{m}}{\text{s}}$$

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

$$44.0 = 2.50(8.20) - \frac{1}{2} a(8.20)$$

$$a = -0.700 \frac{\text{m}}{\text{s}^2}$$

Prob. 4

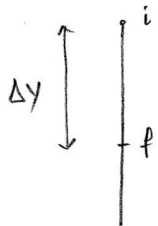


$$\begin{aligned} \Delta y &= ? \\ \Delta t &= 3.00 \text{ s} \\ a &= -9.8 \frac{\text{m}}{\text{s}^2} \end{aligned}$$

$$\begin{aligned} v_i &= \\ v_f &= 0 \end{aligned}$$

$$\begin{aligned} \Delta y &= v_f \Delta t - \frac{1}{2} a \Delta t^2 \\ &= 0 - \frac{1}{2} (-9.8) (3.00)^2 \\ &= 44.1 \text{ m} \end{aligned}$$

Prob. 5



$$\begin{aligned} \Delta y &= 12.2 - 36.6 \\ &= -24.4 \text{ m} \\ \Delta t &= 2.00 \text{ s} \\ a &= -9.8 \frac{\text{m}}{\text{s}^2} \end{aligned}$$

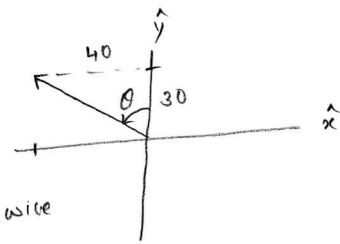
$$\begin{aligned} v_i &= \\ v_f &= ? \end{aligned}$$

$$\begin{aligned} \Delta y &= v_f \Delta t - \frac{1}{2} a \Delta t^2 \\ -24.4 &= v_f (2.00) - \frac{1}{2} (-9.8) (2.00)^2 \\ v_f &= -2.4 \frac{\text{m}}{\text{s}} \end{aligned}$$

Prob. 6

magnitude = $\sqrt{40^2 + 30^2} = 50.0$ units

direction: $\theta = \tan^{-1}\left(\frac{40}{30}\right) = 53.1^\circ$ counterclockwise w.r.t. $+\hat{y}$



Prob. 7

$$\begin{aligned} \vec{A} &= 4.00 \hat{i} + 2.00 \hat{j} \\ \vec{B} &= -5.00 \hat{i} + 3.00 \hat{j} \\ \vec{C} = \vec{A} + \vec{B} &= -1.00 \hat{i} + 5.00 \hat{j} \end{aligned}$$

magnitude: $|\vec{C}| = \sqrt{5^2 + 1^2} = 5.10$

direction: $\theta = \tan^{-1}\left(\frac{5.00}{1.00}\right) = 78.7^\circ$ clockwise w.r.t. $-\hat{x}$

