Name________________________________

Sept. 19, 2007

Quiz #1 — Fall 2007

Phys 2010 – NSCC

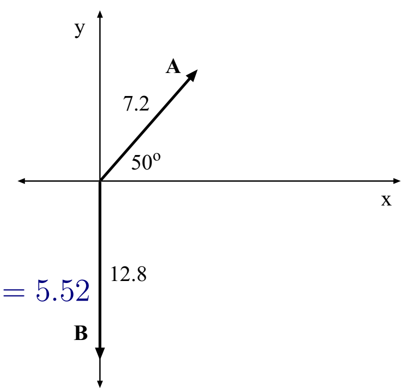
1. The moon is receding from the Earth at a rate of about $3.0\,\frac{\text{cm}}{\text{year}}$. Convert this value to units of $\frac{\text{m}}{\text{s}}$.

You can use the relation 1 year $= 3.16 \times 10^7$ s.

We find:

$$3.0\,\frac{\text{cm}}{\text{year}} = (3.0\,\frac{\text{cm}}{\text{year}})\left(\frac{1.0\text{ m}}{100\text{ cm}}\right)\left(\frac{1\text{ year}}{3.16 \times 10^7\text{ s}}\right) = 9.49 \times 10^{-10}\,\frac{\text{m}}{\text{s}}$$

2. Vector $\mathbf{A}$ has a magnitude of 7.2 and is directed at 50° above the x axis. Vector $\mathbf{B}$ has a magnitude of 12.8 and points in the $-y$ direction.



a) Find the x and y components of $\mathbf{A}$ and $\mathbf{B}$.

With $\theta = 50°$,

$$A_x = A\cos\theta = 7.2\cos 50° = 4.63 \qquad A_y = A\sin\theta = 7.2\sin 50° = 5.52$$

Since $\mathbf{B}$ points in the $-y$ direction and has magnitude 12.8 it is clear that

$$B_x = 0 \qquad B_y = -12.8$$

b) Find the magnitude and direction of $\mathbf{A} + \mathbf{B}$

If $\mathbf{C} = \mathbf{A} + \mathbf{B}$ then

$$C_x = A_x + B_x = 4.63 \qquad C_y = A_y + B_y = -7.28$$

Then

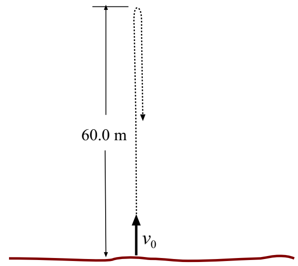
$$C = \sqrt{C_x^2 + C_y^2} = 8.63$$

and the direction of $\mathbf{C}$ is given by

$$\tan\theta = \frac{C_y}{C_x} = -1.57 \qquad \Longrightarrow \qquad \theta = \tan^{-1}(-1.57) = -57.5°\ .$$

This result for the angle is correct because $\mathbf{C}$ clearly has to be in the 4th quadrant.

3. A rock is thrown vertically upward from ground level so that it reaches a maximum height of 60.0 m.



a) What was the initial speed of the rock?

From the time that the rock is thrown to the time it reaches max height, we know:

$$y = 60.0 \text{ m} \qquad v = 0 \qquad a = -g = -9.8\tfrac{\text{m}}{\text{s}^2}$$

We can solve for v_0 using

$$v^2 = v_0^2 + 2ay \qquad \Longrightarrow \qquad v_0^2 = v^2 - 2ax = 0 - 2(-9.8\tfrac{\text{m}}{\text{s}^2})(60.0 \text{ m}) = 1176 \tfrac{\text{m}^2}{\text{s}^2}$$

Then:

$$v_0 = 34.3\tfrac{\text{m}}{\text{s}}$$

b) How long did it take the rock to reach maximum height?

At what time does $v = 0$? Use

$$v = v_0 + at \qquad \Longrightarrow \qquad t = \frac{(v - v_0)}{a} = \frac{(0 - 34.3\frac{\text{m}}{\text{s}})}{-9.8\frac{\text{m}}{\text{s}^2}} = 3.50 \text{ s}$$

You must show all your work and include the right units with your answers!

$$A_x = A\cos\theta \qquad A_y = A\sin\theta \qquad A = \sqrt{A_x^2 + A_y^2} \qquad \tan\theta = A_y/A_x$$

$$v_x = v_{0x} + a_x t \qquad x = v_{0x}t + \tfrac{1}{2}a_x t^2 \qquad v_x^2 = v_{0x}^2 + 2a_x x \qquad x = \tfrac{1}{2}(v_{0x} + v_x)t$$

$$v_y = v_{0y} + a_y t \qquad y = v_{0y}t + \tfrac{1}{2}a_y t^2 \qquad v_y^2 = v_{0y}^2 + 2a_y y \qquad y = \tfrac{1}{2}(v_{0y} + v_y)t$$

$$g = 9.80\tfrac{\text{m}}{\text{s}^2} \qquad \mathbf{F}_{\text{net}} = m\mathbf{a}$$