Name_____

Sept. 15, 2008

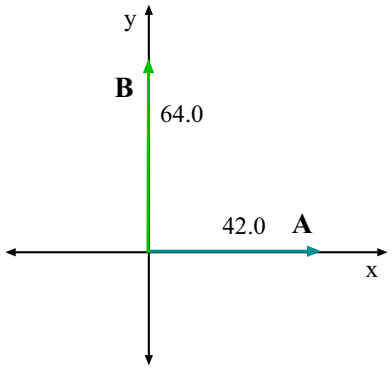
Quiz #1 — Fall 2008

Phys 2110 – Sec 3

1. Convert $0.027\ \frac{\text{g}}{\text{cm}^2}$ (a mass per unit area) to units of $\frac{\text{kg}}{\text{m}^2}$

$$0.027\ \tfrac{\text{g}}{\text{cm}^2} = (0.027\ \tfrac{\text{g}}{\text{cm}^2})\left(\frac{1\ \text{kg}}{1000\ \text{g}}\right)\left(\frac{100\ \text{cm}}{1\ \text{m}}\right)^2 = 0.27\ \tfrac{\text{kg}}{\text{m}^2}$$

2. Vector **A** has magnitude 42.0 and points in the $+x$ direction. Vector **B** has magnitude 64.0 and points in the $+y$ direction.



Find the direction and magnitude of $\mathbf{B} - \mathbf{A}$.

Here, $\mathbf{A} = 42.0\mathbf{i}$ and $\mathbf{B} = 64.0\mathbf{j}$. Then

$$\mathbf{B} - \mathbf{A} = -42.0\mathbf{i} + 64.0\mathbf{j}$$

This is a vector in the second quadrant. Its magnitude is

$$\text{Mag} = \sqrt{(-42.0)^2 + (64.0)^2} = 76.6$$

The direction of this vector is found from

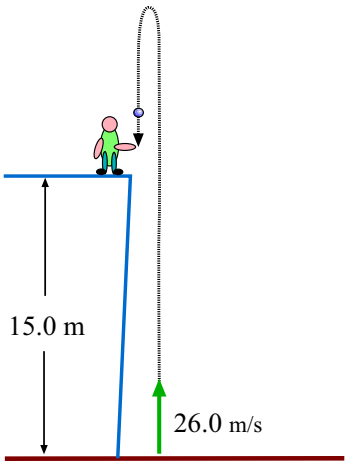
$$\tan\theta = \frac{V_y}{V_x} = -1.52$$

which can't be $-56.7°$ as a calculator gives, but rather

$$\theta = -56.7° + 180° = 123°$$

Magnitude and direction are $\boxed{76.6}$ and $\boxed{123°}$.

3. From ground level you toss a ball upward with a speed of $26.0\frac{\text{m}}{\text{s}}$. It rises and then on way down it is caught your friend at a height of 15.0 m above the ground.



a) What is the *velocity* of the ball when your friend catches it?

Use

$$v^2 = v_0^2 + 2a(y - y_0) = (26.0\tfrac{\text{m}}{\text{s}})^2 2(-9.8\tfrac{\text{m}}{\text{s}^2})(15\text{ m}) = 382\ \tfrac{\text{m}^2}{\text{s}^2}$$

Since v must be negative, this gives

$$v = -19.5\tfrac{\text{m}}{\text{s}}$$

b) What was the maximum height attained by the ball?

Maximum height is the place where $v = 0$. We can use:

$$0 = v_0^2 + 2a(y) \qquad \Longrightarrow \qquad y = -\frac{v_0^2}{2a} = -\frac{(26.0\frac{\text{m}}{\text{s}})^2}{2(-9.8\frac{\text{m}}{\text{s}^2})} = 34.5\text{ m}$$

c) How long was the ball in flight?

Using the answer from (a), find the time at which $v = -19.5\frac{\text{m}}{\text{s}}$:

$$v = v_0 + at \qquad \Longrightarrow \qquad t = \frac{v - v_0}{a} = \frac{-19.5\frac{\text{m}}{\text{s}} - 26.0\frac{\text{m}}{\text{s}}}{(-9.8\frac{\text{m}}{\text{s}^2})} = 4.64\text{ s}$$

d) At what time (after the launch) did the ball pass your friend on the way *up*?

Here we just directly find the time(s) at which $y = 15$ m. The y equation gives

$$15\text{ m} = (26.0\tfrac{\text{m}}{\text{s}})t + \tfrac{1}{2}(-9.80\tfrac{\text{m}}{\text{s}^2})t^2$$

This gives the quadratic equation

$$4.9t^2 - 26t + 15 = 0$$

which has *two* solutions of which we want the smallest one. The quadratic formula gives:

$$t = \frac{26 - \sqrt{26^2 - 4(4.9)(15)}}{9.8} = 0.659\text{ s}$$

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

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

$$v = v_0 + at \qquad x = x_0 + v_0 t + \tfrac{1}{2}at^2 \qquad v^2 = v_0^2 + 2a(x - x_0) \qquad x - x_0 = \tfrac{1}{2}(v_0 + v)t$$

$$g = 9.80\tfrac{\text{m}}{\text{s}^2} \qquad 1\text{ kg} = 10^3\text{ g}$$