Name_____

Sept. 19, 2011

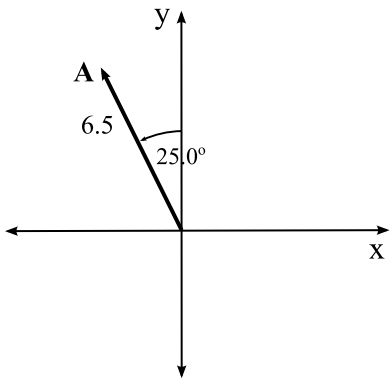
Quiz #1 — Fall 2011

Phys 2110 – Sec 4

1. Convert $0.150\,\frac{\text{m}^2}{\text{kg}}$ to units of $\frac{\text{cm}^2}{\text{g}}$.

$$0.150\,\tfrac{\text{m}^2}{\text{kg}} = \left(0.150\,\tfrac{\text{m}^2}{\text{kg}}\right)\left(\frac{100\text{ cm}}{1\text{ m}}\right)^2\left(\frac{1\text{ kg}}{10^3\text{ g}}\right) = \boxed{1.50\,\tfrac{\text{cm}^2}{\text{g}}}$$

2. **a)** Find the x and y components of the vector $\mathbf{A}$ which has magnitude 6.5 and points at 25.0° counterclockwise from the $+y$ axis.



Measured the normal way the direction of $\mathbf{A}$ is $\theta = 25° + 90° = 115°$, so

$$A_x = 6.5\cos(115°) = \boxed{-2.75} \qquad A_y = 6.5\sin(115°) = \boxed{5.89}$$

b) Find the magnitude and direction of the vector given by

$$\mathbf{C} = -4.00\hat{\mathbf{i}} - 6.00\hat{\mathbf{j}}$$

Magnitude is

$$C = \sqrt{C_x^2 + C_y^2} = 7.21$$

Direction is given by

$$\tan\theta = \frac{C_y}{C_x} = 1.50$$

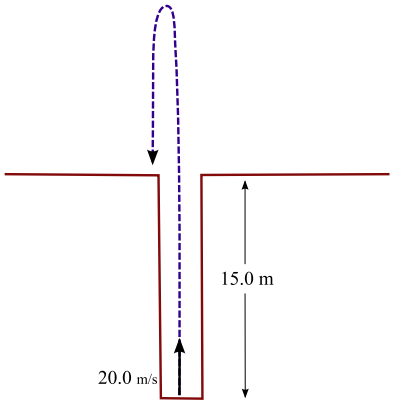
Calculator gives

$$\theta \stackrel{?}{=} 56.3°$$

which can't be right as the vector is in the third quadrant, so add (or subtract) 180° to get the right angle:

$$\theta = 56.3° + 180° = \boxed{236°} = \boxed{-124°}$$

3. A rock is fired straight upward at a speed of $20.0\frac{\text{m}}{\text{s}}$ from the bottom of a hole 15.0 m deep! After flying (nearly) vertically upward it descends and lands at ground level.



a) What was the maximum height attained by the rock *as measured above ground level*?

With the origin at ground level, $y_0 = -15.0$ m, and at maximum height, $v = 0$ so with $a = -g$ we get

$$v^2 = v_0^2 + 2a(y - y_0) \qquad \Longrightarrow \qquad y - y_0 = \frac{v^2 - v_0^2}{2(-g)} = \frac{-(20/0\frac{\text{m}}{\text{s}})^2}{2(-9.8\frac{\text{m}}{\text{s}^2})} = 20.4 \text{ m}$$

so

$$y = y_0 + 20.4 \text{ m} = -15.0 \text{ m} + 20.4 \text{ m} \qquad \Longrightarrow \qquad y = \boxed{5.4 \text{ m}}$$

(By choice of the coordinates, this is the height above ground level.)

b) What was the speed of the rock when it hit the ground?

For the interval from the firing to landing, $v_0 = 20.0\frac{\text{m}}{\text{s}}$, $y - y_0 = 15.0$ m so

$$v^2 = v_0^2 + 2a(y - y_0) = (20.0\tfrac{\text{m}}{\text{s}})^2 + 2(-9.8\tfrac{\text{m}}{\text{s}^2})(15.0 \text{ m})$$

Solve for v:

$$v^2 = 106\ \tfrac{\text{m}^2}{\text{s}^2} \qquad \Longrightarrow \qquad |v| = \boxed{10.3\tfrac{\text{m}}{\text{s}}}$$

c) How long was the rock in flight?

The *velocity* at impact was $-10.3\frac{\text{m}}{\text{s}}$. Use

$$v = v_0 + at \qquad \Longrightarrow \qquad t = \frac{v - v_0}{a}$$

Plug in numbers:

$$t = \frac{-10.3\frac{\text{m}}{\text{s}} - 20.0\frac{\text{m}}{\text{s}}}{(-9.80\frac{\text{m}}{\text{s}^2})} = \boxed{3.09 \text{ s}}$$

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

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

$1 \text{ kg} = 10^3 \text{ g}$ $\quad 1 \text{ m} = 100 \text{ cm}$ $\quad g = 9.80\frac{\text{m}}{\text{s}^2}$ $\quad$ Ignore air resistance.

$$A = \sqrt{A_x^2 + A_y^2} \qquad \tan\theta = \frac{A_y}{A_x}$$