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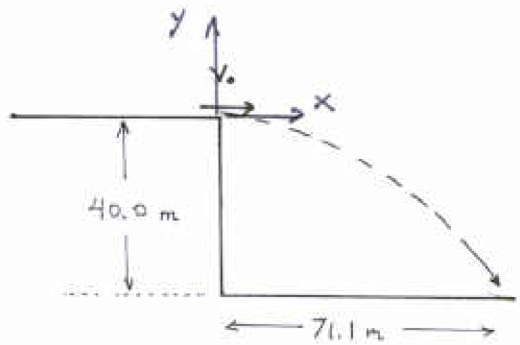
Phys 121 — Section 2

Quiz #2



1. A rock is thrown *horizontally* from the top of a 40 m–high cliff in Physicsland. It lands 71.1 m from the base of the cliff.

a) How long was the rock in flight?

Use the y-eqn of motion:

$y = v_{oy}t + \frac{1}{2}a_y t^2 = 0 - \frac{1}{2}gt^2$

When is $y = -40.0\text{m}$? Solve for t:

$-40.0\text{m} = -\frac{1}{2}(9.80\frac{m}{s^2})t^2 \qquad t^2 = \frac{2(40.0\text{m})}{(9.80\frac{m}{s^2})} = 8.16\,s^2$

$\boxed{t = 2.86\,s}$

b) What was the initial speed of the rock?

From the x-eqn of motion,

$x = v_{x0}t + \frac{1}{2}a_x t^2 = v_{x0}t$

At $t = 2.86s$ we know that $x = 71.1$ m so

$71.1\text{m} = v_{x0}(2.86s) \quad \rightarrow \quad v_{x0} = 24.9\frac{m}{s}$

Since the rock has only an x-comp of velocity then the initial speed is also $\boxed{24.9\frac{m}{s}}$

c) What was the speed of the rock at impact?

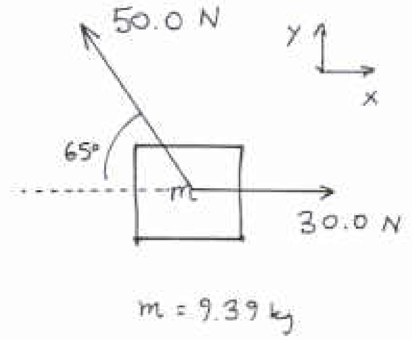
At impact $(t = 2.86s)$ we have:

$v_x = v_{ox} = 24.9\frac{m}{s}$ (No x-acceleration!)

$v_y = v_{oy} + a_y t = 0 + (-9.80\frac{m}{s^2})(2.86s) = 28.0\frac{m}{s}$

Then the speed is

$v = \sqrt{v_x^2 + v_y^2} = \boxed{37.5\frac{m}{s}}$



2. Two (and *only* these two!) forces act on a 9.39 kg mass, as shown: A 30.0 N force acts along the $+x$ axis, and a 50.0 N force acts at an angle 65.0° upward from the $-x$ axis.

a) Find the x and y components of the acceleration of the mass.

Newton sez:

$$\Sigma F_x = (30.0\,N) - (50.0\,N)\cos 65° = 8.87\,N$$

$$a_x = \frac{\Sigma F_x}{m} = \frac{8.87\,N}{(9.39\,kg)} = \boxed{0.944\,\frac{m}{s^2}}$$

$$\Sigma F_y = (50.0\,N)\sin 65° = 45.3\,N$$

$$a_y = \frac{\Sigma F_y}{m} = \frac{45.3\,N}{(9.39\,kg)} = \boxed{4.83\,\frac{m}{s^2}}$$

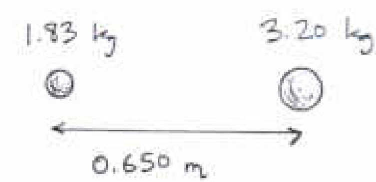
b) Find the magnitude and direction of the acceleration of the mass.

Trig!

$$a = \sqrt{a_x^2 + a_y^2} = \boxed{4.92\,\frac{m}{s^2}}$$

$$\text{Direction (above x axis)} = \tan^{-1}\left(\frac{a_y}{a_x}\right) = \boxed{78.9°}$$

3. A 1.83 kg mass and a 3.20 kg mass (both "small" in size) are separated by 0.650 m. What is the magnitude of the force of gravitational attraction between them?



$$\text{Mag of grav attr force} = F = G\frac{m_1 m_2}{r^2} = \left(6.67\times10^{-11}\,\frac{N\,m^2}{kg^2}\right)\frac{(1.83\,kg)(3.20\,kg)}{(0.650\,m)^2} = \boxed{9.24\times10^{-10}\,N}$$

You must show all your work!

$$A_x = A\cos\theta \qquad A_y = A\sin\theta \qquad A = \sqrt{A_x^2 + A_y^2} \qquad \theta = \tan^{-1}\left(\frac{A_y}{A_x}\right)$$

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

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

$$\Sigma\vec{F} = F_{net} = ma \qquad F = G\frac{m_1 m_2}{r^2} \qquad G = 6.67\times10^{-11}\,\frac{N\cdot m^2}{kg^2} \qquad g = 9.80\,\frac{m}{s^2}$$