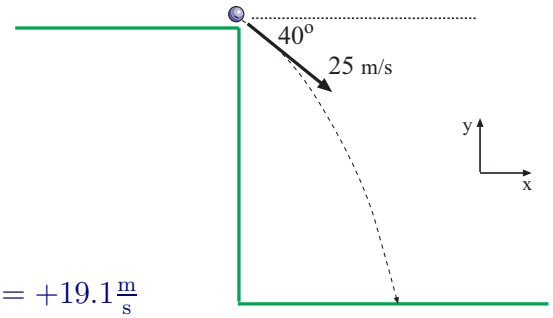
Name_____

Feb. 16, 2007

Quiz #2 — Spring 2007

Phys 2110 – Sec 2

1. A projectile is fired from the cliff with an initial speed of 25$\frac{\text{m}}{\text{s}}$; it is fired at an angle of 40° *below* the horizontal. It strikes the ground 5.20 s later.



a) What are the components of the projectile's initial velocity?

$$v_{ix} = (25.0\tfrac{\text{m}}{\text{s}})\cos 40^\circ = +19.1\tfrac{\text{m}}{\text{s}}$$

$$v_{iy} = (25.0\tfrac{\text{m}}{\text{s}})\sin 40^\circ = -16.1\tfrac{\text{m}}{\text{s}}$$

b) How high is the cliff?

What is value of y at $t = 5.2$ s? Use the y equation of motion; projectile starts at the origin:

$$y = v_{iy}t + \tfrac{1}{2}a_y t^2 = (-16.1\tfrac{\text{m}}{\text{s}})(5.2\text{ s}) + \tfrac{1}{2}(-9.8\tfrac{\text{m}}{\text{s}^2})(5.2\text{ s})^2 = -216\text{ m}$$

The cliff is $\boxed{216\text{ m}}$ high.

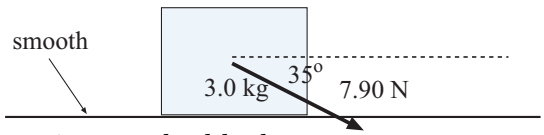
c) How far from the base of the cliff did the projectile land?

What is the value of x at $t = 5.2$ s? Use the x equation of motion:

$$x = v_{ix}t + \tfrac{1}{2}a_x t^2 = (19.1\tfrac{\text{m}}{\text{s}})(5.2\text{ s}) = 99.3\text{ m}$$

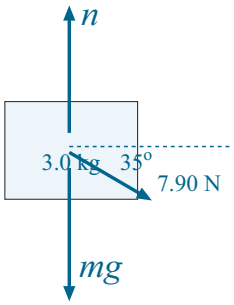
The projectile lands $\boxed{99.3\text{ m}}$ from the base of the cliff.

2. A 3.0 kg block slides on a frictionless horizontal surface. The block is pulled with an applied force of 7.90 N directed at 35.0° *below* the horizontal.



a) Draw a free–body diagram showing all the forces acting on the block:

Forces are shown in the picture at the right. Gravity force goes down, normal force goes upward and the applied force of 7.9 N points at 35° below the horizontal.



b) What is the magnitude of the normal force of the surface on the block?

The total vertical (y) force on the block must be zero since its motion is horizontal. This gives:

$$n - mg - (7.90\text{ N})\sin 35^\circ = 0$$

Then:

$$n = mg + (7.90\text{ N})\sin 35^\circ = (3.0\text{ kg})(9.8\tfrac{\text{m}}{\text{s}^2}) + 4.53\text{ N} = 33.9\text{ N}$$

c) What is the magnitude of the block's acceleration?

Apply Newton's 2nd law for the force(s) in the x direction:

$$F_{\text{net},x} = (7.9\text{ N})\cos 35^\circ = 6.47\text{ N} = ma_x$$

Then:

$$a_x = \frac{(6.47\text{ N})}{(3.0\text{ kg})} = 2.16\tfrac{\text{m}}{\text{s}^2}$$

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

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

$$v_x = v_{ix} + a_x t \qquad x = x_i + v_{ix}\Delta t + \tfrac{1}{2}a_x(\Delta t)^2 \qquad v_x^2 = v_{ix}^2 + 2a_x\Delta x \qquad x - x_i = \tfrac{1}{2}(v_{ix} + v_x)\Delta t$$

$$v_y = v_{iy} + a_y t \qquad y = y_i + v_{iy}\Delta t + \tfrac{1}{2}a_y(\Delta t)^2 \qquad v_y^2 = v_{iy}^2 + 2a_y\Delta y \qquad y - y_i = \tfrac{1}{2}(v_{iy} + v_y)\Delta t$$

$$g = 9.80\tfrac{\text{m}}{\text{s}^2} \qquad a = g\sin\theta \qquad \mathbf{F}_{\text{net}} = m\mathbf{a} \qquad f_{\text{s}}^{\text{max}} = \mu_{\text{s}} n \qquad f_{\text{k}} = \mu_{\text{k}} n$$