PHY 115 – Spring 2014

Quiz 3

NAME: _____

DATE: 3/12/2014

Choose 3 out of the 4 problems below, or do all the problems.

Please use g = 9.80 m/s²

1.

In a videogame, a savvy orangutan fires a cannonball with an initial speed of 55.6 m/s, at an angle of 41.2° above the positive horizontal axis. The cannonball is fired from ground level, and returns to ground level. What is the horizontal range of the flight? Neglect air resistance and wind.

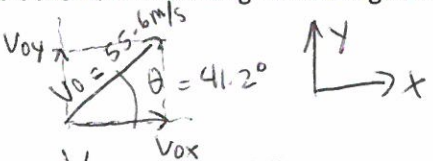
a. 156 m

b. 208 m

c. 313 m

d. 357 m

e. 415 m



$V_{0x} = V_0 \cos\theta =$
$= 55.6\ m/s \cos 41.2° =$
$= 41.83\ m/s$

$V_{0y} = V_0 \sin\theta =$
$= 55.6\ m/s \sin 41.2° = 36.62\ m/s$

$\Delta x = V_{0x} t$ (*) ; $t = ?$

Finding t:

$\Delta \vec{y} = 0 = \vec{V}_{0y} t + \frac{1}{2} \vec{g} t^2$

$0 = 36.62\ m/s\ t - 4.90\ t^2$

$\div t \Rightarrow t = \frac{-36.62\ m/s}{-4.90\ m/s^2} = 7.47\ s$

Substitution (*)

$\Delta x = 41.83\ m/s \times 7.47\ s \simeq \boxed{313\ m}$

2.

Another savvy orangutan drops a bomb from an airplane flying horizontally at a constant speed. Neglecting air resistance and wind, at the time the bomb hits the ground the horizontal position of the airplane:

a. is the same horizontal position of the bomb.

b. is in front of the bomb.

c. is behind the bomb.

d. is unrelated to the horizontal position of the bomb.

e. depends on the mass of the airplane.

Since the speed of the plane is constant and there is no air resistance/wind, the horizontal speed of the bomb is equal to the horizontal speed of the airplane $\Rightarrow V_{0x\,bomb} = V_{0x\,plane} = V_x$

$\Delta x = V_{0x\,bomb} t = V_{0x\,plane} t = V_x t$

3.

A snake is watching a rabbit. The snake is at rest at position (0.00 m, 0.00 m). The rabbit is initially at position (2.00 m, 2.50 m) with respect to the snake. Noticing the presence of the reptile, the rabbit moves to position (-4.00 m, 4.50 m) relative to the snake. What is the rabbit's displacement vector (direction and magnitude)?

a. Magnitude: 6.32 m, direction: 18.4 degrees with respect to the positive horizontal axis.

b. Magnitude: 6.32 m, direction: 162 degrees with respect to the positive horizontal axis.

c. Magnitude: 5.65 m, direction: 19.3 degrees with respect to the positive horizontal axis.

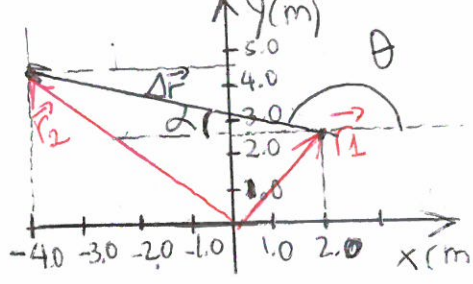
d. Magnitude: 6.30 m, direction: 70.7 degrees with respect to the positive horizontal axis.

e. Magnitude: 5.65 m, direction: 70.7 degrees with respect to the positive horizontal axis.

$\vec{r}_1 = (2.00\ m, 2.50\ m)$

$\vec{r}_2 = (-4.00\ m, 4.50\ m)$

$\Delta\vec{r} = \vec{r}_2 - \vec{r}_1 = (-6.00\ m, 2.00\ m)$



$\Delta r = ?\ ,\ \theta = ?$

$\Delta r = \sqrt{(-6.00\ m)^2 + (2.00\ m)^2}$

$= \sqrt{40.0\ m^2} \simeq \boxed{6.32\ m}$

$\theta = 180° - \alpha$

$\alpha = \tan^{-1}(2.00/6.00)$

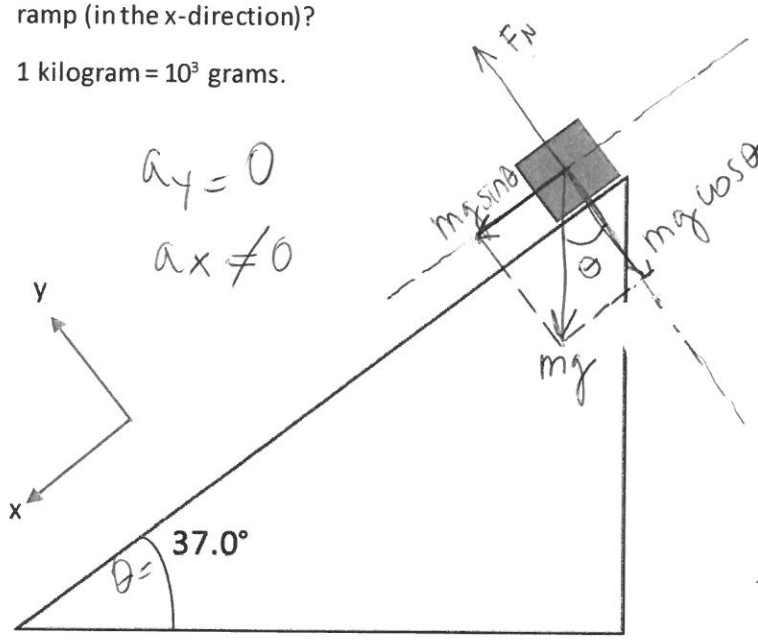
$\simeq 18°$

$\Rightarrow \boxed{\theta \simeq 162°}$

4.

A Rubik's cube is sliding on a frictionless ramp. The mass of the cube is 180 grams. The angle of the incline is 37.0°, as shown below. What is magnitude of the force that accelerates the cube down the ramp (in the x-direction)?

1 kilogram = 10^3 grams.



$a_y = 0$

$a_x \neq 0$

$\sum F_y = 0 = F_N - mg\cos\theta$

$\sum F_x = mg\sin\theta = ma_x$

the only force that accelerates the cube in the x-direction is

$F_x = mg\sin\theta = ma_x =$

$m = 0.180\,kg$

$g = 9.80\,m/s^2$

$\sin\theta = \sin 37.0^\circ \approx 0.602$

a. 0.108 N

b. 1.06 N

c. 1.33 N

d. 1.41 N

e. 1.62 N

Magnitude:

$F_x = mg\sin\theta = 1.80\times10^{-1}\,kg \times 9.80\,m/s^2 \times 0.602$

$\simeq \boxed{1.06\,N}$