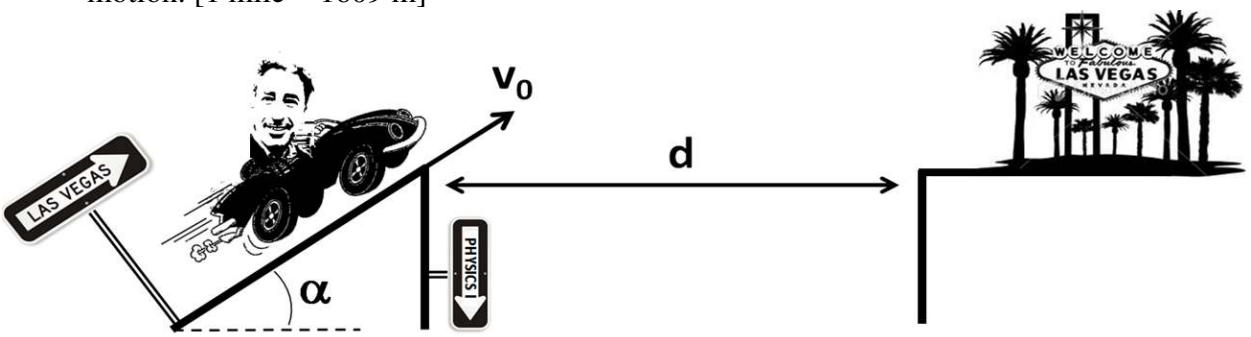
EXAM #1: SPRING SEMESTER 2017 –PHY2048
16 February 2017 – Instructor: Enrique del Barco

NAME _____

P.1 (25 points): Will Enrique make it across the **d** = 200 m road gap into Vegas? Use $\mathbf{v_0}$ = 110 miles/hour, $\alpha = 40^o$ and g = 10m/s^2 to calculate: His a) range and b) maximum height. In addition, c) derive step by step the expression for the time to achieve maximum height from the original equations of motion. [1 mile = 1609 m]



a) Range $X_R \equiv R = \dfrac{V_0^2 \sin(2\alpha)}{g} = 238\ m > d$

$V_0 = 110 \dfrac{miles}{hour} \dfrac{1\,hour}{3600\,s} \cdot \dfrac{1609\,m}{1\,mile} = 49.16\ m/s$

b) $Y_M = \dfrac{V_0^2 \sin^2\alpha}{2g} = 49.94 \sim 50\ m$

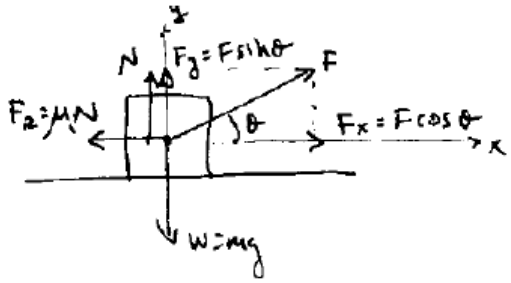
c) Time to arrive to a maximum height:

At the maximum height $V_y = 0$, therefore

$V_y = V_{y0} + gt = 0 \quad [V_{y0} = V_0 \sin\alpha]$

$g t_M = V_0 \sin\alpha \rightarrow t_M = \dfrac{V_0 \sin\alpha}{g}$

P.2 (25 points): A 50.0-kg box is being pulled along a horizontal surface by means of a rope that exerts a force of 250 N at an angle of 28.0 degrees above the horizontal. The coefficient of kinetic friction between the box and the surface is 0.350. a) What is the acceleration of the box?



y) $\Sigma F_y = ma_y = 0 \rightarrow N + F_y - W = 0$

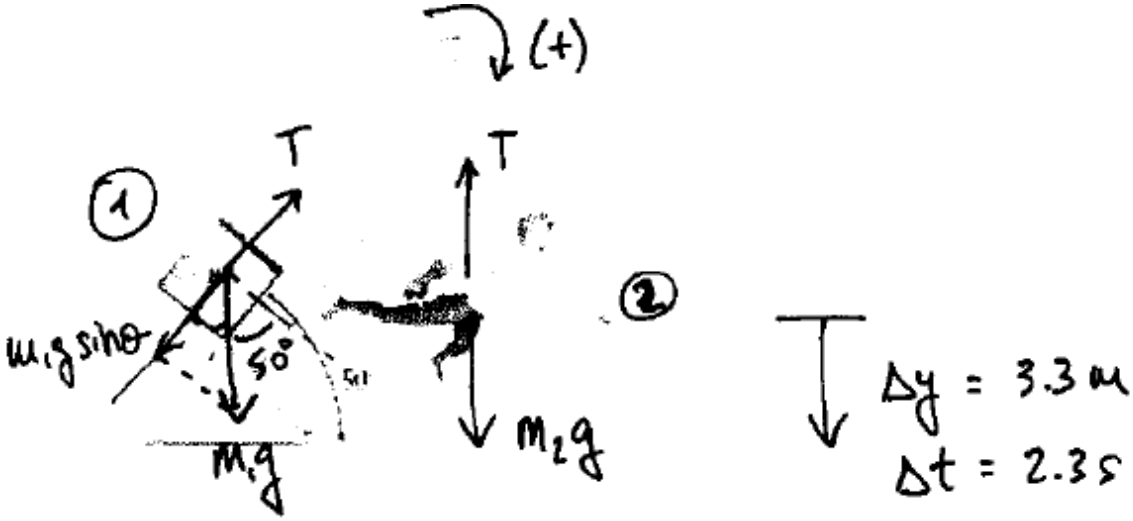
$$N = mg - F\sin\theta$$

x) $\Sigma F_x = ma_x \rightarrow F_x - F_R = ma_x \rightarrow a_x = \frac{F_x - F_R}{m}$

$$a_x = \frac{F\cos\theta - \mu N}{m} = \frac{F\cos\theta - \mu\,[mg - F\sin\theta]}{m}$$

:) $$a_x = \frac{250\,N \cdot \cos 28^\circ - 0{,}350\left[50\,kg \cdot 9.81\,\frac{m}{s^2} - 250\,N\,\sin 28^\circ\right]}{50\,kg} = 1.8\ m/s^2$$

P.3 (25 points): During a stage production of Peter Pan, the 56-kg actress playing Peter has to fly in vertically (descend). To be in time with the music, she must, starting from rest, be lowered a distance of 3.3-m in 2.3-s at a constant acceleration. Backstage, a smooth surface sloped at 50° supports a counterweight of mass *m*, as shown below. a) What mass of the counterweight must the stage manager use? b) What is the resulting tension in the wire?



Acceleration:

$$y - y_0 = \Delta y = \frac{1}{2} a t^2 \longrightarrow \boxed{a = \frac{2\Delta y}{t^2} = \frac{2 \times 3.3\,m}{(2.3)^2 s^2} = 1.248 \frac{m}{s^2}}$$

a) Second Newton's law for each object:

$$\text{①} \quad T - m_1 g \sin\theta = m_1 a$$
$$+ \ \text{②} \quad m_2 g - T = m_2 a$$
$$= \quad \cancel{T} - m_1 g \sin\theta + m_2 g - \cancel{T} = m_1 a + m_2 a$$

Solving for m_1:

$$m_1 a + m_1 g \sin\theta = -m_2 a + m_2 g$$
$$m_1 (a + g \sin\theta) = m_2 (g - a) \longrightarrow \boxed{m_1 = m_2 \frac{(g-a)}{a + g\sin\theta} = 54.7\,kg}$$

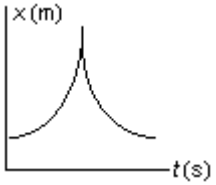
b) From equation ② we obtain:

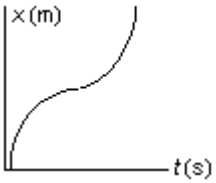
$$\boxed{T = m_2 (g - a) = 56\,kg \left(9.81 \frac{m}{s^2} - 1.248 \frac{m}{s^2}\right) = 479\,N}$$

Q1 (5 points) The position of an object at equal time intervals is shown below:

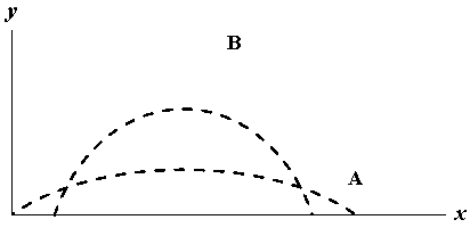
Which graph below correctly represents position versus time for this object?

a. 

b. 

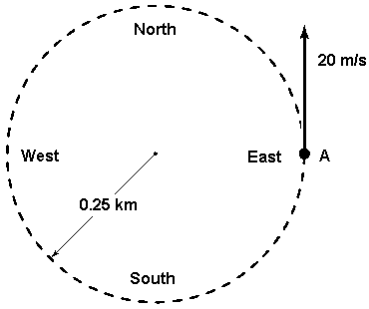
c. 

Q2 (5 points) Two balls, projected at different times so they don't collide, have trajectories A and B, as shown below.
Which statement is correct?



a. v_{0B} must be greater than v_{0A}.
b. Ball A is in the air for a longer time than ball B.
c. Ball B is in the air for a longer time than ball A.
d. Ball B has a greater acceleration than ball A.
e. Ball A has a greater acceleration than ball B.

Q3 (5 points) A car travels counterclockwise around a flat circle of radius 0.25 km at a constant speed of 20 m/s. When the car is at point A as shown in the figure, what is the car's acceleration?



a. 1.6 m/s^2, south
b. Zero
c. 1.6 m/s^2, east
d. 1.6 m/s^2, north
e. 1.6 m/s^2, west

Q4 (5 points) A book is placed on a chair. Then a videocassette is placed on the book. The floor exerts a normal force

a. on all three.
b. only on the book.
c. only on the chair.
d. upwards on the chair and downwards on the book.
e. only on the objects that you have defined to be part of the system.

Q5 (5 points) Two people, each of 70 kg mass, are riding in an elevator. One is standing on the floor. The other is hanging on a rope suspended from the ceiling. Compare the force $\vec{\mathbf{F}}_F$ the floor exerts on the first person to the force $\vec{\mathbf{F}}_R$ the rope exerts on the second person. Which statement is correct?

a. They are equal and opposite in direction.
b. They are equal and have the same direction.
c. $\vec{\mathbf{F}}_R$ is greater than $\vec{\mathbf{F}}_F$, but they have the same direction.
d. $\vec{\mathbf{F}}_R$ is greater than $\vec{\mathbf{F}}_F$, but they have opposite directions.
e. $\vec{\mathbf{F}}_R$ is less than $\vec{\mathbf{F}}_F$, but they have the same direction.