Name _____ Date _____

Honors Physics Gravity and Circles WS #5H

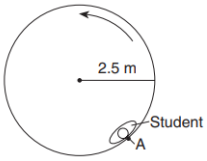
Period _____ Mrs. Nadworny

Amusement Park Physics

Directions – Read textbook pages 257 – 262. Solve the following problems using the GUESS method and correct significant figures. Be sure to show ALL work!

Base your answers to questions 1 and 2 on the information below.

The diagram shows the top view of a 65-kilogram student at point A on an amusement park ride. The ride spins the student in a horizontal circle of radius 2.5 meters, at a constant speed of 8.6 meters per second. The floor is lowered and the student remains against the wall without falling to the floor.



1. Which vector represents the direction of the centripetal acceleration of the student at point A?

A) B) C) D)

2. The magnitude of the centripetal force acting on the student at point A is approximately

(A) 1.2×10^4 N (B) 1.9×10^3 N (C) 2.2×10^2 N (D) 3.0×10^1 N

Base your answers to questions 3 and 4 on the information below.

A go-cart travels around a flat, horizontal, circular track with a radius of 25 meters. The mass of the go-cart with the rider is 200. kilograms. The magnitude of the maximum centripetal force exerted by the track on the go-cart is 1200. newtons.

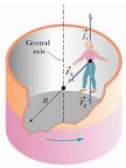
3. What is the maximum speed the 200.-kilogram go-cart can travel without sliding off the track?

(A) 8.0 m/s (B) 150 m/s (C) 12 m/s (D) 170 m/s

4. Which change would increase the maximum speed at which the go-cart could travel without sliding off this track?

A) Decrease the coefficient of friction between the go-cart and the track.
B) Decrease the radius of the track.
C) Increase the radius of the track.
D) Increase the mass of the go-cart.

5. The Rapid Rotor amusement park ride is spinning fast enough that the floor beneath the rider drops away and the rider remains in place. If the Rotor speeds up until it is going twice as fast as it was previously, what is the effect on the frictional force on the rider?



A) The frictional force is reduced to one-fourth of its previous value.
B) The frictional force is the same as its previous value.
C) The frictional force is reduced to one-half of its previous value.
D) The frictional force is increased to four times its previous value.

Continued on next page

1. A popular carnival ride consists of seats attached to a central disk through cables. The passengers travel in uniform circular motion. As shown in the figure, the radius of the central disk is R_0 = 2.80 m, and the length of the cable is L = 3.40 m. The mass of one of the passengers (including the chair he is sitting on) is 69 kg. The angle θ that the cable makes with respect to the vertical is 30.0°

Hint: $r = R_0 + L_x$

   a. What is the magnitude of the force exerted by the cable on the chair?

$\theta_{needed} = 90° - \theta_{given} = 90° - 30.0° = 60.0°$

$F_{net_y} = 0N$

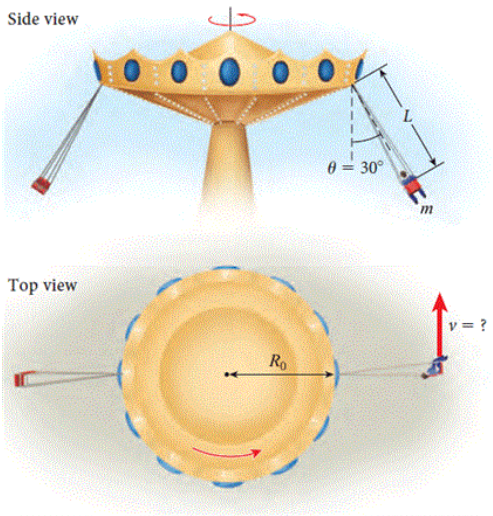
$F_{T_y} = mg$

$F_T \sin\theta = mg$

$F_T = \dfrac{mg}{\sin\theta}$

$F_T = \dfrac{(69kg)(9.81\frac{m}{s^2})}{\sin 60.0°}$

$F_T = 780\ N$



   b. If the angle θ that the cable makes with respect to the vertical is 30.0°, what is the speed, v, of this passenger?

$\theta_{needed} = 90° - \theta_{given} = 90° - 30.0° = 60.0°$

$r = R_0 + L\cos\theta = 2.80\text{ m} + (3.40\text{ m})(\cos 60.0°) = 4.50\text{ m}$

$F_{Tx} = F_T \cos\theta$

$F_{Tx} = 780N\ (\cos 60.0°)$

$F_{Tx} = 390N$

$F_{Tx} = \dfrac{mv^2}{r}$

$v = \sqrt{\dfrac{F_{Tx} \cdot r}{m}}$

$v = \sqrt{\dfrac{(390\text{ N})(4.50\text{ m})}{69\text{ kg}}}$

$v = 5.0\text{ m/s}$

2. A satellite orbits the Earth with a speed of 5000. meters per second. The radius of its orbit is tripled. What is its new speed?

$F_c = F_g \quad \dfrac{mv^2}{r} = \dfrac{GMm}{r^2} \quad v = \sqrt{\dfrac{Gm}{r}} = \sqrt{\dfrac{(1)(1)}{(3)}} = \dfrac{1}{\sqrt{3}} \quad \dfrac{5000.m/s}{\sqrt{3}} = 2887\frac{m}{s}$

Answers in size order: 5.0, 780, 2887