HW #7: Circular Motion (Due 1 am central time, 3/16, Monday).

HW #8: Application of Newton's laws
(Due 1 am central time, 3/23, Monday).

Lecture on 3/13, Friday, will be given by Prof. Sirenko. (same room)

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Last Class...

B2, Ch6. Sec.1-2 : Circular Motion
Uniform Circular Motion

Today.. Non-uniform circular Motion

Other Application of Newton's Laws (B.2, Ch.6, S.3-4)
Non-Uniform circular motion

Changing speed, or, changing magnitude of velocity

Motion along a circle: Changing direction of velocity

Why do we study non-uniform circular motion?

Some exciting motions are non-uniform circular motions!

Example →

An object moving along a circular path with a constant speed:
- Only radial acceleration
- Net force directed toward the center of a curvature (circle).

An object moving along the circular path with a changing speed:
- Both radial and tangential accelerations
- Net force NOT directed toward the center of a curvature (circle).

Radial acceleration: changing direction
Tangential acceleration: changing speed
Even for Non-Uniform circular motion,

Radial component of acceleration
\[ |a_r| = \frac{v^2}{r} \]

Radial component of net force
\[ |F_r| = m \frac{v^2}{r} \]

Radial components follow the same relations as uniform circular motions!

Example: Roller coaster ride (see note)
Example: Ball attached to a rope (see note)

iClicker Quiz

For the roller coaster, the magnitude of normal force at B is ______ mg.

(a) equal to 
(b) less than 
(c) greater than
iClicker Quiz

For the roller coaster, the magnitude of normal force at A is _______ mg.

(a) equal to
(b) less than
(c) greater than

Example: Car moving along a curved horizontal road (see note)

A 1000 kg car moving on a horizontal road negotiates a curve with a radius 20 m. If the coefficient of static friction is 0.5 between the road and tire, what is the maximum speed the car can have to make the turn successfully?
Example: Two objects moving together

A block of mass 4.26 kg lies on a frictionless horizontal surface. The block is connected by a cord passing over a pulley to another block of mass 2.16 kg which hangs in the air, as shown on the following picture. Assume the cord to be light (massless and weightless) and unstretchable and the pulley to have no friction and no rotational inertia.

The acceleration of gravity is 9.8 m/s².

Calculate the acceleration of the first block. Answer in units of m/s².

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Calculate the acceleration of the first block. Answer in units of m/s².

006 (part of 1) 10 points

A 4.8 kg object hangs at one end of a rope that is attached to a support on a railroad boxcar. When the car accelerates to the right, the rope makes an angle of 22° with the vertical.

The acceleration of gravity is 9.8 m/s².

Find the acceleration of the car. (Hint: \[ \vec{a}_{\text{object}} = \vec{a}_{\text{car}} \])