READ 5.4-5.6

H.W #4 solutions on
class web page

Chapter 5

Circular Motion; Gravitation

Uniform circular motion:
motion of an object traveling at a constant instantaneous speed on a circular path

$\vec{v}$ is changing direction → <u>acceleration</u>

centripetal acceleration (radial)

$$a_R = \frac{v^2}{r} \quad (a_c)$$

Few more Definitions

PERIOD (T): TIME to make 1 complete revolution

Frequency (f): number of revolutions in a given time

Frequency and period are related

$T = 1/f \qquad f = \frac{1}{T}$

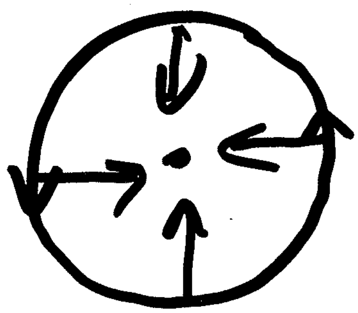
ex) if it takes 4 s for a complete revolution, what is T and f?

$T = 4s \qquad f = \frac{1}{4s}$ (Hz)

Hertz $\left(\frac{1}{s}\right)$

$a_R = \frac{v^2}{r}$ magnitude

$\vec{a}$ is a vector so need a direction



what direction is acceleration?

always toward <u>center</u>

Note a_R not constant
magnitude constant
direction changing

Newton's 2nd law

$$\Sigma F = m a_R = \frac{mv^2}{R}$$

It is **not** a new force. It is the net sum of all forces in radial direction

Tensions

Friction

Centripetal force does **not** appear on free body diagrams

It is <u>not</u> a new force. It is the net sum of all forces in radial direction

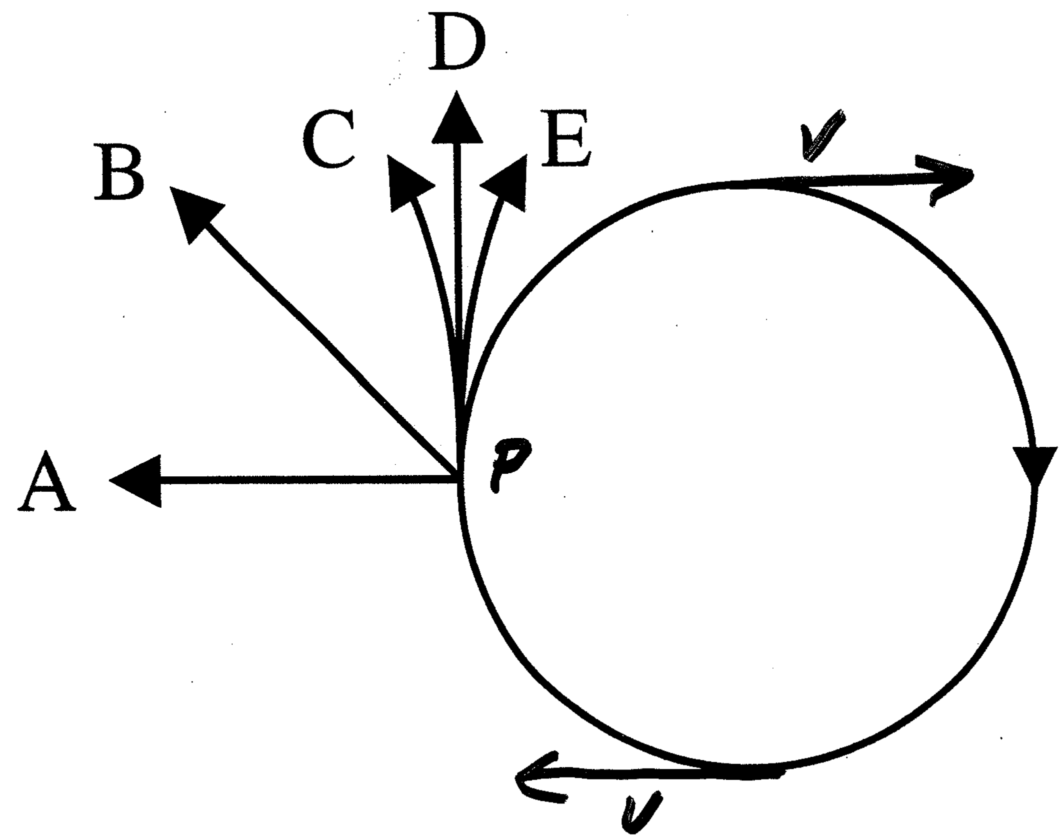
Tensions

Friction

Centripetal force does <u>not</u> appear on free body diagram.

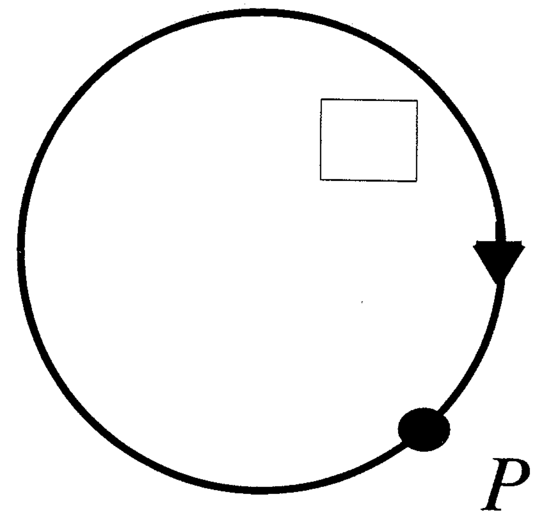
Interactive Question

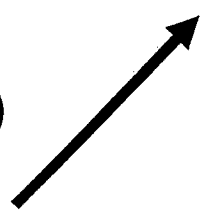
A girl attaches a rock to a string which she then swings clockwise in a horizontal circle. The string breaks at point P on the sketch which shows a view from above. What path will the rock follow?

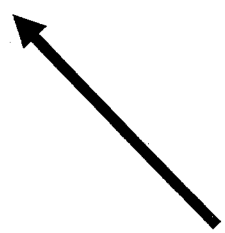


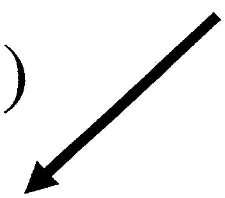
Interactive Question

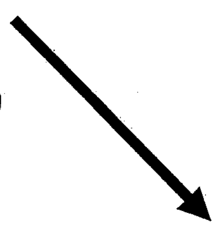
A rock is twirled on a string at a constant speed in a clockwise direction as shown. The direction of its acceleration at point P is



A) 

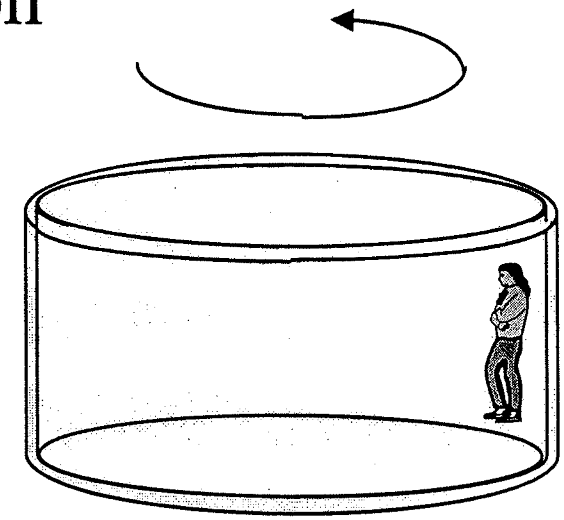
B) 

C) 

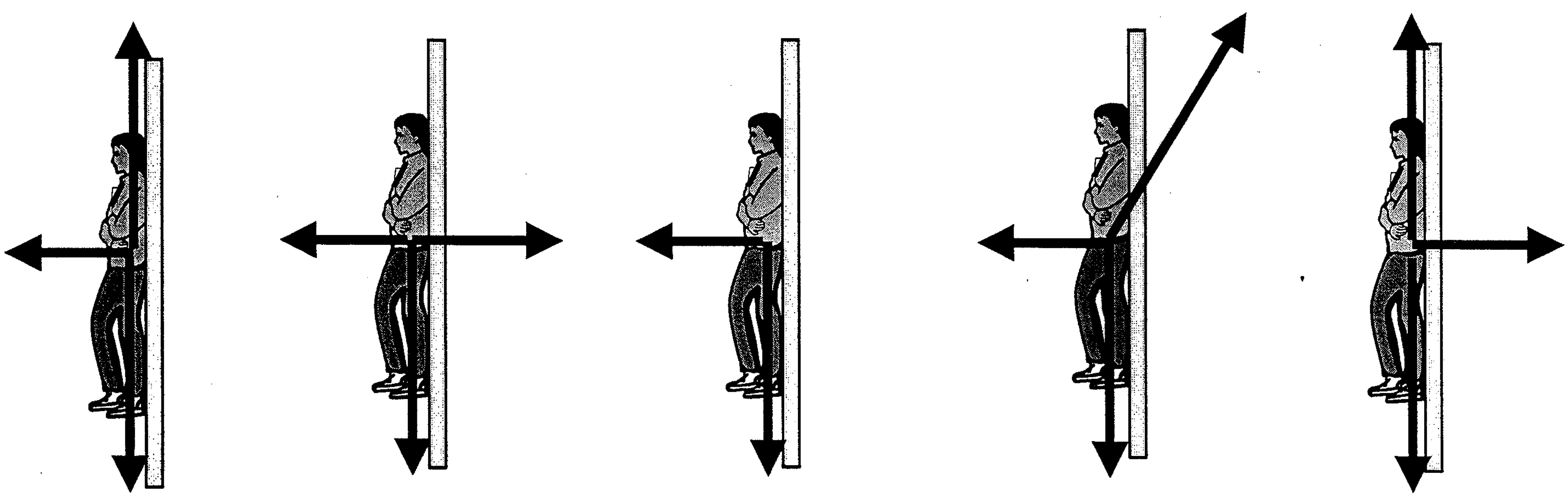
D) 

E) 

Interactive Question

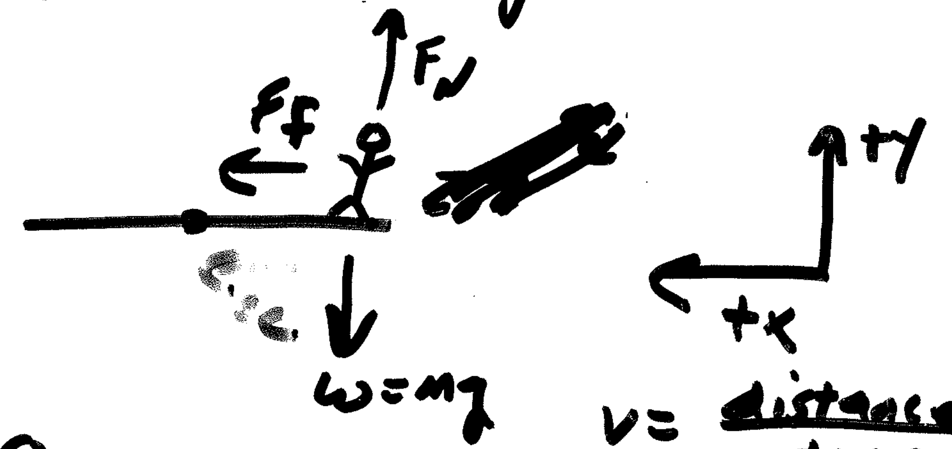


A rider in an amusement park ride, the "barrel of fun" finds herself stuck with her back to the wall. Which diagram correctly shows the forces acting on her?



A) B) C) D) E)

ex) merry-go-round has a radius of 11 m. It rotates at a rate of 1 revolution every 8.2s. If $\mu_s = 0.7$ can you stand at edge without sliding?



$v = \frac{\text{distance}}{\text{time}}$

$v = \frac{2\pi r}{T}$

$v = 2\pi r f$

y: $F_N - mg = 0$

$a_R = \frac{v^2}{r}$

$m a_r = \frac{m v^2}{r} = \frac{m(2\pi r f)^2}{r}$

$m a_r = \frac{m 4\pi^2 r^2 f^2}{r} = m 4\pi^2 r f^2 = m a_r$

$a_r = 4\pi^2 (11\,m)\left(\frac{1\,rev}{8.2\,s}\right)^2 = \boxed{6.5\,m/s^2}$

max frictional force

$\mu_s F_N = \mu_s m g$

$m a_{c\,max} = (0.7)\, m\, (9.8\,m/s^2)$

$a_{c\,max} = 6.9\,m/s^2$

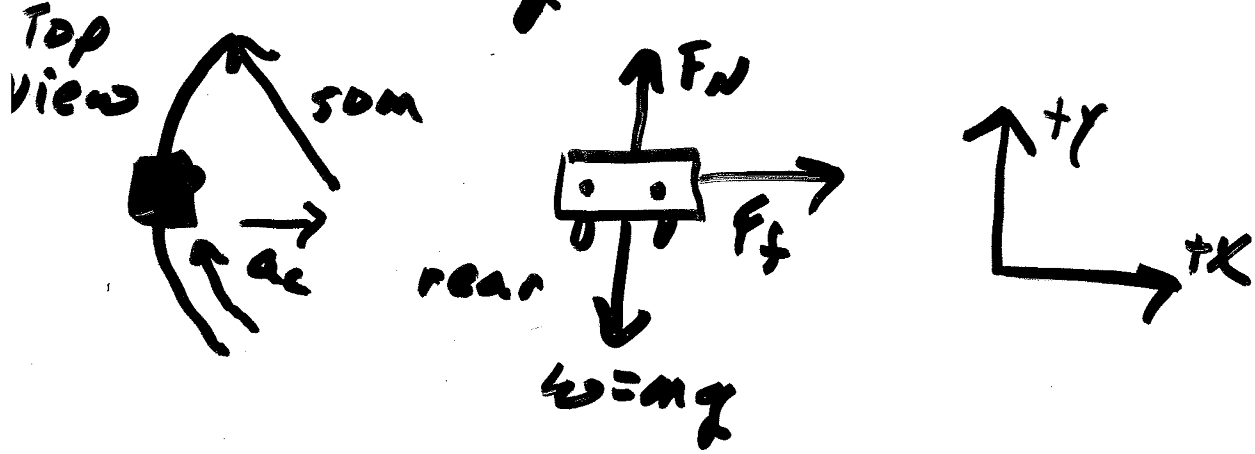
yes

Interactive Question

A 1500 kg car travels at a constant speed of 22 m/s around a circular track which has a radius of 80 m. Which statement is true concerning this car?

A) The velocity of the car is changing.
B) The car is characterized by constant velocity.
C) The car is characterized by constant acceleration.
D) The car has a velocity vector that points along the radius of the circle.
E) More than one of the above is true.

Ex) A car turns a corner on a road of radius 50.0 m. Find max speed car can negotiate turn without sliding. $\mu_s = 0.9$



y: $F_N - mg = 0$

x: $F_f = ma_c = mv^2/r$

$F_f = \mu_s F_N = \mu_s mg$

$\mu_s \cancel{m} g = \cancel{m} v^2/r \Rightarrow v^2 = \mu_s g r$

$v = \sqrt{\mu_s g r}$

$v = \sqrt{(0.9)(9.8\,m/s^2)(50\,m)} = \boxed{21\,m/s}$