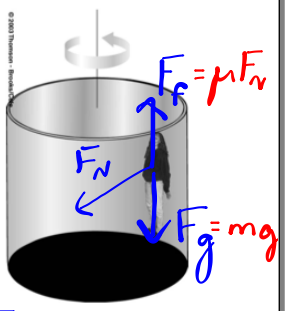
4. At amusement parks, there is a popular ride where the floor of a rotating cylindrical room falls away, leaving the backs of the riders "plastered" against the wall. What is the minimum coefficient of static friction that must exist between a rider's back and the wall, if the rider is to remain in place when the floor drops away?



$\Sigma F = mv^2/r$

$F_N = m\frac{v^2}{r}$

$\mu \cdot F_N = mg$

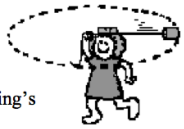
$\mu \frac{\cancel{m}v^2}{r} = \cancel{m}g$

$\mu = \frac{rg}{v^2}$

$V_{min} = \sqrt{\frac{rg}{\mu}}$

Proportional Reasoning IB 11

1. A student swings a rubber stopper around on a string at a constant speed with a centripetal acceleration of 6.0 m/s^2, as shown. What would happen to the acceleration if:



a) the speed is doubled?

4 $a = \frac{(2V)^2}{r}$

b) the speed is halved?

$\frac{1}{4}$ $a = \frac{(\frac{1}{2}V)^2}{r}$

c) the string's length is tripled?

$\frac{1}{3}$ $a = \frac{V^2}{3r}$

d) the speed is doubled and the string's length is halved?

8 $a = \frac{(2V)^2}{(\frac{1}{2}r)}$

e) the mass of the stopper is doubled?

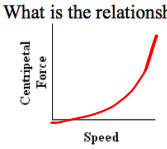
same

f) What would happen to the tension in the string if the mass is doubled and the speed is halved?

$2m\frac{(\frac{1}{2}v)^2}{r}$

Graphical Relationships

2. What is the relationship between centripetal force and speed?

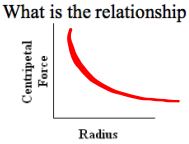


Control: m, r

$\Sigma F = \frac{m v^2}{r}$

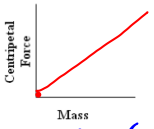
ΣF vs T ?

3. What is the relationship between centripetal force and radius?



Control: v, m

4. What is the relationship between centripetal force and mass?



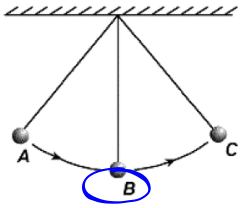
Control: v, r

Vertical Circles

IB 11

1. Is a swinging pendulum in equilibrium? Explain.

no, direction & speed change



2. Is a swinging pendulum in uniform circular motion? Justify your answer.

not const speed

3. Compare the tension in the pendulum's string as it swings.

F_T max at B

fastest

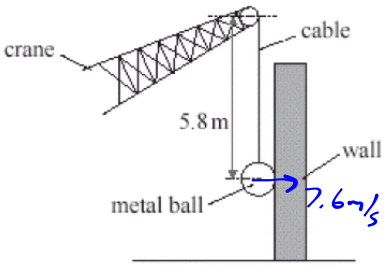
$a_c = \frac{v^2}{r}$

4. Compare the tension in a swinging pendulum to one that is hanging motionless. Sketch appropriate diagrams to aid your explanation.

Hanging

Swinging

5. A 2100-kg demolition ball is attached to the end of a 5.8-m cable.



a) Determine the tension in the cable as the ball hangs motionless.

$F_T = 21000\ N$

$F_g = mg = 21{,}000\ N$

b) The ball is pulled back and released. At the lowest point of the swing, the ball is moving at a speed of 7.6 m/s. Determine the tension in the cable upon impact with the wall.

F_T +

F_g −

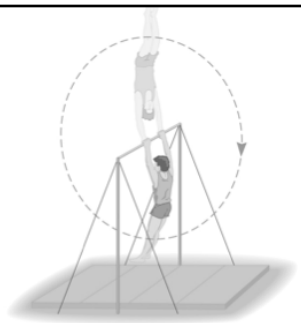
$\Sigma F = m\,v^2/r$

$F_T + F_g = m\,v^2/r$

$F_T = m\frac{v^2}{r} - F_g$

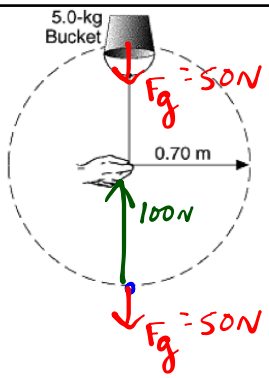
$2100\,kg\frac{(7.6\,m/s)^2}{5.8\,m} - 21{,}000\,N \sim 42{,}000\,N$

6. How much force does this 55 kilogram gymnast deed to hold onto the bar as they swing through the bottom of their swing at 3.4 meters per second? Assume their center of mass is approximately 0.80 meter from their outstretched hands.



1330 N

7. a) What is the maximum speed that this bucket can have at the bottom of its swing if the breaking strength of the rope is 100. newtons?



Breaks at Bottom

$\Sigma F = m\frac{v^2}{r}$

$F_T + F_g = ma$

(+) (-) (+)

+ = points 'in'

$v = \sqrt{\frac{r}{m}(F_T + F_g)}$

+100N -50N

b) What is the minimum speed the bucket must have at the top of its swing to make it around without the water falling out?

V_{min} at top

if $F_g = \Sigma F_{in}$

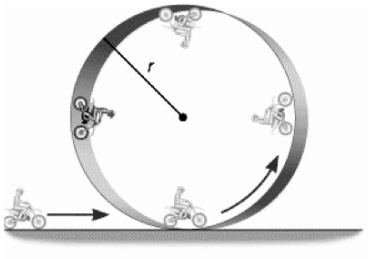
$\cancel{m}g = \frac{\cancel{m}v^2}{r}$

$v_{min} = \sqrt{rg}$

F_g

8. a) Compare the force exerted by the track on the cyclist at the top and the bottom.

Bottom: Top:



b) Derive an expression for the minimum speed the cyclist must have at the top to successfully make it around the track without falling.