[redacted]

NOV 15

Circular Motion is a form of simple harmonic motion

Period (T) is the time required for one cycle, measured in seconds

$$\boxed{T = \frac{\text{time total}}{\#\ \text{cycles}}}$$

Frequency (f)
how often motion is repeated
measured in Hertz (Hz)

$$\boxed{f = \frac{1}{T}}$$

Uniform circular motion (UCM)
→ same shape / radius
→ constant speed

- if we change direction continuously we must have some acceleration

centripetal acceleration ← $\boxed{a_c = \frac{v^2}{r}}$ → centripetal velocity (constant speed)

radius

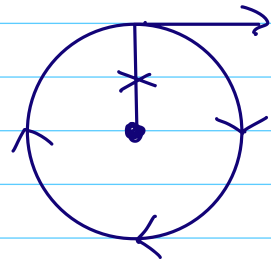
Speed can be calculated as $v = \frac{2\pi r}{T}$

$$\boxed{a_c = \frac{4\pi^2 r}{T^2}}$$

If there is acceleration, there is F_{net}

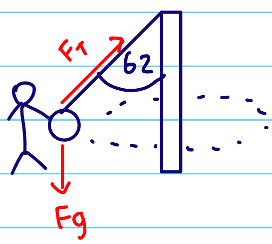
$$\boxed{F_c = \frac{mv^2}{r}} \quad \boxed{F_c = \frac{m4\pi^2 r}{T^2}} \quad \boxed{F_c = m4\pi^2 r f^2}$$

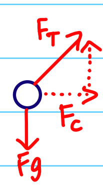
Ex ① Viewed from above. Suppose UCM & the string breaks at X, which way will the object go?



Velocity is $\perp$ to radius

Ex ② If the length of string is $L = 1.25\,m$ what is the speed of the ball?





$1.25 \sin 62^\circ = R$

$R = 1.104\ m$

$\tan 62^\circ = \dfrac{F_c}{F_g}$

$mg\tan 62^\circ = F_c$

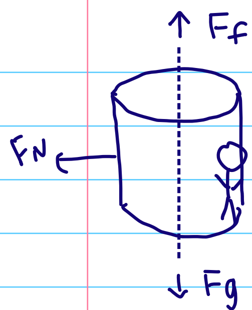
$\cancel{m}g\tan 62^\circ = \dfrac{\cancel{m}v^2}{r}$

$\sqrt{(9.8)(1.104)(\tan 62^\circ)} = v$

$4.51\ m/s = v$

Assignment p. 139-140 1-10 odd

NOV 17 Ex ① An amusement park ride spins fast enough so a person is stuck to the wall and does not side down. If the radius of the ride R is 5.0 m and $\mu = 0.4$. Find the period of the ride.



$$F_f = F_g$$
$$\mu F_N = mg$$

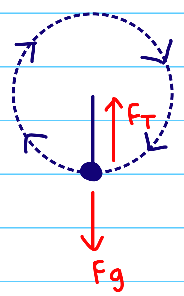
The net force $= F_N$
End result is UCM
$$F_N = F_c$$

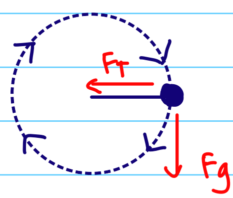
$$\mu F_c = mg$$
$$\mu \left(\frac{m 4\pi^2 r}{T^2}\right) = mg$$

$$\frac{0.4}{9.8} \times 4\pi^2 5 = T^2$$

$$T = 2.84s$$

Ex ② The vertical circle.
A ball $m = 0.15$ kg at the bottom of the circle $r = 1.1$ m
has $v = 6.4$ m/s. Find F_T





$$F_{net} = F_c = F_T - F_g$$

$$F_T - F_g = \frac{mv^2}{r}$$
$$= \frac{(0.15)(6.4)^2}{1.1}$$
$$F_T = 5.58 + mg$$
$$F_T = 5.58 + (0.15)(9.8)$$
$$F_T = 7.1 \text{ N}$$

Determine the minimum velocity at the top of the circle
to keep it in UCM

When F_T is minimum $= 0$

$$F_g + F_T = F_c$$

$$mg = \frac{mv^2}{r}$$

$$gr = v^2$$

$$v = 3.28 \text{ m/s}$$

NOV 21

Assume the driver maintains constant speed
what is the minimum speed needed to enter the loop
radius = 6.096 m

At top $F_c = F_g$

$$\frac{mv^2}{r} = mg$$

$$v = \sqrt{gr}$$

using energy

$$\frac{1}{2}mv_{in}^2 = mgh + \frac{1}{2}mv_{top}^2$$

$$\frac{1}{2}v_{in}^2 = g2r + \frac{1}{2}gr$$

$$\frac{1}{2}v_{in}^2 = (2.5)gr$$

$$v_{in} = \sqrt{5gr}$$

$$= 17.283 \text{ m/s}$$

$$= 62.21 \text{ km/h}$$

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Driver experiences F_N at the bottom

$$F_{net} = F_c = F_g + F_N$$

$$\frac{mv_{in}^2}{r} = -mg + F_N$$

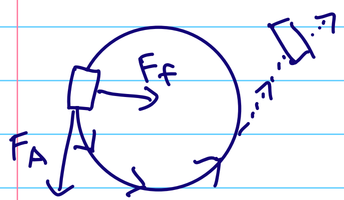
$$5mg = -mg + F_N$$

$$6mg = F_N$$

experiences 6 times as much weight

NOV 27 Marking on curves

Ex① on a flat road, a car ($m = 1000$ kg) rounds a circle ($r = 50.$ m) at $v = 14$ m/s. What μ_s will allow the car to make the turn & not skid?



$$F_c = \frac{mv^2}{r}$$

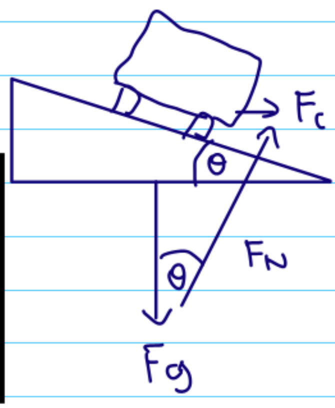
$$\mu \cancel{m} g = \frac{\cancel{m} v^2}{r}$$

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

$$\mu = \frac{14^2}{(9.8)(50)} = 0.4$$

μ is greater than 0.4

Ex ⑦ A car is driving around a circle radius r on a banked road what is the car's velocity v if it is to travel around the circle without friction



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$$\tan\theta = \frac{F_c}{F_g}$$

$$\tan\theta\, gr = v^2$$

$$v = \sqrt{gr\tan\theta}$$

P. 140 # 17, 18, 20