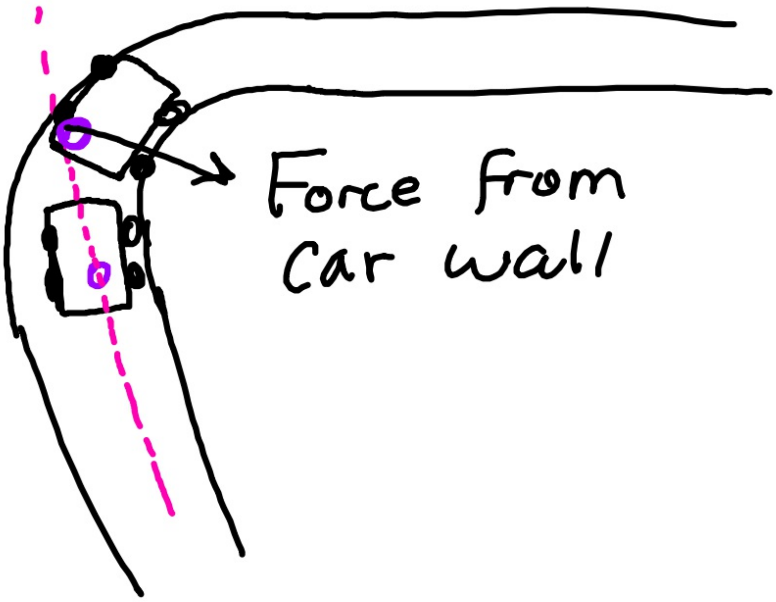
Bellwork 4/24

Why do you get slammed against the side of a car when the driver takes a turn too fast?



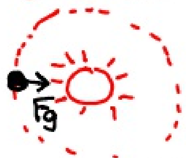
Uniform Circular Motion
UCM

- Uniform → perfect circle
  → constant speed
- An object CAN move at a constant speed and still accelerate (turn)
- Circular motion requires an inward force

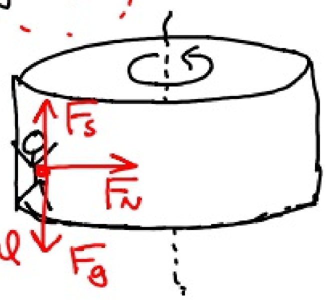
Centripetal

Examples

1. Planet revolving around the sun



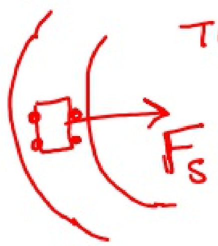
2\.



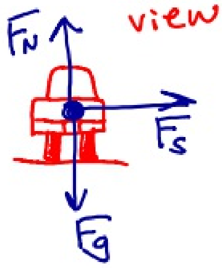
Normal Force is Centripetal Force

3\. Car turning

TOP VIEW



side view



Static Friction is Centripetal Force

V = velocity

r = radius (m)

π = 3.14.....

a_c = centripetal acceleration

T = period (s)

time it takes to make 1 circle

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

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

$$\underbrace{\sum F}_{\text{centripetal net force}} = m a_c$$

Circular Motion Practice sheet 1

$$\boxed{\begin{matrix} T \\ r \\ v \\ a_c \end{matrix} \quad v = \frac{2\pi r}{T} \quad a_c = \frac{v^2}{r}}$$

NEW FORMULAS

① $v = 8.8\frac{m}{s}$ $\quad r = 25\,m$

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

$a_c = \frac{(8.8\frac{m}{s})^2}{25\,m}$

$a_c = 3.1\,\frac{m}{s^2}$

② $T = 5.5\,s$ $\quad r = 56\,m$

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

$V = \frac{2\pi(56m)}{5.5s}$

$V = 64.0\frac{m}{s}$

$a_c = \frac{v^2}{r} = \frac{(64)^2}{56} = 73\,\frac{m}{s^2}$

③ $r = 2m$ $\quad T = 0.2s$

$V = \frac{2\pi r}{T} = 63\frac{m}{s}$

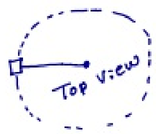
$a_c = \frac{v^2}{r} = 1985\,\frac{m}{s^2}$

---

1. $T = 1.18\,s$

$m = 0.013\,kg$

$r = 0.93\,m$



FBD

a)

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

$V = \frac{2\pi(0.93m)}{1.18s}$

$V = 4.95\frac{m}{s}$

$\Sigma F = ma_c$

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

$F_T = \frac{(0.013kg)(4.95\frac{m}{s})^2}{0.93m}$

$\boxed{F_T = 0.343\,N}$

b) m is doubled

$v = \frac{2\pi r}{T}$ (no change)

$a_c = \frac{v^2}{r}$ (no change)

$F_T = ma_c$ (F_T is doubled)

c) r is doubled

$v = \frac{2\pi r}{T}$ (v is doubled)

$a_c = \frac{v^2}{r} = \frac{\left(\frac{2\pi r}{T}\right)^2}{r} = \frac{\frac{4\pi^2 r^{\cancel{2}}}{T^2}}{\cancel{r}} = \frac{4\pi^2 r}{T^2}$ (a_c is doubled)

$F_T = ma_c$ (force is doubled)

d) T is halved

$\Rightarrow$ v is doubled

$\Rightarrow$ a_c is 4 times larger

$\Rightarrow$ F_T is 4 times larger