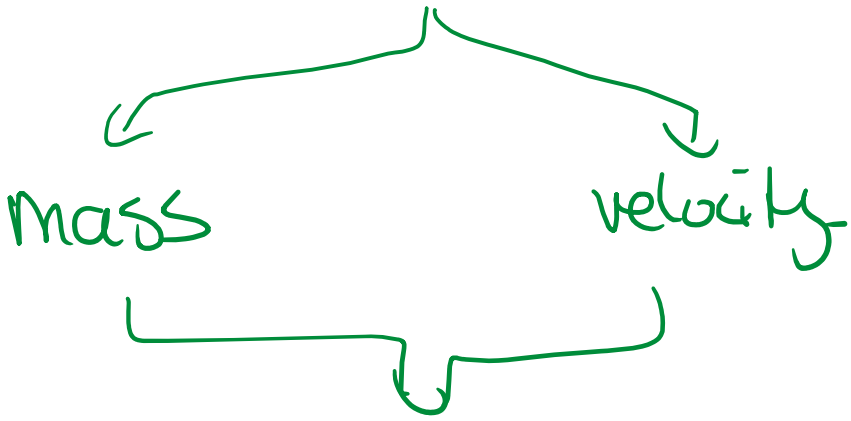
Momentum



try to keep object as is

at rest — motion

Inertia

$W = m \times g$

$F = m$ $\boxed{a}$

$F - AR$

K

100 kg

W = 980 N

No air

980 = 100 × a

a = 9.8 m/s²

N

200 kg

W = 1960 N

1960 = 200 a

a = 9.8 m/s²

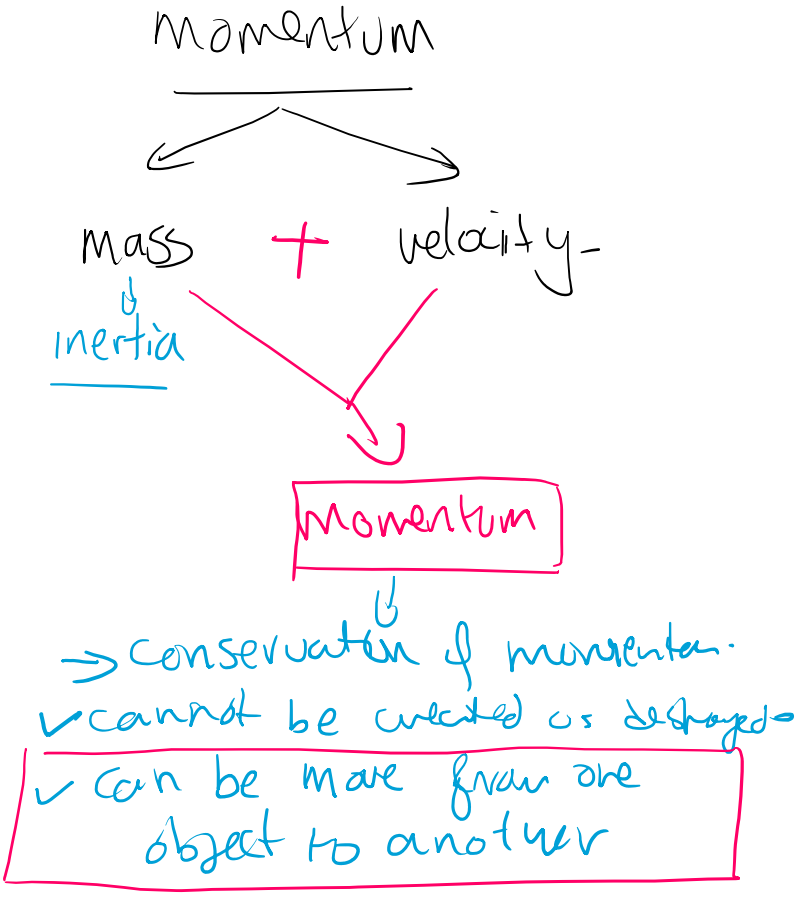
F = 980 − 100N

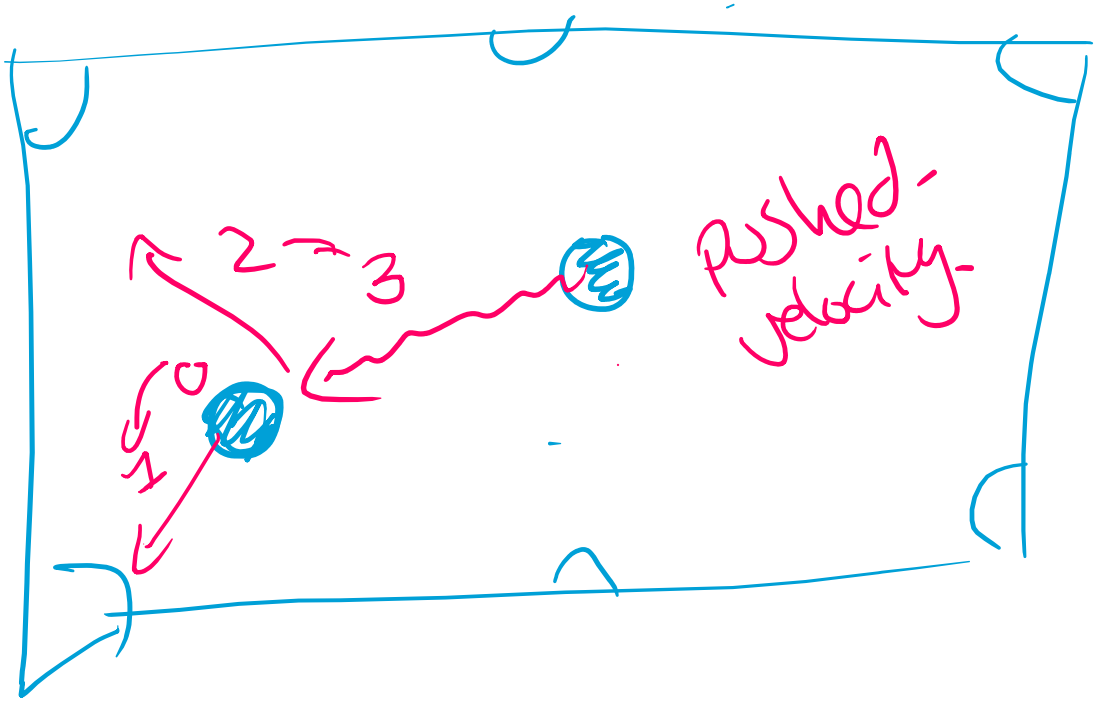
Rf = 880N / 100

a = 8 m/s²

1960 − 100 = 1860

a = 1860 / 200 = 9.3


momentum
mass
+
velocity
inertia
momentum
→ conservation of momentum.
✓ cannot be created or destroyed
✓ can be more from one object to another

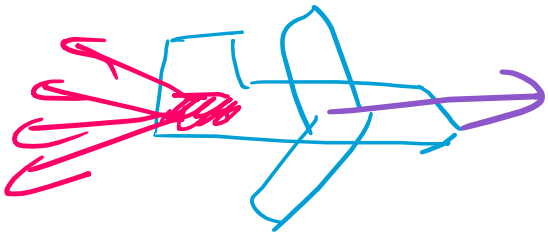

2
3
0
1
pushed
velocity

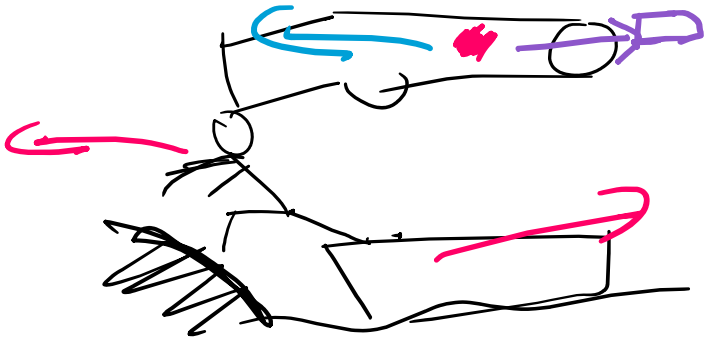
Momentum (P)

$$P = m\,V$$

Collision

Explosion





Collision

① 2 objects moving & collide.

conservation of momentum

momentum before = momentum after

$(m_1 u_1) + (m_2 u_2) = (m_1 v_1) + (m_2 v_2)$

A BMW car of mass 1600kg travelling at 30 km/hr hit- a toyota of mass 1000kg moving at a speed of 10km/hr after the collision, the BMW slowed to 25km/hr. how fast is the toyota.?

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$$

$$(1600 \times 30) + (1000 \times 10) = (1600 \times 25) + 1000v_2$$

$$v_2 = \frac{(1600 \times 30) + (1000 \times 10) - (1600 \times 25)}{1000}$$

$$= 18 \text{ km/hr}$$

a train of mass 15000kg. travelling at a speed of 150 km/hr hits a Toyota standing still on the tracks the mass of Toyota is 1000kg.

If the trains slows by 1 km/hr (149 km/hr)

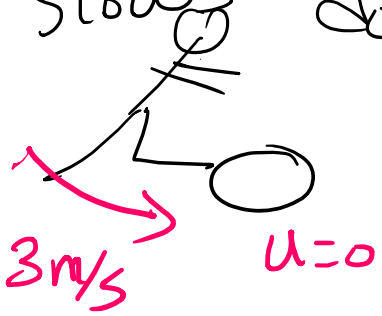
$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$$

$$(15000 \times 150) + (1000 \times 0) = (15000 \times 149) + (1000 v_2)$$

$$v_2 = \frac{15000 \times 150 - (15000 \times 149)}{1000}$$

$$v_2 = 15 \text{ km/hr}$$

A football of mass 1 kg is kicked by a players foot of 5kg. If the player kicked his foot at a speed of 3 m/s, what is the speed of the ball if the foot slows down to 1 m/s



momentum (p) before = after

foot + ball = foot + ball

$(5 \times 3) + (1 \times 0) = (5 \times 1) + (1 \times v)$

$15 = 5 + v$

$v = 15 - 5 = 10$ m/s

Explosion.

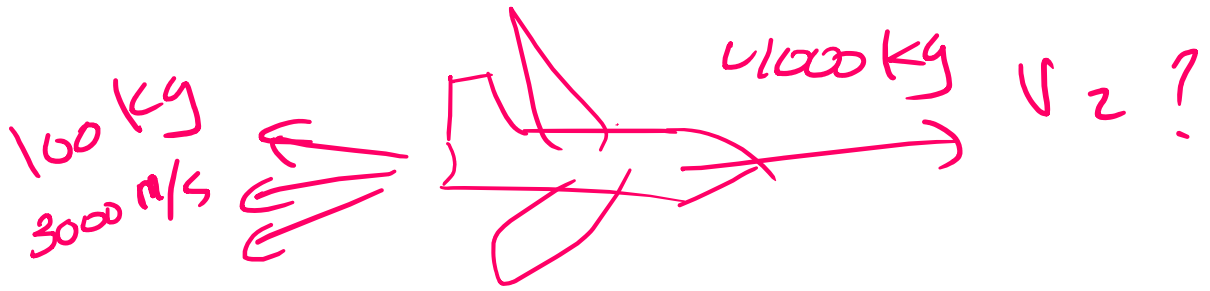
Momentum before = momentum after.

Speed = 0

Momentum = 0

0 = momentum after

A plane carrying fuel starts its jet engine & begins to move. If the fuel exhaust is leaving the plane at 3000 m/s. what is the speed of the plane if mass of plane = 4000 kg & the fuel emitted per second is 100 kg.



Total momentum after = zero.

fuel + plane = 0

(100 X 3000) + (4000 v) = 0

$\frac{300000}{4000} = v = \boxed{75 \text{ m/s}}$

Impulse

change in momentum = force x time

impulse = Δp = $f \times t$

$p = mv$ → initial u, final v

$\Delta p = mv - mu$

$\Delta p = m(v-u)$

$$ft = m(v-u)$$

A car crashes into a wall and stops. the passenger has a mass of 50kg & was travelling in the car at 100km/hr. If his head hit the windscreen for 0.5 seconds, what is the force to his head?

$$\Delta p = ft$$

$$m(v-u) = ft$$

$100 \frac{km}{hr} \frac{\times 1000}{\times 60 \times 60}$

$$f = \frac{m(v-u)}{t}$$

$$= \frac{50\,000 \times (-27.78)}{0.5}$$

$$= 2.8 \times 10^6 \text{ N}$$

the car company installed an air bag such that the passengers head will slow down in 2 seconds. calculate force.

$$\Delta p = ft$$

$$f = \frac{m(v-u)}{t}$$

$$= \frac{50000(-27-78)}{2}$$

$$f = 694\ kN$$

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momentum = m v

= 0.5 x 0.32

= 0.16 kg m/s

after collision (they joined)

$(m_1 + m_2) V$

$(m_1 u_1) + (m_2 u_2) = (m_1 + m_2) V$

$0.16 + 0 = (0.5 + 0.3) V$

$v = \frac{0.16}{0.8} = 0.2$ m/s

Q3 a) i)

$$mv = 70 \times 20 = 1400 \text{ kgm/s}$$

kg m/s

$$f \times t = \text{Impulse} = \Delta p$$

$$m(v-u) = 70(0-20)$$

$$= -1400 \text{ kgm/s}$$

(−) → opposite direction.

$$a = \frac{v-u}{t} = \frac{0-20}{0.2}$$

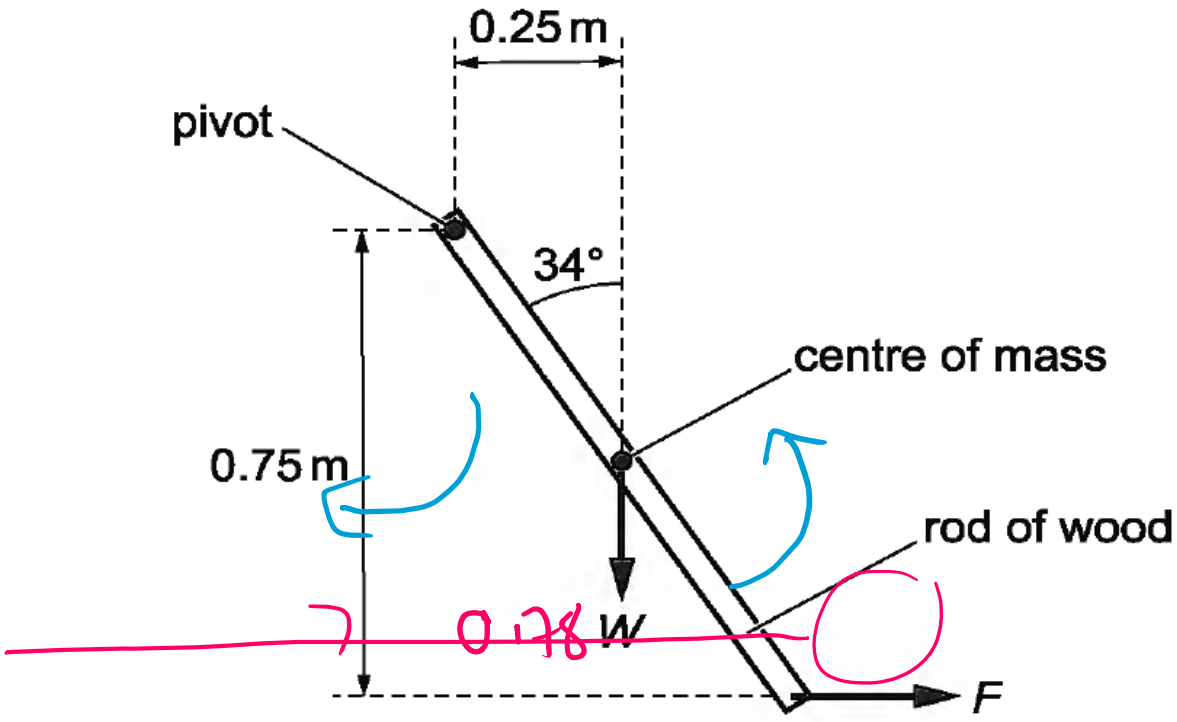
$$= -100 \text{ m/s}^2$$

$a = -80\ m/s^2$

$m = 70kg$

$F = m\ a.$

$F = 70 \times 80 = 5600N$



$W = mg = 0.08 \times 9.8 = 0.78$ N

$M_{weight} = 0.78 \times 0.25 = 0.195$ Nm

$M_{force} = f \times 0.75$

Since rod is stationary

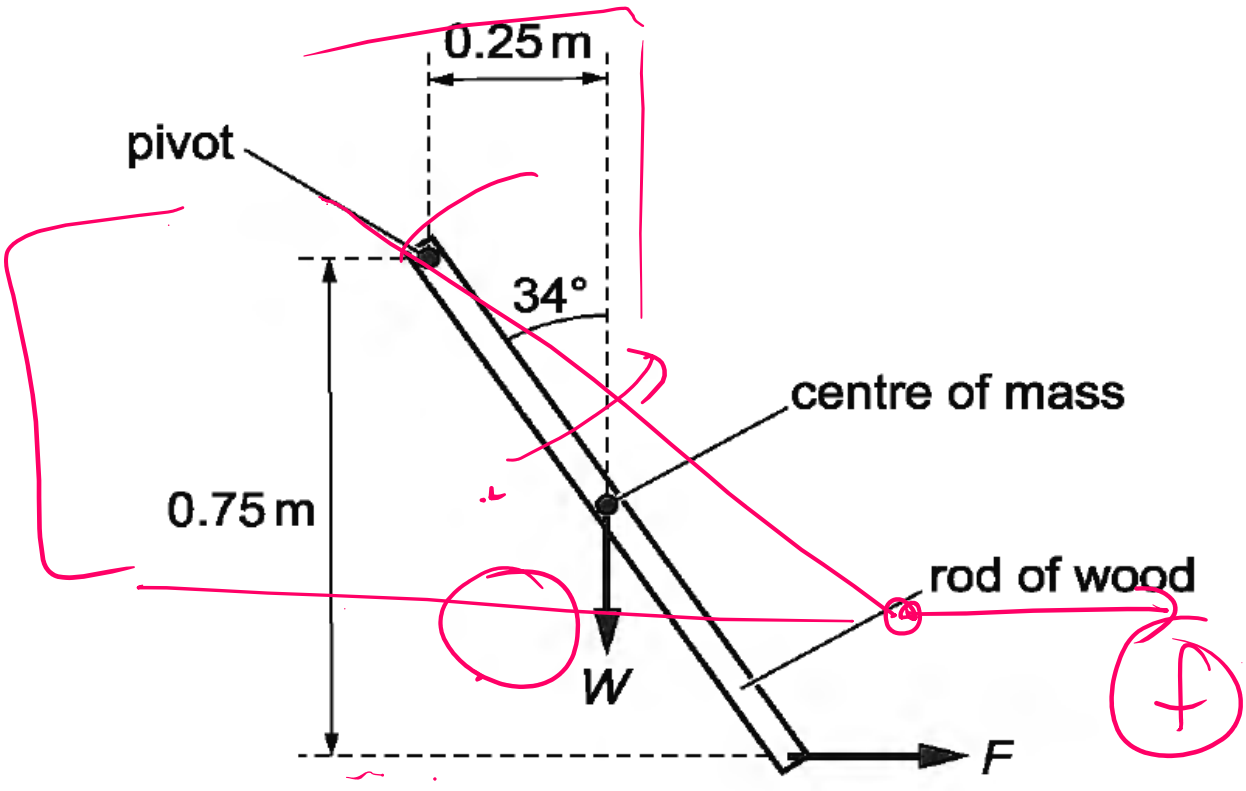
clockwise moment = Anti clockwise moment

So $M_{force} = 0.195$ Nm

moment f = $f \times d$

$0.195 = f \times 0.75$

$f = \frac{0.195}{0.75} = \boxed{0.26\ N}$



Solution make f bigger

o