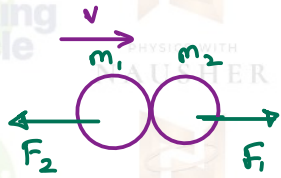
Linear Momentum and its conservation



N3 Law:
- Forces are equal and opposite
- Forces act on each other for same time.

$$F_2 = -F_1$$

time of collision for both is same.

$$F_2 t = -F_1 t$$

∴ Multiply both sides with t.

$$\Delta p_2 = -\Delta p_1$$

∴ Since $\Delta p = F \times t$
Hence Δp is also equal and opposite

Principle of conservation of momentum

The total linear momentum before a collision is equal to the total linear momentum after a collision unless an external resultant force acts on the system.

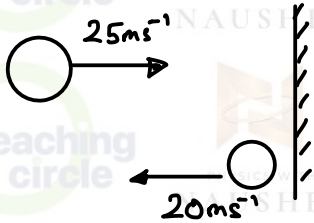
- Momentum is a vector quantity, therefore:
  - opposing vectors can cancel out, resulting in a net zero momentum.

Total/Resultant Momentum = _____

If resultant momentum is zero, then P_2 = _____ Ns.

Total/Resultant momentum = ____

- An object collides collides with another object and rebounds, will have a _____ velocity before and _____ velocity after.



- Momentum is always conserved. Why? _____

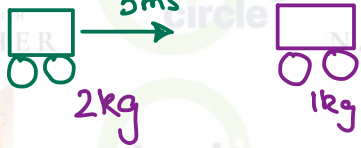
$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$$

Always assume _____ to be positive.

1-D collisions

Collisions which cause particles to move in 1-direction only.

(1)



Before

move off together with speed v

Find v.

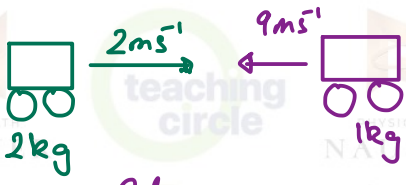
(2)

Before

After

Find v?

③

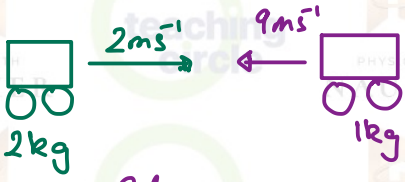


Before

After

Find v?

④

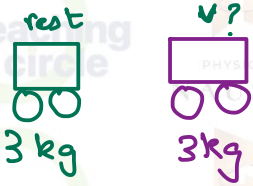


Before

move off together

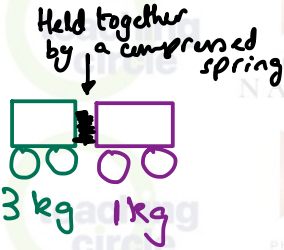
Find velocity and state direction.

⑤



Find velocity and state direction.

⑥



Total initial momentum

= _____

i) Total final momentum =

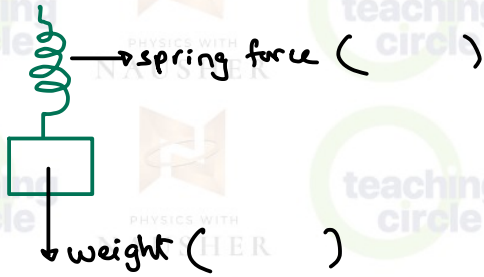
_____

ii) Predict direction of green and purple car.

iii) If 3kg moves with a speed of 3.3ms⁻¹, find the velocity of 1kg mass.

External and Internal forces

- External forces are forces that act on the body from outside e.g friction and weight.
- Internal forces are forces exchanged by particles in the system e.g tension in a string / spring between two bodies
- A system with no external forces acting is described as an isolated system.



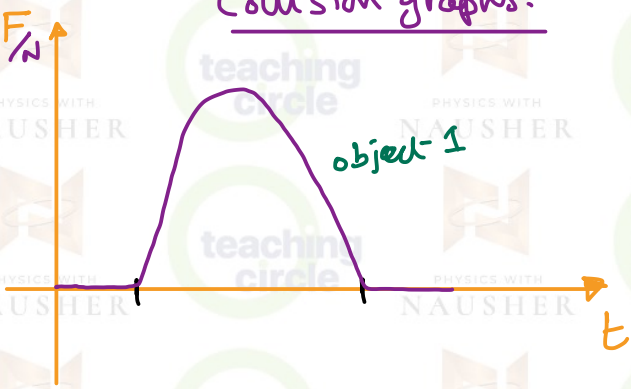
Note:
3 factors

① Short time frame of collision ⟶ usually ms

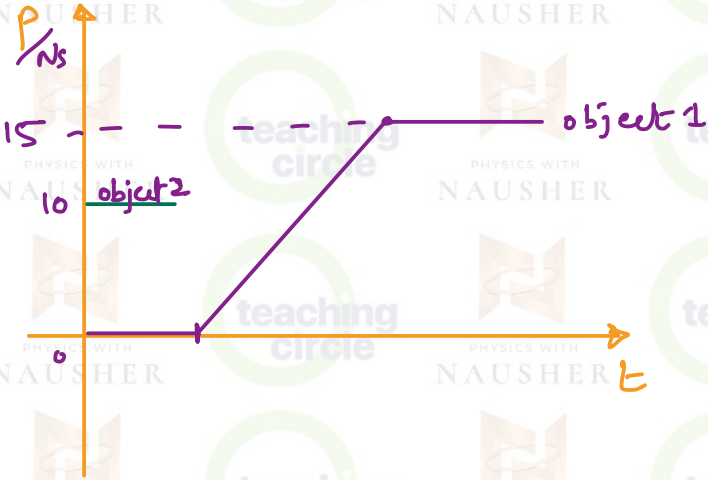
② Dominance of internal forces ⟶ forces between colliding objects

③ Effect of gravity and friction ⟶ gravity effects vertical motion

Collision graphs.



Show object 2 on graph.



Show object 2 on graph.

Elastic and Inelastic Collisions

Type of collision	Momentum	Kinetic Energy	Total Energy
elastic	conserved	conserved	conserved
inelastic	conserved	not conserved	conserved

Note:
- A way to identify (NOT TO VERIFY) → cannot be used if question says prove
- Elastic Collisions are commonly those whose objects collide and do not stick together on impact.
- Inelastic collisions are where colliding objects stick together after collision.
- To prove whether a collision is elastic or inelastic, compare the amount of Kinetic Energy of the system before and after collision.
  - If KE is conserved, collision is elastic
  - If KE is not conserved, it is an inelastic collision.

An isolated system consists of two bodies on which no external forces act. The two bodies collide with each other and stick together on impact.
Which row correctly compares the total kinetic energy and the total momentum of the bodies before and after the collision?

	total kinetic energy before and after the collision	total momentum before and after the collision
A	different	different
B	different	the same
C	the same	different
D	the same	the same