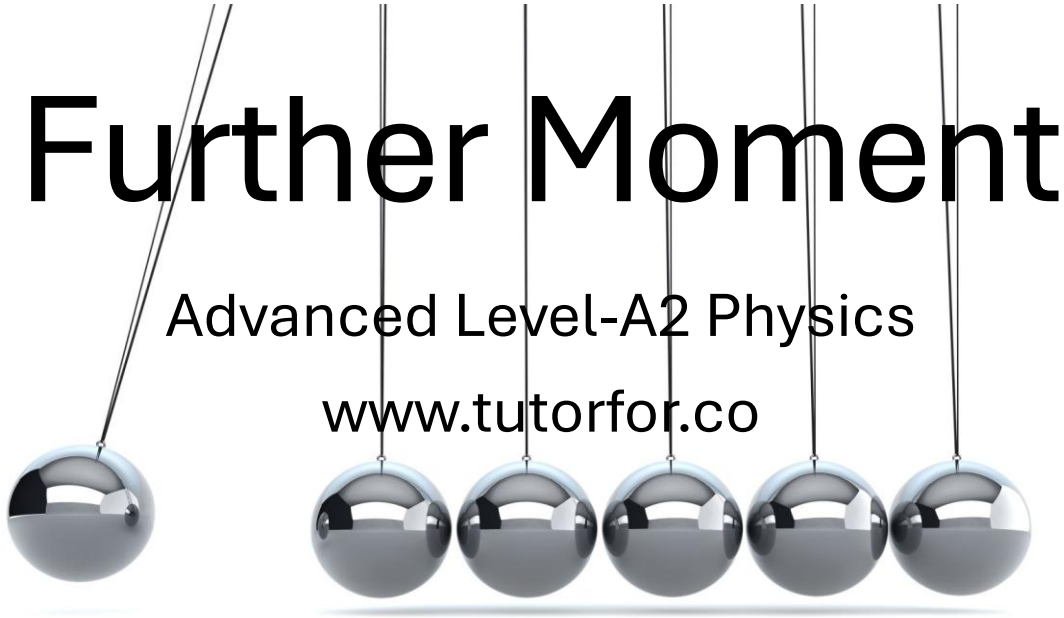
5A Further Momentum



Advanced Level-A2 Physics

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Energy in collisions

- Elastic collisions:

A collision in which kinetic energy is conserved is called an elastic collision.

Kinetic energy before the collision = kinetic energy after the collision

- Inelastic collisions:

A collision in which total kinetic energy is not conserved is called an inelastic collision.

Concept Learning Question

A 2 kg ball moving at a velocity of 5 m/s collides with a stationary ball of 3 kg. After the collision, both balls move in the same direction with a velocity of 2 m/s. Is this an elastic collision?

Momentum

- Momentum = mass x velocity. p =mv
- Momentum is a vector quantity.
- SI unit of momentum = kg m / s or N s
- Unbalanced force = rate of change of momentum.

$$F = \frac{\Delta p}{\Delta t} = \frac{mv - mu}{\Delta t}$$

- Impulse = change in momentum.
- $Impulse = F \times \Delta t = mv - mu = \Delta p$

Particle momentum

$$E_k = \frac{1}{2}mv^2 \qquad p = mv$$

$$E_k = \frac{1}{2}\frac{(mv)^2}{m}$$

$$E_k = \frac{1}{2}\frac{p^2}{m}$$

Law of conservation of momentum

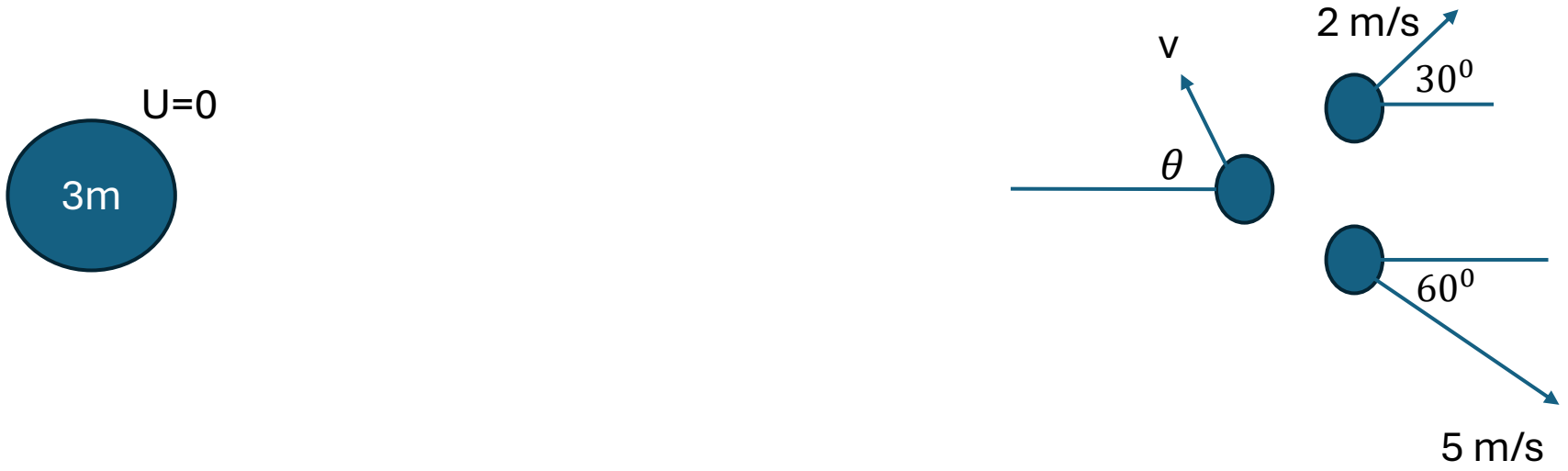
- The total momentum of a closed system remains constant if no external forces act on it.

Mathematically, it can be expressed as:

Total Initial Momentum=Total Final Momentum

Concept Learning Questions

1) A mass of 5 kg moving at a velocity 3m/s collides with a stationary object of mass 2 kg. After the collision both objects joined and move to the same direction. Find the speed of the joined object.

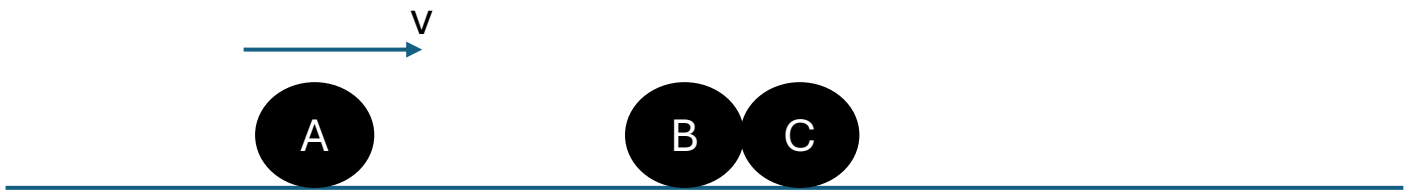


2) A mass of 3m kg explodes into 3 equal masses and two of them moving at speed of 2 m/s and 5 m/s as mentioned on the above diagram. Find the speed v of the third mass.

3) A shell explodes into three fragments of equal masses. Two fragment fly off at right angles to each other with speed of 9 m/s and 12 m/s. What is the speed of the third fragment ?

4) A cricket ball of mass 150 g is moving with a velocity 12 m/s and is hit by a bat so that the ball turned back with a velocity of 20 m/s. The force of the blow acts for 0.1 s. What is the average force exerted on the ball by the bat?

5) Two identical balls marked B and C, in contact with each other and at rest on a horizontal frictionless table, are hit head on by another identical ball marked A moving with a speed v as shown in the following figure. What is observed, if the collision is elastic ?



a) Ball A comes to rest and balls B and C roll out with speed $\frac{v}{2}$

b) Ball A and B come to rest and Ball C rolls out with speed v

c) Balls A,B and C roll out with speed $\frac{v}{3}$

d) Ball A,B and C come to rest.