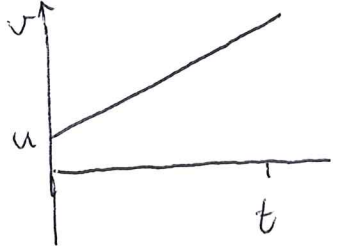
Mechanics

Linear motion "kinematics"

1-dimensional problems

- e.g. vertical motion
- Projectiles!
  - (↑) $u \sin\theta$
  - (→) $u \cos\theta$
  - parabola!
  - (→) speed = $\frac{\text{distance}}{\text{time}}$
  - (↑) Equations of motion (suvat)
    - "Range" → Calculate time for $s_v = 0$
    - "Height of ___" → Calculate horizontal time

Acceleration is constant



- s =
- u =
- v =
- a =
- t =

$v = u + at$

$v^2 = u^2 + 2as$

$s = \frac{1}{2}(u+v)t$

$s = ut + \frac{1}{2}at^2$

$(s = vt - \frac{1}{2}at^2)$

↳ Forces also constant

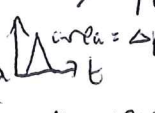
- "Maximum height" → $v = 0$
- Motion is usually symmetrical
- Define direction before starting e.g. (←)

Forces

Just one object

NB: Free-body diagrams

F



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

Newton's Laws:

N1 = An object will remain at constant velocity unless acted upon by a resultant force.

N2 = Resultant force is proportional to rate of change of momentum in the same direction.

N3 = if body A exerts a force on body B, then body B exerts an equal and opposite force on body A

- ★ the same type of force
- ★ the same magnitude of force
- ★ need to act at different bodies

Momentum

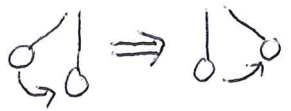
Conservation of momentum:

In an isolated system with no net external forces, momentum is conserved.

Elastic collision:

Kinetic energy is constant

For two balls, maximum energy transfer occurs when masses are equal.



Work, energy & power

Sankey diagrams

Efficiency

Conservation of energy

Kinetic energy = $\frac{1}{2}mv^2$

Gravitational potential = mgh

Elastic = $\frac{1}{2}kx^2$ (NB: $F = kx$)

Work done = $F \times d$ in the same direction

Power = $\frac{E}{t}$ ↳ For an object at constant speed $P = Fv$