Forces (and motion 1)

1. Scalar and vector

Distance is a scalar quantity (magnitude only) and measures how far something moves. **Displacement** is a vector quantity (magnitude and direction) and measures how far something is from its starting point.

Speed is a scalar quantity, the speed of a moving object is rarely constant and an average speed is often calculated.

Velocity is a vector quantity. It is a measure of the displacement divided by the time taken to move.

5. Terminal velocity

Initial acceleration due to weight.

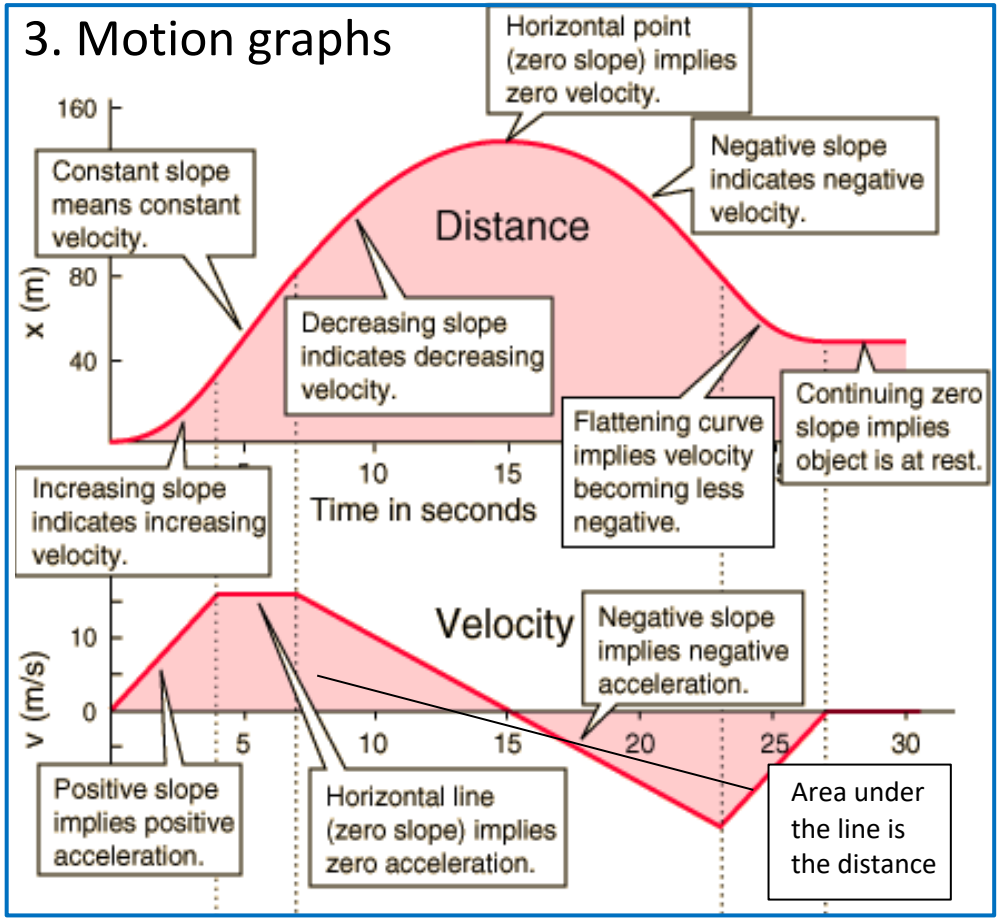
Drag forces increasing, but still accelerating.

Drag balances weight and terminal velocity reached.

Larger surface area means the drag force increases causing deceleration.

Lower terminal velocity reached

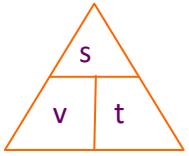
3. Motion graphs



4. Velocity and acceleration

$$distance\ travelled = velocity \times time$$

(m) (m/s) (s)



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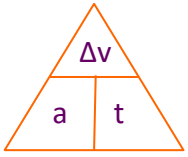

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$$acceleration = \frac{change\ in\ velocity}{time}$$

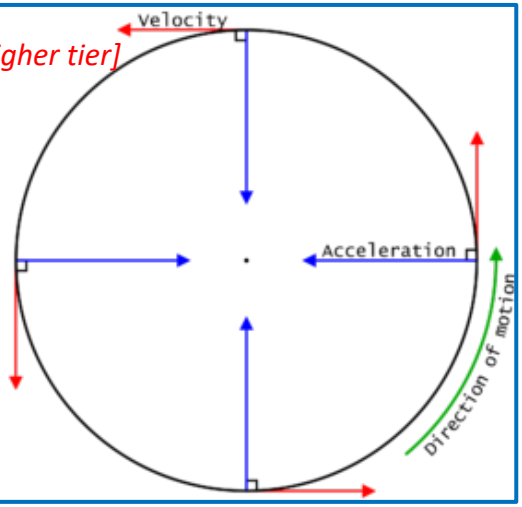
(m/s²) (m/s) (s)

2. Circular motion *[Higher tier]*

Circular motion involves constant speed, but a changing velocity due to the change in direction.

A **change in velocity** over time is the definition of acceleration.

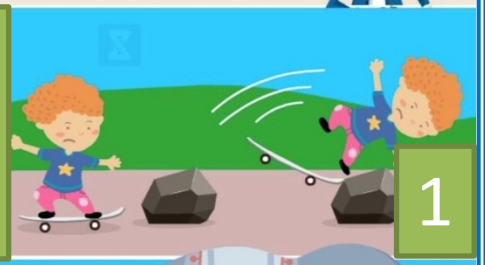
This means that an object travelling in a circle will be accelerating due to a resultant force acting towards the centre of the circle.



Forces (and motion 2)

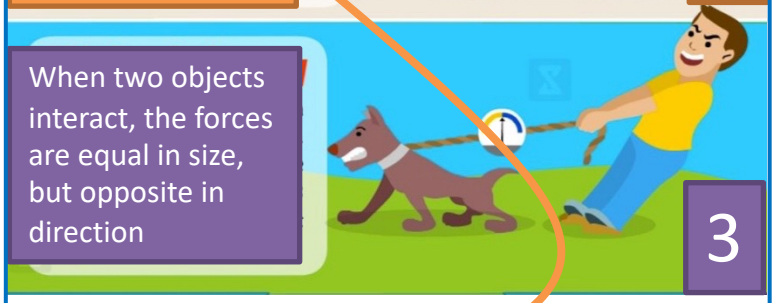
6. Newton's laws of motion

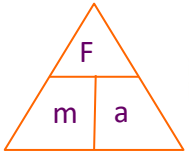
An object will continue to be at rest or a steady speed unless acted on by a resultant force.



Acceleration is proportional to the resultant force, and inversely proportional to the mass.

When two objects interact, the forces are equal in size, but opposite in direction





$force = mass \times acceleration$

(N) (kg) (m/s^2)

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7. Stopping distances

Thinking distance is the distance travelled while a driver reacts to a situation.

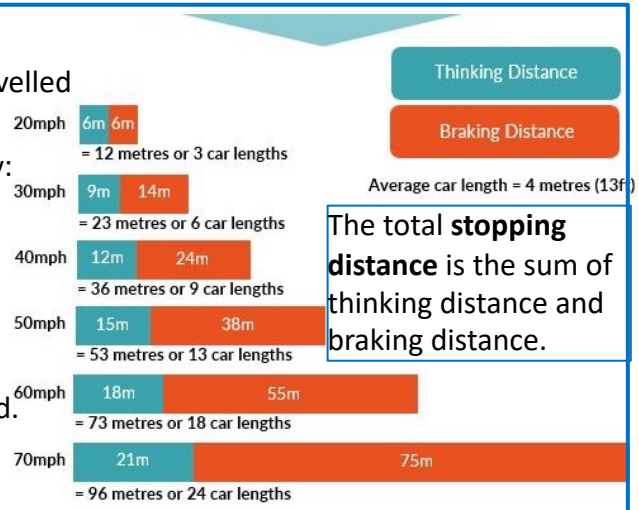
Thinking distance may be affected by:

- tiredness
- drugs
- alcohol
- distractions e.g. mobile phone.

Braking distance is the distance travelled while the brakes are applied.

A vehicle's braking distance may be affected by:

- the condition of the road
- the weather
- the condition of the car
- the mass of the vehicle.



The total **stopping distance** is the sum of thinking distance and braking distance.

When a force is applied to the brakes, work is done by friction. This decreases the kinetic energy store of the car, but increases the thermal store of the brakes and surroundings, increasing the temperature.

8. Momentum [Higher tier]

In a closed system, **momentum** is conserved; the total momentum before a collision is equal to the total momentum after a collision.

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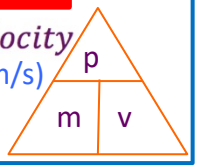
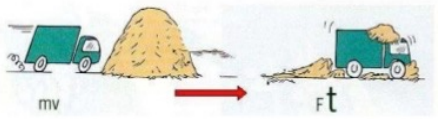
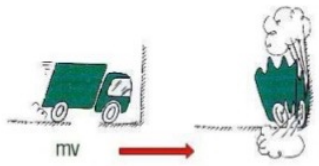
$momentum = mass \times velocity$

(kgm/s) (kg) (m/s)



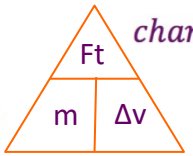
9. Change in Momentum *(Separate Physics only)*





For a **change in momentum**, force and time are inversely proportional; if you can increase the time of a collision you can decrease the force involved.

Seat belts, air bags, crash mats, cycle helmets and cushioned surfaces for playgrounds all use this idea.



$change\ in\ momentum = force \times time$

(kgm/s) (N) (s)

On sheet