# Unit-1

IGCSE(9-1)-Physics

# Forces & Motion

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# Forces & Motion

a) Units 

b) Movement & Position

c) Forces, Movement, Shape & Momentum.

# Movement & Position

# Intended Learning Outcomes



Paper-1 & Paper-2



## Students will be assessed on their ability to:

1.3 Plot and explain distance-time graphs.

1.4 Know and use the relationship between avg speed, distance moved, and time taken. (avg speed=$\frac{distance\ moved}{time\ taken}$)

1.5 Practical: Investigate the motion of everyday objects such as toy cars or tennis balls.

1.6 Know and use the relationship between acceleration, change in velocity and time taken $\left(a = \frac{v-u}{t}\right)$

1.7 Plot and explain velocity-time graphs.

1.8 Determine acceleration from the gradient of the velocity-time graphs.

1.9 Determine the distance travelled from the area between the velocity-time graph and the time axis.

- 2.0 Use the relationship between final speed, initial speed, acceleration and distance moved.($v^2 = u^2 + 2as$)

# Distance & Displacement

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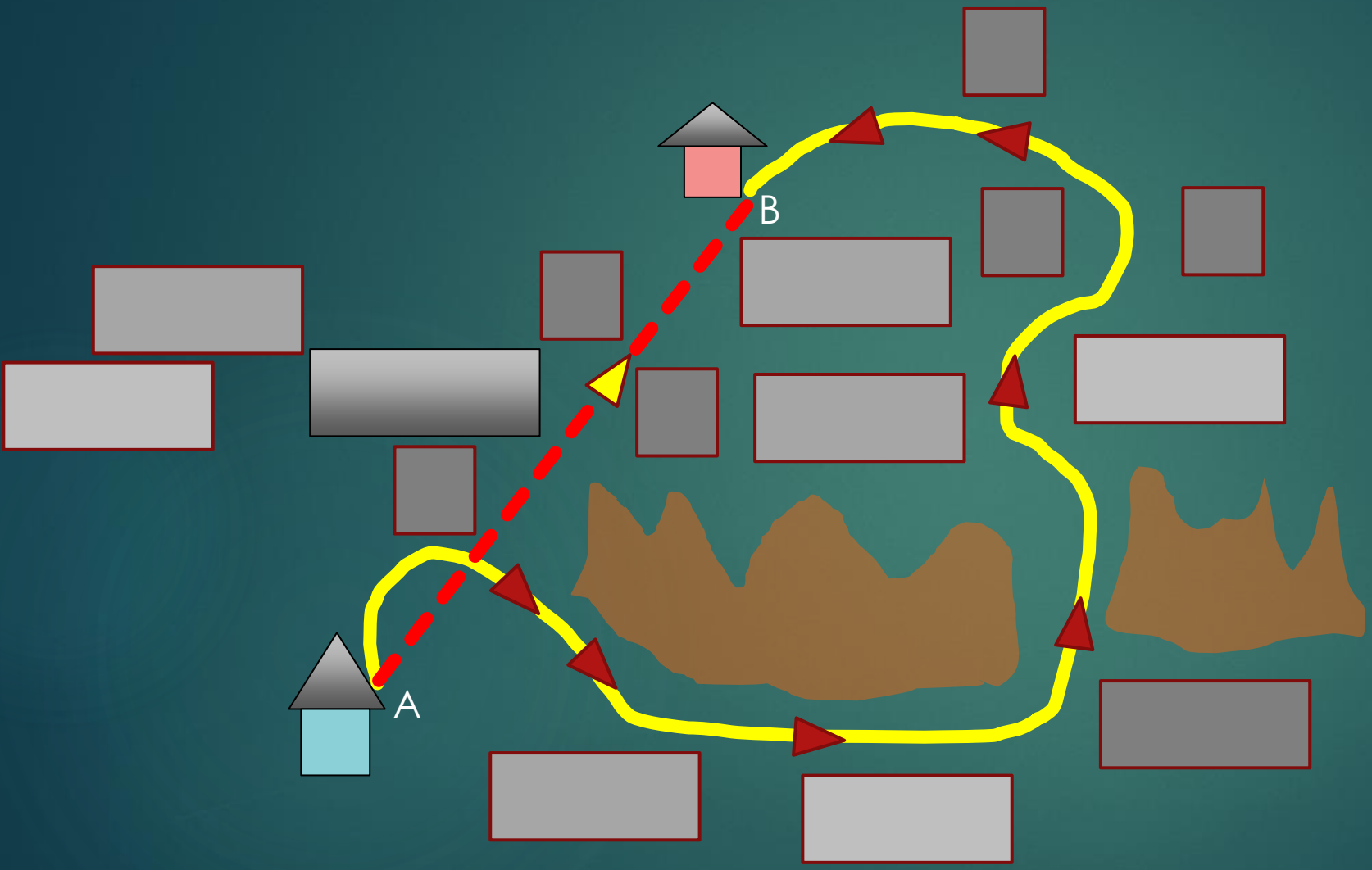
# Distance & Displacement



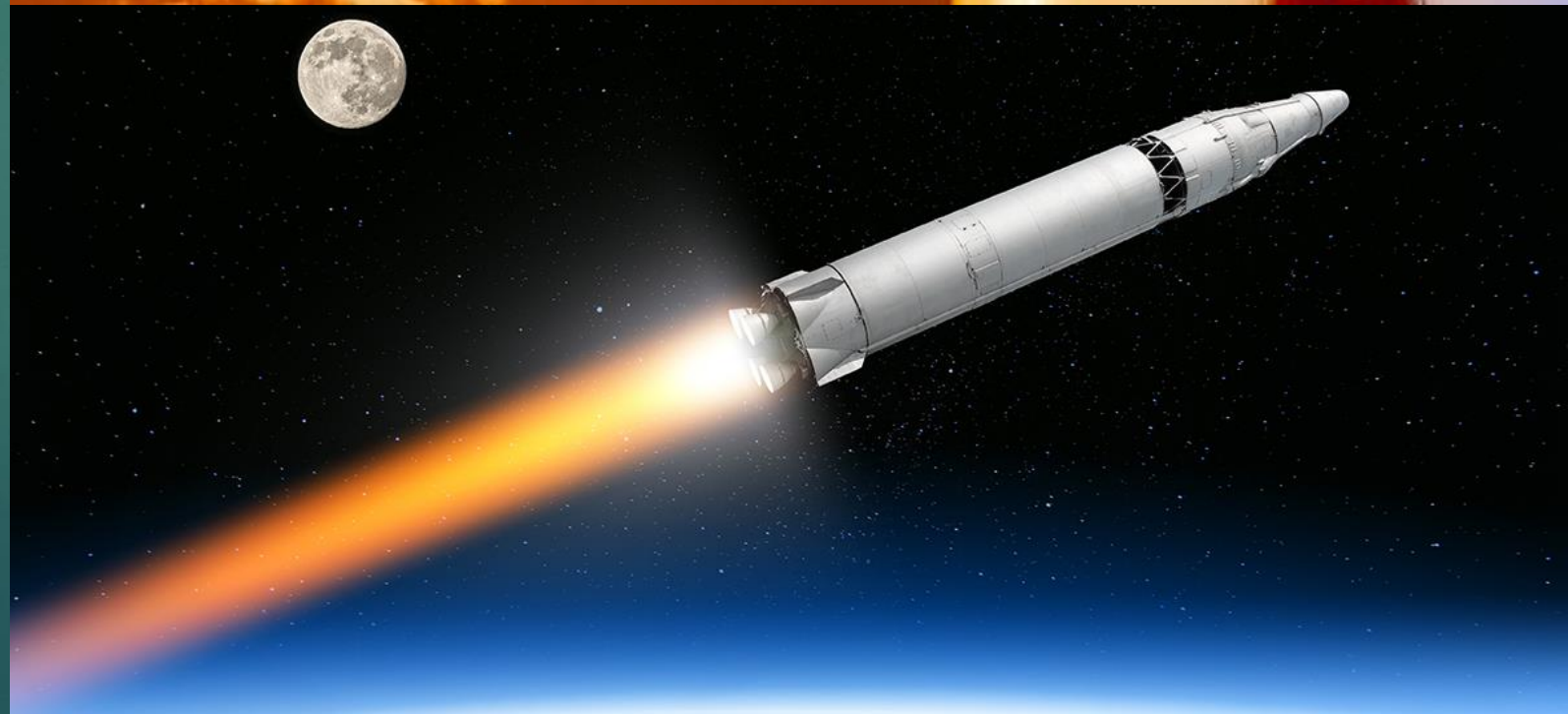

The length of the path between two points is called the distance.

Distance has no specific direction.

Displacement is the distance(straight) travelled in a particular direction .

The SI unit of distance and displacement- metre(m)

# Vector quantities & scalar quantities

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# Vector quantities & scalar quantities

- A vector quantity is a quantity that has both magnitude(size) and direction.

Ex: Displacement, Force, Momentum, Acceleration, Velocity

- A scalar quantity is a quantity that has only a magnitude(size) and no direction.

Ex: Distance, time, volume, speed, mass, temperature


The speed of an object at a particular moment in time is called instantaneous speed

# Instantaneous speed

# Average speed

**The ratio between the total distance moved and the total time taken for a journey is called the average speed of an object.**

$$Average\ speed = \frac{total\ distance\ moved}{total\ time\ taken}$$

$$v = \frac{s}{t}$$

**Don't use 'd' as a symbol for distance!**

# Units of speed

$$\text{m/s} \leftarrow v = \frac{s}{t} \quad (s \rightarrow \text{m},\ t \rightarrow \text{s})$$

s-distance moved
t-time taken
v-speed

SI unit of speed is metre per second(m/s).

Other units for speed:

- kilometre per hour(km/h)
- centimetre per second(cm/s)
- millimetre per second(mm/s)

**Metric units only!**

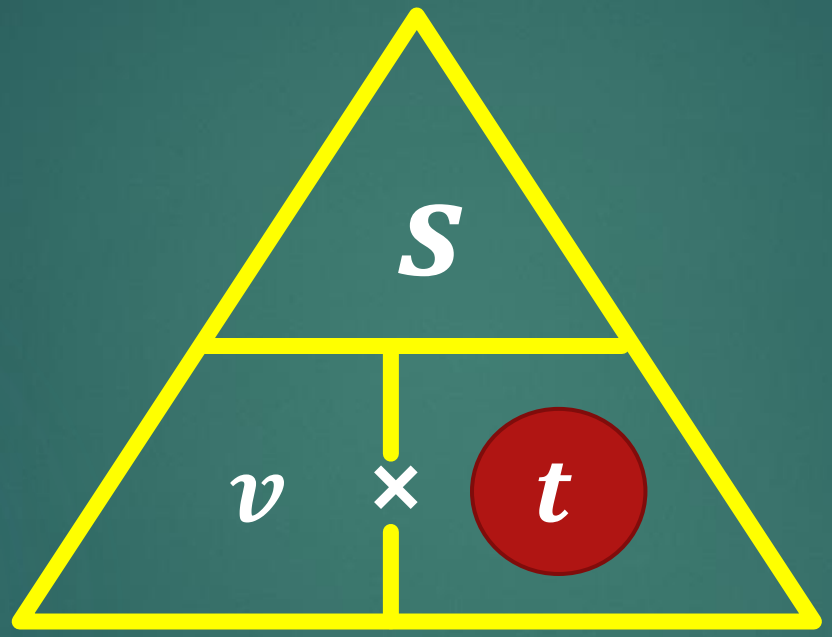
In this syllabus:

# Concept learning:

A car travels 240 km in 3 hours. Find the average speed of the car in km/h .

$$v = \frac{S}{t} \qquad v = \frac{240\ km}{3\ h} = 80\ km/\text{h}$$

You can use the triangle method to rearrange the equation




Example:

$$t = \frac{s}{v}$$

# Concept learning:

A car travels with an average speed of 50 km/h .
Find the time taken to travel 250 km .

$$v = \frac{s}{t}$$

$$t = \frac{250\ \cancel{km}}{50\ \cancel{km}/h} = 5\ h$$

$$\mathrm{t} = \frac{s}{v}$$

# Concept learning:

**A car travels with an average speed of 60 km/h. Find the distance travelled within 2 hours .**

$$v = \frac{s}{t}$$

$$s = v \times t$$

$$s = 60 \frac{km}{h} \times 2h = 120\ km$$

# Unit conversions between km/h & m/s.

1 h = 60 x 60 s = 3600 s
1 km = 1000 m

## Convert 1 km/h to m/s

$$\frac{1\ km}{1\ h} = \frac{1000\ m}{3600\ s} = \left(\frac{5}{18}\right) m/s = \frac{1}{3.6}\ m/s$$

- Divide the (km/h) speed value by 3.6 and write the answer in m/s.

Ex: Write 144 km/h in m/s

144 ÷ 3.6 = 40 m/s

# Concept learning:

**A car traveling with a speed of 72 km/h. Find the average speed of the car in m/s.**

$$72 \div 3.6 = 20 \text{ m/s}$$

Or

$$\frac{72\ km}{1\ h} = \frac{72 \times 1000\ m}{1 \times 3600\ s} = 20 \text{ m/s}$$

# Unit conversions between km/h & m/s.

## Convert 1 m/s to km/h

$$\frac{1\ m}{1\ s} = \frac{0.001\ km}{\left(\frac{1}{3600}\right) h} = 3.6\ km/h$$

- Multiply the (m/s) speed value by 3.6 and write the answer in km/h.

Ex: Write 10 m/s in km/h.

10 × 3.6 = 36 km/h

# Concept learning:

**A car traveling with a speed of 25 m/s. Find the average speed of the car in km/h.**

$$25 \times 3.6 = 90 \text{ km/h}$$

Or

$$\frac{25\ m}{1\ s} = \frac{25 \times 0.001\ km}{(1 \div 3600)h} = 90 \text{ km/h}$$

# Practical:

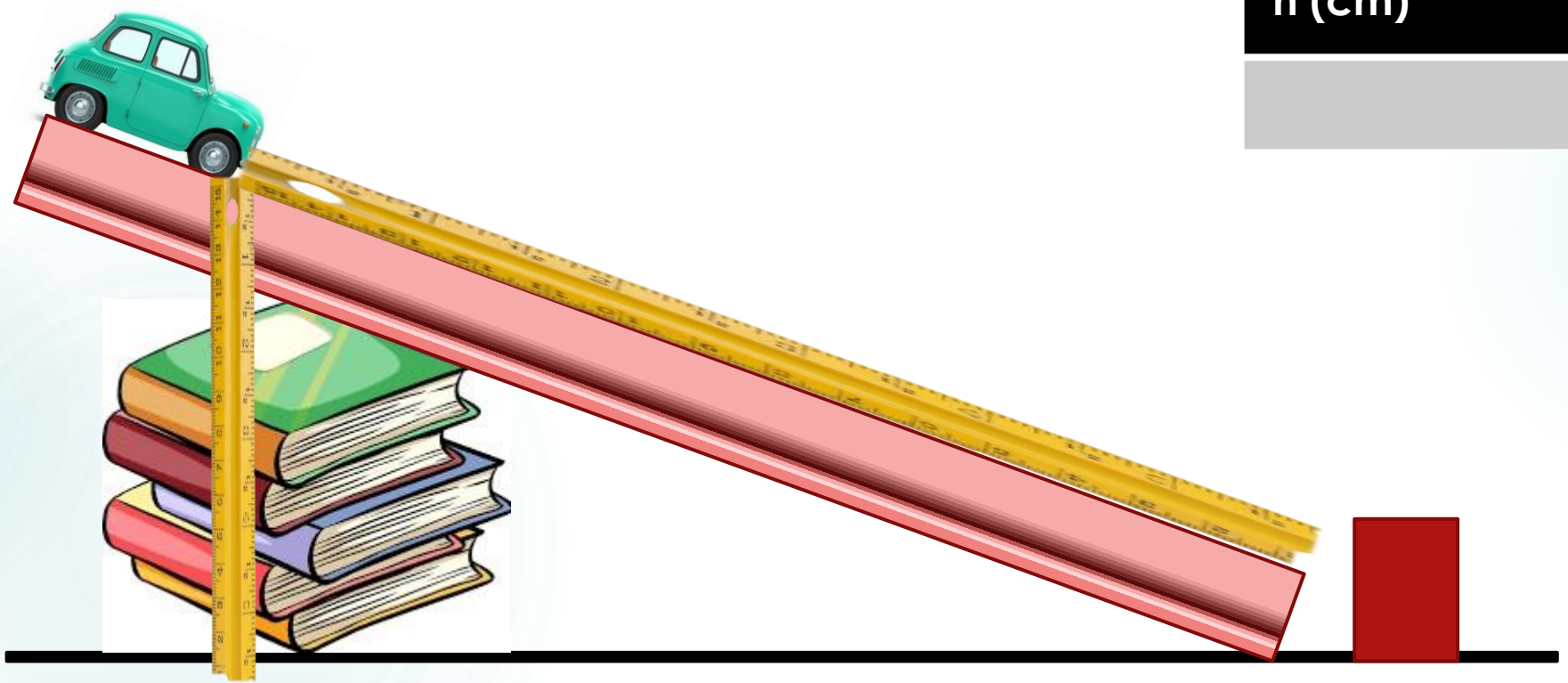
## INVESTIGATE THE MOTION OF EVERYDAY OBJECTS SUCH AS TOY CARS OR TENNIS BALLS

$$v = \frac{(AB)}{t}$$

AB= ….

| h (cm) | $t(s)$ |
|---|---|
| | |

$$t = \frac{t1 + t2 + t3}{3}$$



If one value is quite different from the others it should be treated as **anomalous** (the result is not accurate) and ignored or repeated.

**Reaction time= 250 ms**



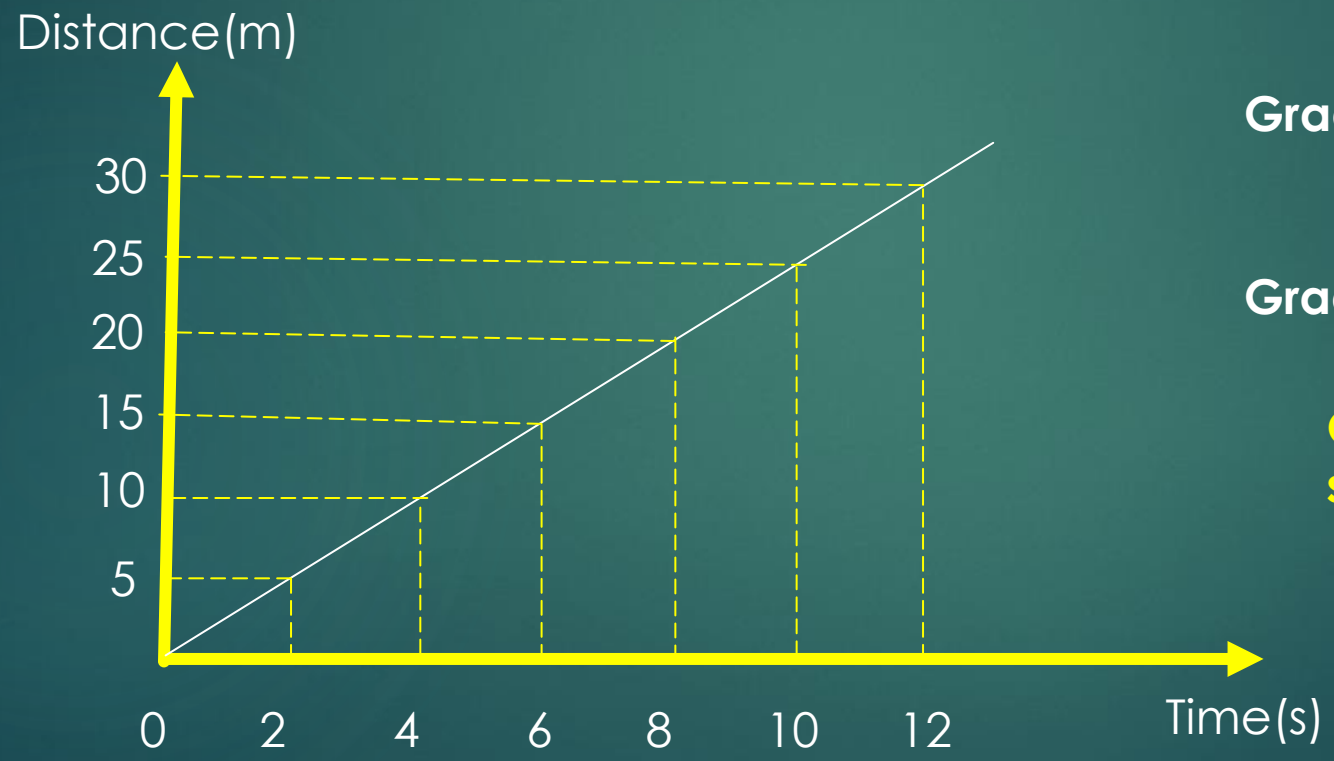

# Alternative methods.

# Distance-time graphs (s-t graphs)

The s-t graph shows how the distance traveled by an object (on a straight path) changes with time

# 1.3 Distance-time graphs(s-t graphs)

| Time(s) | 0 | 2 | 4 | 6 | 8 | 10 | 12 |
|---|---|---|---|---|---|---|---|
| Distance(m) | 0 | 5 | 10 | 15 | 20 | 25 | 30 |




**Gradient** = $\frac{difference\ in\ y}{difference\ in\ x}$

**Gradient** = $\frac{(30-5)\ m}{(12-2)s} = \frac{25}{10}$ **m/s = +2.5 m/s**

**Gradient of a s-t graph shows the speed of the object**

**Graph is a straight line with a constant positive gradient.**

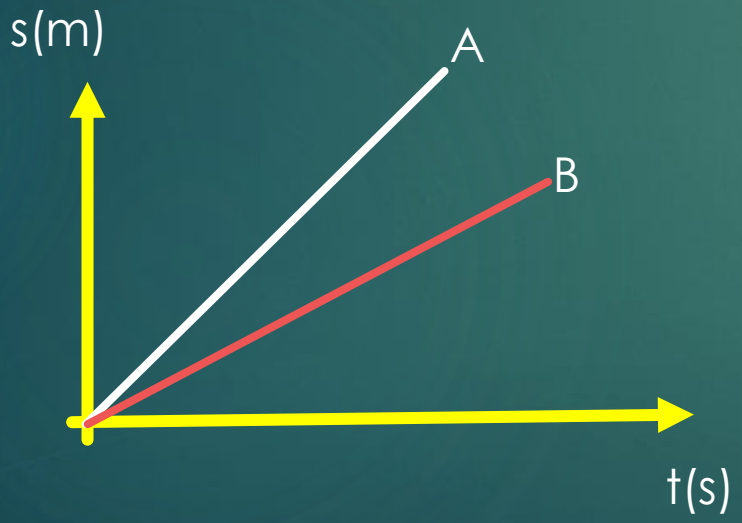
# 1.3 Distance-time graphs(s-t graphs)




**Properties of the graph.**

- Straight line with a constant positive gradient.

**The object is moving with a steady(constant) speed.**




**Properties of the graphs.**

- Straight lines with constant positive gradients.

**Both objects moving with steady(constant) speeds.**

- Graph A has a higher gradient(steeper) than graph B

**The object A is moving with a higher steady(constant) speed than object B.**

# 1.3 Distance-time graphs(s-t graphs)


**Properties of the graph.**

- Straight line with zero gradient.

**The object is not moving(stationary)**


**Properties of the graph.**

- Straight line with a negative gradient.

**The object is moving towards the initial direction(opposite direction) with a constant speed.**

# 1.3 Distance-time graphs(s-t graphs)


**Properties of the graph.**

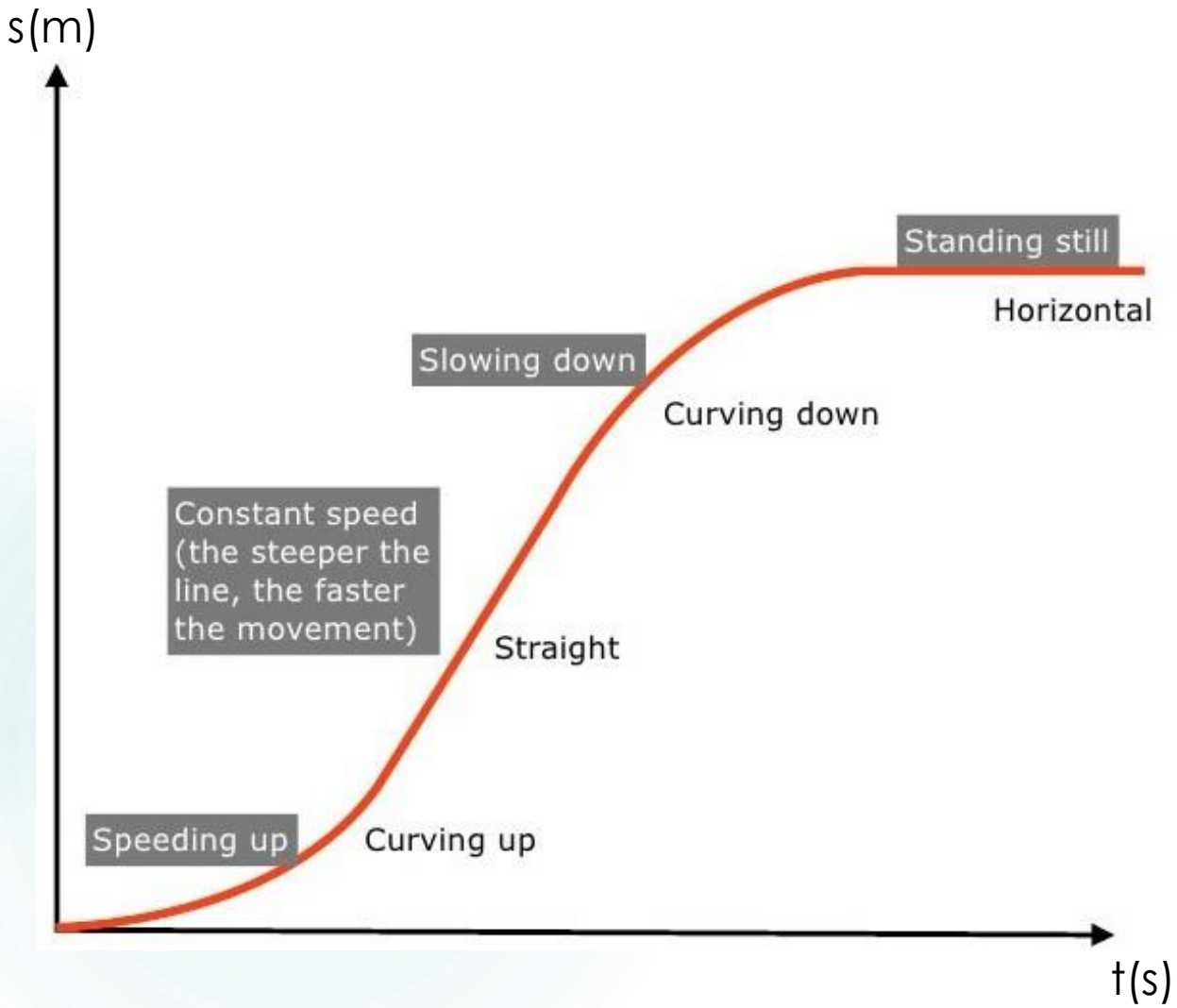
- A curved line with an increasing gradient.

**The object is moving with an increasing speed(acceleration)**


**Properties of the graph.**

- A curved line with a decreasing gradient.

**The object is moving with a decreasing speed(deceleration).**


s(m)
Standing still
Horizontal
Slowing down
Curving down
Constant speed (the steeper the line, the faster the movement)
Straight
Speeding up
Curving up
t(s)

Summery

# Next: Velocity & Acceleration

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