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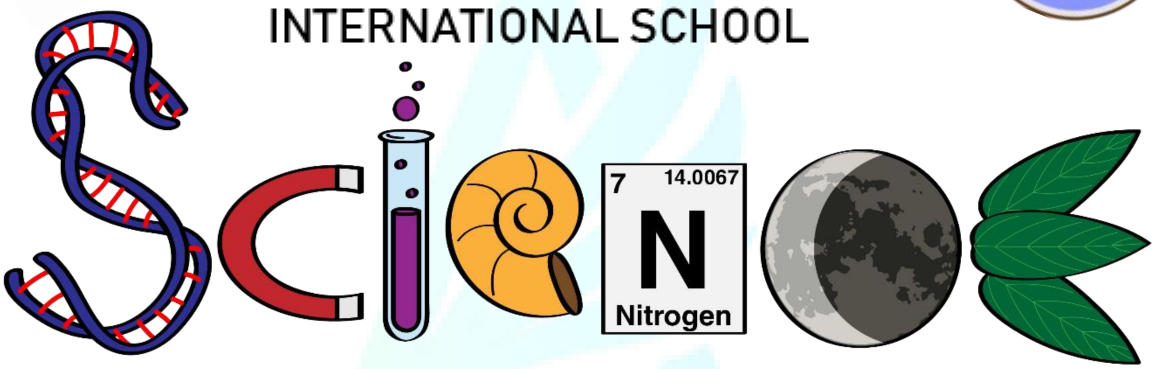


Science Department

2023/2024

Year 7 -Term 3

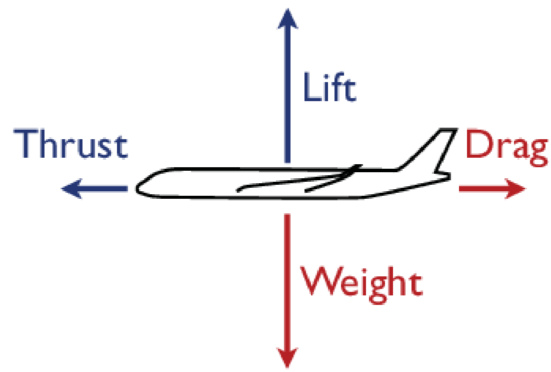
Revision Pack of Unit 3 (Stage 8)

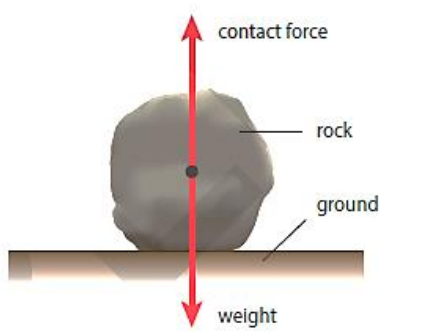
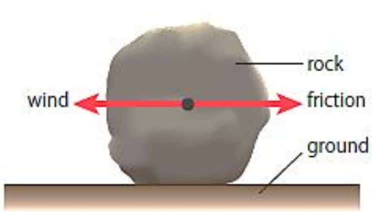
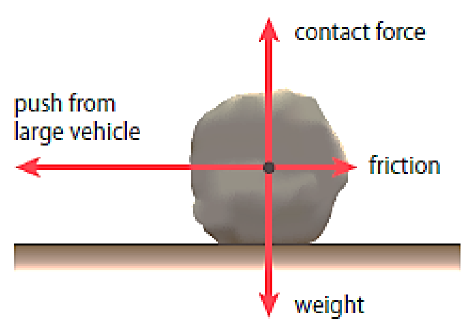
Name: …………………………………………………….

Class: ……………………………………………………

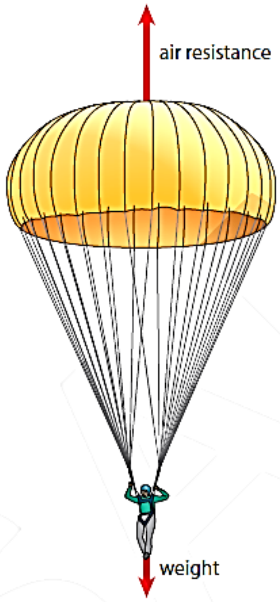
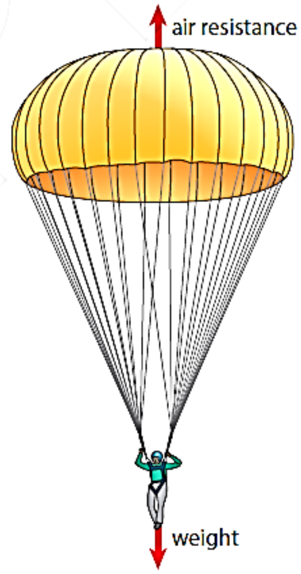
3.1 Forces and Motion

- Force is push or pull
- Measured in Newton
- The force diagram is represented by arrows
- The forces act on any objects may be:

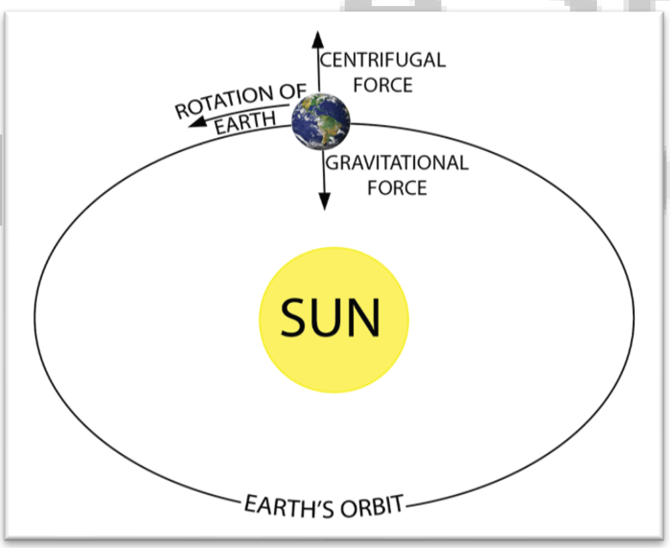


	Balanced force	Unbalanced force
Description	Equal in size – opposite in direction	Not equal in size and/or not in the opposite direction
Cause	No change in movement	Change in movement
Signs or types of change	1- The object is **not** moving 2- The object is moving at a **constant speed** in a **straight line**	1- Change speed (faster or slower) 2- Change direction (moving in a curved or circular path)
Examples	The force diagram shows the balanced forces acting on the rock. The forces acting on the rock when the wind is blowing.	The forces are no longer balanced and the rock will start to move.

Other examples:

	
When the parachute first opens, the forces are unbalanced. This unbalanced force makes the object slow down.	When the object slows, the air resistance decreases, so the forces become balanced again. Then the object falls at a constant speed. This force diagram shows the object falling at a constant speed.

<u>Why is the Earth not pulled by the Sun or floating in space?</u>



To keep orbiting around the Sun, two forces have to be balanced:

1- Gravitational force of the Sun
2- The centrifugal force that is created due to the spinning of the Earth on its axis

Summary

- When forces are equal in size and opposite in direction, the forces are balanced.
- Balanced forces cause no change in movement.
- When forces are not equal in size and/or act in directions that are not opposite, the forces are unbalanced.
- Unbalanced forces cause change in movement: speeding up, slowing down or changing direction.

Size of forces	Direction of forces	Balanced or unbalanced	Change in movement
Equal	Opposite	Balanced	None
Equal	Not opposite	Unbalanced	Change of direction
Not equal	Opposite	Unbalanced	Increase or speed
Not equal	Not opposite	Unbalanced	Increase or decrease speed and change of direction

3.2 Speed

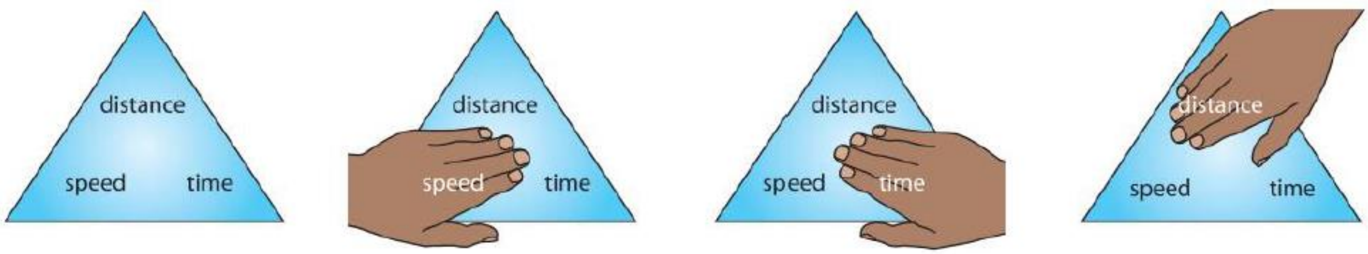
Speed is the distance that was covered during a certain time.

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

The unit of speed is m/s (Metres per second means metres for each second)

Note: the term **average speed** is sometimes used because the speed of an object during a journey is not always **constant**.

Use the triangle to calculate any of them:



$\text{speed} = \frac{\text{distance}}{\text{time}}$ $\text{time} = \frac{\text{distance}}{\text{speed}}$ $\text{distance} = \text{speed} \times \text{time}$

Worked example

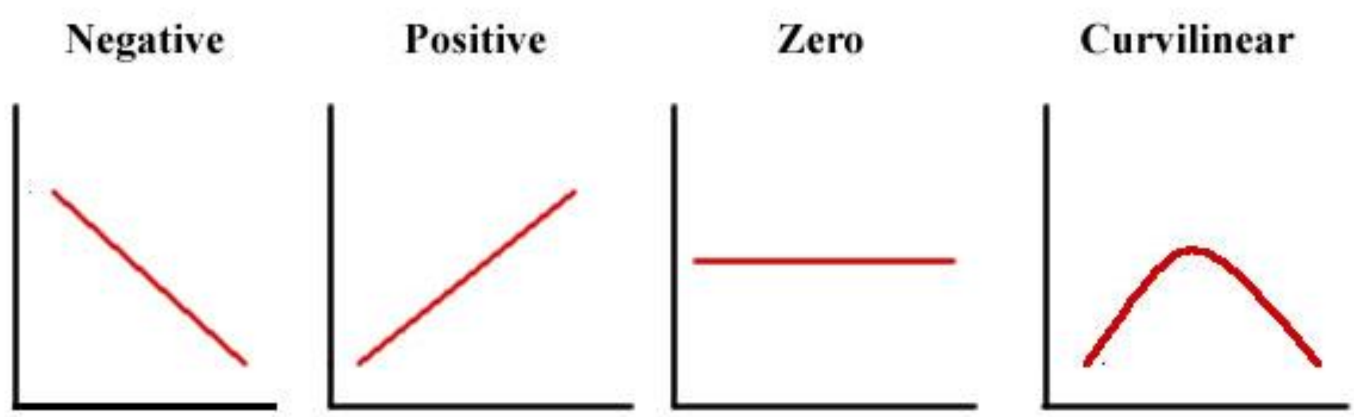
Question Marcus rides his bicycle at a speed of 4 m/s for 60 s. How far does he go in this time?	**Question** Sofia is in a car travelling at a speed of 35 m/s. How long will the car take to travel 2100 m?
Answer $\text{distance} = \text{speed} \times \text{time}$ $= 4 \times 60$ $= 240\,\text{m}$	**Answer** $\text{time} = \frac{\text{distance}}{\text{speed}}$ $= \frac{2100}{35}$ $= 60\,\text{s}$

3.3 Describing movement (Distance-Time Graph)

Why do we use graphs?

Graphs are more useful than words for describing movement because:
- it is easier to see trends and patterns
- you can read any value of distance or time during the journey, from the graph
- other values, such as speed, can be calculated from a graph
- information about the whole journey can be seen easily.

Types of graphs:

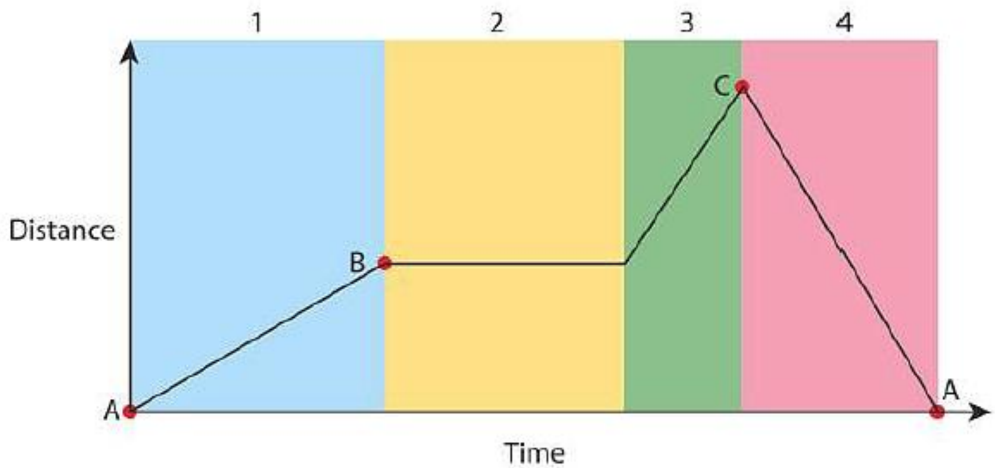


Inversely proportional relation When a factor increases, the other decreases	**Direct proportional relation** When a factor increases, the other increases	**Zero Slope** When a factor increases, the other is the same	**Curve** When a factor increases, the other increases then decreases

Note:

To describe the movement of an object (or its speed), you have to figure out how the distance changes with time.

Distance-Time Graph:



This is a distance-time graph. It shows the journey of a car from a starting position A to a destination, C. The car then returns to its starting position.

Area 1: (From A-B)

- The distance increases with time.
- The car was moving at a constant speed, so the graph has an *upward slope*.

Area 2:

- The distance is constant while the time is passing.
- The car is at rest or stationery, so the speed is zero and the graph is leaner.

Area3:

- The distance is increasing with time but faster than (A-B).
- The car travels a greater distance each second. So, the distance-time graph shows this as a *steeper* straight, *upward-sloping* line.

Area 4: (C-A)

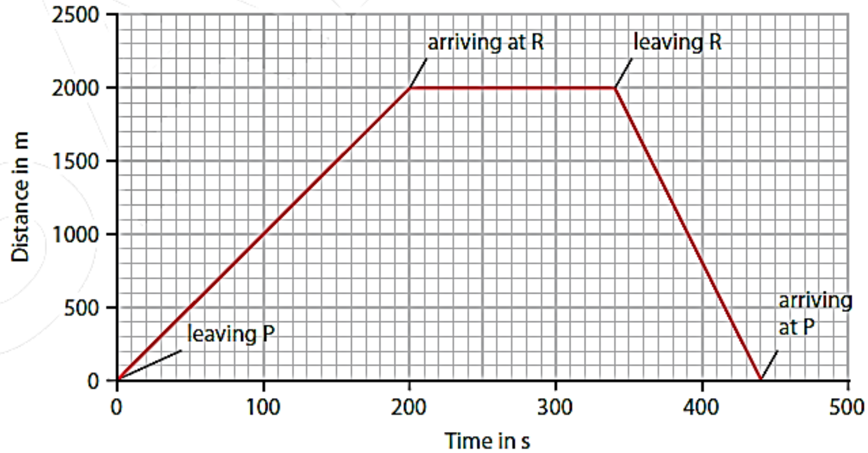
- The distance decreases with time.
- The car travels at a constant speed back to the starting position, A. The distance-time graph shows this as a straight, *downward*-sloping line.

Worked example

Question

This distance–time graph shows a short train journey between two stations, P and R, that are 2000 m apart.

- The train leaves station P at time 0.
- The train takes 200 s to travel from P to R.
- The train stops at station R for 140 s.
- The train then travels back to station P in a time of 100 s.



e At what speed does the train travel from station P to station R?

f What is the speed of the train on the way back from station R to station P?

Answer

a The distance is 2000 m and the time taken is 200 s.

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

$$= \frac{2000}{200}$$

$$= 10\ \text{m/s}$$

b The distance is 2000 m and the time taken is 100 s.

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

$$= \frac{2000}{100}$$

$$= 20\ \text{m/s}$$

3.4 Turning forces

One of the effects of the force is changing the direction of an object.

The object that turns is called a **lever**.
The point around which the lever turns is called the **pivot**.

The moment is the turning effect of a force.

The moment of a force depends on the following:
- The size of the force (the bigger the force, the bigger the moment)
- The distance between the position where the force acts and the pivot (the greater the distance, the greater the moment).

You can calculate a moment from this equation:

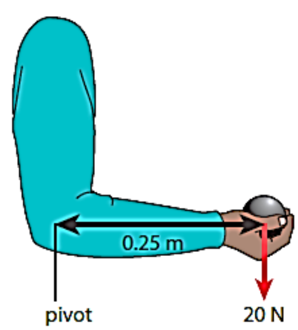
$$\text{moment} = \text{force} \times \text{distance}$$

The unit of force is the Newton and the unit of distance is the metre.
Therefore, the unit of moment is Newton × metre, which is written as **Newton metre** or N m.
*Remember to use an upper-case N and a lower-case m when writing N m.

Worked example

Question

Look at this diagram. What is the moment caused by the weight on the arm?

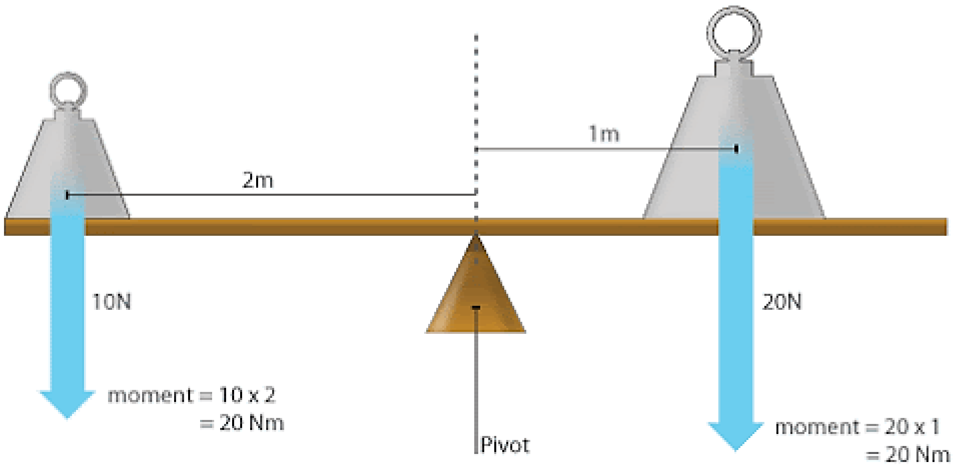


Answer

$$\begin{aligned}\text{moment} &= \text{force} \times \text{distance}\\ &= 20 \times 0.25\\ &= 5\,\text{N m}\end{aligned}$$

Balancing

A seesaw is a **type of lever** that people sit on either side of the pivot of a seesaw.
A seesaw will be balanced when the moments on both sides of the pivot are equal and opposite.



Worked example

Question

Marcus, with a weight of   sits at a distance of   from the pivot of a seesaw. Arun, has a weight of 800 N. Where should Arun sit to make sure the seesaw is balanced?

Answer

Marcus will exert a moment of $600 \times 2 = 1200$ Nm

For the seesaw to be balanced, the moment on the other side must also be 1200 Nm.

$$\text{moment} = \text{force} \times \text{distance}$$

$$\text{So, distance} = \frac{\text{moment}}{\text{force}}$$

$$\text{distance} = 1200\ \text{Nm}/800\ \text{N}$$

$$= 1.5\ \text{m}$$

3.5 Pressure between solids

Pressure shows how the force is concentrated on a certain area.

Pressure is affected by 2 factors:

1- Force
2- Surface area

- Force is directly proportional to the pressure (increasing the force, increases the pressure).
- Surface area is inversely proportional to the pressure (increasing the surface area, decreases the pressure)

How to calculate pressure?

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

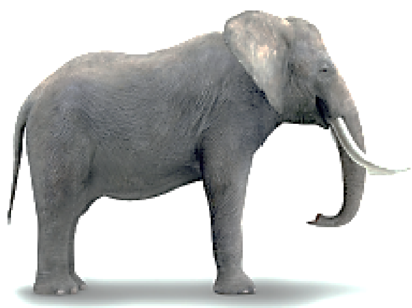
- Pressure is force divided by area. The unit of force is the Newton and the unit of area is the metre squared. That means the unit of pressure is **Newtons per metre squared or N/m2**.

To find pressure	To find force	To find area
F / P × A	F / P × A	F / P × A
$P = \frac{F}{A}$	$F = P \times A$	$A = \frac{F}{P}$

Worked example

Question

Imagine an elephant standing on four feet, as shown in the picture.



The weight of the elephant is 50 000 N.
The total area of all four feet is $0.4\,m^2$.

What is the total pressure that the elephant exerts on the ground?

Answer

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

$$= \frac{50\,000}{0.4}$$

$$= 125\,000\ N/m^2$$

The unit of pressure here is N/m^2 because the area is given in m^2.

Question

The total weight of a bicycle and rider is 1000 N.

The bicycle has two tyres in contact with the ground and the weight is supported equally on both tyres.

The area of each tyre in contact with the ground is $5\,cm^2$

What is the pressure that each tyre exerts on the ground?

Answer

$$\text{weight on each tyre} = \frac{1000}{2}$$

$$= 500\ N$$

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

$$= \frac{500}{5}$$

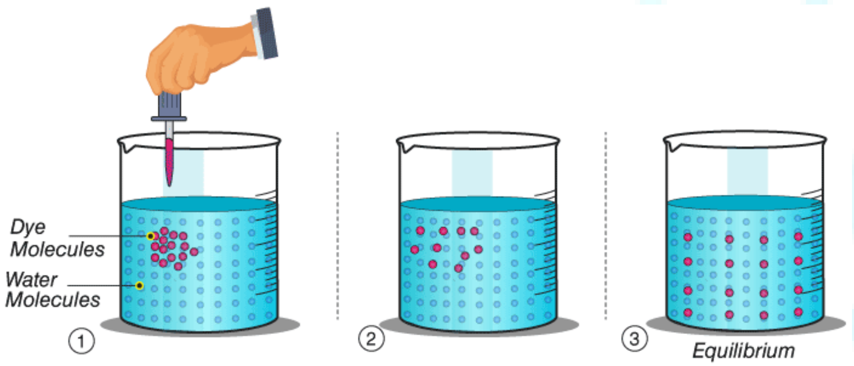
$$= 100\ N/cm^2$$

Notice how the unit of pressure here is N/cm^2 because the area of the tyres is given in cm^2.

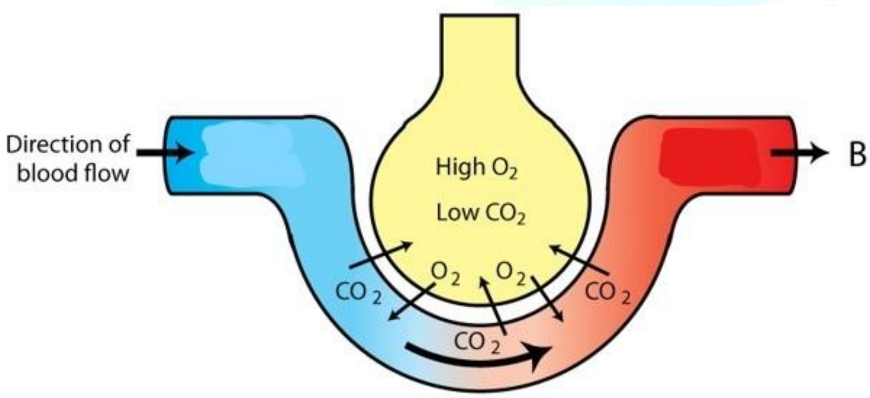
Recapping Diffusion

Diffusion is the movement of particles from an area of high concentration to an area of low concentration.

- Diffission happens in liquids and gases



Diffusion between liquids



Diffusion between gases

Factors that affect the speed of diffusion:

1- Temperature:
The higher the temperature, the faster the diffusion.
(Higher temperature makes particles move faster (collide more), so the particles can spread out faster).

2- The difference in concentration:
The bigger the difference in the concentrations of the particles, the faster the diffusion.