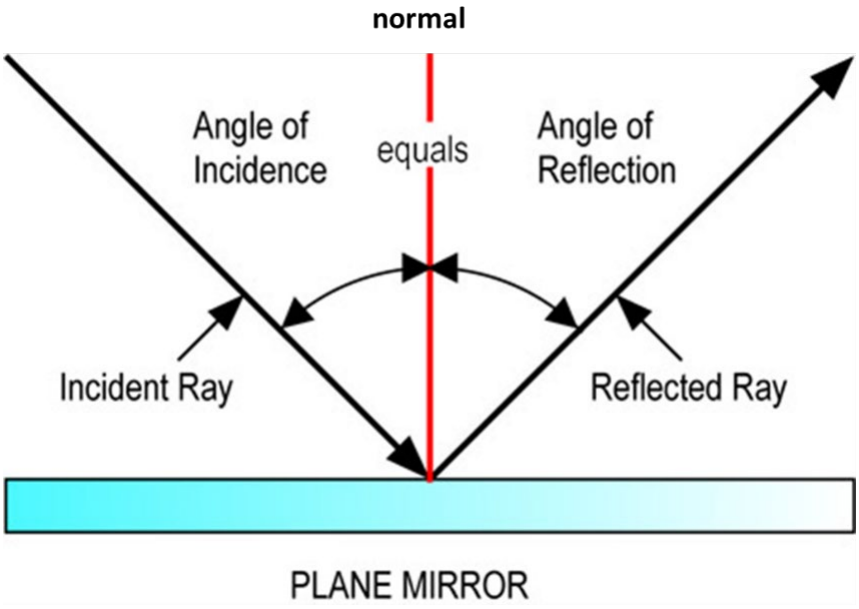
Ray diagrams in a plane mirror

Ray diagrams are used to show an image of an object reflected in a mirror. Straight lines from the object are drawn towards the mirror. Using the rule from the **angle of incidence** and **reflection** the lines are then reflected back. Arrows are used on the lines to show the light rays' direction.

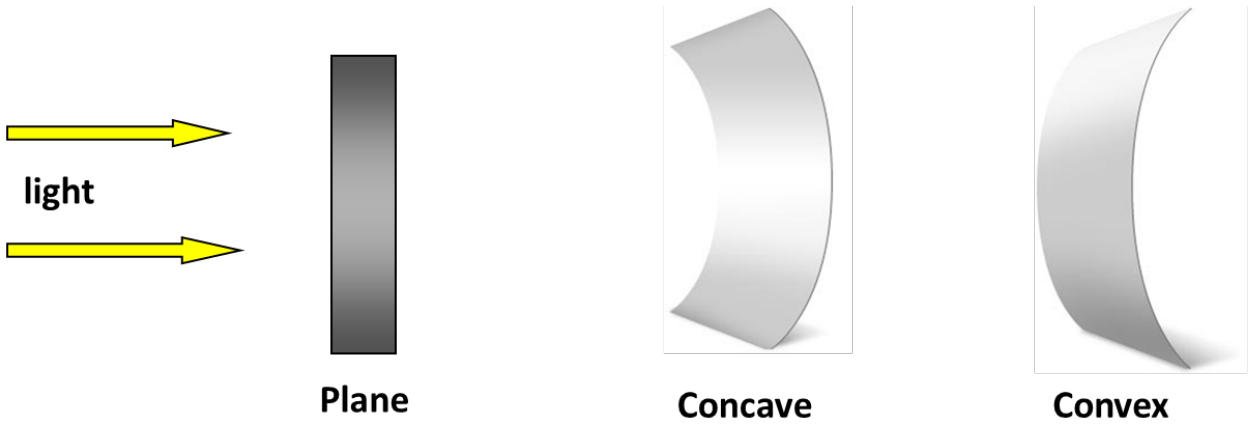
The main rule for mirrors is that **the angle of incidence equals the angle of reflection**.



This means that the angle of the light ray between where it arrives and the perpendicular line called the **normal**, to where it hits on the surface of the mirror is the same angle it leaves and the same perpendicular (**normal**) line.

Convex and concave mirrors

Mirrors work because light is reflected from them. The three types of mirrors are:



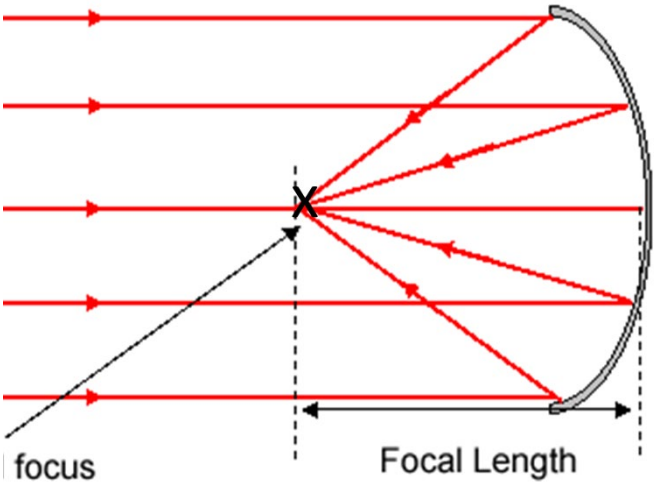
The images in the **plane** mirrors are the same size, the right way up but laterally inverted (changed right to left) and is a flat reflecting surface.

The images in the **concave** mirror are

a) magnified and the right way up when you are near to the mirror
b) smaller and upside down when you are further away from the mirror

The images in the **convex** mirror are reduced and the right way up

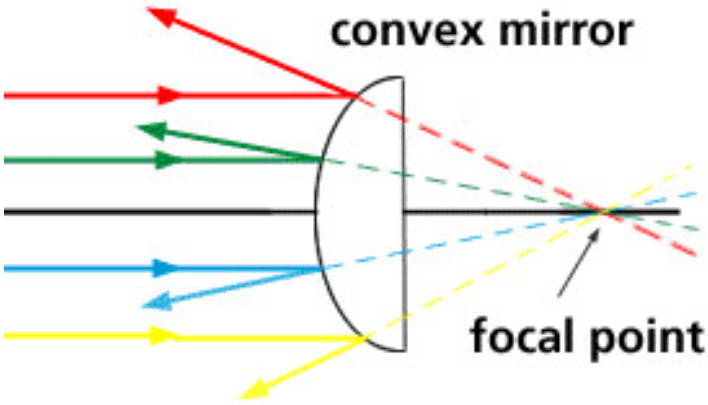
Ray diagrams in a concave mirror



With **concave mirrors**, light being reflected converges (goes in an inward direction) towards the focal point (x). From a distance, images appear upside down but when brought nearer, image become larger in size and appears right side up. A focal point is where parallel rays meet.

Ray diagrams in a convex mirror

The image formed in a **convex mirror** is always upright and smaller in size. The light rays diverge (spread apart). The focal point is behind the mirror where light rays do not actually pass through.



Everyday use for concave and convex mirrors

Convex traffic safety mirrors are designed for road safety to see better at blind corners, concealed entrances and exits. Convex ceiling dome mirrors are used in surveillance for shops because they allow someone to watch what is going on in a wide area. They are also used in car side mirrors to see a wide view from behind.	**Concave** mirrors are commonly found in the head lights of vehicles making the light more reflective and wider, making it possible for the drivers to have a better view at night. Concave mirrors are also used in microscopes and face mirrors to enlarge the view as magnified and the right way up when you are near to the mirror
	

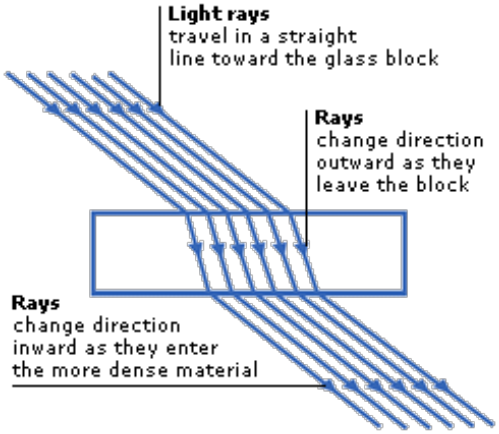
Light can be Refracted by a lens

Refraction

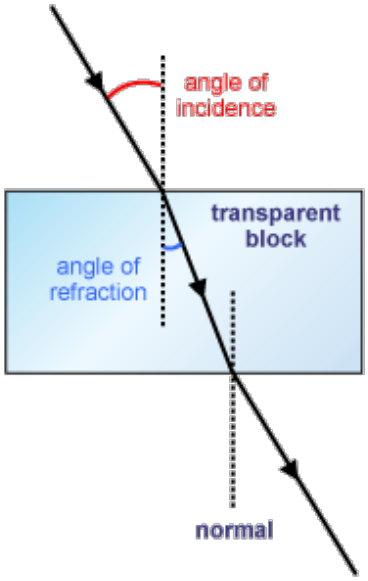
A glass or plastic lens is **transparent**. This means that light can be transmitted through the object without the light being absorbed.

The medium of a plastic or glass lens has a different **optical density** to air. Light rays entering the lens are refracted to a different angle.

Refraction is when light travels between two optically different (densities) mediums that bend light towards or away from the normal.



Refraction in a glass block

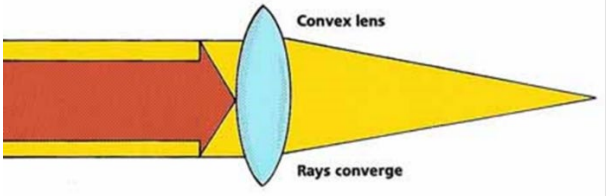


The ray of light bends or **refracts inwards** when it moves into the glass. This makes the **angle of refraction smaller than the angle of incidence**.

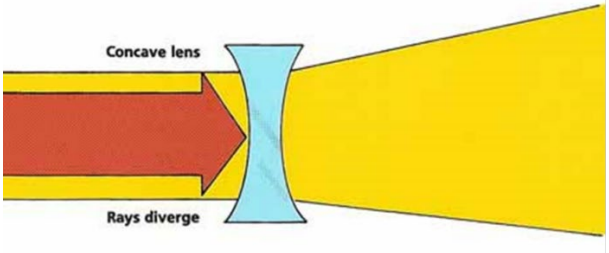
When the ray emerges from the glass back into the air then it continues on a **parallel** path to the original ray.

A **medium** is any space or substance which will allow light to travel through it called transmission. Examples of different media include air, water and glass. Each medium has different **optical density**. The optical density of a medium affects the **speed** at which light rays travel through. When a light ray passes from one medium into another (e.g. from air into water) it will change direction where two media meet. This 'bending' of light is called **refraction** and it always occurs when the two media have different optical densities.

Concave and convex lens



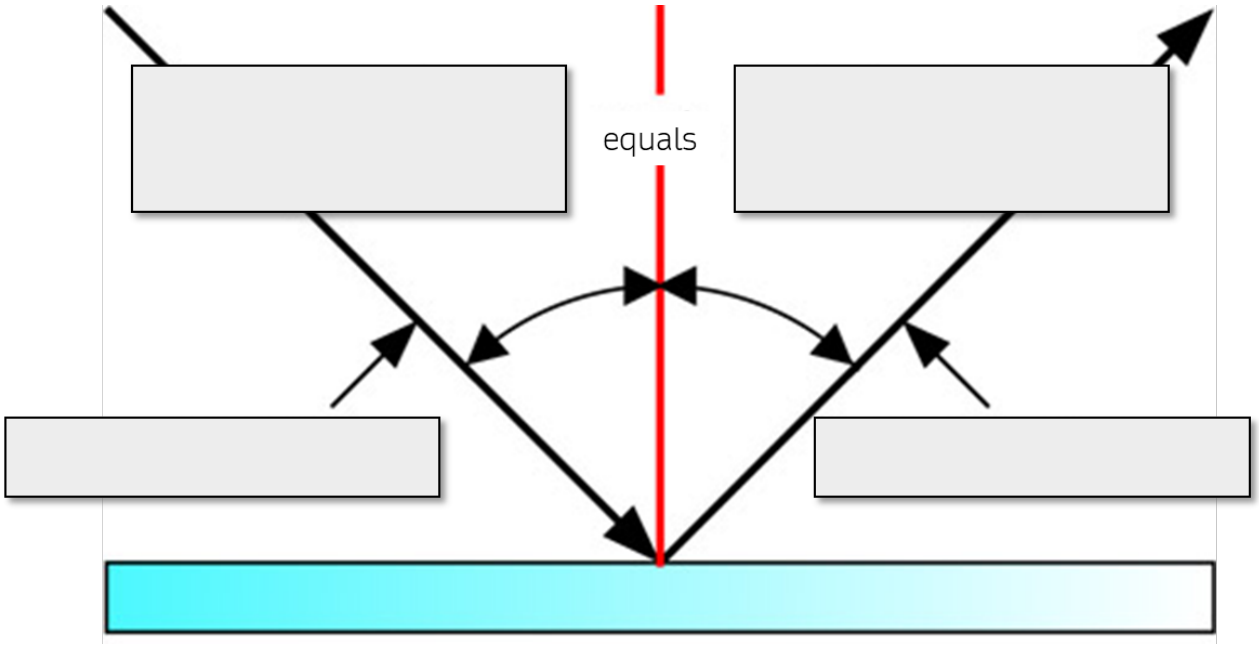
Lenses that **curve outwards** are known as convex lenses.
When light enters them it refracts inwards once it leaves the lens.



Lenses that **curve inwards** are known as concave lenses.
When light enters them it refracts outwards once it leaves the lens.

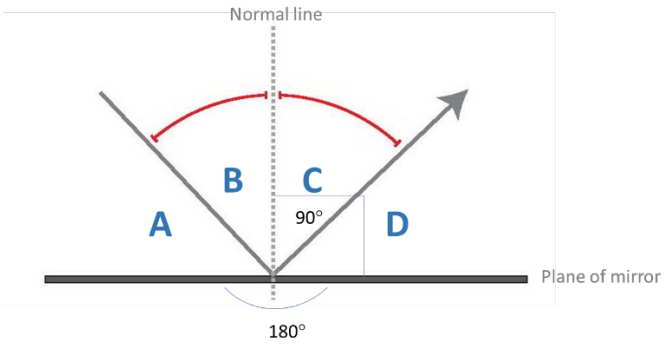
1. Complete the ray diagram for a flat mirror

reflected ray	angle of incidence	incident ray	angle of reflection



2. State the Law of reflection

3. Using the Law above, calculate the 'missing' angles in the following setups:



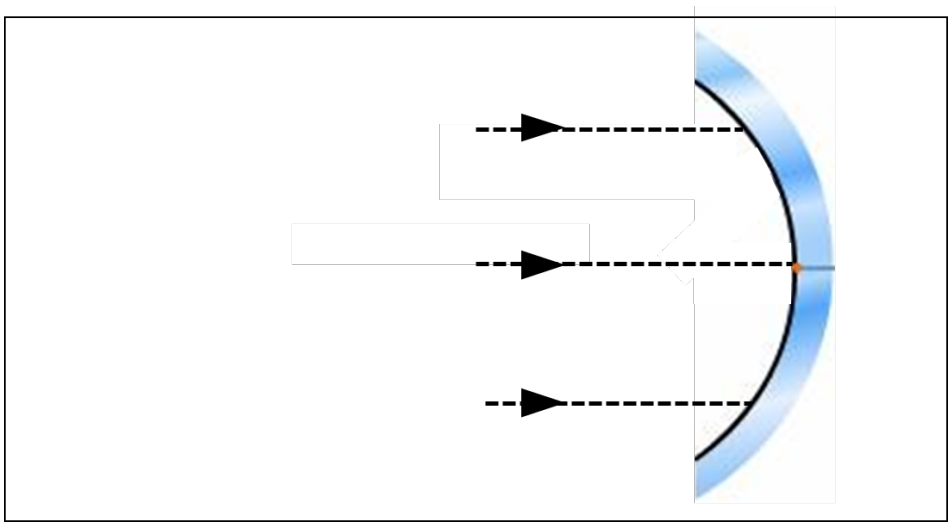
setup	A	B	C	D
1	60°		30°	
2		55°		
3			47°	
4				17°

4. Identify the shapes of following mirrors and lenses as either **convex** or **concave**

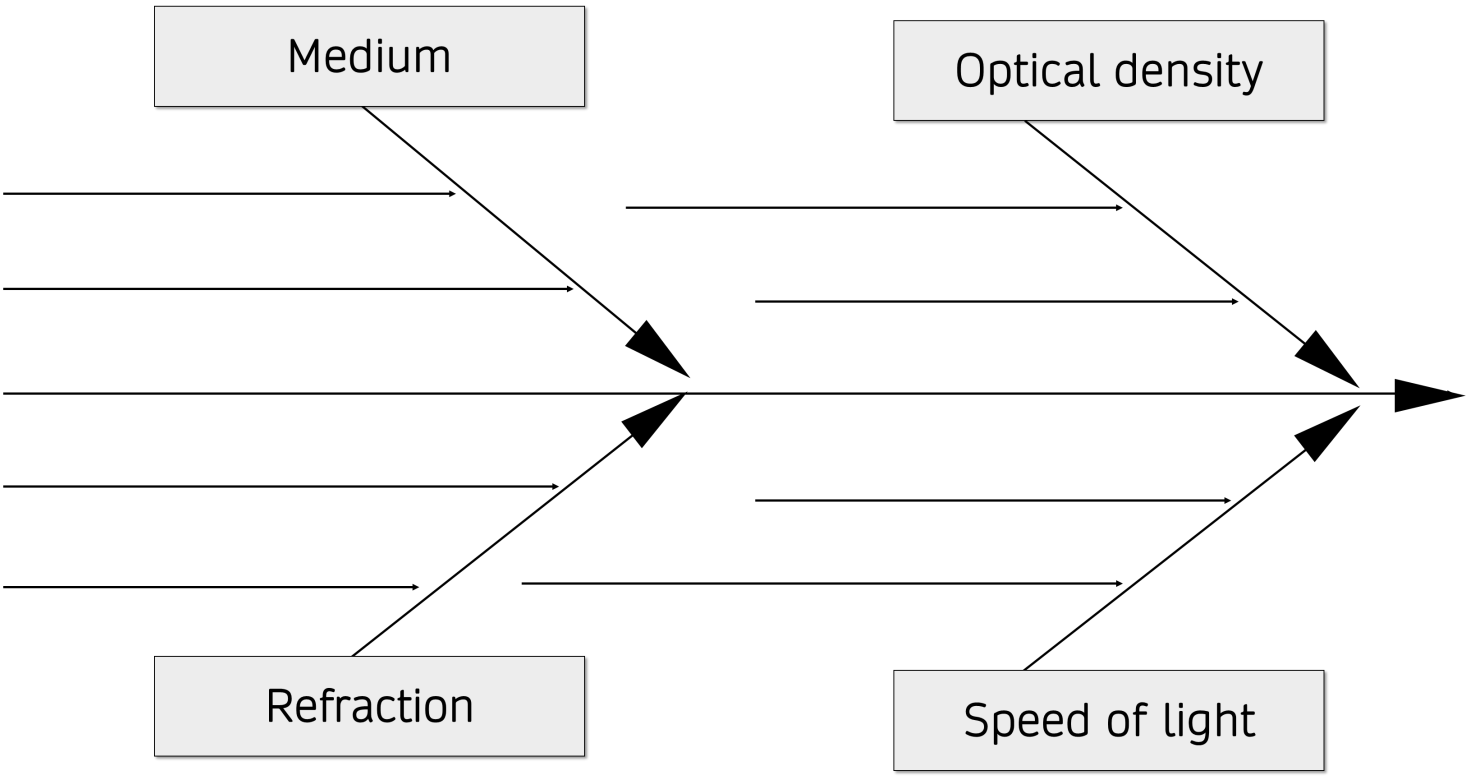
5. After research, construct a summary chart showing uses for convex and concave mirrors and link to why that type of mirror is useful for that purpose – an example is given.

Uses of Mirrors	
Concave mirrors	Convex mirrors
❑ Makeup mirror – the concave mirror makes the image larger when close to mirror	❑
❑	❑
❑	❑
❑	❑
❑	❑

6. Complete the diagram to show the direction of the rays after the hit the surface of the mirror



7. Effect: **Light is bent as it passes through another medium.** Use the fishbone to summarise the causes – use previous notes and research to find information.



8. Complete the diagrams to show light rays travelling through the square lenses