

## Chapter 5

Date: \_\_\_\_\_

### Ray Model of Light

#### 1 Introduction

##### What is Light?

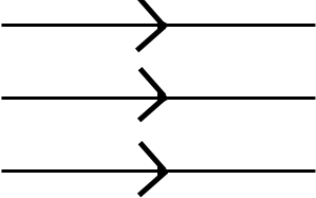
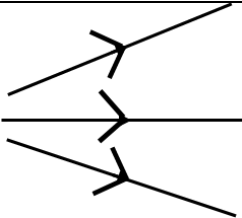
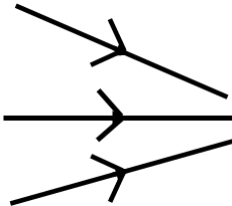
Definition: \_\_\_\_\_  
\_\_\_\_\_

- Light travels in \_\_\_\_\_ lines.
- Light travels at a very high speed. It travels at a speed of \_\_\_\_\_ in a vacuum.

Light Ray: A \_\_\_\_\_ line of light

Light Beam: A \_\_\_\_\_ of light.

##### Different Beams of Light

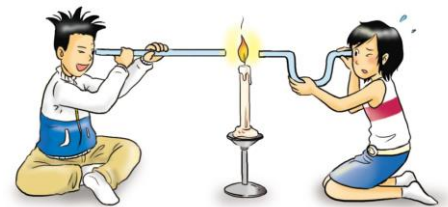
		
Parallel beam	Divergent beam (fan outwards)	Convergent beam (merge to a point)

##### How do we know that light travels in a straight line?

Through a **straight** hose: \_\_\_\_\_

Through a **bent** hose: \_\_\_\_\_

Conclusion: This shows that \_\_\_\_\_, but travels in \_\_\_\_\_.



#### 2 Shadows and Eclipses

##### What is a shadow?

When light shines on an object, some rays of light are \_\_\_\_\_ by the object while other rays continue to travel \_\_\_\_\_.

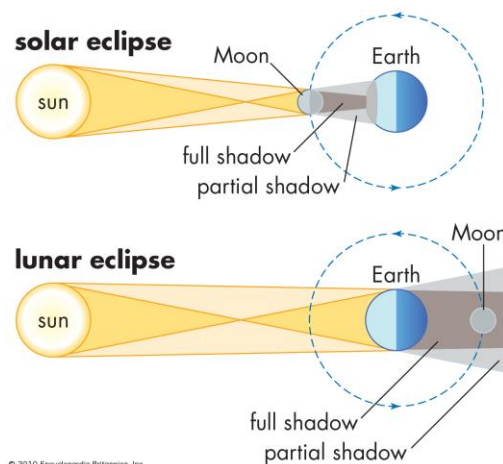
The \_\_\_\_\_ behind the object which \_\_\_\_\_ is called the \_\_\_\_\_.



## What is an Eclipse?

An eclipse of the Sun occurs when the \_\_\_\_\_ comes between the Sun and the Earth.

The moon \_\_\_\_\_ from the Sun and casts a \_\_\_\_\_ on the Earth.

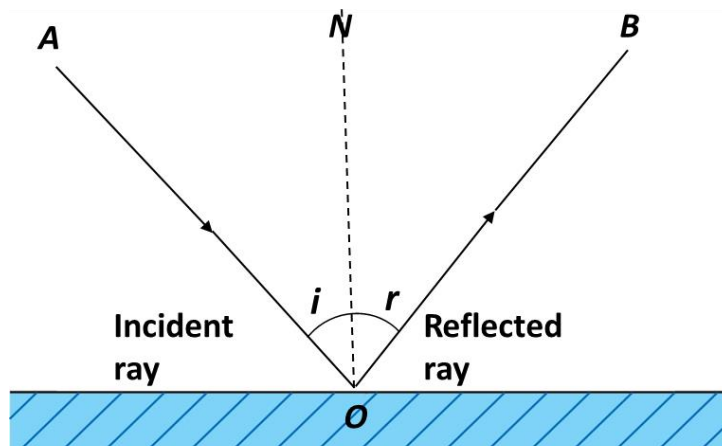


## 3 Reflection of Light and its practical uses

### What is Reflection?

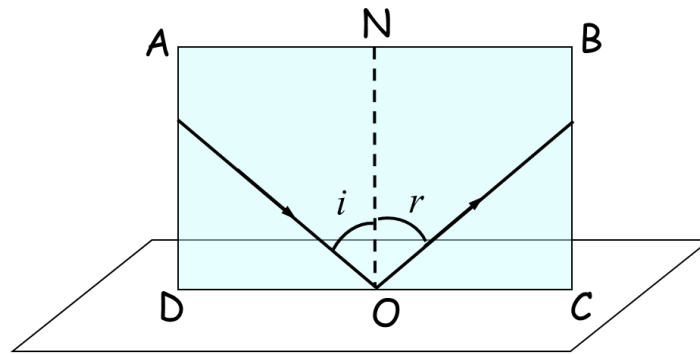
The \_\_\_\_\_ in a mirror is formed when light rays \_\_\_\_\_ the mirror and travel to your eyes. This bouncing of light off a mirror is called \_\_\_\_\_.

### Features of a Ray Diagram



Terminology	Definition
Plane mirror	A flat mirror.
Normal	The line (ON) is _____ to the mirror at the point of incidence.
Incident Ray	The ray (OA) that _____ the mirror.
Angle of Incidence ( )	Angle between the _____ to the _____.
Reflected Ray	The ray (OB) that _____ the mirror.
Angle of Reflection ( )	Angle between the _____ and the _____.

## Laws of Reflection

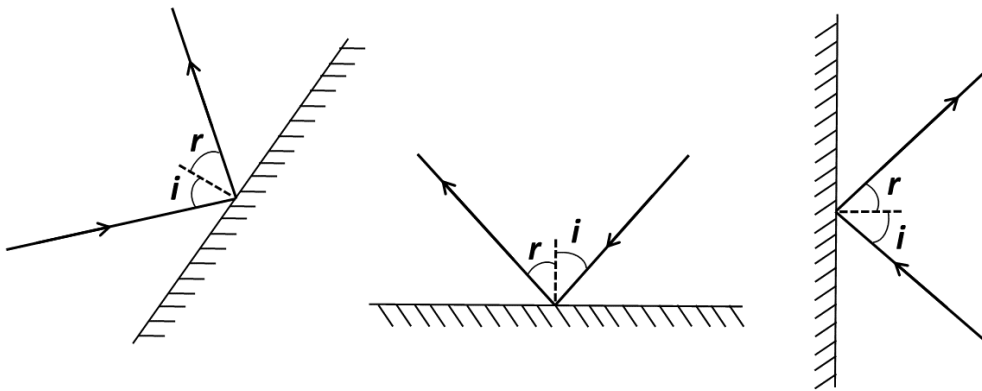


1. The incident ray, normal and reflected ray all lie on the same \_\_\_\_\_.
2. The angle of incidence is always \_\_\_\_\_ to the angle of reflection.

$$\angle \text{ } = \angle \text{ }$$

### Reflection – when light ray strikes at different angles

No matter which angle the light ray strikes the mirror the angle of incidence will **always be equal** to the angle of reflection.

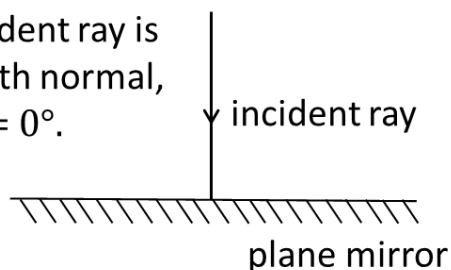


### Reflection – when light ray strikes at 90° to plane mirror.

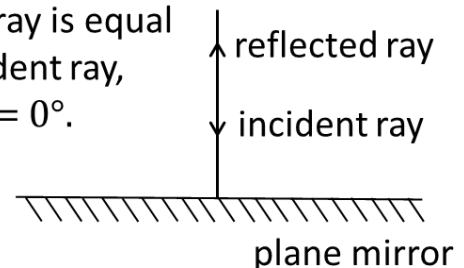
When a ray of light strikes the mirror at a right angle (90°), **angle of incidence** is \_\_\_\_\_.

It is then reflected along the same path.

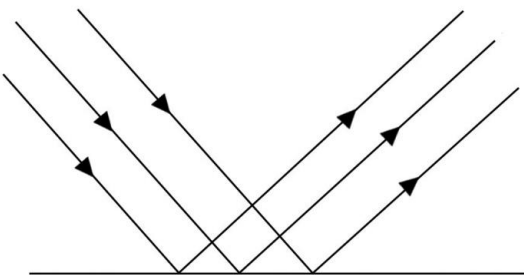
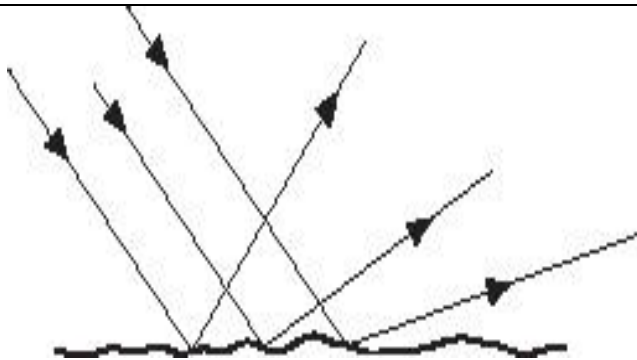
when incident ray is aligned with normal,  
 $\angle i = 0^\circ$ .



reflected ray is equal to incident ray,  
 $\angle r = 0^\circ$ .



## Types of Reflection

Regular Reflection	Diffused Reflection
	
<p>On a smooth surface,</p> <ul style="list-style-type: none"><li>• A parallel beam of light is reflected as a parallel beam.</li><li>• An _____ is formed.</li></ul>	<p>On a rough surface,</p> <ul style="list-style-type: none"><li>• A parallel beam of light is reflected as individual rays reflected in different directions.</li><li>• _____ is formed.</li></ul>

## Ray Diagram (Reflection)

4 steps for drawing ray diagrams

- 1) \_\_\_\_\_ the position of the image behind the mirror.
  - Ensure distance between object and mirror is \_\_\_\_\_ to distance between image and mirror.
  - Image must be drawn in dotted lines – indicated image is \_\_\_\_\_.
- 2) Draw a pair of \_\_\_\_\_ from the **image** to the observer.
  - Use **dotted** lines (\_\_\_\_\_) for the rays behind the mirror.
  - Use **solid** lines (\_\_\_\_\_) for rays in front of the mirror.
  - Rays must start from \_\_\_\_\_ point of the image.
- 3) Draw a pair of \_\_\_\_\_ from the **surface of the mirror to the object**.
  - Ensure that the pair of rays emerge from \_\_\_\_\_ point of the object – must be \_\_\_\_\_ as the image.
- 4) Draw \_\_\_\_\_ to indicate the direction of the light rays.
  - From image to eye
  - From object to mirror

Draw the ray diagram for the object given:

Object, O



Practice 1

B



## **Practice 2**

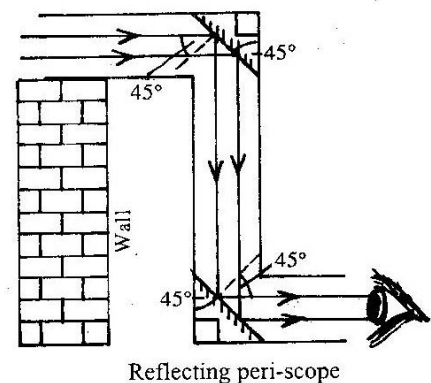


### **Characteristics of an image of a plane mirror:**

1. The distance of the image from the mirror is \_\_\_\_\_ to the distance of the object from the mirror.
2. The image and the object are of the \_\_\_\_\_.
3. The image is \_\_\_\_\_.
4. The image is \_\_\_\_\_. This means the left and right side of the image are reversed.
5. The image is \_\_\_\_\_. This means that the image cannot be projected onto a screen behind the mirror.

### **Uses of Plane mirrors**

- Helps a driver see the traffic behind.
- Helps a person check his appearance.
- Makes a room bigger.
- Periscope is a device that are made of \_\_\_\_\_ plane mirrors to see over obstacles.



## Uses of Curved Mirrors

- **Convex mirrors** form \_\_\_\_\_ that are always \_\_\_\_\_ than the object. This allows for a \_\_\_\_\_ field of view.

- **Uses of convex mirrors**

- At \_\_\_\_\_ corners of traffic junctions
- \_\_\_\_\_ mirror
- Mirrors placed at the \_\_\_\_\_ of shops.



**Convex mirror**

- **Concave mirrors** form \_\_\_\_\_ images if the object is **close** to the mirror. If the object is **further away**, the image is \_\_\_\_\_.

- **Uses of concave mirrors**

- Compact make-up and shaving kits
- Dentist's mirror



**Concave mirror**

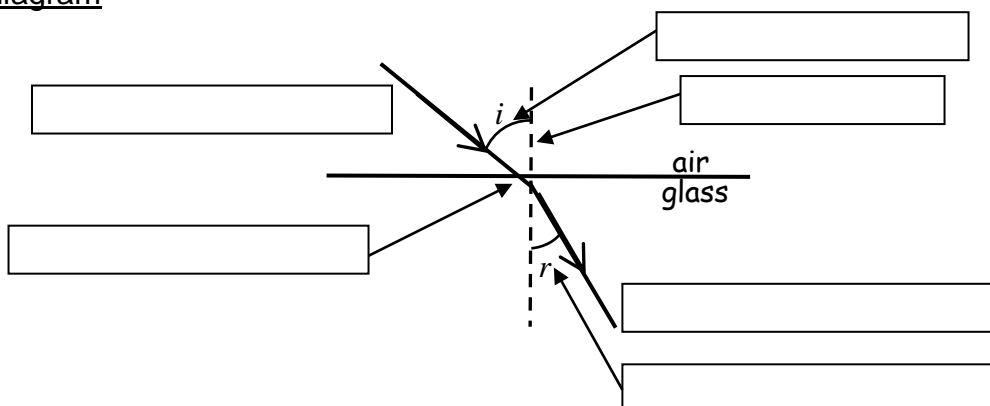
## 4 Refraction and its practical uses

### **What is Refraction?**

Refraction is the \_\_\_\_\_ when it passes from one transparent medium into another of different \_\_\_\_\_ (e.g. from air to water).

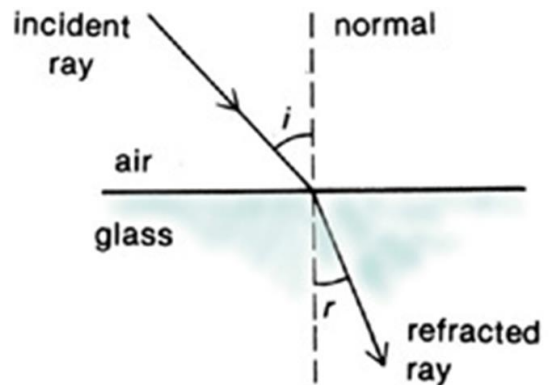
Refraction is caused by a \_\_\_\_\_ in speed of light as it passes through a different transparent medium.

### Label the diagram

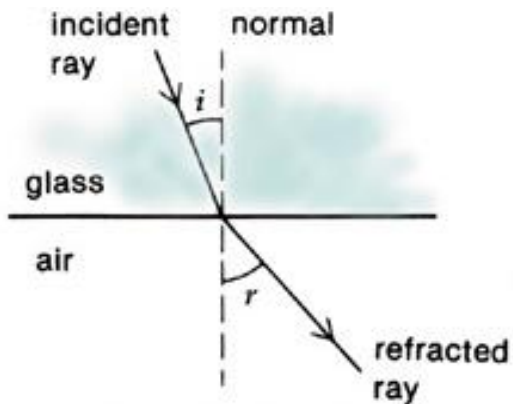


**Refraction – when a ray of light travels from an optically LESS dense medium to MORE an optically more dense medium.**

- speed of light \_\_\_\_\_,
- the ray of light bends \_\_\_\_\_ the normal.
- Therefore,



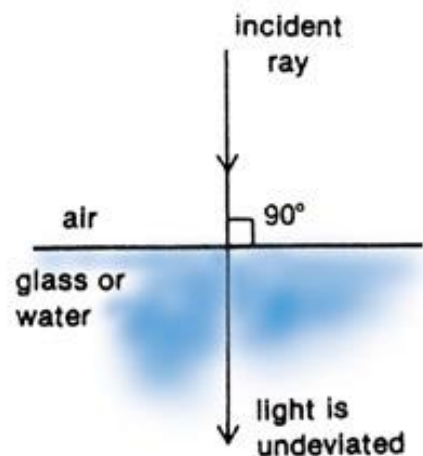
**Refraction – when a ray of light travels from an optically MORE dense medium to more an optically LESS dense medium.**



- speed of light \_\_\_\_\_,
- the ray of light bends \_\_\_\_\_ the normal.
- Therefore,

**Refraction – when a ray of light enters another medium perpendicular to the surface.**

- speed of light \_\_\_\_\_.
- \_\_\_\_\_ of ray is observed.
- Therefore,

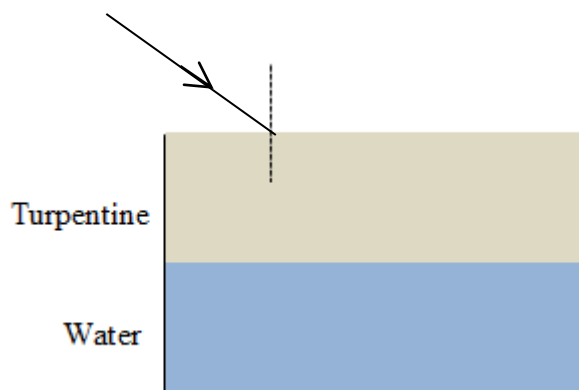


\*Note: There is still a change in speed of light although there is no bending (deviation) observed.



### Test yourself!

The diagram shows a tank of turpentine and water. It is known that the optical density of air, turpentine and water increases in the following order: air, water, turpentine. With this information, complete draw the path of the light ray till it exits the tank.

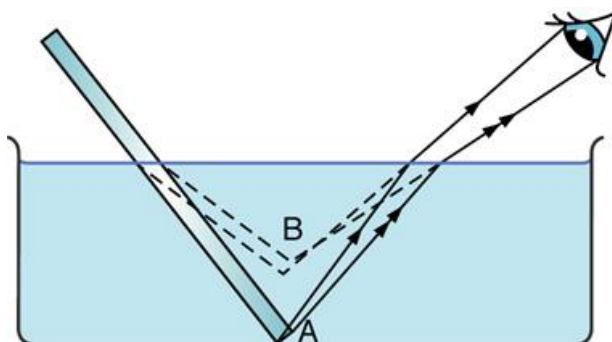


### Effects of Refraction

The \_\_\_\_\_ of light causes an object to appear \_\_\_\_\_ than it actually is when a transparent material is on top.



In the diagram, refraction causes point **A** to \_\_\_\_\_ to the surface at **B**. So to the eyes, the straw appears to bend \_\_\_\_\_ the surface of the water.

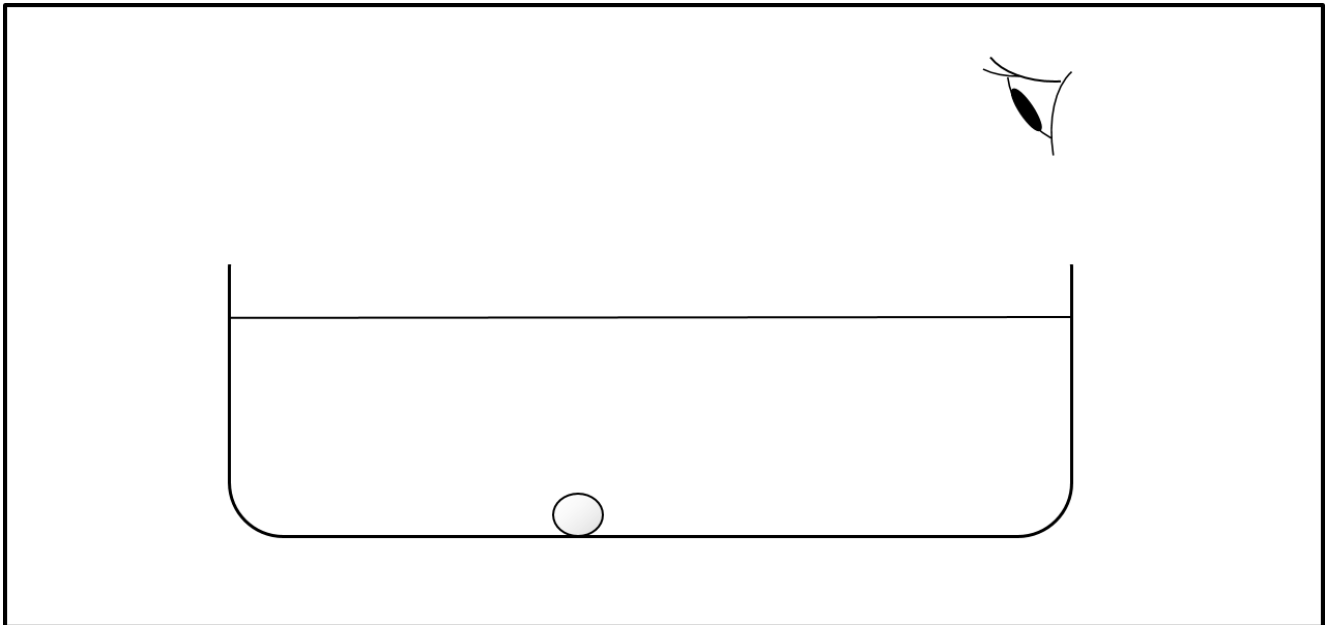


## Ray Diagram (Refraction)

4 steps for drawing ray diagrams

- 1) \_\_\_\_\_ the position of the image.
  - Object appears \_\_\_\_\_.
  - Image should be drawn directly \_\_\_\_\_ the object.
  - Image should be \_\_\_\_\_ and same \_\_\_\_\_.
- 2) Draw a pair of \_\_\_\_\_ from the **image** to the observer.
  - Start from \_\_\_\_\_ point of the image.
  - Use dotted lines (\_\_\_\_\_) from the image to the surface of the water.
  - Use solid lines (\_\_\_\_\_) from the surface to the observer.
- 3) Draw a pair of \_\_\_\_\_ from the **object** to the surface.
  - Use solid lines (\_\_\_\_\_) to connect the incident rays to the refracted rays.
- 4) Draw \_\_\_\_\_ to indicate the direction of the light rays.

**Draw the ray diagram for the object.**



## 5 Colours

### **What is a spectrum of white light?**

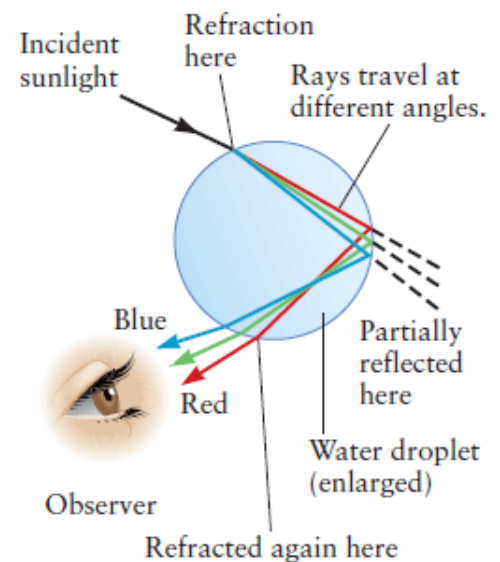
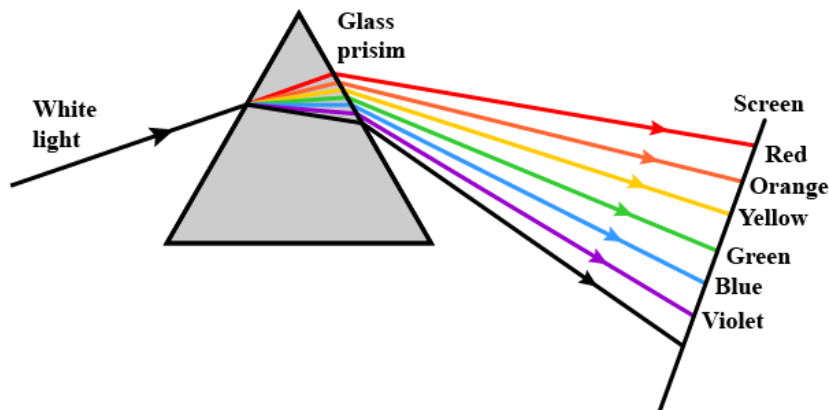
Ordinary light (or white light) is a mixture of \_\_\_\_\_ different colours called a \_\_\_\_\_.

When a beam of white light passes through a \_\_\_\_\_, the light splits up and \_\_\_\_\_ into a spectrum.

The Spectrum consists of seven colours: R\_\_\_\_, O\_\_\_\_, Y\_\_\_\_, G\_\_\_\_, B\_\_\_\_, I\_\_\_\_ and V\_\_\_\_.

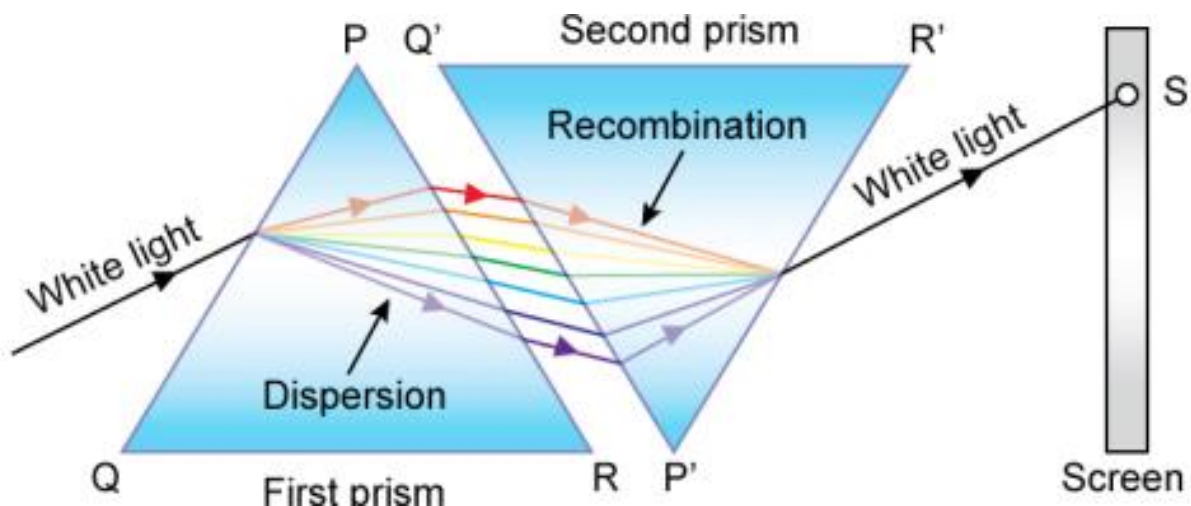
### **What causes the colours in a rainbow?**

Sunlight (white light) passes through rain drops. Each rain drop acts as a \_\_\_\_\_ and \_\_\_\_\_ the white light to form the colour of the spectrum.



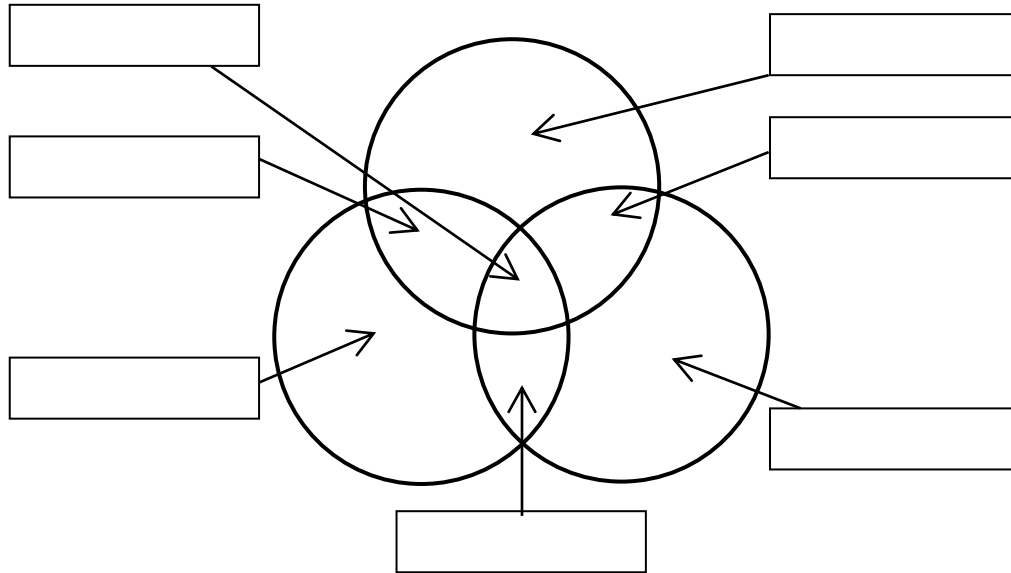
### **White light can also be obtained by combining the colours together.**

By using two prisms, one to disperse white light into its colours and the second one to converge the coloured light rays together to form white light.



## Colour Mixing

- Primary colours of light: \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_.
- Mixing two primary coloured lights at a time gives: \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_ lights.
- Mixing all three primary coloured lights gives: \_\_\_\_\_ light.

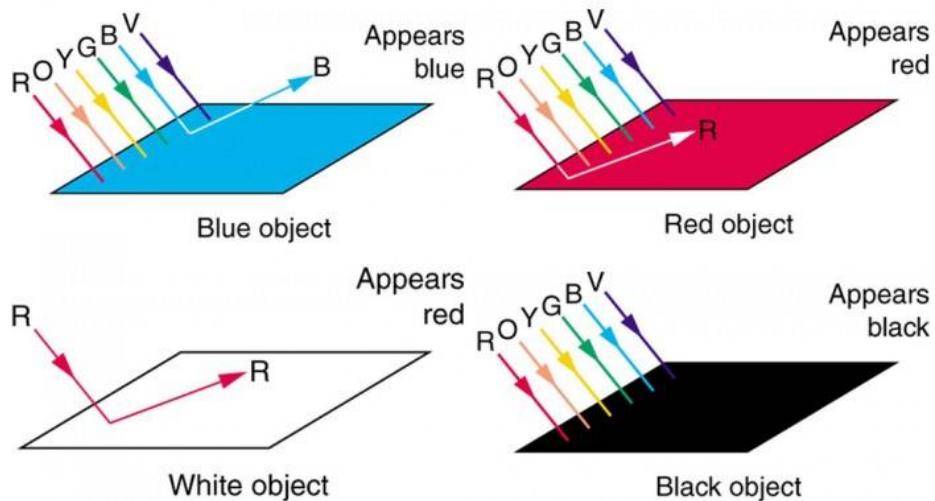


## Seeing Coloured objects in White light

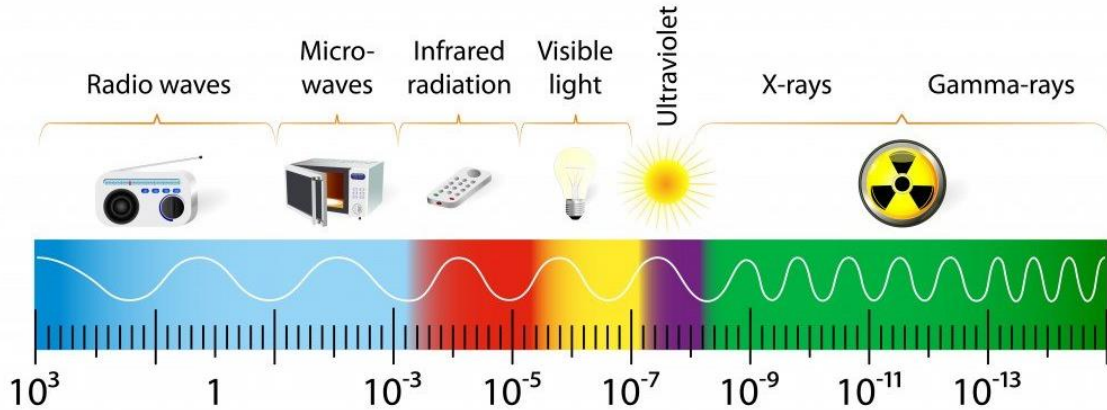
When white light shines on a coloured object, some of the colours in the spectrum are \_\_\_\_\_ and some are \_\_\_\_\_.

## Seeing Coloured objects in coloured light

The colour of an object is the colour of the light that is \_\_\_\_\_ from it into our eyes.



## 6 Electromagnetic (EM) Spectrum



The electromagnetic waves in the spectrum:

- (a) Radio waves
- (b) Microwaves
- (c) Infrared radiation
- (d) Light
- (e) Ultraviolet radiation
- (f) X-rays
- (g) Gamma rays

Each electromagnetic waves have their function e.g. radio waves are used in the transmitting of radio signals.

### Beneficial and Harmful Effects of infrared radiation and ultraviolet radiation:

#### **a) Infrared radiation**

Beneficial	Harmful
Use in remote control, night vision goggles, lasers, thermographic cameras, communications devices and weather satellites.	Large doses of infrared radiation can damage _____.  Exposure to intense electromagnetic radiation, including infrared radiation, can damage the eye.

## b) Ultraviolet radiation

Beneficial	Harmful
UV from the Sun is needed by our bodies to produce _____ which helps strengthen bones, muscles and the body's immune system.  Useful for disinfection and _____ of surgical instrument.	Overexposure of u.v. can cause <ul style="list-style-type: none"><li>• sunburn</li><li>• _____</li></ul>

## 7 Light Pollution

- Excessive artificial lighting causes \_\_\_\_\_, making the sky look bright even at night and difficult to observe the stars
- A lot of \_\_\_\_\_ is used
- Light pollution can be harmful to human health, causing problems such as stress, headaches and sleep deprivation
- Nocturnal animals may have trouble hunting for food because it is too bright.

## Essential Takeaways

1. Light rays as representation of light
2. Use of light rays to explain reflection and refraction
3. Use of light rays to predict effects of refraction