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MODELS: Ray of Light

CHAPTER ANALYSIS

7 KEY CONCEPTS

- Show an understanding that the ray model represents the path taken by light
- Recognise that light travels in straight lines, forming shadows when blocked
- Explain how reflection is affected by smooth and rough surfaces using the ray model of light
- Predict the characteristics of the image formed by a plane mirror using the ray model of light
- Describe the effects and uses of reflecting surfaces (eg. plane and curved)
- Describe some effects of refraction
- Describe the dispersion of white light by a prism using the ray model of light

3 ADVANCED CONCEPTS

- Show an understanding that the change in the speed of light in different media causes refraction
- Explain how we see the colour of objects in white light and coloured light such as red, blue, and green
- Investigate the effects of refraction in practical activities and make inferences through observations in everyday life

KEY CONCEPT

LIGHT

Luminous objects produce light, and are sources of light (sun, stars, fire, etc.)

Non-luminous objects do not produce light, and are not sources of light (tree, book, etc.)

PROPERTIES OF LIGHT

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Light travels **in straight lines**.

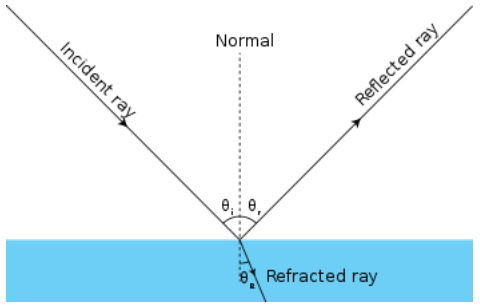
- Hence, a ray of light is represented by **a straight line with an arrow** to indicate its direction *(ray model of light)*

When light is blocked, **shadows** are formed.

- The area behind the object that receives no light is the shadow

REFLECTION

Definition: the bounding of light off a mirror

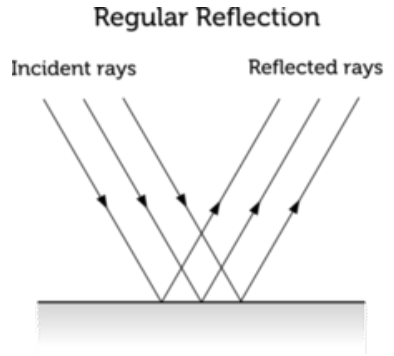


- **Incident ray**: ray of light travelling towards the mirror
- **Reflected ray**: ray of light travelling away from the mirror
- **Normal**: Imaginary line at right angles to the mirror
- **Angle of incidence**: angle between normal and incident ray
- **Angle of reflection**: angle between normal and reflected ray

TYPES OF REFLECTIONS

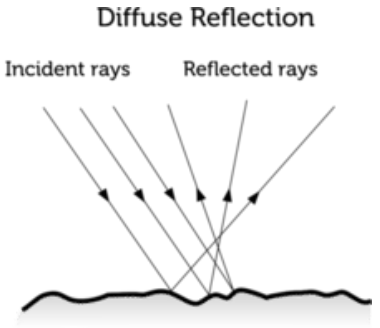
Regular reflection

- Occurs when parallel rays of light hit a **smooth** surface such as a plane mirror -> reflected as **parallel** rays
- Image is **clear and undistorted**



Diffuse reflection

- Occurs when parallel rays of light hit a **rough** surface such as frosted glass or rough paper -> reflected off the surface at different angles
- Rough surfaces have **many different angles of incidence**
- Image is **distorted**



MIRRORS

PLANE MIRRORS

Properties

- The image formed is always a **virtual image**
- The image is **laterally inverted**

Uses of plane mirrors

- Rearview mirror inside a car helps the driver see traffic behind the car
- A plane mirror on a wall makes a room look bigger

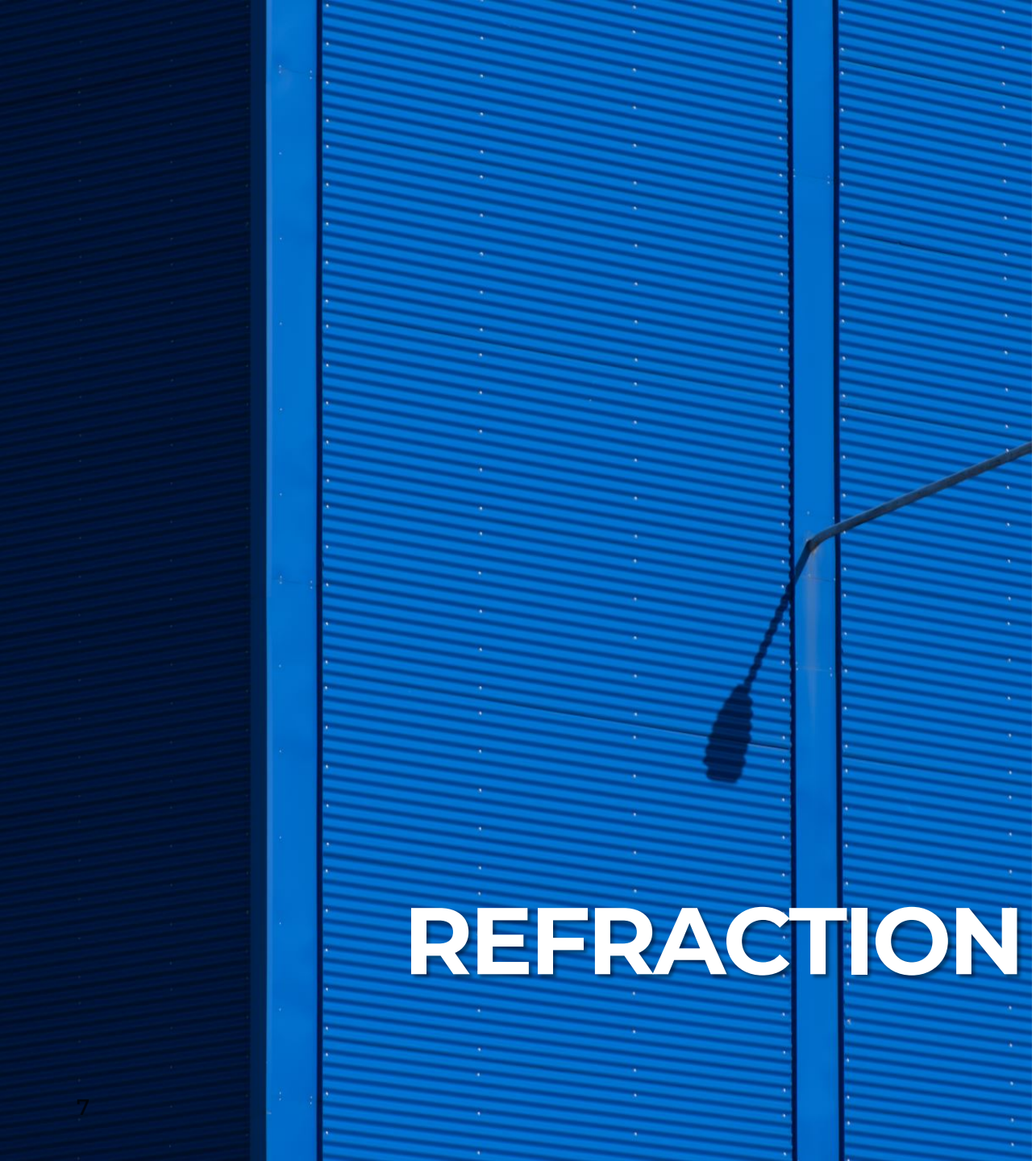
CURVED MIRRORS

Convex mirrors

- Form upright images that are always smaller than the objects
- Have a large 'field of view' to see many things

Concave mirrors

- Form upright magnified images if the objects are close to the mirrors

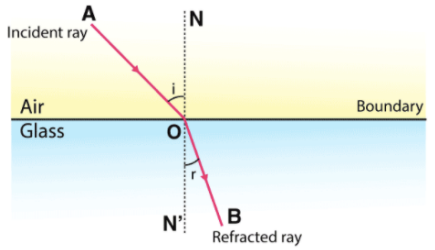


REFRACTION

REFRACTION

Definition: Refraction refers to the bending (change in direction) of light as it passes from one transparent material to another of a different optical density.

This is because its speed changes as it travels from one transparent material into another. Light travels slower in materials that are optically denser.



As light travels from air into glass, it **slows down** and **bends towards the normal**.

Examples of refraction

- Swimming pool appears shallower than it actually is
- Straws appear to ‘bend’ towards the surface of water

KEY CONCEPT

COLOURS

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Dispersion

Definition: separation or splitting of white light into its separate colours
Occurs when a beam of white light travels through the glass prism.

When light shines on a coloured object, some of the colours in the spectrum are **reflected** and some are **absorbed**.

- White objects: reflected all the colours and absorbed none
- Black objects: absorbed all the colours
- Blue objects: reflected blue light and absorbed all the other colours

Coloured light

Example: using a green apple under *green light* and *red light*

Green light: Green apple appears green because it reflects the green light

Red light: Green apple appears black because it absorbs the red light

KEY CONCEPT

IMPACTS OF LIGHT ON SOCIETY

BENEFITS & NEGATIVE EFFECTS

Benefits of lighting

- Electric lamps light up our homes at night
- Streetlights help car drivers to see at night
- Lights help us to decorate our surroundings

Negative effects of lighting

Light pollution refers to the presence of artificial light in the night environment.

Effects

- Advertising signs (used unnecessarily late at night) cause light pollution and contribute to energy wastage
- Artificial lights may cause tiredness, headaches and sleeplessness in people who work at night

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