P13:

Light

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Learning Objectives

01

Reflection

- Law of reflection
- Reflection with plain mirrors
- Image types

02

Ray diagrams

- Construction

03

Refraction

- Snell's law
- Total internal reflection

04

Convex and concave lens

- Principles of drawing ray diagrams with lenses

05

Questions

Reflection

Rectilinear propagation of light

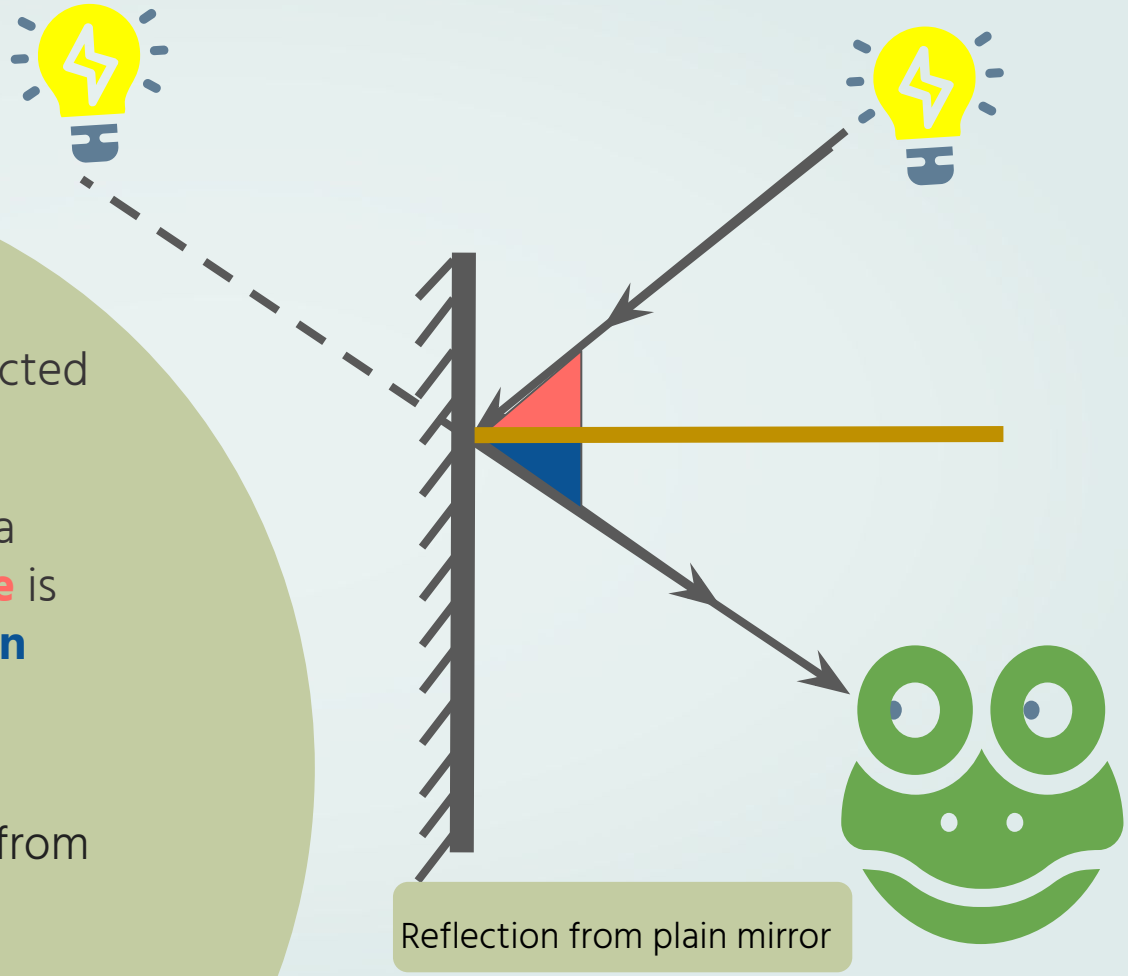
The tendency of light to travel in a straight path/line

Laws of Reflection

1)Normal, incident ray and reflected ray lie on the same plane

2)Whenever light incidents on a surface, the **angle of incidence** is equal to the **angle of reflection**

Note: both **Li** and **Lr** are taken from the **normal**



Reflection from plain mirror

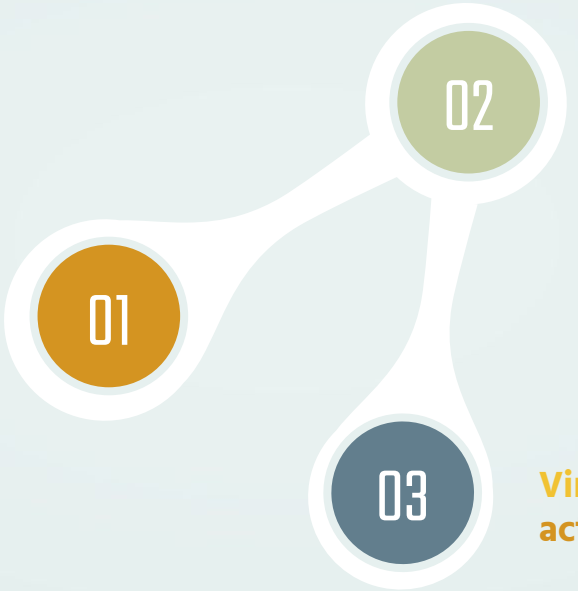
Virtual images

- Can’t be formed on a screen
- The same size as the object
- The same distance behind the mirror as the object it is in front of
- Laterally inverted

Real images

- Can be formed on a screen
- Not the same size as the object
- Not the same distance behind the mirror as the object it is in front of
- Inverted

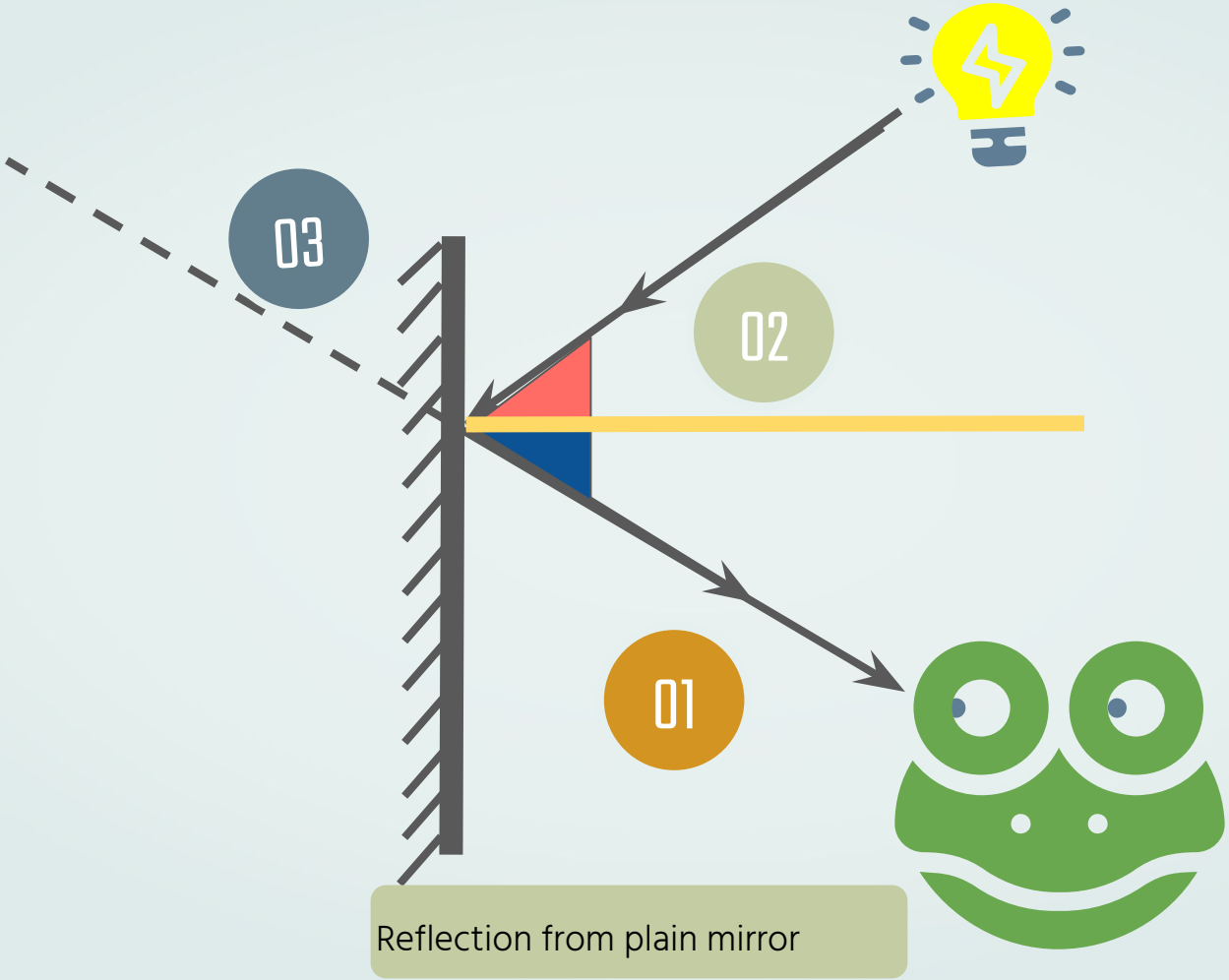
Rules to construct ray diagrams



The path light takes is always along a **straight path/line**

The **angle of incidence** has to be equal to the **angle of reflection**

Virtual rays are to be **dotted**, whereas **actual rays** are to be **homogenous**


03
02
01
Reflection from plain mirror

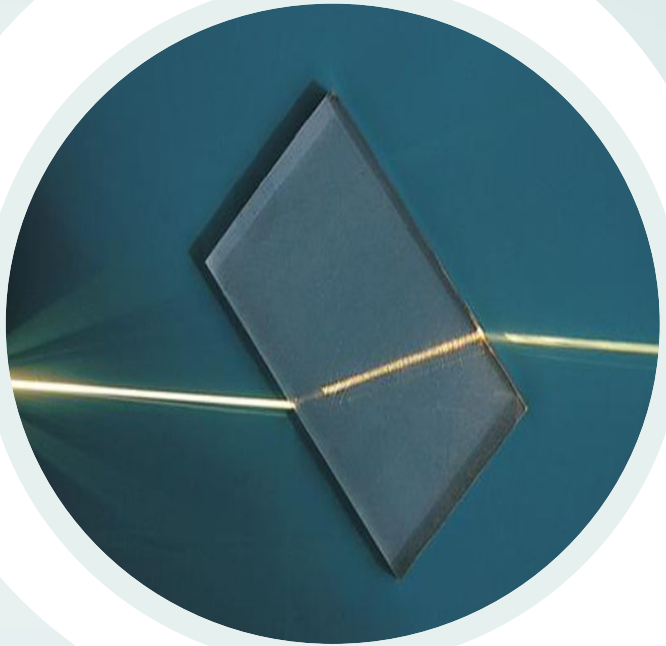
Number of images formed by two mirrors tilted at an angle θ

$$(360/\theta)-1$$

Refraction

Refraction:

The change in direction of light propagation as a result of the change in the speed of light in different medium



Snell's law

$$\text{Refractive index} = \frac{\sin(i_{\text{ncident angle}})}{\sin(r_{\text{efracted angle}})}$$

$$\text{Relative Refractive index} = \frac{\text{Speed of light in medium(1)}}{\text{Speed of light in medium(2)}}$$

$$\text{Refractive index} = \frac{\text{Speed of light in medium}}{\text{Speed of light in vacuum}}$$

Refractive index:

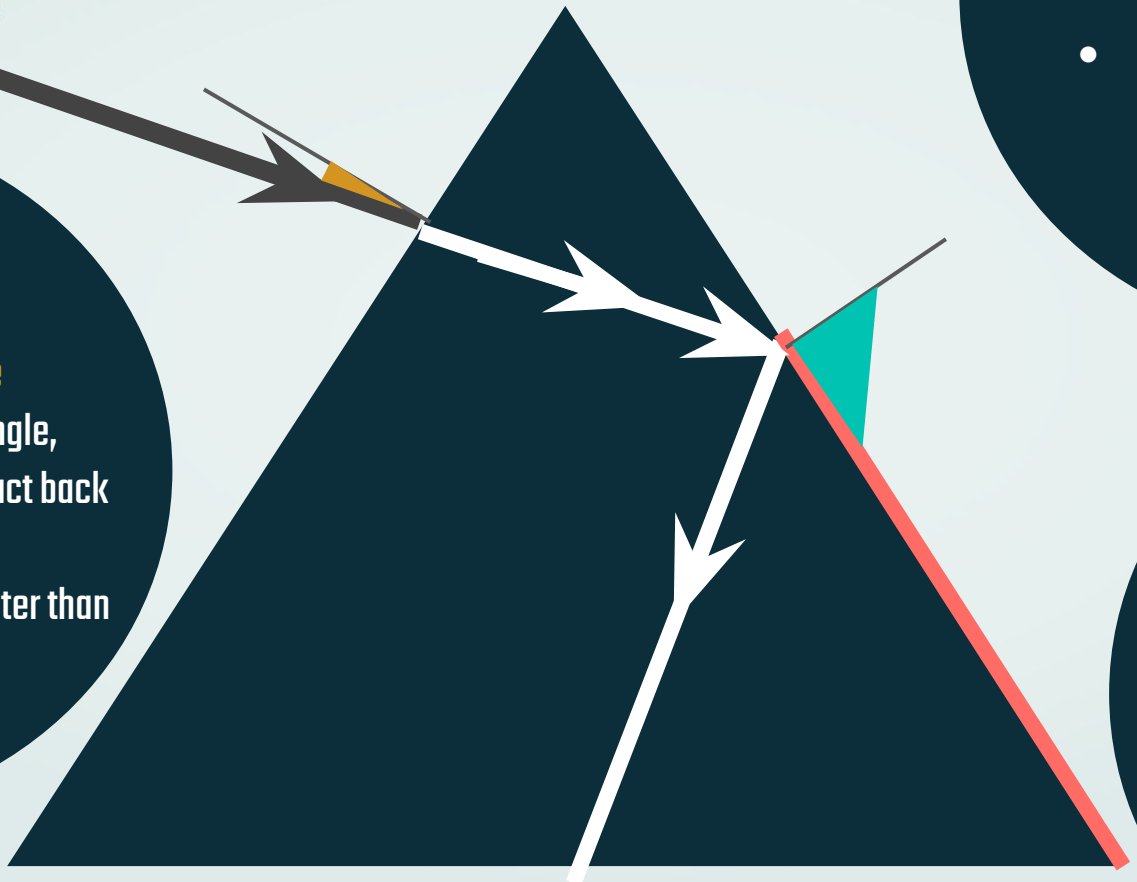
the ratio of the velocity of light in a vacuum to its velocity in a specified medium

Total Internal Reflection

Conditions:

- Incident angle must be greater than critical angle
- Light must pass **from** a **rarer** medium to a denser one

When the incident angle surpasses the critical angle, causing the light to refract back into the medium (refraction angle is greater than 90*)



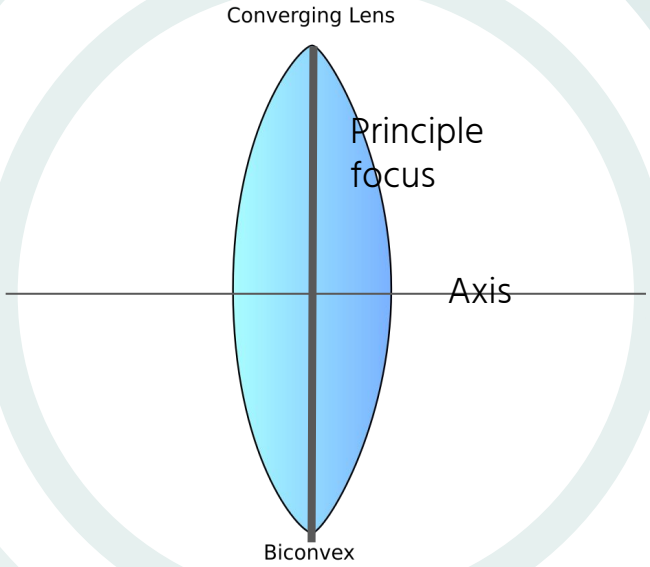
Critical angle:
The incident angle which results in the **refracted angle** bei
greater than 90*

04

Convex and Concave lens

Convex lens

- Bulges at the middle, and tapers off at the ends

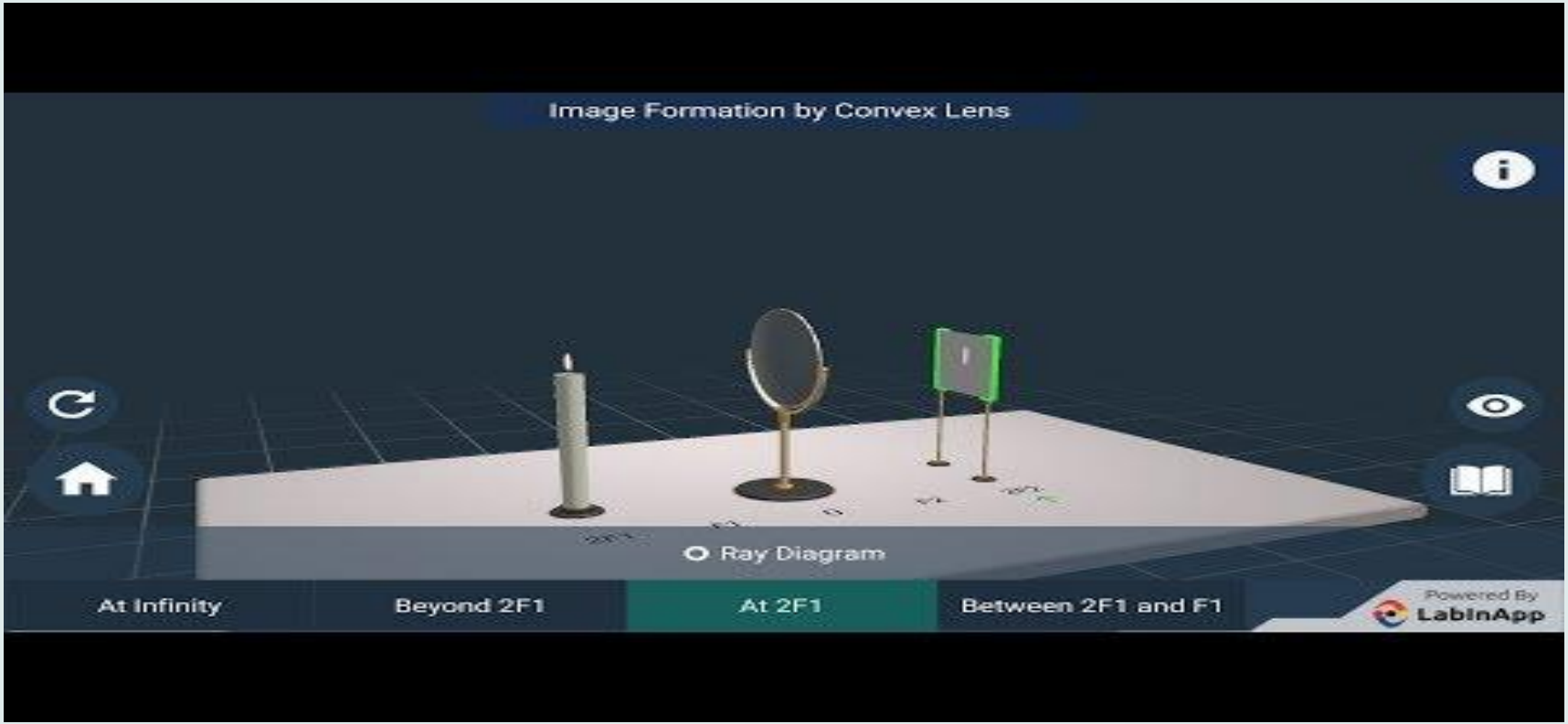


- A ray passing through the optical center does not change direction

Rules for drawing ray diagrams:

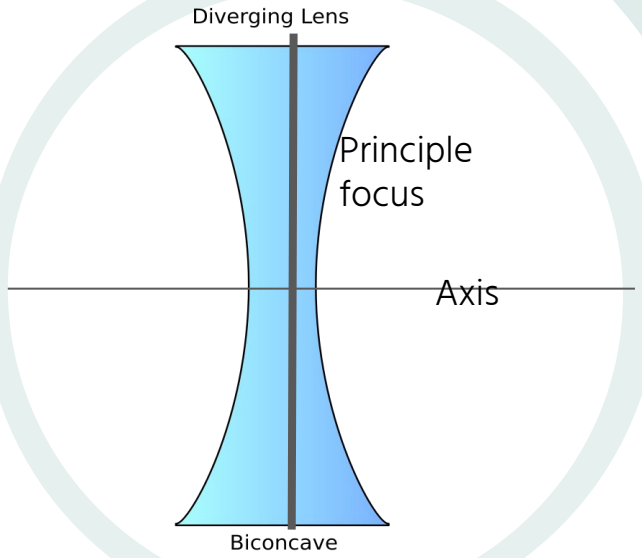
- Incident rays parallel to the principal axis,refracts and passes through the principal focus.
- If a ray is incident through the principal focus, it becomes parallel to the principal axis after refraction.

Types of images formed by convex lens at different lengths



Concave lens

- Bulges at the ends, and tapers off in the middle



- A ray passing through the optical center does not change direction

Rules for drawing ray diagrams:

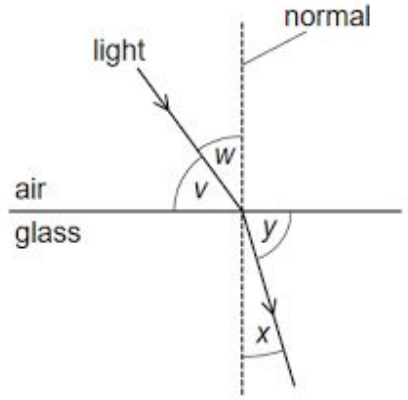
- Incident rays parallel to the principal axis,diverges and appears to be passing through the principal focus.
- If a ray is incident through the principal focus, it becomes parallel to the principal axis after refraction.

CONCAVE LENS

Solved examples

The diagram shows light travelling from air into glass.

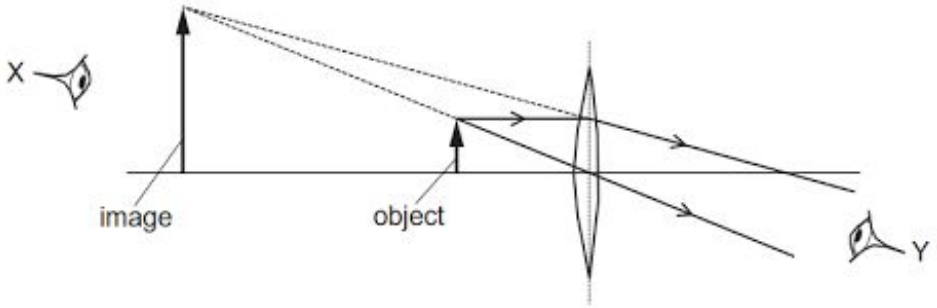
Four angles *v*, *w*, *x* and *y* are shown.



Which formula is used to calculate the refractive index *n* of the glass?

A $n = \frac{\sin v}{\sin y}$ B $n = \frac{\sin v}{\sin x}$ C $n = \frac{\sin w}{\sin y}$ D $n = \frac{\sin w}{\sin x}$

The diagram shows a converging lens forming an image of an object.



Which statement about the image is correct?

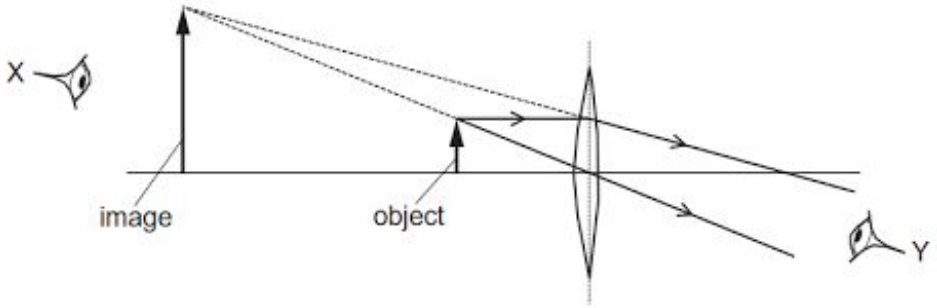
A It is real and can be seen by an eye at X.

B It is real and can be seen by an eye at Y.

C It is virtual and can be seen by an eye at X.

It is virtual and can be seen by an eye at Y.

The diagram shows a converging lens forming an image of an object.



Which statement about the image is correct?

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B It is real and can be seen by an eye at Y.

C It is virtual and can be seen by an eye at X.

It is virtual and can be seen by an eye at Y.

Mind map:

Light

Snell's law

TIR

Rules for ray diagrams

Refraction

Rules for ray diagrams

reflection

Laws of reflection

Lens

concave

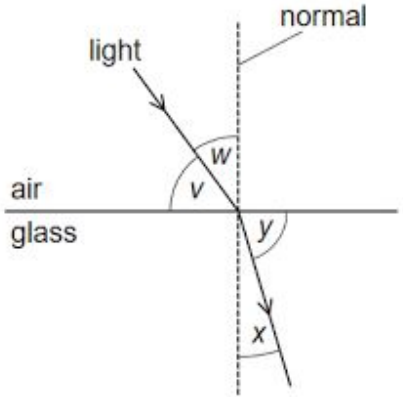
Convex

Rules for ray diagrams

Questions

The diagram shows light travelling from air into glass.

Four angles *v*, *w*, *x* and *y* are shown.



Which formula is used to calculate the refractive index *n* of the glass?

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Fig. 7.1 represents an object O placed in front of a converging lens.

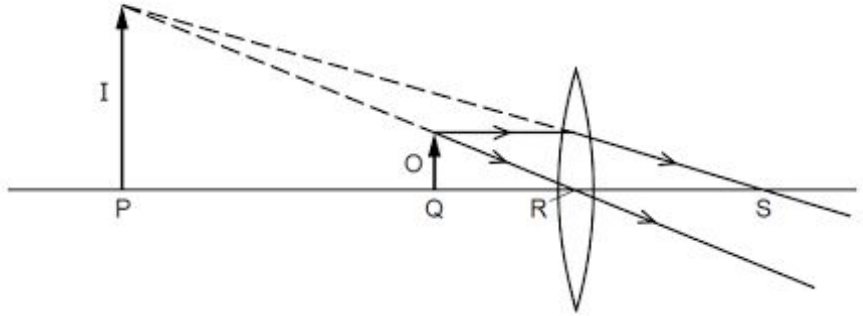


Fig. 7.1

(i) State a full description of the image I.

.....[2]

(ii) Using the letters on Fig. 7.1, identify the focal length of the lens.

.....[1]

(iii) On Fig. 7.1, draw an eye suitably placed to view the image I. [1]

(a) Fig. 7.1 shows a convex lens being used to produce an image of an object.

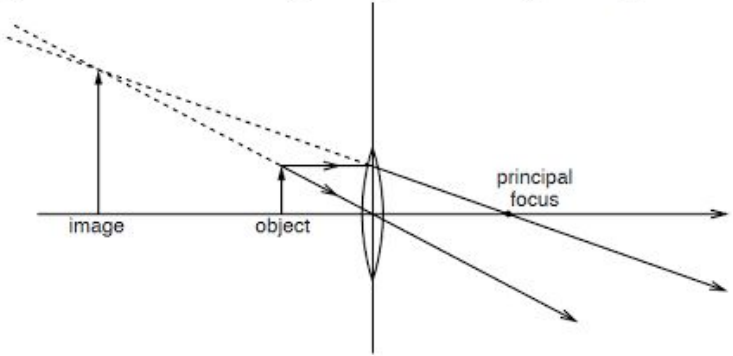
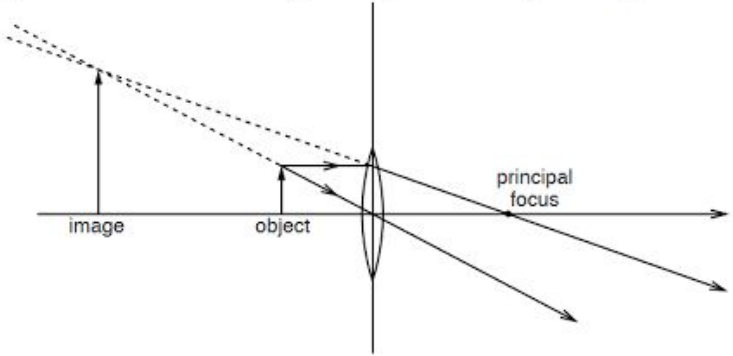


Fig. 7.1

(i) Place **three** ticks in the table that describe this image.

can only be formed on a screen	
diminished	
enlarged	
inverted	
real	
same size	
upright	
virtual	

(a) Fig. 7.1 shows a convex lens being used to produce an image of an object.



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MERCI.