Refraction *(Physics only)*

What is refraction?

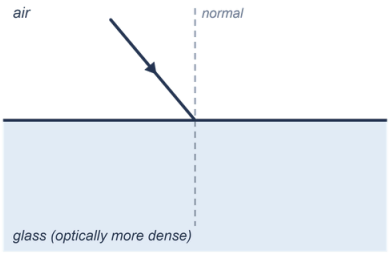
Refraction is when a wave moves into an optically _____ medium, _____ down and changes _____ (bends _____ the normal).

☐ denser ☐ slows
☐ direction ☐ towards

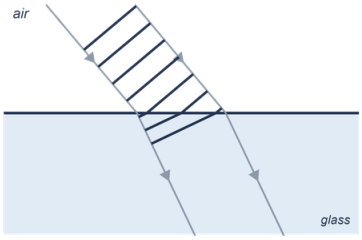
Light going from air into glass

wavefronts and sound: Higher

1 · DRAW THE REFRACTED RAY



2 · COMPLETE THE WAVEFRONTS IN THE GLASS



3 · WHY DO THE WAVEFRONTS GET CLOSER?

In words _____

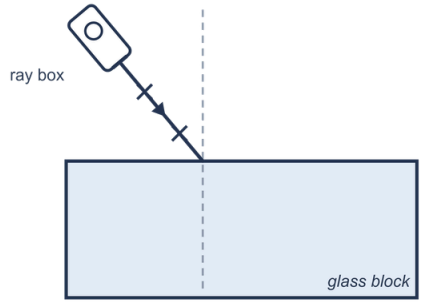
In symbols _____

The frequency stays the _____. In glass the speed is _____, so the wavelength is _____ — the wavefronts are _____ together.

	speed	frequency	wavelength
light: air → glass			
sound: air → water			

Required practical — reflection and refraction of light

DRAW THE REFLECTED AND REFRACTED RAYS. LABEL *I* AND *R*.



The crosses mark the ray so it can be traced with a ruler.

angle of incidence (°)	angle of reflection (°)	angle of refraction in glass (°)
20	20	13
30	30	19
40	40	25
50	50	31
60	60	35

CONCLUSION

The angle of incidence is _____ to the angle of reflection.

The angle of refraction in the glass is _____ than the angle of incidence in the air.

HOW COULD YOU MAKE THE MEASUREMENTS MORE ACCURATE? GIVE TWO WAYS.

_____

_____

Exam-style question

(a) A ray of light enters the glass block with an angle of incidence of **50°**. Use the table to give the angle of refraction. [1]

(b) Explain why light changes direction when it goes from air into glass at an angle. [2]

(c) A sound wave of frequency **500 Hz** travels from air into water. Sound travels at **1500 m/s** in water. Calculate the wavelength in water, and state what happens to the frequency. [3] *(Higher)*

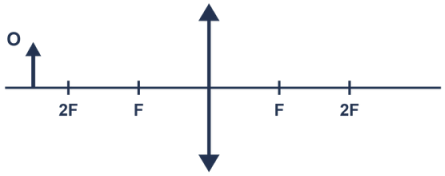
[Total: 6 marks]

ANSWER

Lenses *(Physics only)*

Convex (converging) lens — complete the ray diagram, then ring the right words

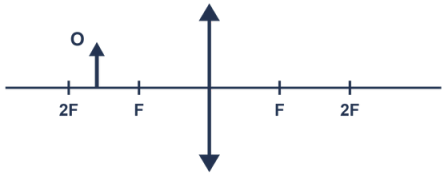
OBJECT FURTHER THAN 2F



real / virtual
upright / inverted
magnified / diminished

Use: _____

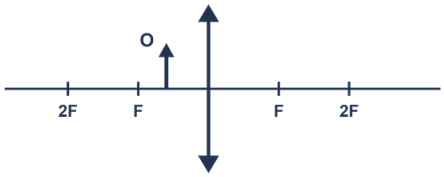
OBJECT BETWEEN 2F AND F



real / virtual
upright / inverted
magnified / diminished

Use: _____

OBJECT CLOSER THAN F

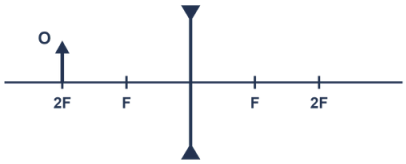


real / virtual
upright / inverted
magnified / diminished

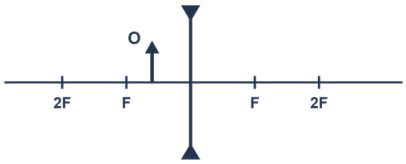
Use: _____

Concave (diverging) lens · real and virtual · magnification

OBJECT AT 2F



OBJECT CLOSER THAN F



WHEREVER THE OBJECT IS, THE IMAGE IS ALWAYS:

real / virtual
upright / inverted
magnified / diminished

Use: _____

REAL OR VIRTUAL?

A **real** image

_____

A **virtual** image

_____

MAGNIFICATION

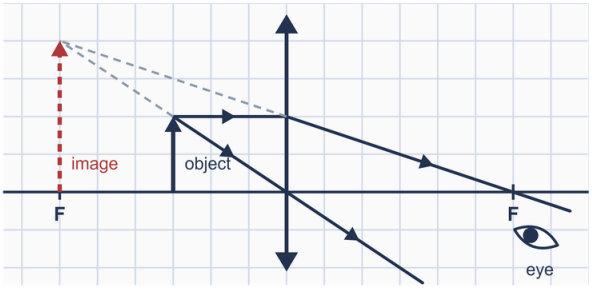
magnification = _____

Does magnification have a unit? _____

An object is **2.0 cm** tall. Its image is **6.0 cm** tall.

Magnification = _____

Exam-style question — a magnifying glass



Drawn full size · each square is 5 mm

(a) What type of lens is shown? Draw a ring around your answer. **[1]**

concave converging diverging

(b) Calculate the magnification produced by the lens. The object and image are drawn full size. **[2]**

(c) Is the image real or virtual? Give a reason. **[2]**

[Total: 5 marks]