MR SULLY UNFOLDS PHYSICS ANSWERS

Reflection and refraction

AQA 4.6.1.3 · 4.6.2.2 · RP9
Waves · Paper 2
Foundation & Higher · Required practical 9 (Physics only)

Name _____ Class _____ Date _____

When a wave reaches a boundary between two materials, it can be reflected, absorbed or transmitted. If it changes speed, it **refracts**.

KEY IDEAS

- The **normal** is a line drawn at 90° to the surface. Angles are always measured from the normal.
- Reflection: angle of incidence = angle of reflection.
- Refraction: light slowing down (e.g. air → glass) changes direction **towards** the normal; speeding up changes direction **away** from it. Light doesn't bend: the change of direction happens at the boundary because the speed changes. Along the normal, the direction doesn't change.

Section A · Recall

Grade 4–5

1 State three things that can happen to a wave at a boundary between two materials. [3]

Reflected, absorbed, transmitted (and refracted)

2 What is the normal? [1]

An imaginary line at 90° to the surface where the ray hits it.

3 Light hits a mirror at an angle of incidence of 35°. State the angle of reflection. [1]

35°

Section B · Ray diagrams

Grade 5–6

4 Complete the ray diagram to show light entering a glass block at an angle and leaving it again. Label the normals and the angles of incidence and refraction. [4]



Normals drawn (1); changes direction towards the normal entering (1); away from the normal leaving (1); emerging ray parallel to incident ray, angles labelled (1).

5 Explain what causes refraction. [1]

The wave changes speed as it crosses the boundary between two materials.

Section C · Stretch

Grade 7+

6 Use the idea of wavefronts to explain why light changes direction towards the normal when it enters glass at an angle. (Higher) [3]

One end of each wavefront enters the glass first and slows down,

while the rest of the wavefront is still moving faster in air.

So the wavefront changes direction, towards the normal.

7 The student also shines the ray at a mirror, at a sheet of shiny metal and at matt white paper. Describe and explain the differences in the reflected light. [3]

Mirror and shiny metal: a clear reflected ray; angle of reflection = angle of incidence (specular).

Matt paper: no clear reflected ray; the light is scattered in many directions (diffuse reflection),

because the rough surface has normals pointing in many different directions.

Exam-style question

AQA style

8 A student investigates how light is refracted by a glass block using a ray box. (Physics only)

a Describe how the student should measure the angle of refraction. [3]

Draw around the block and mark the incoming and outgoing rays with crosses.

Remove the block, join the rays and draw the normal.

Measure the angle between the refracted ray and the normal with a protractor.

b Suggest why the student should use a narrow ray of light. [1]

It makes it easier to mark the centre of the ray, so the angles are more accurate.

c Give one hazard and how to reduce the risk. [1]

The ray box gets hot: let it cool before touching / don't touch the bulb.

Total: _____ / 21

How confident am I?

	Not yet	Nearly	Got it
I can draw ray diagrams for reflection and refraction	☐	☐	☐
I can explain refraction using speed and wavefronts	☐	☐	☐
I can describe the light practical	☐	☐	☐