Revision Notes for Standard Grade

Physics

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Note to student

- **The course**

  This book is designed to cover all of the learning outcomes of the Standard Grade Physics syllabus for examinations in 1994 onwards.

Exam structure

- General Paper $1\,^1/_2$ hours approximately 90 marks, close to an equal split between Knowledge and Understanding and Problem Solving
- Credit Paper $1\,^3/_4$ hours approximately 100 marks, close to an equal split between Knowledge and Understanding and Problem Solving
- Practical Abilities is assessed within the school.

Symbols in the book

- ❑ General level material ❍ Credit level material

Using the book

- You can indicate your knowledge of each statement with a tick in the box at the left hand side.
- Space has been left at the right hand side so that you can make additional notes.
- You can also mark statements with a highlighter pen.

Exam advice

- Make sure that you have a calculator, ruler, pen, pencil and rubber.
- Draw a graph lightly in pencil; when you are certain it is correct, go over in ink.
- In numerical questions always put the information into symbol form and check it is in basic units.
- Remember to give units for all answers.
- Working through past papers is an essential part of your preparation.

Revision checklist

Topic	Subtopic	Tick (√) when revised 1	2	3
Telecommunications	1. Communication through the air and through wires			
	2. Waves			
	3. Radio and television			
	4. Optical fibres			
	5. Satellites and dish aerials			
Using Electricity	1. From the wall socket			
	2. Alternating and direct current			
	3. Resistance			
	4. Useful circuits			
	5. Behind the wall			
	6. Movement from electricity			
Health Physics	1. The use of thermometers			
	2. Using sound			
	3. Light and sight			
	4. Using the spectrum			
	5. Nuclear radiation - humans and medicine			
Electronics	1. Overview			
	2. Output devices			
	3. Input devices			
	4. Digital processes			
	5. Analogue processes			
Transport	1. On the move			
	2. Forces at work			
	3. Movement means energy			
Energy Matters	1. Supply and demand			
	2. Generation of electricity			
	3. Source to consumer			
	4. Heat in the home			
Space Physics	1. Signals from space			
	2. Space travel			

UNIT 3 HEALTH PHYSICS

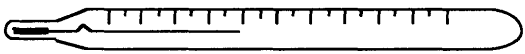
Section 1 The use of thermometers

- A **thermometer** requires some measurable physical property that changes with temperature.

- In a **thermocouple**, the voltage varies with temperature.

- In a mercury in glass thermometer, the volume of the mercury and hence the length of the column of mercury changes with temperature.

- **A clinical thermometer**



(1) The thermometer has a constriction (kink); this makes the mercury thread break as it cools and contracts; the thread stays at the maximum temperature.
(2) The thermometer measures only over a small range (35 - 43 °C); this is just above and below the body temperature of 37 °C.
(3) A toughened glass tube with a shaped front acts as a lens to magnify the mercury thread.

- **Measuring body temperature**

(1) Shake the thread down to make the mercury go back into the bowl.
(2) Place the bowl under the tongue and leave for a few minutes.
(3) Read the scale opposite the end of the mercury thread to give the temperature.

- Normal body temperature is 37 °C.

- If the temperature is above 37 °C, the person is feverish, usually due to some infection;
if the temperature is above 43 °C the person is close to death!

- If the temperature is below 34 °C, the person is suffering from **hypothermia**; if the temperature is below 28 °C the person is close to death!

- ❑ Sound is caused by **vibrations** and can only be transmitted when there are particles to vibrate; therefore sound travels through solids, liquids and gases but not through a vacuum.

- ❑ The **stethoscope** picks up sounds from the body and passes the vibrations along a column of air in the tube to the doctor's ears; the sounds are loudest when there is **resonance** between the skin and the bell.

- ❑ There are two bells in a stethoscope:
  (1) an open bell for low frequency heart sounds,
  (2) a closed bell for high frequency lung sounds.

- ❑ The normal range of human hearing is approximately 20 Hz to 20 000 Hz; sounds with frequencies above this range are called **ultrasounds.**

- ❑ Ultrasound is used to:
  (1) examine a baby in the womb (safer than X-rays),
  (2) break up kidney stones in the body (no surgery).

- ○ When used to examine the foetus, ultrasound is directed into the mother's body; a layer of jelly stops the skin reflecting the sound waves;
  the waves reflect off the baby and these reflections are used to build up the image of the baby.

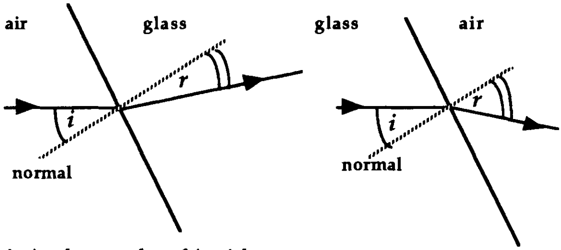
- ❑ **Noise levels** are measured in **decibels, dB**;
  typical noise levels are:

minimum sound that can be heard	0 dB
ordinary conversation	60 dB
heavy lorry	95 dB
pneumatic drill	100 dB
pop group at 1 m	110 dB
jet engine	130 dB
pain threshold	140 dB

- ❑ Regular exposure to noise above 90 dB can cause damage to hearing.

- ❑ Noise levels from 90 dB upwards are examples of noise pollution. *Learn at least two.*

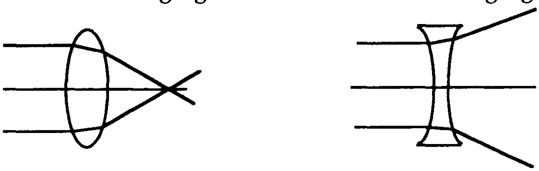
- **Refraction** of light occurs when light moves from one material into another and is usually accompanied by a change in direction:



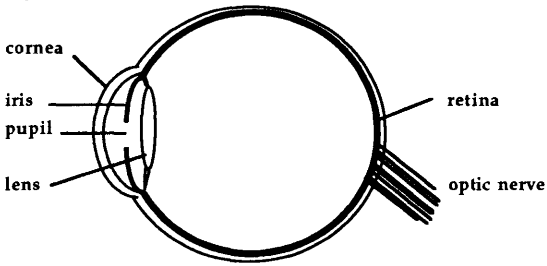
- *i* is the angle of incidence;
  r is the angle of refraction;
  the **normal** is a construction line at right angles to the boundary at the point where the incident ray meets the boundary.

- There are two main shapes of lens:

  Convex (converging) **Concave** (diverging)



- **The eye**

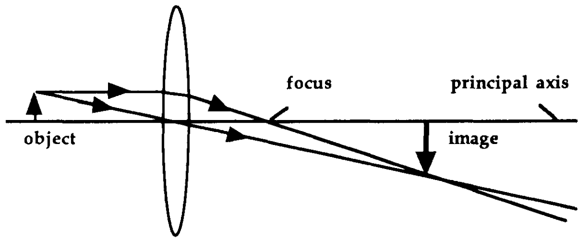


- Light is focused on the retina at the back of the eye by:

  (1) the cornea - most refraction takes place here,
  (2) the lens - can change shape and gives fine control of focusing.

- The image formed on the retina is upside down (inverted) and back to front (laterally inverted).

❑ A ray diagram shows that an inverted image is formed on the retina:

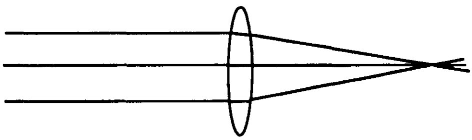


❑ The position of any image can be found by drawing two rays:

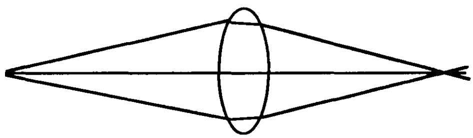
(1) a ray through the centre of the lens which does not change direction,
(2) a ray parallel to the principal axis which goes through the focus.

○ The lens in the eye can change shape;
this is called **accommodation**.

○ Light rays coming from a **distant object** arrive at the eye parallel;
the lens is **thin**:



○ Light rays from a **nearby object** diverge;
the lens is much **thicker**:



❑ The **focal length** of a convex lens is the distance between the lens and the point where parallel rays are brought to a focus;
this can be measured experimentally by obtaining a clear image of a distant object, eg. the view from a window on a screen;
the focal length is the distance between the lens and the screen.

- People can only see clearly if the light is focused on the retina.
- In **long sight**, light from nearby objects is focused behind the retina and only objects a long way away are clear.
- In **short sight**, light from distant objects is focused in front of the retina and only objects close at hand are clear.
- Both long and short sight can be corrected using lenses.
- **Long sight**

  Use of a convex lens causes light to converge more, so that it is focused on the retina:

- **Short sight**

  Use of a concave lens causes light to diverge before it enters the eye so that it is focused on the retina:

- The **power** of a lens is measured in **dioptres, D.**
- Power is related to focal length by the equation:

$$\textbf{power of lens} = \frac{1}{\textbf{focal length (in metres)}}$$

or

$$\textbf{focal length} = \frac{1}{\textbf{power}}$$

- Both focal length and power are:

  negative for **concave lens**
  positive for **convex lens**

○ *Example*

A lens has a focal length of -25 cm. Find the power of the lens and state whether it is concave or convex.

Step 1 Put the information into symbol form and change to basic units.

$f = -25 \text{ cm} = -0.25 \text{ m}$

Step 2 Choose the correct equation.

$$\textbf{power} = \frac{1}{f}$$

Step 3 Put the numbers into the equation and calculate the answer.

$$\textbf{power} = \frac{1}{f} = \frac{-1}{0.25} = \mathbf{-4\ D}$$

DO NOT FORGET UNITS.

Since the power is negative, it is a **concave** lens.

❑ **Fibre optics** can be used to transmit 'cold light'; since the source of the light can be a long way from the tip of the fibre optic, only the light reaches the tip and not the heat, ie. 'cold light'.

○ An **endoscope** (or fibroscope) consists of two bundles of optical fibres;
the first bundle carries cold light down to the tip;
the second bundle has a lens at the tip and sends an image back up the fibre optic;
the tube is flexible and can be moved around inside the body to view the inside.

○ The light passes down the optical fibre by **total internal reflection**.