St Ninian's HS

S2 Physics

Medical Physics

Self Checks

Thermometry

1. **State** the average normal body temperature in °C.

2. A nurse makes the following statement:

"Small variations in body temperature (such as 0.5°C) are considered normal."

State whether the nurse is correct and **justify** your answer.

3. A patient has their temperature recorded as seen below:

a) **State** the temperature of the thermometer in °C.

The patients' returns for a second examination and discovers their temperature has risen by 3.5°C

b) **Determine** their body temperature during their second examination.

c) **Explain** whether this new temperature is concerning.

4. A student makes the following statement:

"a laboratory thermometer is more precise than as a clinical thermometer for measuring body temperature as it measures a bigger range of values"

Explain why the student is incorrect.

5. **Describe** the main features of a clinical thermometer that make it suitable for measuring body temperature.

Using Sound

The Stethoscope

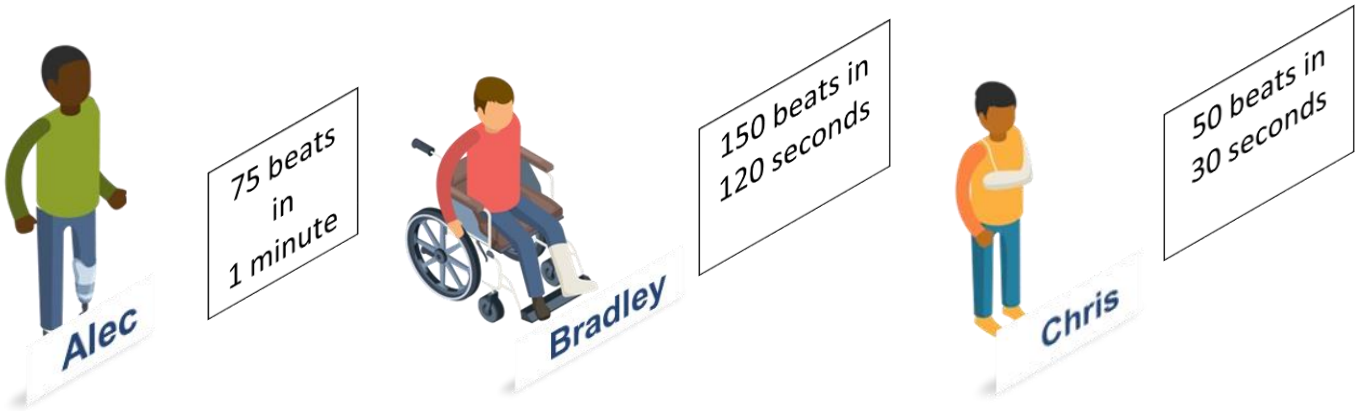
1. Stethoscopes are used for listening to sounds inside the human body.

   a) State the purpose of using a stethoscope for this.

   b) Identify two body parts a stethoscope is often used for.

2. Stethoscopes can be used to determine a patients BPM (beats per minute).

a) For the patients below **determine** their BPM



A normal resting heart rate for adults ranges from 60 to 100 beats per minute.

b) **Describe** factors that may cause this number to rise.

ECGs

1. **State** what ECG stands for.

2. **Determine** the heart rate (BPM) of the graphs using the formula:

Heart rate = 300 ÷ (number of large squares in one R-R interval)

a)

b)

c)

d)

e)

f)

3. The above graphs all show regular heart beats. **Sketch** an ECG for an irregular heartbeat.

Ultrasound

1. An ultrasound machine is used to scan for pregnancies. It emits waves that have a frequency of 2MHz.

a) **Express** this value in Hz

b) **State** what is meant by a frequency of 2MHz

c) **Explain** why these waves are consider ultrasound.

2. An ultrasound scan can be used to produce an image of an unborn baby.

a) **Explain** how the image of an unborn baby is formed by ultrasound.

b) **State** the speed of ultras**ound** waves in air.

Ultrasound waves travel at a speed 1500m/s of when travelling through the womb.

c) **Explain** why they travel faster in this situation.

d) It takes the ultrasound wave 0.0005 seconds to reach the baby's head and reflect back to the ultrasound machine.

Calculate the distance between the ultrasound machine and the baby's head.

3. Other than those described above. **Describe** one other use for ultrasounds in medicine.

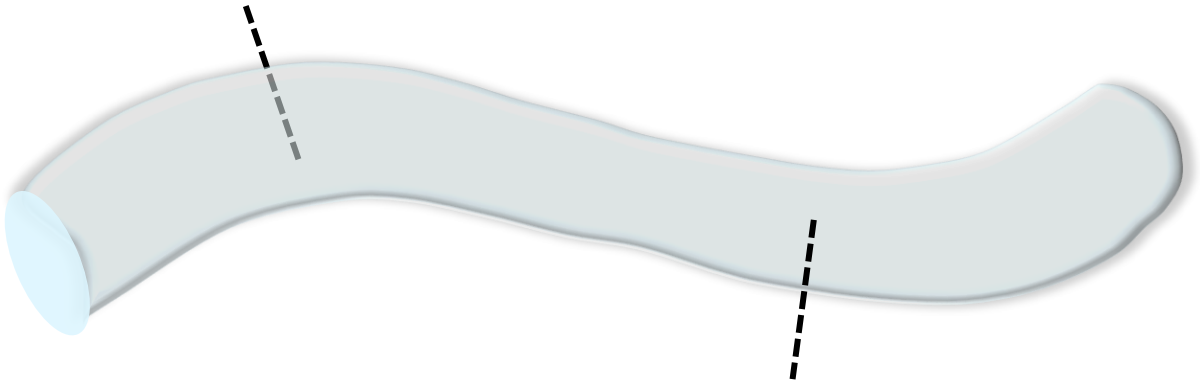
Light and Sight

Optical Fibres

1. Optical fibres are thin bundle of glass that make use a phenomena called TIR.

a) **State** what is meant by TIR.

b) **Copy and complete** the diagram below showing the path of light through the optical fibre.



c) **State** the name given to the dashed lines on the diagram above.

d) On your diagram above label any angles of incidence and angles of reflection.

2. Optical fibres are often used in endoscopy.

a) **Describe** the purpose of endoscopes in medicine.

b) **Explain** an advantage to using an endoscope over other methods such as surgery or X-rays**.**

c) The tip of the endoscope that is inside the patient is designed to be very flexible. **Suggest** one reason for this.

Refraction

1. **Copy and complete** the following:

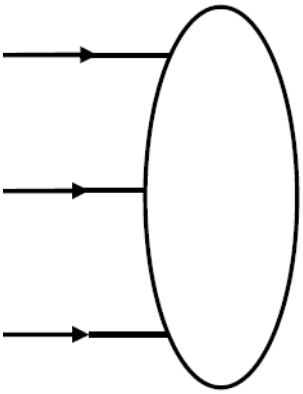
   "In refraction the speed of light _____ as it passes from one material to another.

   Sometimes a ray of light _____ direction as passes from one material to another."

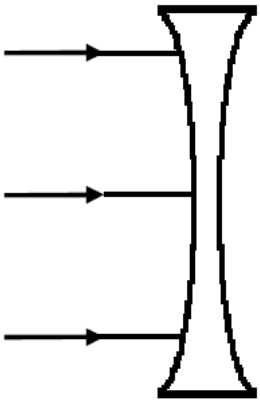
2. Lenses are used to refract light.

   a) **Copy and complete** the following diagrams to show the path of the light rays after passing through the lenses :

   i.



   ii.



   b) **Label** each of the lenses above.

3. Refraction is very important for sight.

   a) The eye has a lens that refracts light. **State** which type of lens this is.

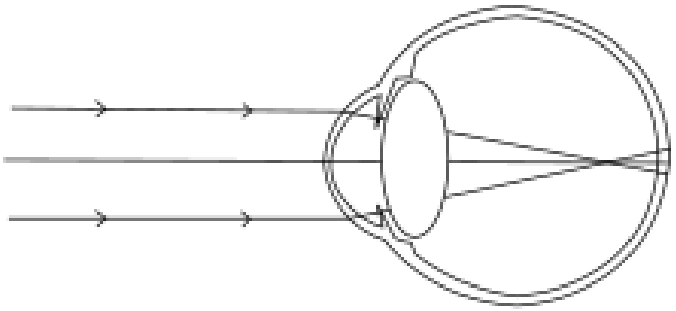
   b) **State** the name for the part of the eye where the light reaches a focal point

4. Joanne can see the number plate on a far away car but cannot see cables clearly when she is wiring a plug.

   a) **Identify** which eye defect Joanne has.

   b) **State** the name of the lens used to correct this eye defect.

5. A student has the following eye defect:

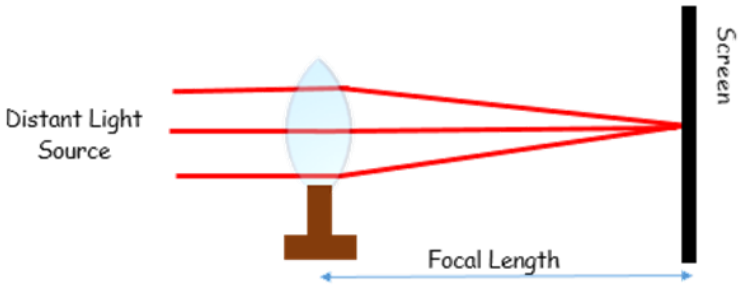


a) Identify which eye defect the student has.

b) Describe what it would look like if they were looking at a distant object.

c) State the name of the lens used to correct this eye defect.

6. A student carries out an investigation into focal length. Their diagram and results are seen below::



Lens Thickness (cm)	Focal Length (cm)
1	65
2	52
3	40
4	34

a) **State** a possible aim for this experiment.

b) The student wishes to ensure it is a fair experiment. **Identify** a controlled variable in this experiment.

c) <u>On graph paper</u>, **draw a graph** of the results above.

d) **State** a conclusion for this experiment (where the table gives the thicknesses)

e) **Suggest** something the student could do to improve the reliability of their results

Using the Spectrum

1. Copy and Complete the table:

Member of the electromagnetic spectrum	Medical Application
	MRI
Microwaves	
	Treating muscle injuries
Visible Light	
	Treating skin conditions
X-rays	
	Sterilizing medical equipment

2. Other than medical applications:

   a) **Describe** a way in which all electromagnetic waves are similar to one another.

   b) **Describe** a way in which all electromagnetic waves are different from one another.

3. Read the following carefully:

"Different types of radiation are used by medical devices in the treatment and detection of illness. Some of the devices which make use of radiation are described below;

A thermographic unit senses radiation from the surface of a patient's body and is used to detect small changes in temperature.

An X-ray unit is used to examine for broken bones.

Laser light is used to heal blood vessels in the eye. The laser emits light radiation with a wavelength greater than that of X-rays.

A gamma camera is used to trace the path of a radioactive material through the body.
The radioactive material which has been injected into the body emits gamma radiation. The gamma radiation emitted has a wavelength which is nearly the same as X-rays."

(a) **Identify** which two radiations have similar wavelengths.

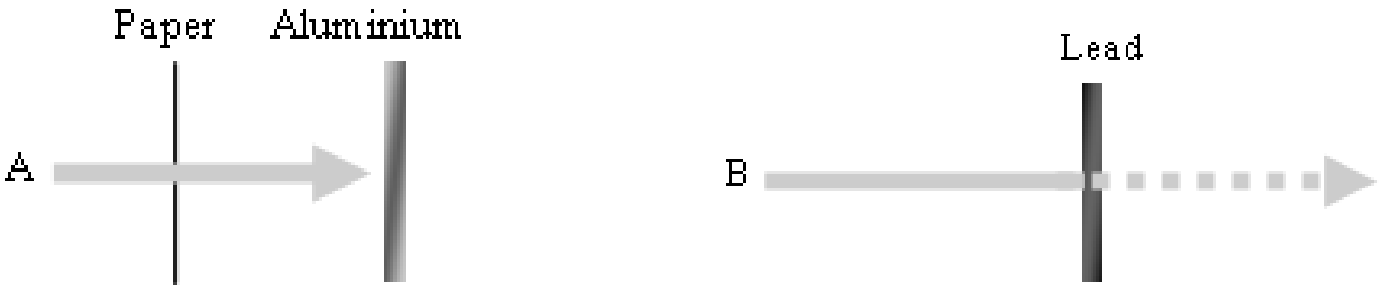
(b) **Identify** which of the radiations, light or X-rays, has the greater wavelength.

(c) **Explain** why, when tracing the path of a radioactive material through the body, the radioactive material injected into the body must emit gamma radiation.

(d) **State** the use made of light radiation.

Nuclear Radiation

1. A radioactive source gives out two different types of radiation;



Identify: i) Radiation A
ii) Radiation B

2. Gamma radiation is dangerous but it is used to detect problems using a gamma camera.

Explain why is a gamma source used rather than alpha or beta sources?

4. **State** three safety precautions that should be taken when handling radioactive sources

5. Express the following absorbed doses in Gy:

a) 12 mGy

b) 0.5 mGy

c) 8 mGy

d) 15 μGy

6. **Calculate** the equivalent dose received if a patient is exposed to:

a) 4 Gy of beta radiation.

b) 80 Gy of slow netrons.

c) 3mGy of gamma radiation.

Radiation weighting factors

Type of radiation	*Radiation weighting factor*
alpha	20
beta	1
fast neutrons	10
gamma	1
slow neutrons	3