



Rushcliffe School

Pearson
BTEC Level 3 National
Certificate in
Applied Science



Rushcliffe School

Transition Booklet for

BTEC Applied Science

Helping you get ready for Level 3 study!

**This transition guide has everything you need to ensure
you hit the ground running in your Applied Science course
in September!**

Why do I need a Transition Booklet?

This pack contains lots of activities and resources to help narrow the gap between GCSE and the start of a level 3 BTEC. It should be completed after the end of Year 11 and the start of September.

Tick the box once a topic has been reviewed and completed

- Task 1 – Wider Reading and Book Review** **(3-6 hours)**

- Task 2 – Securing Your Subject Knowledge**
 - Biology questions** **(3 hours)**

 - Chemistry questions** **(3 hours)**

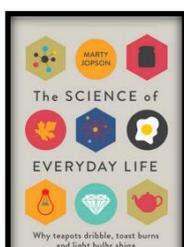
 - Physics questions** **(3 hours)**

- Task 3 – Developing Skills**
 - Cornell notes on Scientific Vocabulary.** **(1 hour)**

Task 1 – Wider reading (Background throughout the summer)

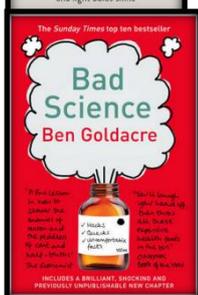
- To help broaden your knowledge and enthuse you as we start our journey into science, we want you to pick a Science book and have a read throughout the summer.
- Once the book is complete we want you to answer a few questions about it! Follow this link: <https://forms.gle/a92y7PXEEyNTv4m6>

Book Recommendations – Some inspiring reading to follow over the summer. You can pick a different one if you like!



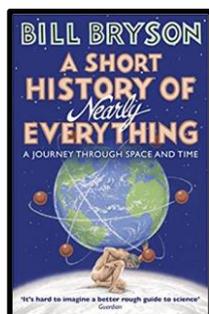
The Science of Everyday Life: Why Teapots Dribble, Toast Burns and Light Bulbs Shine (Paperback) Marty Jopson ISBN-10: 1782434186

The title says it all, lots of interesting science to inspire and enthuse you about science in general and how it can be used to explain the common little questions and curiosities you experience around your home. https://www.amazon.co.uk/Science-Everyday-Life-Teapots-Dribble/dp/1782439609/ref=tmm_pap_swatch_0?encoding=UTF8&qid=1586421445&sr=1-1



Bad Science (Paperback) Ben Goldacre ISBN-10: 000728487X

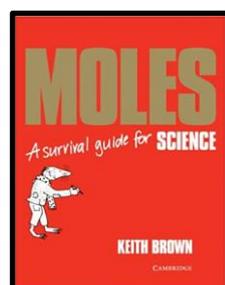
In this book, acclaimed scientist and journalist Ben Goldacre takes a look at the role of science in our society and tears apart anyone who published bad / misleading or dodgy science. This book will make you think about everything the advertising industry tries to sell you by making it sound 'sciency'. https://www.amazon.co.uk/Bad-Science-Ben-Goldacre/dp/000728487X/ref=tmm_pap_swatch_0?encoding=UTF8&qid=1586421679&sr=1-1



A Short History of Nearly Everything (Paperback) Bill Bryson ISBN-10: 978178416185

This is a quest to understand everything that has happened from the Big Bang to the rise of civilization - how we got from there, nothing at all, to here, being us. Bill Bryson's challenge is to take subjects that normally bore the pants off most of us, like geology, chemistry and particle physics, and see if there isn't some way to render them comprehensible to people who have never thought they could be interested in science.

https://www.amazon.co.uk/Short-History-Nearly-Everything-Bryson/dp/1784161853/ref=tmm_pap_swatch_0?encoding=UTF8&qid=1586421942&sr=1-1



Moles – A Survival Guide for Science (Paperback) Keith Brown

ISBN-10: 0521424097

This is a short (33 pages) but really useful book which takes students who normally find the idea of "The Mole" difficult and confusing through a well-constructed and enjoyable journey to conquer the concept and make a lot of the calculations Applied Science much more straightforward. Read this book if you struggled with the GCSE Chemistry Calculations section!

[https://www.amazon.co.uk/Moles-Survival-Guide-Cambridge-](https://www.amazon.co.uk/Moles-Survival-Guide-Cambridge-International/dp/0521424097/ref=sr_1_1?dchild=1&keywords=moles+a+survival+guide+for+science&qid=1586422295&s=books&sr=1-1)

[International/dp/0521424097/ref=sr_1_1?dchild=1&keywords=moles+a+survival+guide+for+science&qid=1586422295&s=books&sr=1-1](https://www.amazon.co.uk/Moles-Survival-Guide-Cambridge-International/dp/0521424097/ref=sr_1_1?dchild=1&keywords=moles+a+survival+guide+for+science&qid=1586422295&s=books&sr=1-1)

Videos to watch online –

Rough science – the Open University – 34 episodes available

Real scientists are ‘stranded’ on an island and are given scientific problems to solve using only what they can find on the island.

Great fun if you like to see how science is used in solving problems.

There are six series in total

<https://www.youtube.com/playlist?list=PLMC - FtZbKXJRIWszjknt63nR9ETWS8rY>

Chemical Curiosities – The Royal Institute Lectures

Highly recommended - Professor Chris Bishop, presenter of the 2008 Royal Institution Christmas Lectures, leads you through a spectacular tour of the curious, and sometimes surprising, world of science.

https://www.youtube.com/watch?v=ti_E2ZKZpC4

There are many other Royal Institute Lectures in Chemistry, Physics and Biology – Have a browse and get inspired!

<https://www.rigb.org/christmas-lectures/watch> and <https://www.youtube.com/user/TheRoyalInstitution>

Task 2 – Prior Knowledge Expectations

- A lot of Year 10 and Year 11 Science provides a foundation for what we study in Year 12 – normally you would have revised this thoroughly for your GCSE Exams!
- Below are some questions relating to all 3 science disciplines.
- The first set of questions are old GCSE questions to remind you of the science you studied in years 10 and 11. The questions in the section marked 'Questions that require Research', are old BTEC Unit 1 questions. To do these you will need to do some research. Happy hunting!
- You will need to bring them to your first lesson to show your teacher. They will be used regularly in the first term of study.
- Here's a useful link

<https://www.studocu.com/en-gb/document/kingston-university/biology/unit-1-revision-guide-fgh/20162403>

Name:

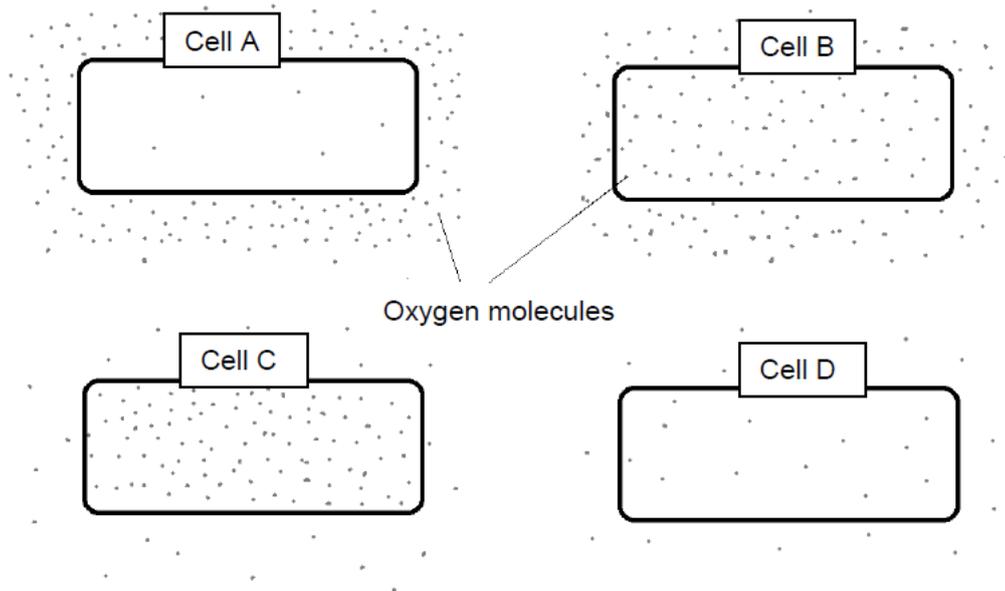
Cell biology – Trilogy

Complete the questions by typing in the answer boxes, which will expand as necessary.

Then fill in the self-assessment form as fully as you can to help you reflect on your work.

- 1.0** Figure 1 shows cells containing and surrounded by oxygen molecules. Oxygen can move into cells or out of cells.

Figure 1



- 1.1** Into which cell, **A**, **B**, **C** or **D**, will oxygen move the fastest?

[1 mark]

Put an X in **one** box only.

A	<input type="checkbox"/>
B	<input type="checkbox"/>
C	<input type="checkbox"/>
D	<input type="checkbox"/>

1.2 Use words from the box to complete the sentences.

[2 marks]

active transport	diffusion	membranes
mitochondria	nuclei	osmosis

Oxygen is taken into cells by the process of .

The parts of cells that use the most oxygen are .

1.3 Which process produces oxygen in some cells?

[1 mark]

Put an X in **one** box only.

Diffusion

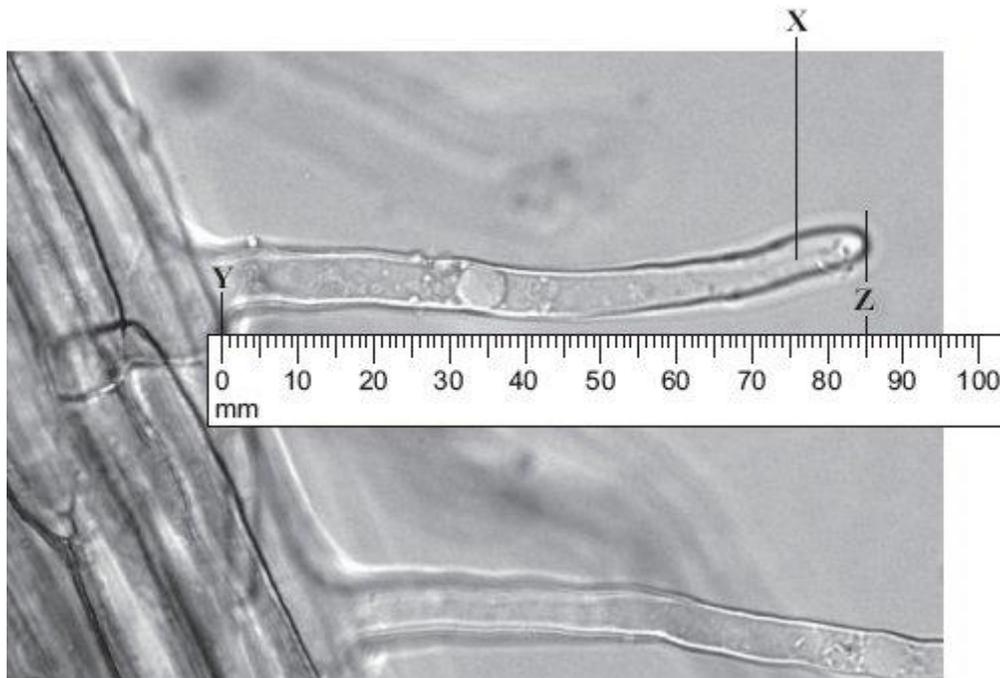
Photosynthesis

Protein synthesis

Respiration

2.0 **Figure 2** shows part of the surface of a plant root.

Figure 2



2.1 There are hundreds of structure **X** on each root.

What is the name of structure **X**?

[1 mark]

2.2 The photograph shows the root magnified 100 times. The distance between **Y** and **Z** in the photograph is the length of structure **X**.

Calculate the actual length of **Y–Z**.

[1 mark]

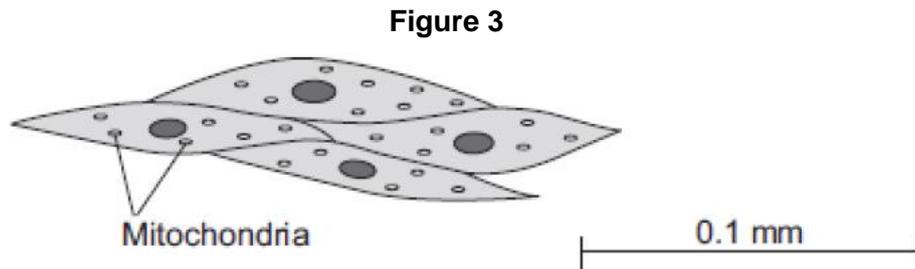
Actual length **Y–Z** = mm

2.3 Structure **X** is very small. There are hundreds of structures like **X** on a plant root.

Explain how this helps the plant.

[2 marks]

3.0 Figure 3 shows muscle cells from the wall of the stomach, as seen through a light microscope.



3.1 Describe the function of muscle cells in the wall of the stomach.

[2 marks]

3.2 The muscle cells in **Figure 3** contain many mitochondria.
What is the function of mitochondria?

[1 mark]

3.3 The muscle cells also contain many ribosomes. The ribosomes cannot be seen in **Figure 3**.
What is the function of a ribosome?

[1 mark]

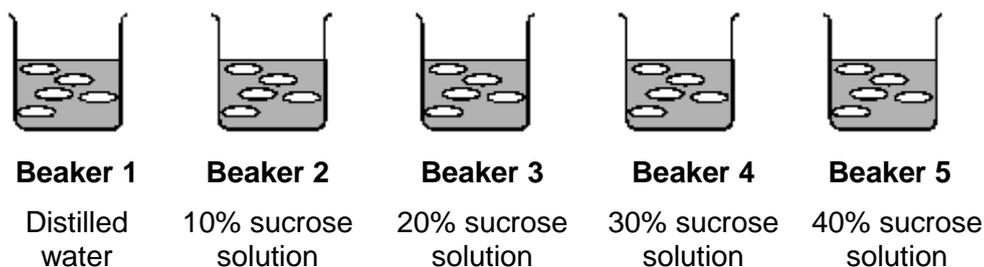
3.4 Suggest why the ribosomes **cannot** be seen through a light microscope.

[1 mark]

4.0 Some students set up an experiment to find the concentration of sucrose solution in potato cells.

The students used discs of potato cut to the same size and weighing approximately 10 grams.

The discs were put into each of five beakers.



4.1 After two hours the students carefully dried the potato disks with paper towel before reweighing the discs.

Why did the students dry the potato before weighing it?

[1 mark]

4.2 The students calculated the percentage gain or loss in mass of potato.

The students' results are shown in the **Table 1**.

Table 1

	Beaker 1	Beaker 2	Beaker 3	Beaker 4	Beaker 5
Final mass in g	13.0	12.2	9.0	7.9	7.3
Initial mass in g	10.0	10.6	10.0	10.1	10.4
Percentage gain or loss in mass	Gain 30%	Gain 15.1%	Loss 10%	Loss 21.8%	

Calculate the percentage loss of mass in beaker 5.

[3 marks]

Percentage loss of mass: %

4.3 Predict the concentration of sucrose solution in the potato cells.

Use the results in **Table 1**.

[1 mark]

Concentration of sucrose solution: %

5.0 Some scientists investigated the rates of absorption of different sugars by the small intestine.

In one experiment they used a piece of normal intestine.

In a second experiment they used a piece of intestine poisoned by cyanide.

Cyanide is poisonous because it prevents respiration.

Table 2 shows their results.

Table 2

Sugar	Relative rates of absorption	
	Normal intestine	Intestine poisoned by cyanide
Glucose	1.00	0.33
Galactose	1.10	0.53
Xylose	0.30	0.31
Arabinose	0.29	0.29

5.1 Name **two** sugars from **Table 2** which can be absorbed by active transport.

[2 marks]

5.2 Use evidence from **Table 2** to explain why you chose these sugars.

[4 marks]

5.3 All of the sugars named **Table 2** can be absorbed by diffusion.
Explain how information from **Table 2** provides evidence for this.

[2 marks]

6.0 Bone marrow contains stem cells.

6.1 Explain why bone marrow can be called a tissue.

[2 marks]

6.2 Read the information about stem cells.

Stem cells are used to treat some human diseases.

Stem cells can be collected from early embryos. These stem cells have not begun to differentiate, so they could be used to produce any kind of cell, tissue or organ. The use of embryonic stem cells to treat human diseases is new and, for some diseases, trials on patients are happening now.

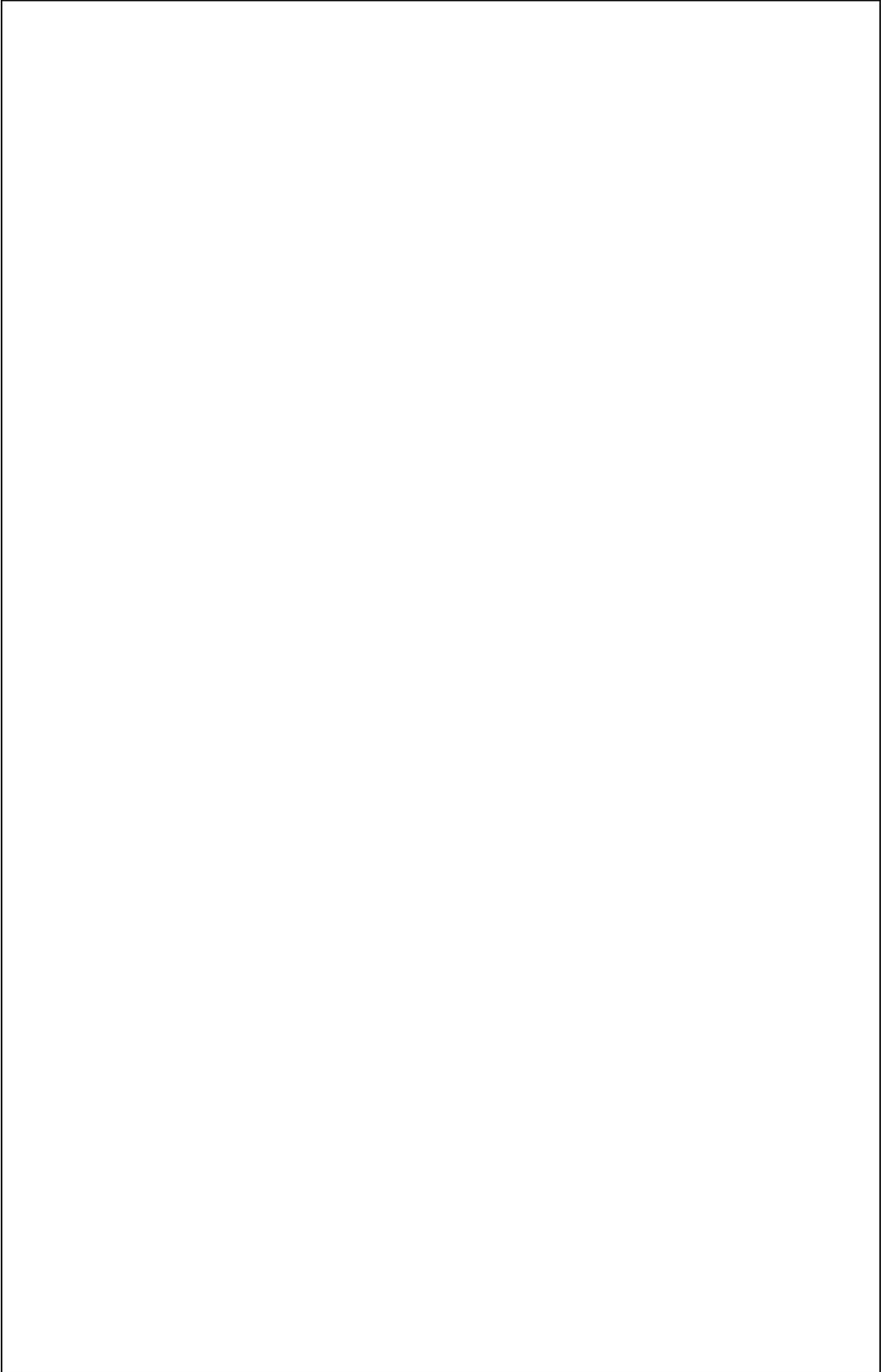
Stem cells can also be collected from adult bone marrow. The operation is simple but may be painful. Stem cells in bone marrow mainly differentiate to form blood cells. These stem cells have been used successfully for many years to treat some kinds of blood disease. Recently there have been trials of other types of stem cell from bone marrow. These stem cells are used to treat diseases such as heart disease.

Evaluate the use of stem cells from embryos or from adult bone marrow for treating human diseases.

You should give a conclusion to your evaluation.

Write your answer on the next page

[5 marks]



CHEMISTRY

Name:

Complete the questions by typing in the answer boxes, which will expand as necessary.

Then fill in the self-assessment form as fully as you can to help you reflect on your work.

1.0 This question is about bonding and atomic structure.

1.1 Match each type of bonding to the description of bonding.

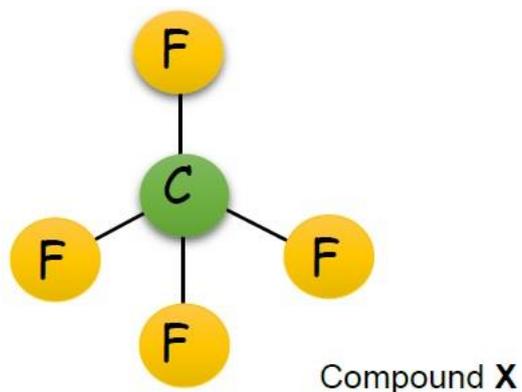
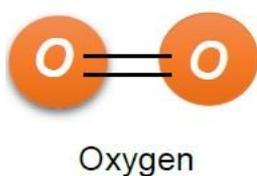
[2 marks]

Type of bonding	Description of bonding
1. Covalent bonding	A Positive ions surrounded by delocalised electrons
2. Metallic bonding	B Strong electrostatic forces of attraction
3. Ionic bonding	C Sharing of electrons

1. 2. 3.

Figure 1 shows the structure of two small molecules, oxygen and compound X.

Figure 1



- 1.2 Oxygen (O₂) is described as a diatomic element.
Suggest what is meant by the term “*diatomic element*”.

[1 mark]

- 1.3 Give the molecular formula of compound X

[1 mark]

- 1.4 Complete the sentence by putting the correct word in the box from the list below.

high medium low

[1 mark]

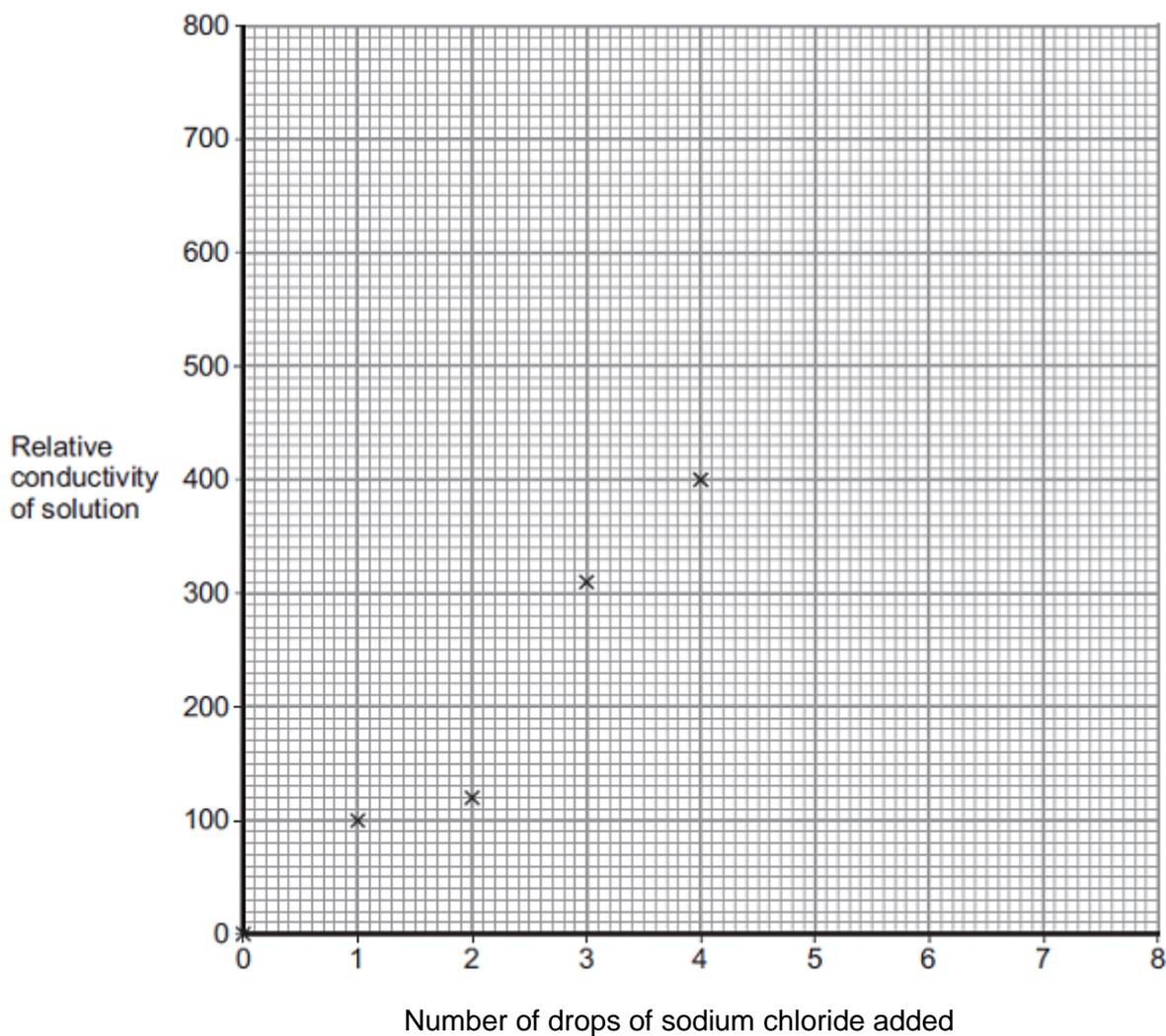
Chemicals with small molecules usually have a melting point.

- 2.0 A student investigated the conductivity of different concentrations of sodium chloride solution. The student's results are shown below.

Number of drops of sodium chloride solution added	Relative conductivity of solution
0	0
1	100
2	120
3	310
4	400
5	510
6	590
7	710
8	800

The student plotted some of the results on the graph shown in **Figure 2** below.

Figure 2



2.1 On the graph:

- Plot the remaining results
- Draw a line of best fit.

[2 marks]

2.2 Draw a ring around the anomalous point.

[1 mark]

2.3 The student compared the conductivity of sodium chloride solution with the conductivity of potassium chloride solution.

State **one** variable the student should keep constant when measuring the conductivity of the two solutions.

[1 mark]

2.4 Explain why sodium chloride solution conducts electricity.

[3 marks]

3.0 Some students were discussing whether to make wires for a phone charger from copper metal or graphite.

3.1 Compare the properties of copper and graphite to decide which material would be better for making the wire.

[6 marks]

3.2 The surface of some metals, such as iron, corrode when exposed to the air.

Explain how this affects the electrical conductivity of the metal.

[3 marks]

4.0 Sodium chloride is an ionic compound.

4.1 Explain why ionic compounds are usually solid at room temperature.

[2 marks]

4.2 Recent research has developed a new type of substance, ionic liquids. Ionic liquids have melting points at close to or below room temperature. Ionic liquids are used in batteries as they conduct electricity.

Explain why ionic liquids are used in batteries but solid ionic compounds are not.

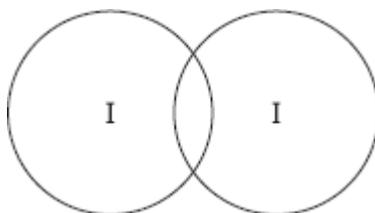
[3 marks]

5.0 Iodine is in Group 7.

5.1 Complete the diagram below to show the bonding in iodine, I₂.

Show the outer electrons only.

[2 marks]



5.2 Explain, in terms of particles, why liquid iodine does not conduct electricity.

[3 marks]

5.3 Many people do not have enough iodine in their diet.

Some scientists recommend that salt should have a compound of iodine added.

Give **one** ethical reason why a compound of iodine should **not** be added to food.

[1 mark]

- 6** A student was investigating a compound, **X**.
The student decided that compound X was an ionic compound.
Give **three** properties of ionic compounds that the student may have found.

[3 marks]

- 7.0** Sodium chloride is an ionic compound.

- 7.1** Explain why ionic compounds are usually solid at room temperature.

[2 marks]

- 7.2** Recent research has developed a new type of substance, ionic liquids.
Ionic liquids have melting points at close to or below room temperature.
Ionic liquids are used in batteries as they conduct electricity.

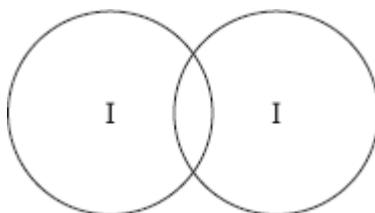
Explain why ionic liquids are used in batteries but solid ionic compounds are not.

[3 marks]

- 8.0** Iodine is in Group 7.

- 8.1** Complete the diagram below to show the bonding in iodine, I_2 .
Show the outer electrons only.

[2 marks]

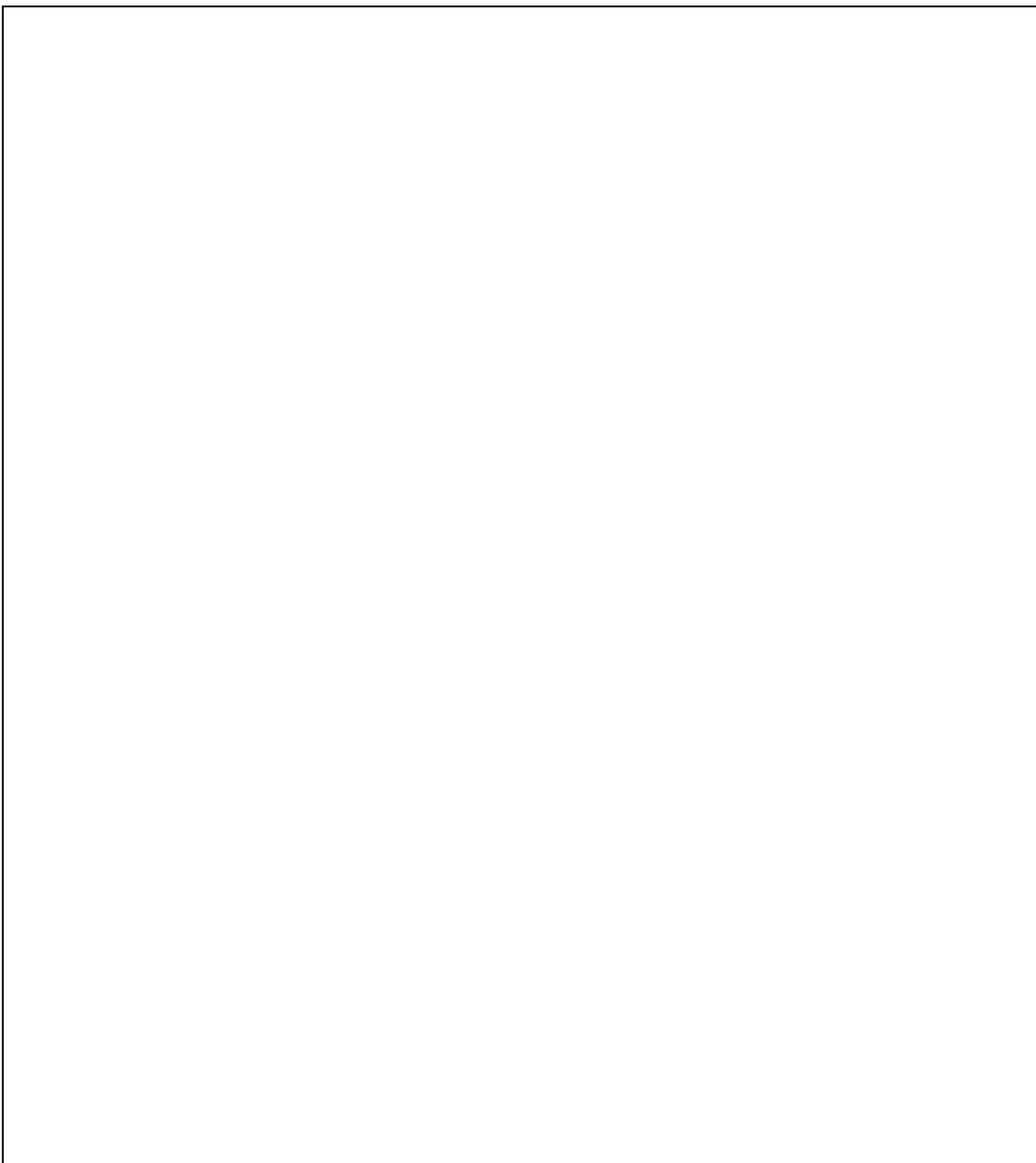


- 8.2** Explain, in terms of particles, why liquid iodine does not conduct electricity.

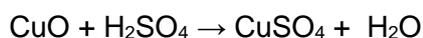
[3 marks]

- 9 A student was investigating a compound, **X**.
The student decided that compound X was an ionic compound.
Give **three** properties of ionic compounds that the student may have found.

[3 marks]



- 10.0 A student made some copper sulfate crystals, CuSO_4 .
The student used 7.95g of copper oxide and 100 cm^3 of a 2.00 mol/dm^3 solution of sulfuric acid.
The equation for the reaction is:



- 10.1 Calculate the number of moles of copper oxide in 7.95 g copper oxide.
Relative atomic masses A_r : O = 16; Cu = 63.5

[2 marks]

Answer = moles

- 10.2 Calculate the number of moles of sulfuric acid in 100 cm^3 of 2.00 mol/dm^3 sulfuric acid.

[2 marks]

Answer = moles

- 10.3 It is common to use an excess of one reactant.
Explain why a reactant is used in excess.

[2 marks]

- 10.4 Another student made copper sulfate using 0.250 moles of copper oxide and 0.500 moles of sulfuric acid.

Calculate the **maximum** mass of copper sulfate which could be produced.

Give your answer to 3 significant figures.

Relative formula mass (M_r) $\text{CuSO}_4 = 159.5$

[4 marks]

Maximum mass of copper sulfate = g

PHYSICS

Name:

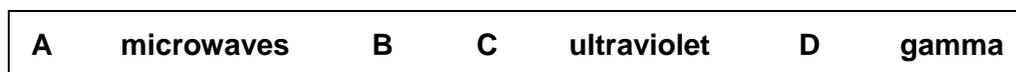
Waves

Complete the questions by typing in the answer boxes, which will expand as necessary.

Then fill in the self-assessment form as fully as you can to help you reflect on your work.

1.0 **Figure 1** shows an incomplete electromagnetic spectrum.

Figure 1



1.1 Which position are X-rays found in?

[1 mark]

Put an X in **one** box only.

A

B

C

D

1.2 Which **three** waves can cause ionisation?

[1 mark]

Put an X in **three** boxes.

- Gamma rays
- Infrared
- Microwaves
- Radio waves
- Visible light
- Ultraviolet
- X-rays

1.3 Electromagnetic waves have many practical uses.

Match each type of electromagnetic wave to its use.

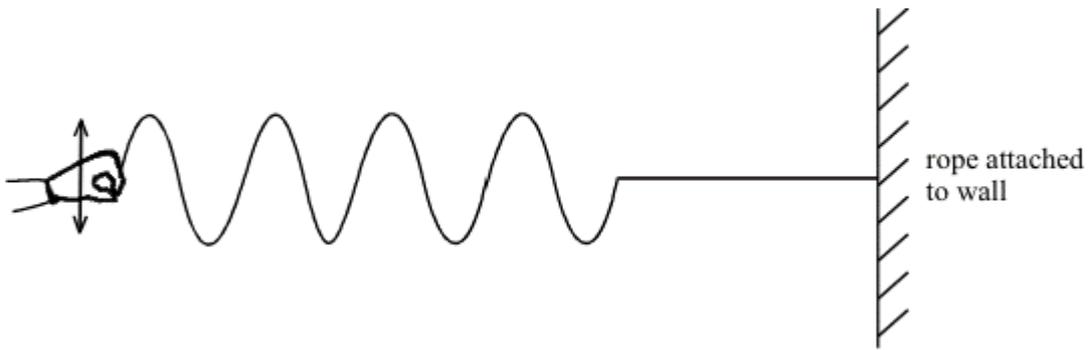
[2 marks]

Electromagnetic wave	Use
1. Radio waves	A Medical treatments
2. Visible light	B Television transmissions
3. Gamma rays	C Fibre optic communications
	D Sun tanning

1. 2. 3.

2.0 **Figure 2** shows some waves travelling along a rope.

Figure 2



2.1 Show on the diagram:

The wavelength of one of the waves (labelled with a **W**)

The amplitude of one of the waves (labelled with an **A**)

[2 marks]

2.2 State the type of waves travelling on the rope.

Explain how you can tell.

[2 marks]

Type of wave

Explanation

2.3 The waves shown in the diagram were produced in two seconds.

Calculate the frequency of the waves.

[2 marks]

Frequency = Hz

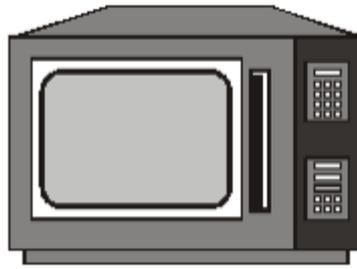
2.4 Calculate the time period of the waves.

State the unit.

[2 marks]

Time period = Unit

3.0 Microwave ovens use microwave radiation to cook food.



The instruction manual of a microwave oven stated:

Frequency of microwaves: 10 000 million Hz.

Wavelength 0.02 m.

3.1 Calculate the speed of waves in the microwave according to the information in the instruction manual.

Give your answer in standard form.

[3 marks]

Speed = m/s

3.2 The speed of visible light is 3×10^8 m/s.

Was the information in the instruction manual correct?

Explain your answer.

[1 mark]

3.3 Simon said “When the microwave is working, it lights up. That’s the microwaves.”

Explain whether Simon was correct.

[2 marks]

3.4 Putting a beaker of water in a microwave and turning it on for a minute or two will increase the temperature of the water.

Describe an experiment to investigate the relationship between the time the microwave is on and the increase in temperature of water in a beaker.

In your answer, include:

- The equipment you will use
- The measurements you will take
- The safety precautions you will take

[6 marks]

4.0 The table gives information about the frequencies in the hearing ranges of three different animals.

Name of mammal	Frequencies in hearing range (Hz)	Wavelength of hearing range (m)
Bat	20 → 160 000	0.0021 → 17.2
Dolphin	40 → 110 000	0.0031 → 8.6
Elephant	5 → 10 000	X → 68.6

4.1 Which animal(s) can hear sounds **higher** than humans?

[1 mark]

Put an X in **one, two or three** boxes.

Bat

Dolphin

Elephant

4.2 Which animal(s) can hear sounds **lower** than humans?

[1 mark]

Put an X in **one, two or three** boxes

Bat

Dolphin

Elephant

4.3 Calculate the minimum wavelength of sound that elephants can hear (X).

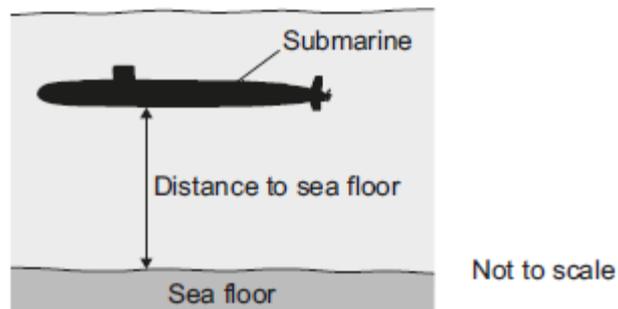
Use information from the table.

[3 marks]

Minimum wavelength = m

5.0 **Figure 3** shows a submerged submarine.

Figure 3



5.1 The submarine sends a pulse of ultrasound to the sea floor.

The pulse returns 0.35 seconds after leaving the submarine.

The speed of sound in water is 1600 m/s.

Calculate the distance from the submarine to the sea floor.

Give your answer to 2 significant figures.

[2 marks]

Distance to sea floor = m

5.2 The submarine moves through the sea and every few seconds sends a pulse of ultrasound to check the distance to the sea floor.

The table shows the time taken for five ultrasound pulses to travel from the submarine to the sea floor and back to the submarine.

Pulse number	Time for pulse to return in seconds
1	0.50
2	0.50
3	0.38
4	0.25
5	0.25

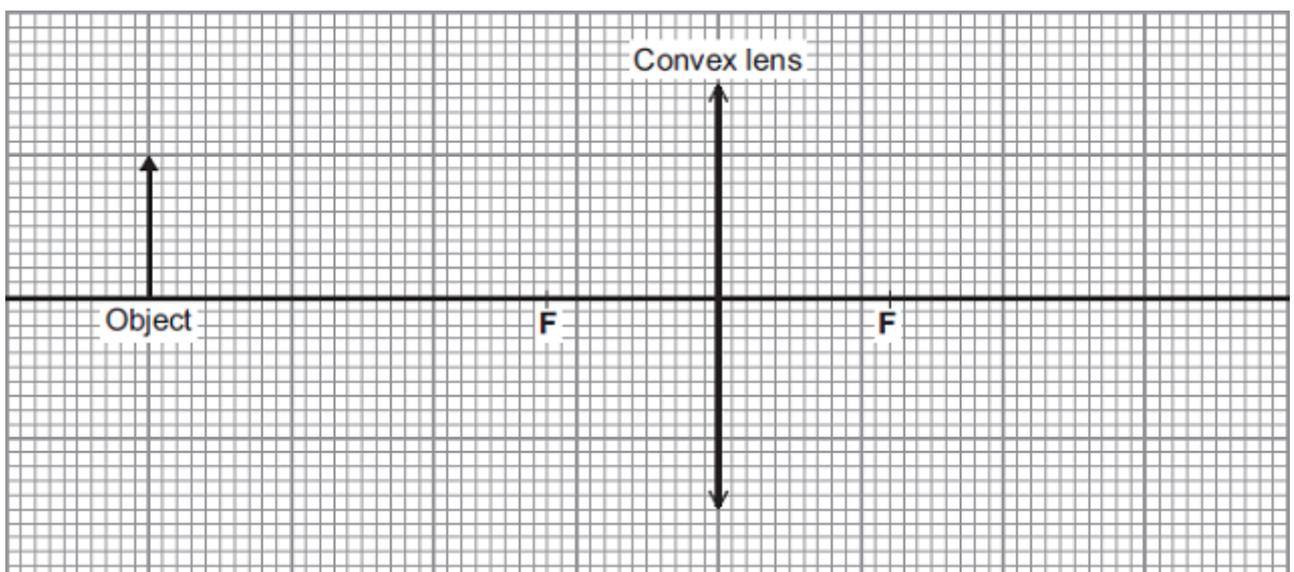
Describe how the distance from the submarine to the sea floor changed over these five pulses.

[3 marks]

6.0 A camera was used to take a photograph. The camera contains a convex (converging) lens.

6.1 Complete the ray diagram to show how the lens produces an image of the object.

[4 marks]



F = Principal focus

6.2 Calculate the magnification of the image.

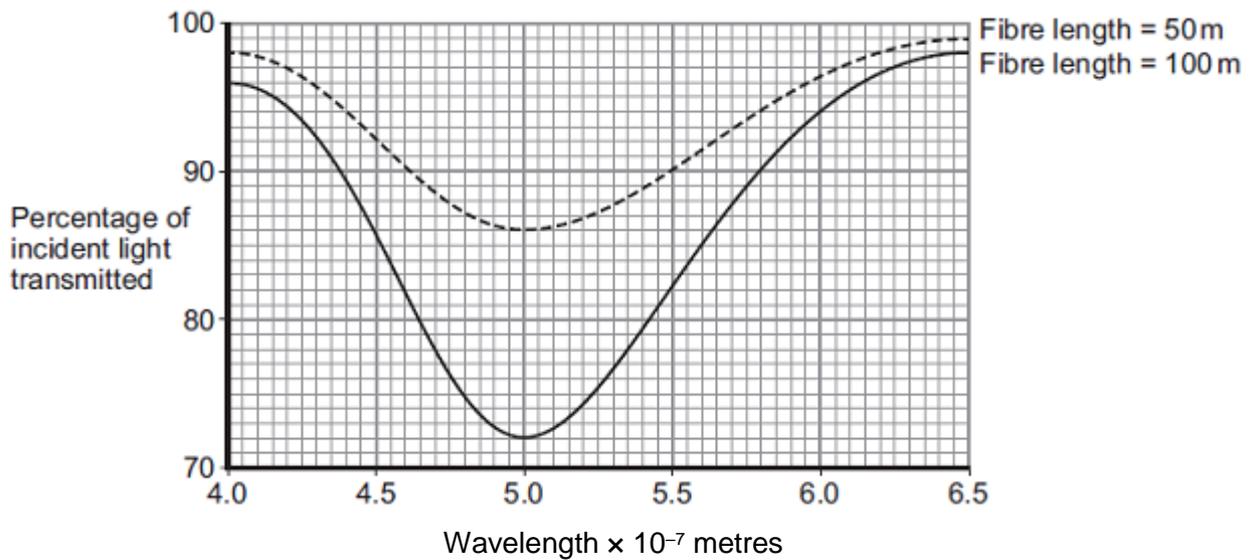
[2 marks]

Magnification =

7.0 Different wavelengths of light can be used to transmit information along optical fibres.

Figure 4 below shows how the percentage of incident light transmitted through a fibre varies with the wavelength of light and the length of the fibre.

Figure 4



7.1 Compare the percentages of incident light transmitted through the two different fibres over the range of wavelengths shown.

[3 marks]

7.2 The speed of light is 3×10^8 m/s.

Calculate the frequency of light that is absorbed the most by the 100m length of fibre.

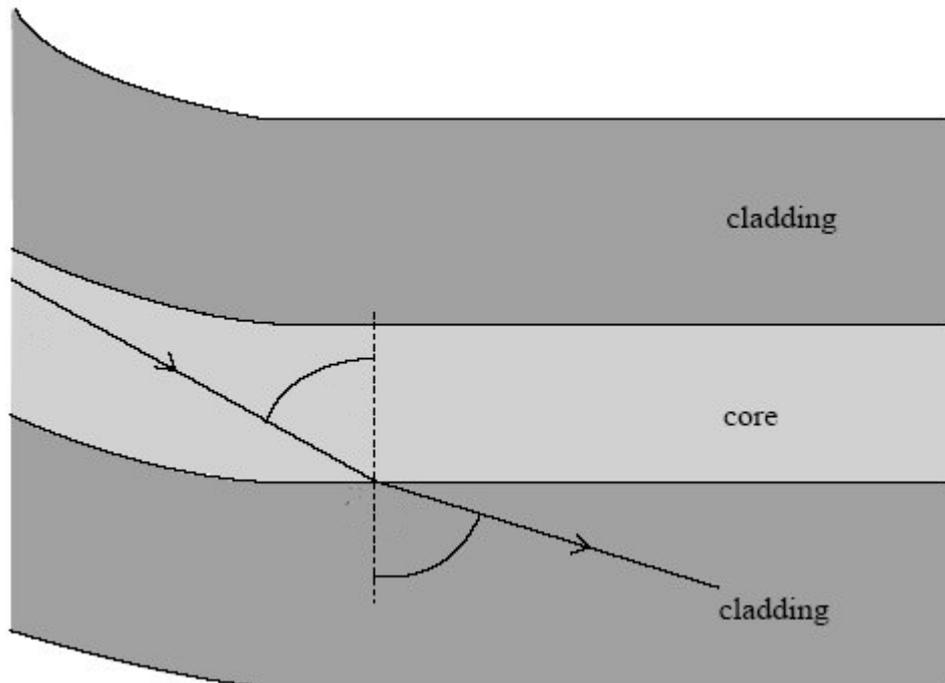
Give your answer in standard form.

[2 marks]

Frequency = Hz

- 7.3 The inside of optical fibres consists of two layers of glass, core and cladding. **Figure 5** shows how light travels between these two layers.

Figure 5

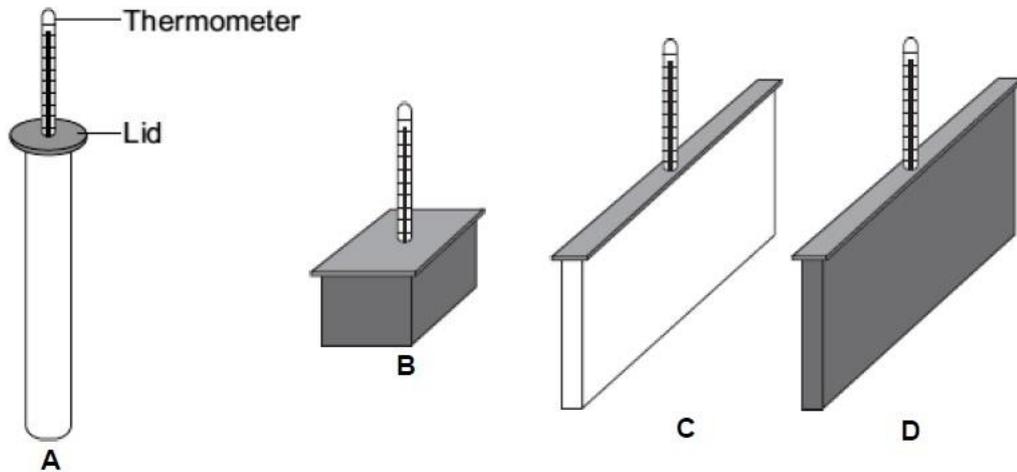


Suggest why the light travels in this way in the optical fibre.

[2 marks]

8.0 A student investigated the effect of shape and colour on heat transfer.

The student used metal containers with the same volume but with different shapes and outside colour. The containers were each filled with water at 100 °C. After 20 minutes the temperature of the water inside each container was measured.



The results from the investigation are given in the table.

Container	Colour	Temperature after 20 minutes in °C	Temperature fall in °C
A	White	86	14
B	Black	86	14
C	White	73	27
D	Black	60	40

8.1 The student uses the results in the table to see if **shape** has affected heat transfer.

State which containers the student should compare to do this.

Give a reason for your answer.

[2 marks]

Containers to compare:

Reason:

8.2 Explain why the temperature of the water in both containers **A** and **B** fell by the same amount.

[2 marks]

Questions which Require Research.

These questions were taken from old BTEC Unit 1 Papers. This will give you a flavour of the standard required. You will need to do some research to answer them.

Q1.

Lithium, Li, is a metal in group 1 of the periodic table.

(i) What is the name given to group 1 of the periodic table?

(1)

- A alkali metals
- B alkaline earth metals
- C halogens
- D transition metals

(ii) Lithium has an atomic number of 3.

Complete the electronic configuration of lithium.

(1)

1s..... 2s.....

(iii) Write the equation to show the first ionisation energy of lithium.

(2)

.....

(Total for question = 4 marks)

Q2.

Chemists use the periodic table to predict the chemical properties of elements based on their location in the table.

Part of the periodic table is shown.

	1	2											3	4	5	6	7	0
1																		
2																		
3	A													C				
4																		D
5						B												
6																		

The letters, A, B, C and D, represent four different elements.

- (i) Which letter represents a transition metal?
- (ii) Which letter represents an atom that forms a +1 ion?
- (iii) Which letter represents an atom that can form ions with different charges?
- (iv) Which letter represents an atom that is unreactive?
- (v) Which letter represents an atom that is found in caffeine?

(vi) Complete the electronic configuration for an atom of sodium.

1s² 2s²

(Total for question = 6 marks)

Q3.

Ammonium chloride, ammonium sulfate and ammonium nitrate are used in fertilisers.

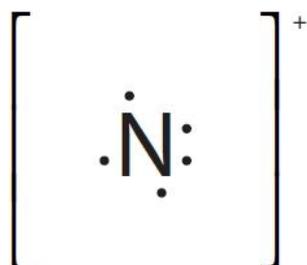
Figure 1 shows the arrangement of electrons in the outer shell of an atom of nitrogen and in an atom of hydrogen.



Figure 1

Complete the dot and cross diagram to show the bonding in the ammonium ion, NH₄⁺.

(2)



(Total for question = 2 marks)

Q4.

A white blood cell is a specialised cell.

Complete the meaning of the term **specialised cell**.

(2)

A cell becomes specialised when its structure is altered. This enables a cell to have a function. This process is called cellular

(Total for question = 2 marks)

Q5.

Alveolar tissue is found in the lungs.

Endothelial tissue is found in the blood vessels.

Describe how a build-up of cholesterol in artery walls is a risk factor in the development of atherosclerosis.

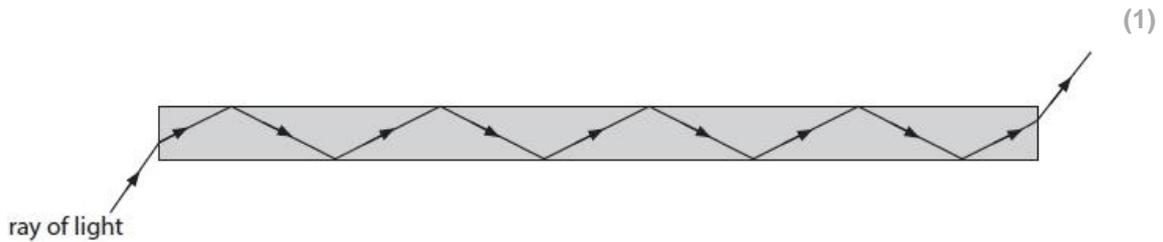
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(Total for question = 4 marks)

Q6.

Figure 5 shows a ray of light entering, travelling through and leaving an optical fibre.
 Add **one** X to Figure 5 to show one point of total internal reflection.



(Total for question = 1 mark)

Q7. Light passes through an optical fibre.
 The optical fibre is made of glass.
 Calculate the critical angle for the glass.

(3)

Refractive index of glass (n) = 1.52

Use the equation $\sin C = \frac{1}{n}$

critical angle for the glass = °

(Total for question = 3 marks)

Q8. The speed of light in air is $3.0 \times 10^8 \text{ m s}^{-1}$.
 The light passes into an optical fibre.
 The refractive index of the optical fibre is 1.55
 Calculate the speed of light in the optical fibre, v .

Use the equation: $n = \frac{c}{v}$

Show your working.

(3)

speed of light in the optical fibre = m s^{-1}

(Total for question = 3 marks)