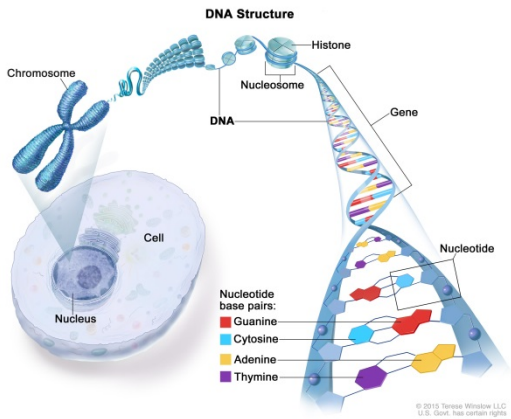
APPLIED SCIENCE TRANSITION GUIDE

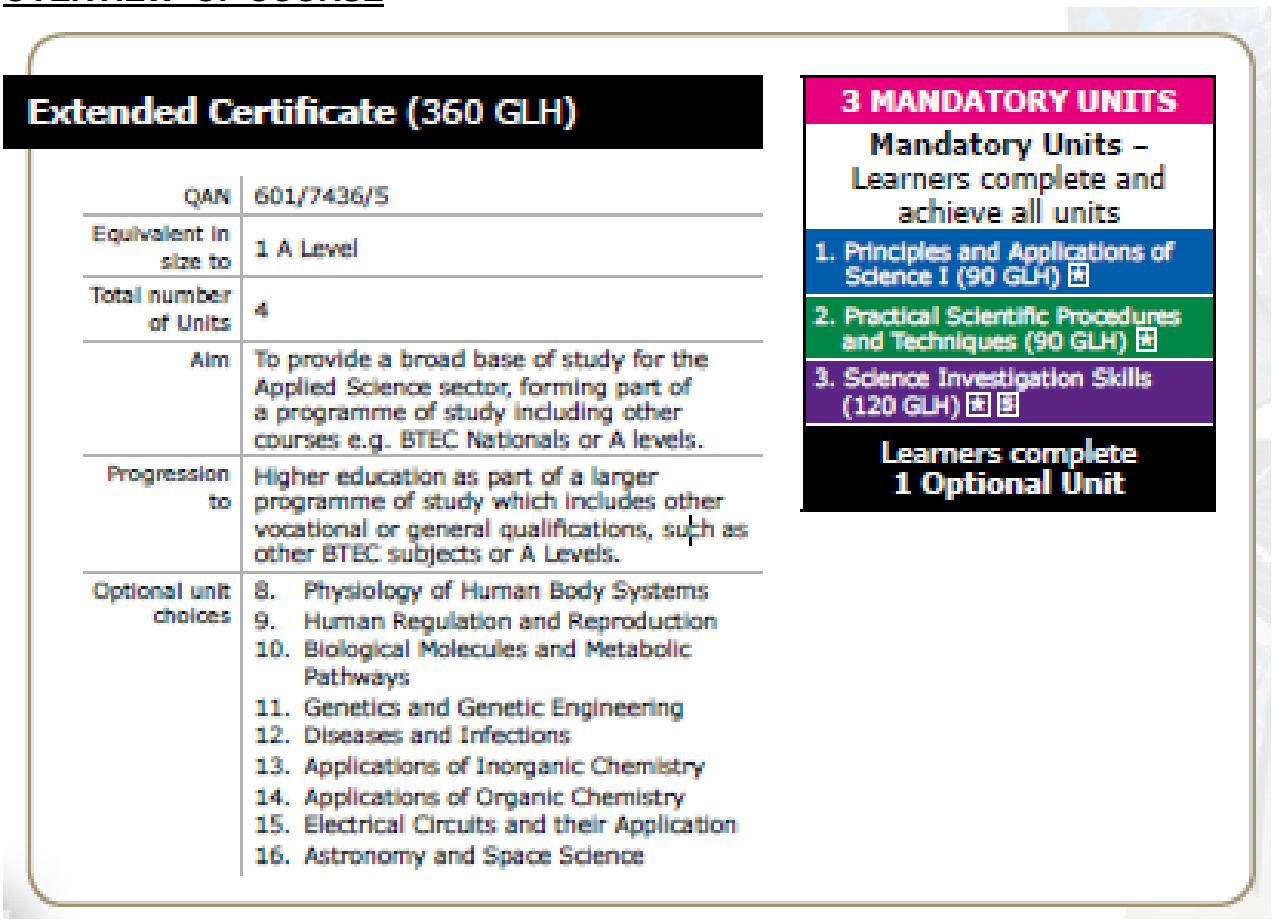
NAME……



Tavistock COLLEGE

Contents Page

OVERVIEW OF COURSE



Extended Certificate (360 GLH)

QAN	601/7436/5
Equivalent in size to	1 A Level
Total number of Units	4
Aim	To provide a broad base of study for the Applied Science sector, forming part of a programme of study including other courses e.g. BTEC Nationals or A levels.
Progression to	Higher education as part of a larger programme of study which includes other vocational or general qualifications, such as other BTEC subjects or A Levels.
Optional unit choices	8. Physiology of Human Body Systems 9. Human Regulation and Reproduction 10. Biological Molecules and Metabolic Pathways 11. Genetics and Genetic Engineering 12. Diseases and Infections 13. Applications of Inorganic Chemistry 14. Applications of Organic Chemistry 15. Electrical Circuits and their Application 16. Astronomy and Space Science

Breakdown of assessment -examination, coursework % etc..

4 units – 3 mandatory units and 1 options

01 principles and application of science: - introduction to BCP at level 3 – Internal exam set by Edexel but marked externally (90 GLH)

02 practical and scientific procedures and technique – CW (90GLH)

03 – Science and investigation skills – Marked with internal assessment (written up by collecting data then high control). Marked externally. (120 GLH)

04 – This is the optional unit either - 8. (60 GLH) to be decided by students

- Physiology of Human Body Systems
- Human Regulation and Reproduction 60
- Biological Molecules and Metabolic Pathways
- Genetics and Genetic Engineering
- Diseases and Infections

Year 12 Applied Science Induction Task

Student Name: ……..

Date Submitted: ……..

This assignment addresses the following Criteria…

Unit 1 – Fundamentals of Science – Induction task **Assessment and grading criteria**		
To achieve a pass grade the evidence must show that the learner is able to:	To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:	To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:
P1 Describe the technique of a standard solution and titration	**M1** Explain technique and methodology. Concluding your results with calculations	**D1** Fully detailed lab report with evaluation and numerical analysis

This task will requires you to produce a full lab report on making a standard solution and then testing the accuracy by performing a titration.

You will produce a standard solution of NaOH or Na_2CO_3 of a known strength (suggest 0.1Mol). The strength of Sodium Carbonate (NaOH or Na_2CO_3) is usually measured in moles. A one molar (1M) solution means one mole of substance (solute) per litre of solution.

Using all the safety measures required, make a 0.1mol solution of Sodium Hydroxide or Sodium Carbonate. You must weigh the reactants and calculate the strength exactly.

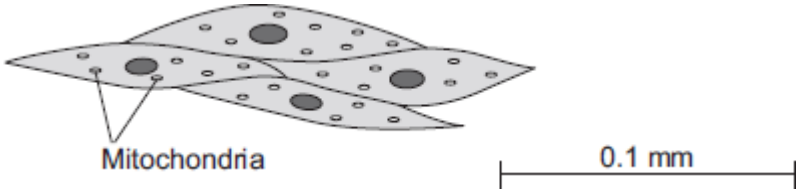
The layout of the report should contain the following headings. Include are some success prompts for your lab report and the **bold headings are essential.**

Heading **Bold** is essential	**Success criteria**
Aim	• To produce a standard solution the test the accuracy against a known concentration of HCl.
Introduction	• Why are titrations and standard solutions created? • Why are titrations performed? • Where and why are the used in industry i.e. pharmacology
Method	• Step by step method • Justification of each equipment for standard solution and titration • Justify each technique for standard solution and titration • Explain your calculation for your standard solution – including units
Diagram/ picture	• labelled diagrams using a pencil/ photograph
Results	• Including table, units, headings, repeatability, mean, appropriate handing of outliners.
Calculations	• Balanced symbol equation • Measure the volume of HCl titrated • Calculate the molarity of HCL • Calculate the concentration of your standard solution • Show your working including equations and correct SI units
Conclusion	• Explain your accuracy of standard solution • Statically analyse your data
Evaluation	• How can you improve the accuracy of your standard solution? • Suggest improvements for ensuring accuracy.

BRIDGING THE GAP SUMMER TASKS

BIOLOGY QUESTIONS

Q1. The image below shows some muscle cells from the wall of the stomach, as seen through a light microscope.



(a) Describe the function of muscle cells in the wall of the stomach.

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(2)

(b) **Figure above** is highly magnified.

The scale bar in **Figure above** represents 0.1 mm.

Use a ruler to measure the length of the scale bar and then calculate the magnification of **Figure above**.

.....

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.....

.....

Magnification = ... times

(2)

(c) The muscle cells in **Figure above** contain many mitochondria.

What is the function of mitochondria?

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(2)

(d) The muscle cells also contain many ribosomes. The ribosomes cannot be seen in **Figure above**.

(i) What is the function of a ribosome?

.....

.....

(1)

(ii) Suggest why the ribosomes **cannot** be seen through a light microscope.

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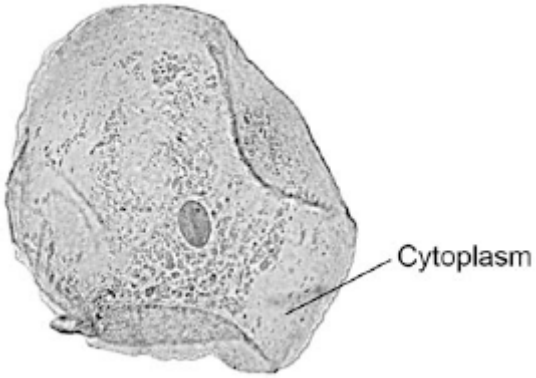
(1)

(Total 8 marks)

Q2.Figure 1 shows a human cheek cell viewed under a light microscope.

Figure 1



(a) Label the nucleus **and** cell membrane on **Figure 1**.

(2)

(b) Cheek cells are a type of body cell.

Body cells grow through cell division.

What is the name of this type of cell division?

Tick **one** box.

Differentiation ☐

Mitosis ☐

Specialisation ☐

(1)

(c) Ribosomes and mitochondria are **not** shown in **Figure 1**.

What type of microscope is needed to see ribosomes and mitochondria?

.....

(1)

(d) What is the advantage of using the type of microscope you named in part **(c)**?

Tick **one** box.

Cheaper ☐

Higher magnification ☐

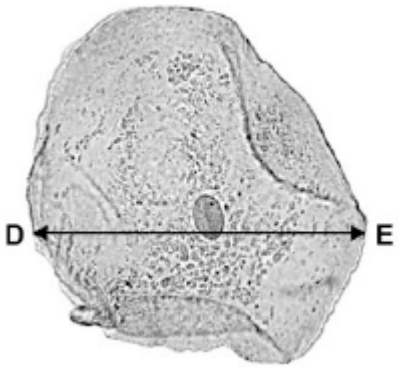
Lower resolution ☐

(1)

(e) The cheek cell in **Figure 2** is magnified 250 times.

The width of the cell is shown by the line **D** to **E**.

Figure 2



Calculate the width of the cheek cell in micrometres (μm).

Complete the following steps.

Measure the width of the cell using a ruler ..... mm

Use the equation to work out the real width of the cell in mm:

$$\textbf{real size} = \frac{\textbf{image size}}{\textbf{magnification}}$$ ..... mm

Convert mm to μm ..... μm

(3)

(f) A red blood cell is 8 µin diameter.

A bacterial cell is 40 times smaller.

Calculate the diameter of the bacterial cell.

Tick **one** box.

0.02 µm ☐

0.2 µm ☐

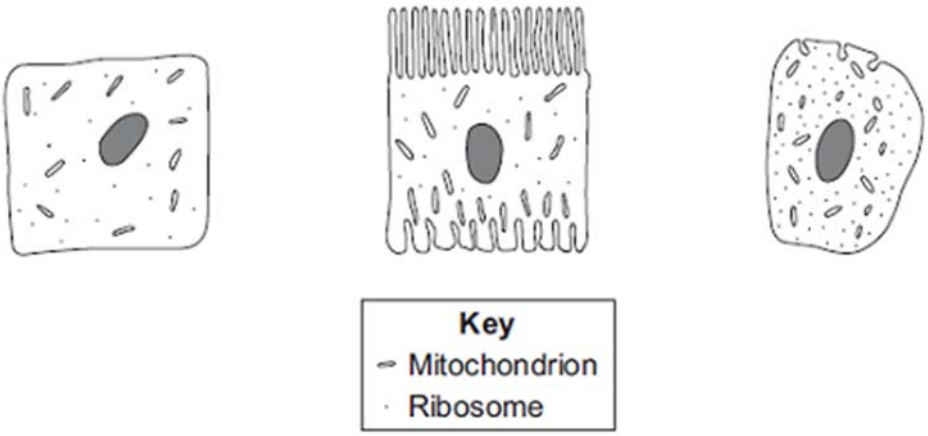
2.0 µm ☐

20.0 µm ☐

(1)
(Total 9 marks)

Q3. Diagrams **A**, **B** and **C** show cells from different parts of the human body, all drawn to the same scale.

A B C



(a) Which cell, **A**, **B** or **C**, appears to be best adapted to increase diffusion into or out of the cell? ☐

Give **one** reason for your choice.

.....

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(1)

(b) (i) Cell **C** is found in the salivary glands.

Name the enzyme produced by the salivary glands.

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(1)

(ii) Use information from the diagram to explain how cell **C** is adapted for producing this enzyme.

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(2)

(Total 4 marks)

Q4. The table shows the concentrations of three mineral ions in the roots of a plant and in the water in the surrounding soil.

Mineral ion	**Concentration in millimoles per kilogram**	
	Plant root	**Soil**
Calcium	120	2.0
Magnesium	80	3.1
Potassium	250	1.2

(a) (i) The plant roots could **not** have absorbed these mineral ions by diffusion. Explain why.

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2)

(ii) Name the process by which the plant roots absorb mineral ions.

.....

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(1)

(b) How do the following features of plant roots help the plant to absorb mineral ions from the soil?

(i) A plant root has thousands of root hairs.

.....

.....

(1)

(ii) A root hair cell contains many mitochondria.

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(2)

(iii) Many of the cells in the root store starch.

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(1)

(Total 7 marks)

Q5. White blood cells protect the body against pathogens such as bacteria and viruses.

(a) (i) Pathogens make us feel ill.

Give **one** reason why.

.....

.....

(1)

(ii) White blood cells produce antibodies. This is one way white blood cells protect us against pathogens.

Give **two** other ways that white blood cells protect us against pathogens.

1.....

.....

2.....

.....

(2)

(b) Vaccination can protect us from the diseases pathogens cause.

(i) One type of virus causes measles.

A doctor vaccinates a child against measles.

What does the doctor inject into the child to make the child immune to measles?

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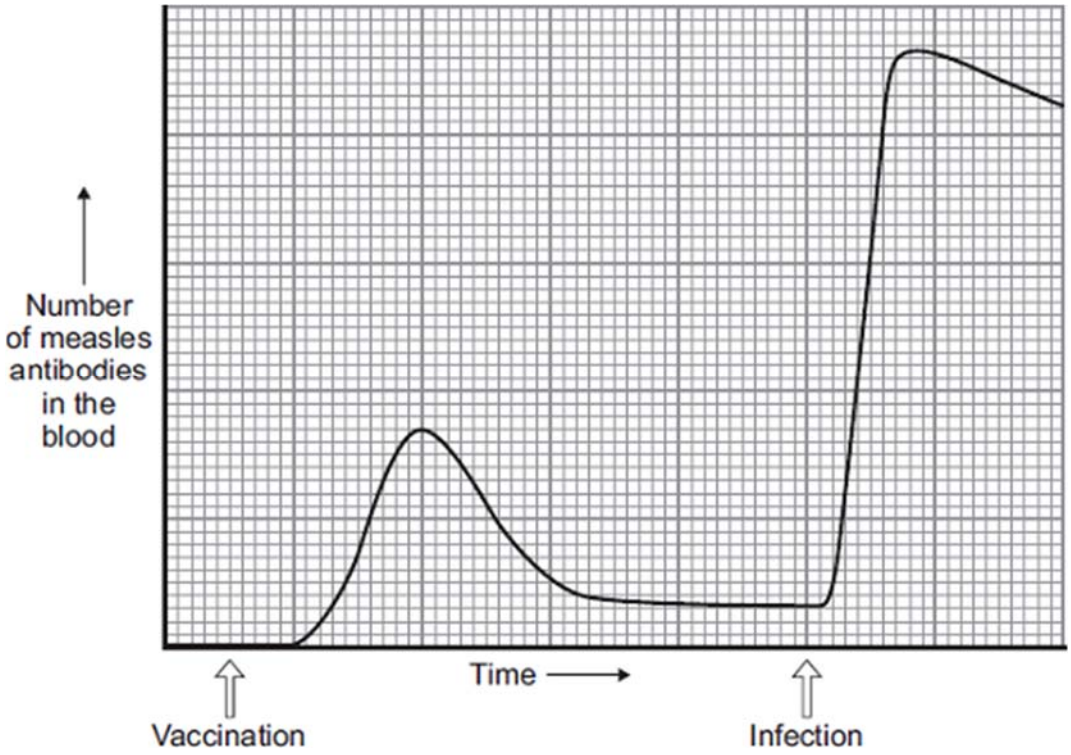
(2)

(ii) A few weeks after the vaccination, the child becomes infected with measles viruses from another person.

The graph shows the number of measles antibodies in the child's blood from before the vaccination until after the infection.



More measles antibodies are produced after the infection than after the vaccination.

Describe other differences in antibody production after infection compared with after vaccination.

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(3)

(iii) Vaccination against the measles virus will **not** protect the child against the rubella virus.

Why?

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(1)

(c) What is the advantage of vaccinating a large proportion of the population against measles?

.....

(1)

(Total 10 marks)

Q6. The circulatory system contains arteries and veins.

(a) (i) Describe how the structure of an artery is different from the structure of a vein.

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(2)

(ii) A comparison is made between blood taken from an artery in the leg and blood taken from a vein in the leg.

Give **two** differences in the composition of the blood.

1

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.....

2

.....

.....

(2)

(b) During operations patients can lose a lot of blood. Patients often need blood transfusions to keep them alive.

The text shows information about a new artificial blood product.

Sea worms give hope for people in need of blood transfusions

Scientists have carried out a five-year trial using a new artificial blood product. The scientists have used a protein from sea worms to create the new artificial blood and the results from the trial are very positive. Thousands of sea worms can be grown and collected.

During the trial, mice were given blood transfusions of the artificial blood. The bodies of the mice tolerated the artificial blood and the artificial blood did not cause any side effects.

Suggest **two** possible advantages of using the new artificial blood, instead of using human blood for a transfusion in humans.

1
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2
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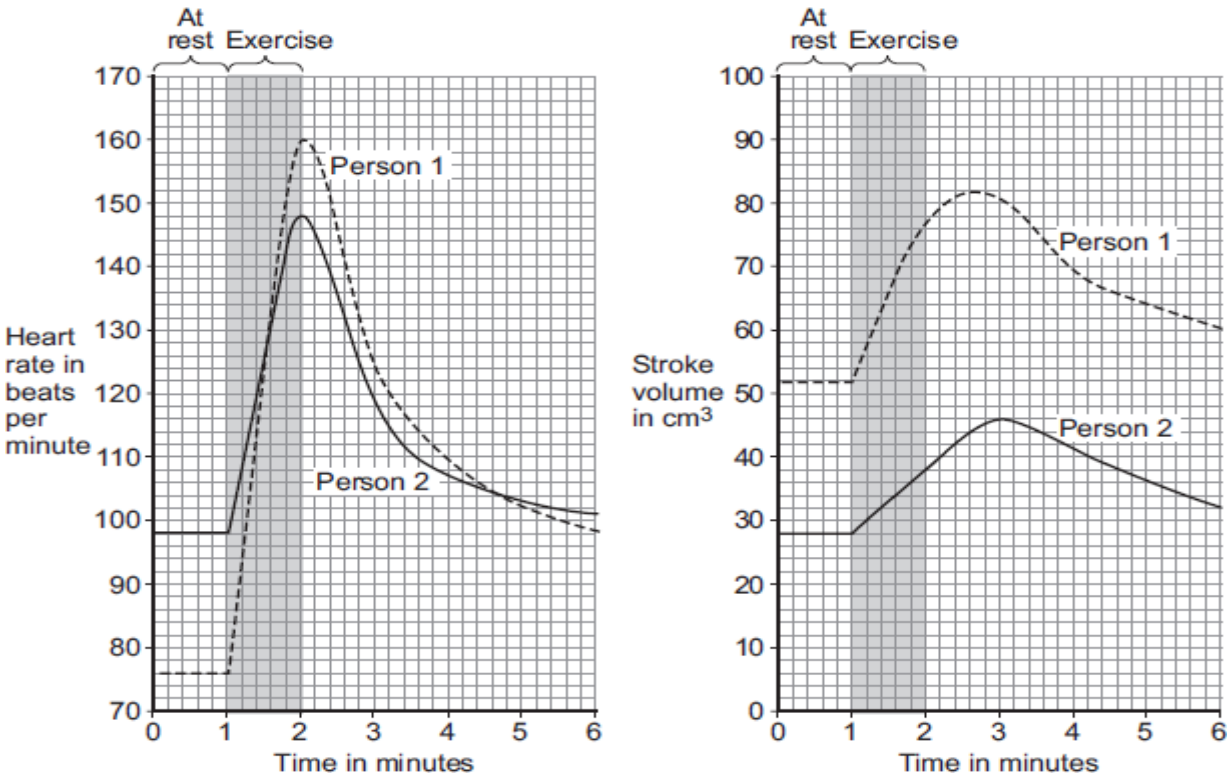
(2)
(Total 6 marks)

Q7. During exercise, the heart beats faster and with greater force.

The 'heart rate' is the number of times the heart beats each minute.The volume of blood that travels out of the heart each time the heart beats is called the 'stroke volume'.

In an investigation, **Person 1** and **Person 2** ran as fast as they could for 1 minute. Scientists measured the heart rates and stroke volumes of **Person 1** and **Person 2** at rest, during the exercise and after the exercise.

The graph below shows the scientists' results.



(a) The 'cardiac output' is the volume of blood sent from the heart to the muscles each minute.

Cardiac output = Heart rate × Stroke volume

At the end of the exercise, **Person 1**'s cardiac output = 160 × 77 = 12 320 cm^3 per minute.

Use information from **Figure above** to complete the following calculation of **Person 2**'s cardiac output at the end of the exercise.

At the end of the exercise:

Person 2's heart rate = ... beats per minute

Person 2's stroke volume = ... cm^3

Person 2's cardiac output = ... cm^3 per minute

(3)

(b) **Person 2** had a much lower cardiac output than **Person 1.**

(i) Use information from **Figure above** to suggest the **main** reason for the lower cardiac output of **Person 2**.

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(1)

(ii) **Person 1** was able to run much faster than **Person 2**.

Use information from **Figure above** and your own knowledge to explain why.

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(5)

(Total 9 marks)

Q8. Pathogenic bacteria and viruses may make us feel ill if they enter our bodies.

(a) Why do bacteria and viruses make us feel ill?

Bacteria

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Viruses

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.....

(2)

(b) Most drugs that kill bacteria cannot be used to treat viral infections.

Explain why.

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(2)

(c) Antibiotic-resistant strains of bacteria are causing problems in most hospitals.

Explain, as fully as you can, why there has been a large increase in the number of antibiotic-resistant strains of bacteria.

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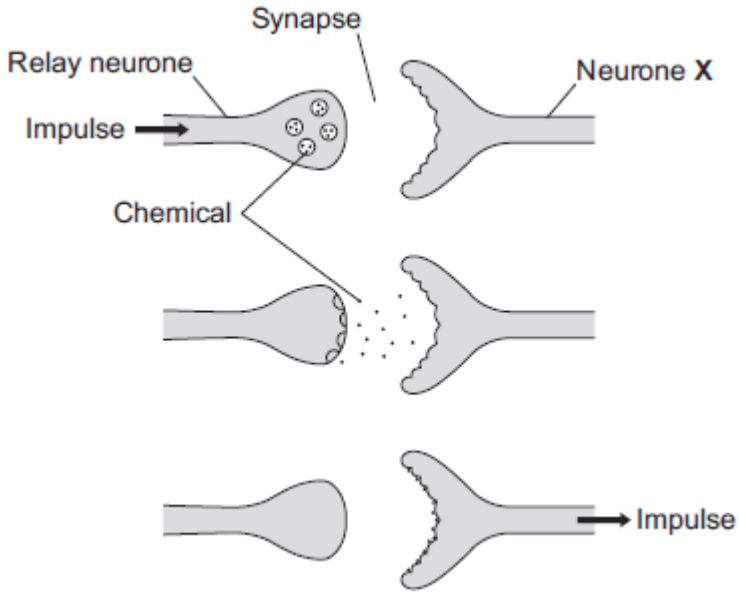
(4)

(Total 8 marks)

Q9. The diagram below shows how a nerve impulse passing along a relay neurone causes an impulse to be sent along another type of neurone, neurone **X**.



(a) What type of neurone is neurone **X**?

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(1)

(b) Describe how information passes from the relay neurone to neurone **X**. Use the diagram to help you.

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(3)

(c) Scientists investigated the effect of two toxins on the way in which information passes across synapses. The table below shows the results.

Toxin	**Effect at the synapse**
Curare	Decreases the effect of the chemical on neurone **X**
Strychnine	Increases the amount of the chemical made in the relay neurone

Describe the effect of each of the toxins on the response by muscles.

Curare

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Strychnine

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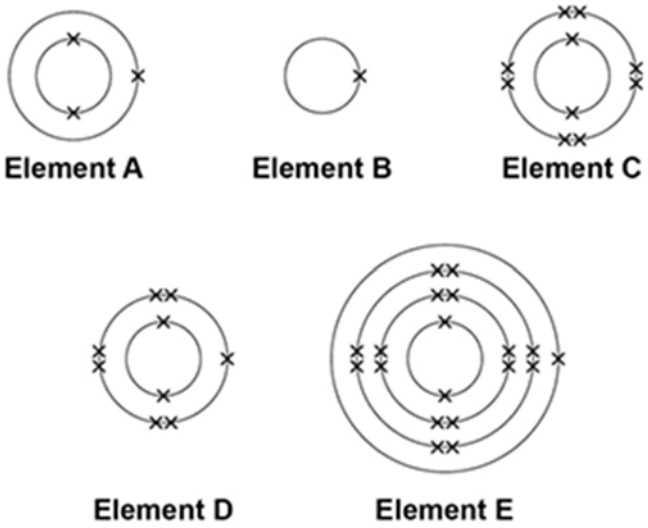
(2)

(Total 6 marks)

CHEMISTRY QUESTIONS

Q1. The electronic structure of the atoms of five elements are shown in the figure below. The letters are **not** the symbols of the elements.



Choose the element to answer the question. Each element can be used once, more than once or not at all.

Use the periodic table to help you.

(a) Which element is hydrogen?

Tick **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐

(1)

(b) Which element is a halogen?

Tick **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐

(1)

(c) Which element is a metal in the same group of the periodic table as element **A**?

Tick **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐

(1)

(d) Which element exists as single atoms?

Tick **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐

(1)

(e) There are two isotopes of element **A**. Information about the two isotopes is shown in the table below.

Mass number of the isotope	6	7
Percentage abundance	92.5	7.5

Use the information in the table above above to calculate the relative atomic mass of element **A**.
Give your answer to 2 decimal places.

Relative atomic mass = ...

(4)
(Total 8 marks)

Q2.(a) Dmitri Mendeleev was one of the first chemists to classify the elements by arranging them in order of their atomic weights. His periodic table was published in 1869.

How did Mendeleev know that there must be undiscovered elements **and** how did he take this into account when he designed his periodic table?

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(2)

(b) By the early 20th century protons and electrons had been discovered.

Describe how knowledge of the numbers of protons and electrons in atoms allow chemists to place elements in their correct order and correct group.

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(3)

(c) The transition elements are a block of elements between Groups 2 and 3 of the periodic table.

(i) Transition elements have similar properties.

Explain why, in terms of electronic structure.

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(2)

(ii) There are **no** transition elements between the Group 2 element magnesium and the Group 3 element aluminium.

Give a reason why, in terms of electronic structure.

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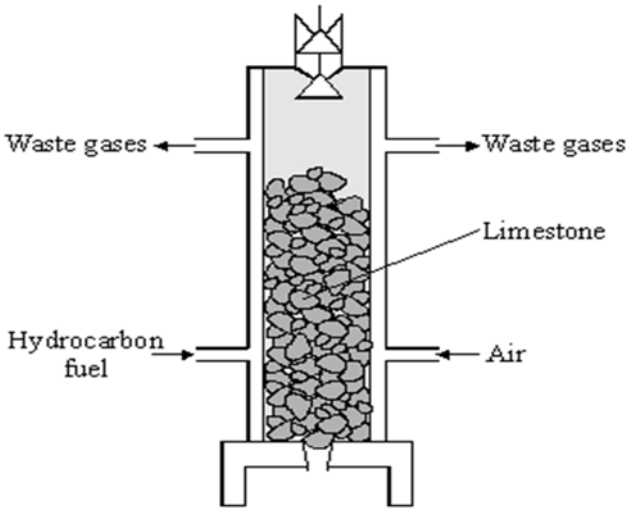
(1)

(Total 8 marks)

Q3. Limestone is a useful mineral. Every day, large amounts of limestone are heated in limekilns to produce lime. Lime is used in the manufacture of iron, cement and glass and for neutralising acidic soils.



$$CaCO_3 \rightleftharpoons CaO + CO_2$$

(i) The decomposition of limestone is a *reversible* reaction. Explain what this means.

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(2)

(ii) Calculate the mass of lime, CaO, that would be produced from 250 tonnes of limestone, $CaCO_3$.

Relative atomic masses: C 12; O 16; Ca 40.

Mass of lime = ... tonnes

(3)

(Total 5 marks)

Q4. A student carried out a titration to find the concentration of a solution of hydrochloric acid. The following paragraph was taken from the student's notebook.

> I filled a burette with hydrochloric acid. 25.0 cm^3 of 0.40 mol/dm^3 potassium hydroxide was added to a flask. 5 drops of indicator were added. I added the acid to the flask until the indicator changed colour. The volume of acid used was 35.0 cm^3.

(a) What piece of apparatus would be used to measure 25.0 cm^3 of the potassium hydroxide solution?

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(1)

(b) Name a suitable indicator that could be used.

.....

(1)

(c) Calculate the number of moles of potassium hydroxide used.

Moles of potassium hydroxide = ... mol

(2)

(d) Calculate the concentration of the hydrochloric acid. The equation for the reaction is:

$KOH + HCl \rightarrow KCl + H_2O$

Concentration of hydrochloric acid = ... mol/dm^3

(2)
(Total 6 marks)

Q5. A student carried out a titration to find the concentration of a solution of sulphuric acid. 25.0 cm^3 of the sulphuric acid solution was neutralised exactly by 34.0 cm^3 of a potassium hydroxide solution of concentration 2.0 mol/dm^3. The equation for the reaction is:

$2KOH(aq) + H_2SO_4(aq) \rightarrow K_2SO_4(aq) + 2H_2O(l)$

(a) Describe the experimental procedure for the titration carried out by the student.

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(4)

(b) Calculate the number of moles of potassium hydroxide used.

Number of moles = ...

(2)

(c) Calculate the concentration of the sulphuric acid in mol/dm^3.

Concentration = ... mol/dm^3

(3)
(Total 9 marks)

Q6. Millions of years ago the Earth formed as a giant ball of molten rock. The outer surface cooled forming a thin, solid outer crust. Volcanic activity on the surface produced an atmosphere containing the compounds carbon dioxide, ammonia, methane and water vapour.

Describe the bonding in any **one** of these compounds. You must include electronic structures in your explanation.

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(Total 4 marks)

Q7. Glass is made from silicon dioxide.

(a) Silicon dioxide has a very high melting point.

Other substances are added to silicon dioxide to make glass. Glass melts at a lower temperature than silicon dioxide.

Suggest why.

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(1)

(b) Sodium oxide is one of the substances added to silicon dioxide to make glass.

(i) Sodium oxide contains Na^+ ions and O^{2-} ions.

Give the formula of sodium oxide.

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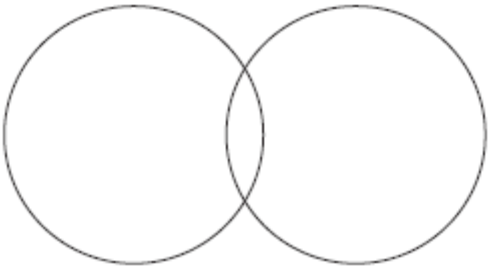
(1)

(ii) Sodium oxide is made by heating sodium metal in oxygen gas.

Complete the diagram to show the outer electrons in an oxygen molecule (O_2).



(2)

(c) Glass can be coloured using tiny particles of gold. Gold is a metal.

Describe the structure of a metal.

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(3)
(Total 7 marks)

Q8. The following article appeared recently in the *Manchester Gazette*.

Sodium Drum Blaze Scare

A 20 litre drum containing sodium burst into flames when it reacted violently with rainwater at a Manchester factory. It is believed that the sodium, which is normally stored under oil, had been accidentally left outside with the lid off.

A factory worker put out the blaze before the fire services arrived, and a leading fire fighter said, "It was fortunate that potassium wasn't involved as it would have reacted more violently and exploded. These Group 1 *alkali metals* can be very dangerous".

(a) Group 1 metals are stored under oil.

Suggest why.

.....

(1)

(b) Balance the equation which represents the reaction between sodium and water.

$$Na + H_2O \rightarrow NaOH + H_2$$

(1)

(c) Explain why the Group 1 metals are called the *alkali metals*.

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(1)

(d) Explain, in terms of electrons, why potassium reacts more violently than sodium.

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(3)
(Total 6 marks)

Q9. In sea water the bromine is present as bromide ions (Br^-). The equation below shows how chlorine can be used to displace bromine from sea water.

$Cl_{2(g)} + 2Br^-_{(aq)} \rightarrow Br_{2(g)} + 2Cl^-_{(aq)}$

Explain, as fully as you can, why chlorine can displace bromine from sea water. To obtain full marks your answer should refer to electronic structure.

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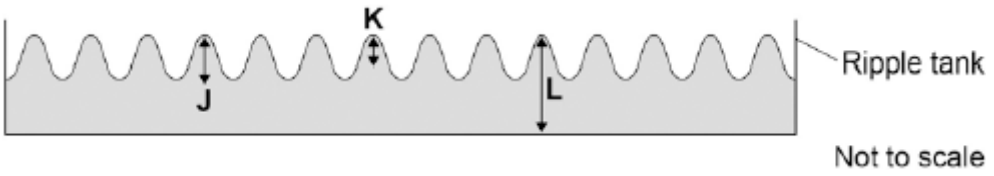
(Total 3 marks)

PHYSICS QUESTIONS

Q1. Small water waves are created in a ripple tank by a wooden bar. The wooden bar vibrates up and down hitting the surface of the water.

The figure below shows a cross-section of the ripple tank and water.



(a) Which letter shows the amplitude of a water wave?

Tick **one** box.

J ☐

K ☐

L ☐

(1)

(b) The speed of the wooden bar is changed so that the bar hits the water fewer times each second.

What happens to the frequency of the waves produced?

Tick **one** box.

Increases ☐

Does not change ☐

Decreases ☐

(1)

(c) Describe how the wavelength of the water waves in a ripple tank can be measured accurately.

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(2)

(d) The speed of a wave is calculated using the following equation.

wave speed = frequency × wavelength

The water waves in a ripple tank have a wavelength of 1.2 cm and a frequency of 18.5 Hz.

How does the speed of these water waves compare to the typical speed of a person walking?

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(4)
(Total 8 marks)

Q2. Waves may be either longitudinal or transverse.

(a) Describe the difference between a longitudinal and a transverse wave.

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(2)

(b) Describe **one** piece of evidence that shows when a sound wave travels through the air it is the wave and not the air itself that travels.

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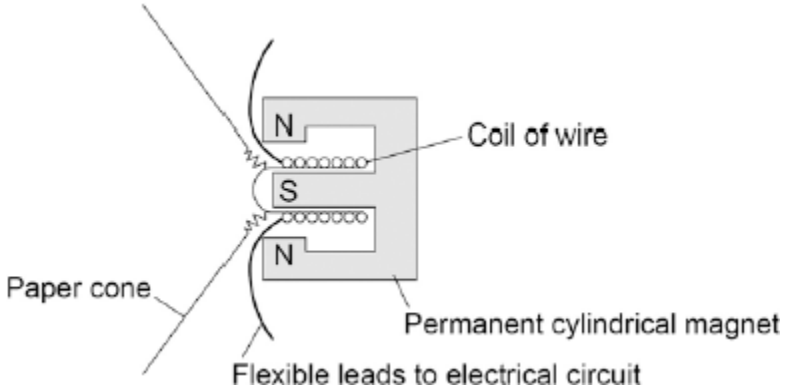
(1)

(c) The figure below shows the parts of a moving-coil loudspeaker.

A coil of wire is positioned in the gap between the north and south poles of the cylindrical magnet.



Explain how the loudspeaker converts current in an electrical circuit to a sound wave.

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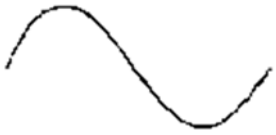
(6)
(Total 9 marks)

Q3. Some students made a small hand-turned a.c. generator, similar to a bicycle dynamo. They connected it to the Y plates of a cathode ray oscilloscope, CRO, and turned the generator slowly. The trace on the CRO looked like this:



They then turned the generator faster and the trace looked like this:

(a) Why did the trace on the CRO show:

(i) an increase in frequency;

.....

(1)

(ii) a decrease in wavelength;

.....

(1)

(iii) an increase in amplitude?

.....

(1)

(b) One way to alter the output from the generator is to change the speed of turning. State **two** other ways to adapt parts of the generator to increase its output.

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(2)

(Total 5 marks)

Q4. (a) The student is using a microphone connected to a cathode ray oscilloscope (CRO).

The CRO displays the sound waves as waves on its screen. What does the microphone do?

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(2)

(b) The amplitude, the frequency and the wavelength of a sound wave can each be either increased or decreased.

(i) What change, or changes, would make the sound quieter?

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(1)

(ii) What change, or changes, would make the sound higher in pitch?

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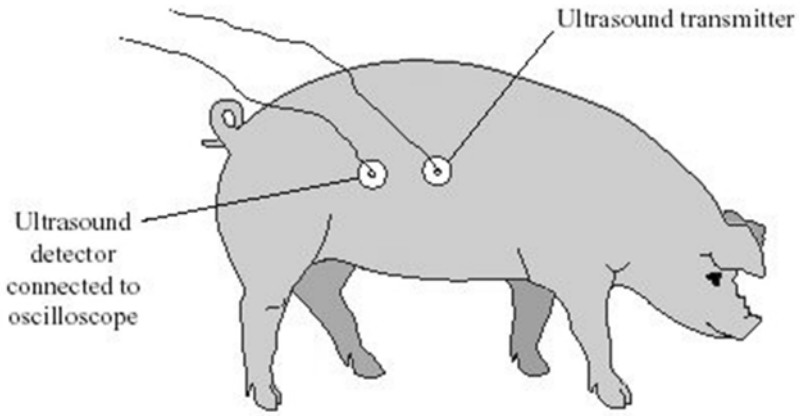
(1)

(Total 4 marks)

Q5. Pigs have a layer of fat in their skin. Underneath the fat is a layer of muscle. Ultrasonic waves are used to measure the thickness of the layer of fat. An ultrasound transmitter and detector are attached to the skin of the pig.



(a) Explain why ultrasound can be used to measure the thickness of the layer of fat.

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(2)

(b) The oscilloscope does not measure distance directly.

(i) What does the oscilloscope measure in this case?

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(1)

(ii) What other information is needed to calculate the thickness of the layer of fat in a pig?

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(1)

(Total 4 marks)

Q6. (a) Microwaves are one type of electromagnetic wave.

(i) Which type of electromagnetic wave has a lower frequency than microwaves?

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(1)

(ii) What do all types of electromagnetic wave transfer from one place to another?

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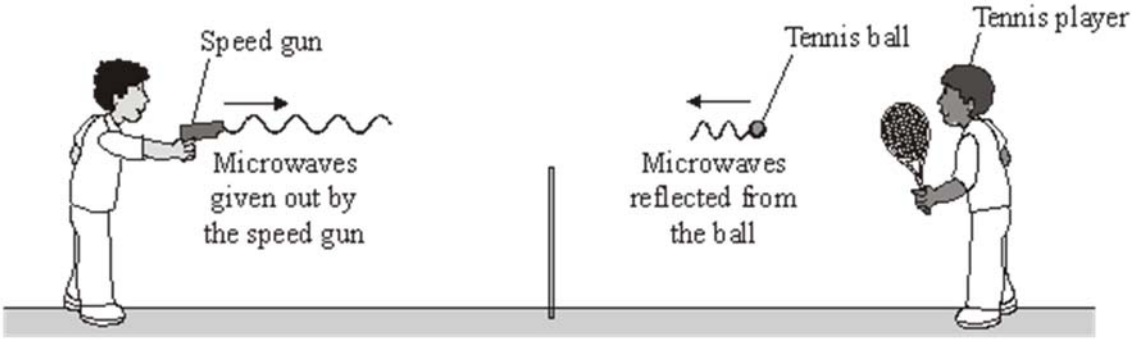
(1)

(b) The picture shows a tennis coach using a speed gun to measure how fast the player serves the ball.



(i) The microwaves transmitted by the speed gun have a frequency of 24 000 000 000 Hz and travel through the air at 300 000 000 m/s.

Calculate the wavelength of the microwaves emitted from the speed gun.

Show clearly how you work out your answer.

Wavelength = ... m

(2)

(ii) Some of the microwaves transmitted by the speed gun are absorbed by the ball.

What effect will the absorbed microwaves have on the ball?

.....

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(1)

(Total 5 marks)

Q7. All radio waves travel at 300 000 000 m/s in air.

(i) Give the equation that links the frequency, speed and wavelength of a wave.

.....

(1)

(ii) Calculate the wavelength, in metres, of a radio wave which is broadcast at a frequency of 909 kHz. Show clearly how you work out your answer.

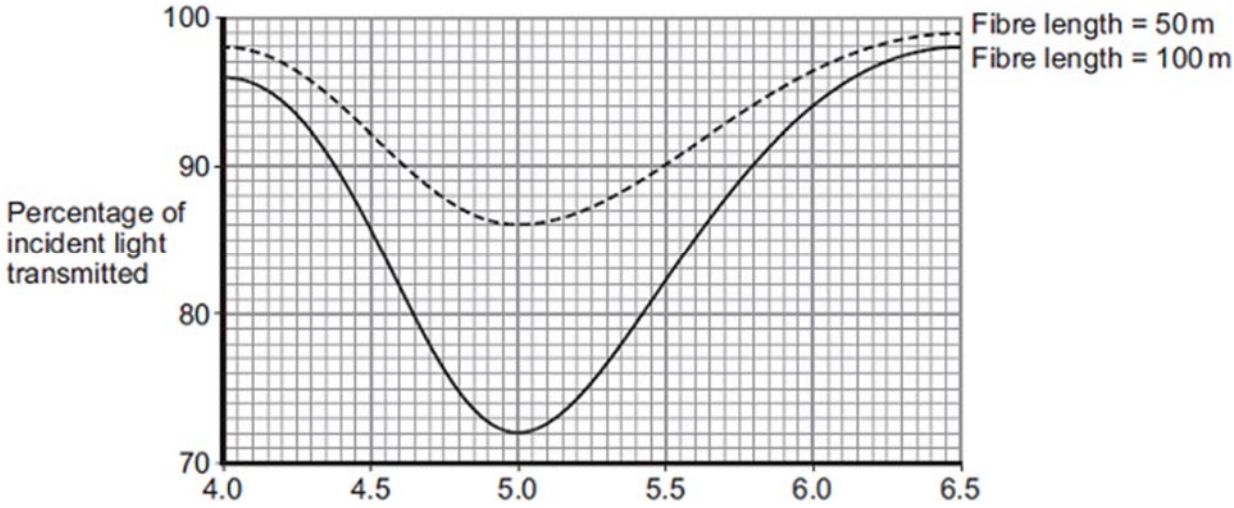
Wavelength = ... metres

(2)

(Total 3 marks)

Q8. Different wavelengths of light can be used to transmit information along optical fibres.

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



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

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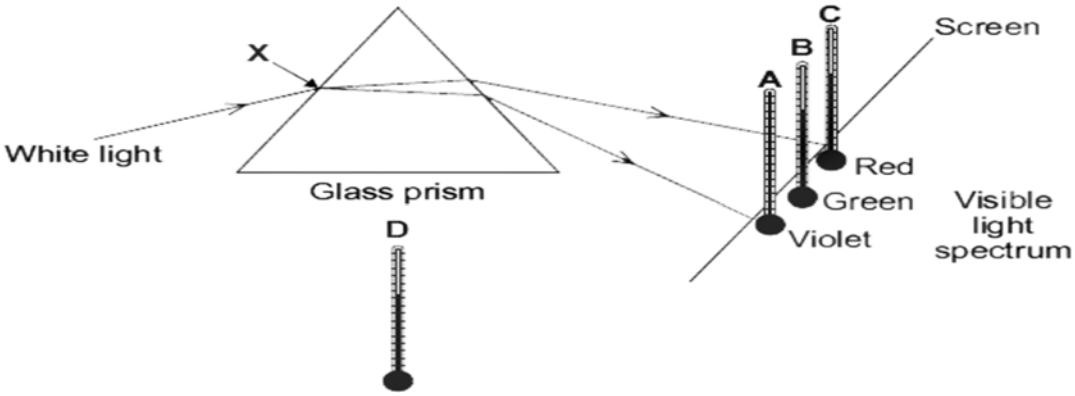
(Total 3 marks)

Q9. The diagram shows the apparatus that a student used to investigate the heating effect of different wavelengths of light.



(a) (i) The student put thermometer **D** outside of the light spectrum.

Suggest why.

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(1)

(ii) The table gives the position and reading of each thermometer 10 minutes after the investigation started.

Thermometer	Position of thermometer	Temperature in °C
A	in violet light	21
B	in green light	22
C	in red light	24
D	outside the spectrum	20

What should the student conclude from the data in the table?

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.**(2)**

(b) A similar investigation completed in 1800 by the scientist Sir William Herschel led to the discovery of infrared radiation.

Suggest how the student could show that the spectrum produced by the glass prism has an infrared region.

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(2)

(c) A person emits infrared radiation at a frequency of 3.2×10^{13} Hz.

Calculate the wavelength of the infrared radiation that a person emits.

Take the speed of infrared radiation to be 3.0×10^{8} m/s.

Show clearly how you work out your answer.

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Wavelength = ... m

(2)

(d) A thermal imaging camera detects infrared radiation. Electronic circuits inside the camera produce a visible image of the object emitting the infrared radiation.

At night, police officers use thermal imaging cameras to track criminals running away from crime scenes.

Thermal imaging cameras work better at night than during the day.

Explain why.

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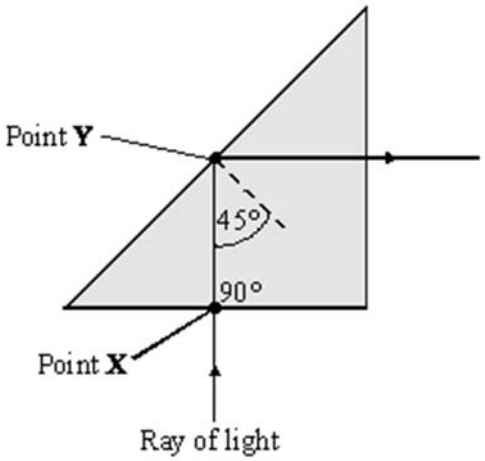
(2)

(Total 9 marks)

Q10. The diagram shows a glass prism.



(i) Explain why refraction has **not** occurred at point **X**.

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(1)

(ii) (A) Give the full name for the process which has occurred at point **Y**.

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(1)

(B) Explain why this process has occurred.

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(2)

(Total 4 marks)