

IGCSE

Science (Double Award)

Sample Assessment
Materials (SAMs)

Edexcel IGCSE in Science (Double Award) (4SC0)

First examination 2011



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Acknowledgements

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Introduction

These sample assessment materials have been prepared to support the specification.

The aim of these materials is to provide students and centres with a general impression and flavour of the actual question papers and mark schemes in advance of the first operational examinations.

Sample question papers

Biology Paper 1	7
Chemistry Paper 1	31
Physics Paper 1	59

Centre No.						Paper Reference	Surname	Initial(s)
Candidate No.						4 S C 0 / 1 B	Signature	

Paper Reference(s)

4SC0/1B

**Edexcel IGCSE
Science (Double Award)**

Biology Paper 1
Sample Assessment Material
Time: 2 hours

Examiner's use only

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Team Leader's use only

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Question Number	Leave Blank
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Total	

Materials required for examination

Ruler

Items included with question papers

Nil

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initials and signature. Check that you have the correct question paper. Answer ALL the questions. Write your answers in the spaces provided in this question paper. Show all the steps in any calculations and state the units. Calculators may be used.

Information for Candidates

The marks for individual questions and the parts of questions are shown in round brackets: e.g. (2). There are 18 questions in this question paper. The total mark for this paper is 120. There are 24 pages in this question paper. Any blank pages are indicated.

Advice to Candidates

Write your answers neatly and in good English.

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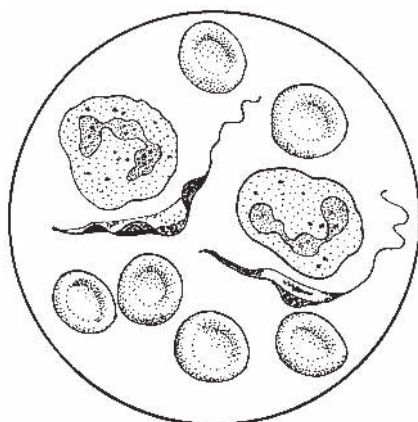


Turn over

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Answer ALL questions.

1. The diagram shows a sample of blood seen using a microscope. The blood was from a person suffering from a disease caused by a microorganism.



- (a) State the number of blood cells in the diagram.

..... (1)

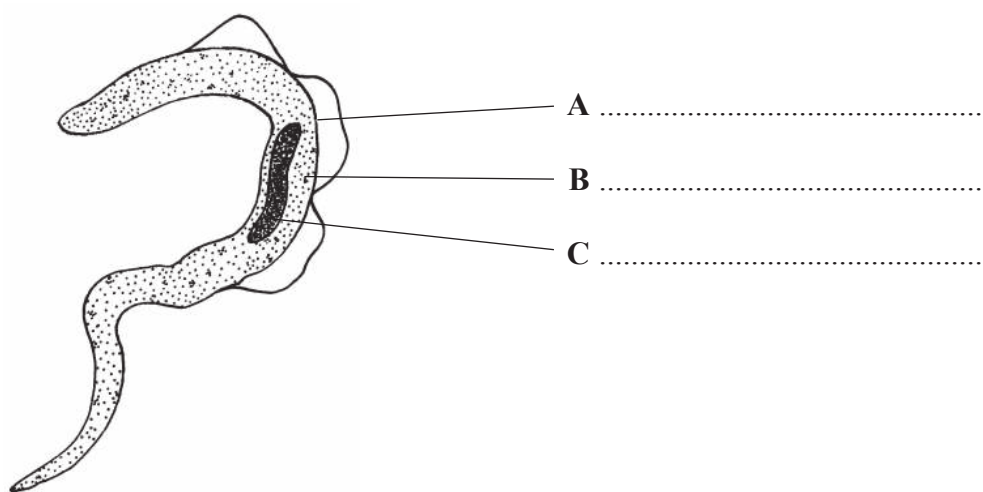
- (b) The microorganism feeds on substances in blood plasma.

Suggest **two** substances, in blood plasma, that the microorganism would use as food.

1

2 (2)

- (c) The diagram shows the microorganism. Name parts **A**, **B** and **C** of this cell on the lines provided.



A
 B
 C

(3) Q1

(Total 6 marks)

2. (a) The table lists types of cell found in the human body.

Complete the table by writing the number of chromosomes found in each cell.

The first one has been done for you.

Name of cell	Number of chromosomes in cell
neurone	46
sperm cell	
red blood cell	
skin cell	

(3)

(b) Sperm cells are needed for fertilisation.

(i) Name the part of the body where sperm cells are made.

..... (1)

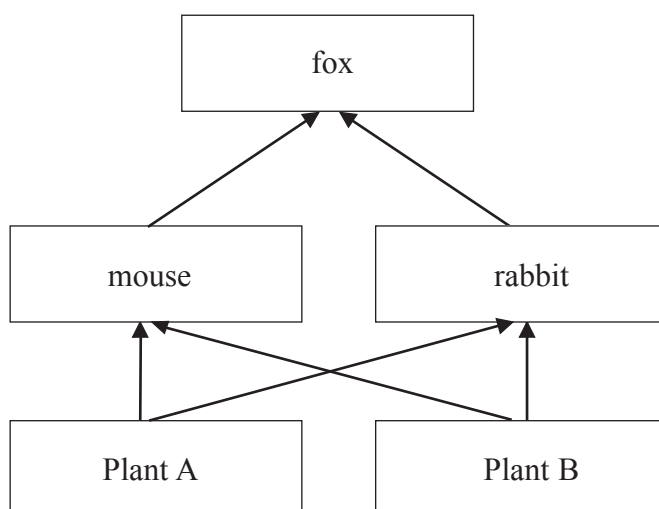
(ii) Name the other type of cell involved in fertilisation.

..... (1)

(Total 5 marks)

Q2

3. The diagram shows a food web.



(a) Use the information in the food web to complete the table below with a number.

The first has been done for you.

Sentence	Number
The number of organisms is	5
The number of producers is	
The number of animals is	
The number of food chains is	

(3)

(b) A disease caused by a virus killed the rabbits in this food web. Use this information to complete the sentences below.

(i) The number of foxes is likely to (1)

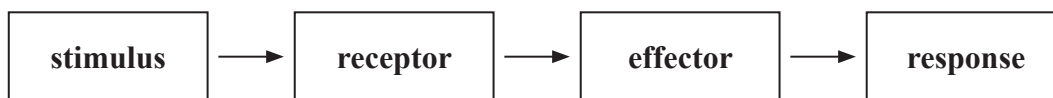
(ii) The number of mice is likely to (1)

(Total 5 marks)

Q3

4. Animals are able to respond to changes in their environment.

(a) A coordinated response requires a stimulus, a receptor and an effector. This is shown below in a flow chart.



The brain can act as the coordinator.

(i) On the flow chart above, draw an **X** on one of the arrows to show where the brain would be involved. (1)

(ii) The brain is part of the central nervous system. Name the other structure which is also part of the central nervous system.

..... (1)

(b) The eye is a sense organ that contains receptors.

(i) Name the stimulus that enters the eye and is detected by the receptors.

..... (1)

(ii) Name the part of the eye that contains receptors.

..... (1)

(iii) Describe how messages travel from receptors in the eye to the brain.

.....

 (2)

(c) Give the name of another sense organ, and the stimulus it detects.

Sense organ


Stimulus

(2)


(Total 8 marks)

Q4

5. Some people carry donor cards like the one shown.



Organ /Tissue Donor Card



I wish to donate my organs and tissues. I wish to give:

any needed organs or tissues
 only the following organs and tissues:

Donor
 Signature _____ Date _____
 Witness _____
 Witness _____

This means that when they die, their body parts can be given to people who need them.

The table gives the function of body parts that are commonly donated. Complete the table by naming the donated body part. Choose words from the list to complete the table.

The first answer has been done for you.

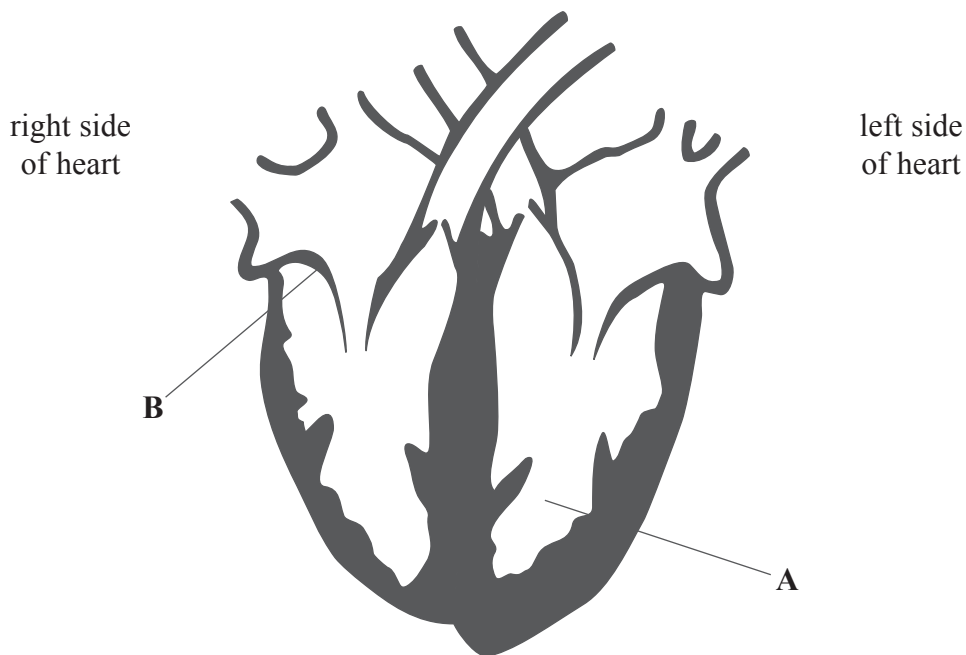
- cornea heart kidney**
lung pancreas skin

Function	Donated body part
breaks down toxic chemicals	liver
produces urine	
pumps blood around the body	
fills with air during breathing	
bends light as it enters the eye	
secretes insulin	

Q5

(Total 5 marks)

6. The diagram shows a section through a human heart.



(a) Name the parts labelled **A** and **B**.

A

B

(2)

(b) On the diagram, draw arrows to indicate the direction of blood flow into, through and out of the right side of the heart.

(2)

(c) State the **function** of the part labelled **B**.

.....

(1)

(d) State **one** way in which the blood in the left side of the heart differs from the blood in the right side of the heart.

.....

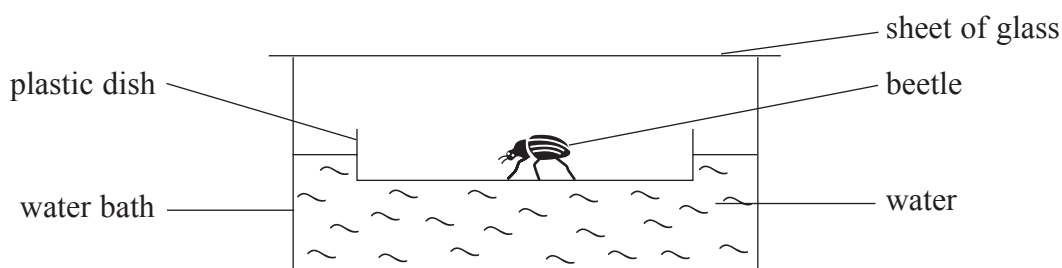
(1)

(Total 6 marks)

Q6

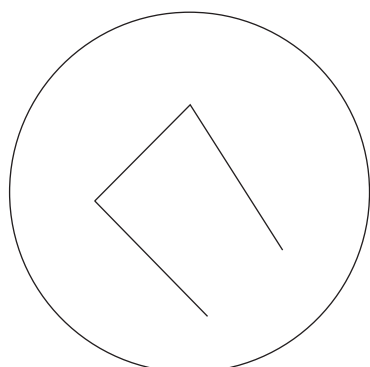
7. A student carried out an investigation to find out how temperature affects movement in beetles. The student placed the beetle in a plastic dish, which was allowed to float on water in a water bath. The water bath could be set at different temperatures from 15 °C upwards.

The apparatus the student used is shown in the diagram below.

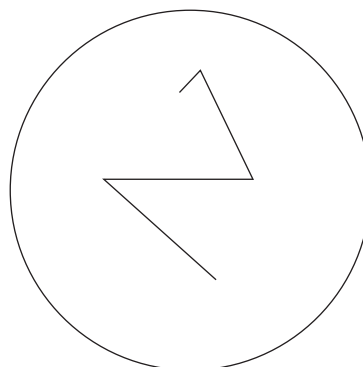


The student wanted to measure the distance moved by the beetle in cm per minute. To do this, the student looked down from the top and recorded the movement of the beetle on the sheet of glass using a pen. The student did this four times (trials) at each temperature using the same beetle.

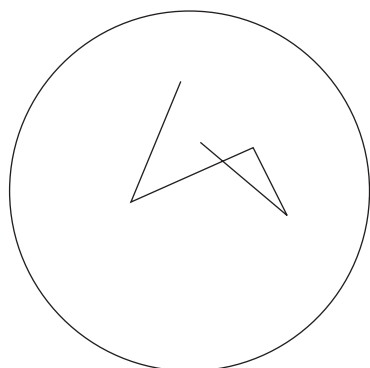
The diagrams show the pen recordings for the beetle's movement during one minute at 25 °C.



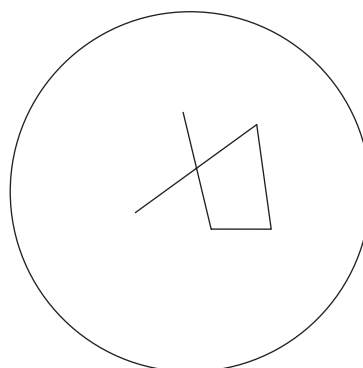
Trial 1



Trial 2



Trial 3



Trial 4

(a) Table 1 shows the results obtained at 15 °C, 20 °C, 30 °C and 35 °C.

Measure the distance moved in cm by the beetle during each trial at 25 °C. Write your answers in the empty boxes in Table 1.

Table 1

Temperature in °C	Distance moved in cm per minute			
	Trial 1	Trial 2	Trial 3	Trial 4
15	2.4	2.1	1.8	1.7
20	4.3	4.1	4.4	4.0
25				
30	7.0	6.7	6.9	6.6
35	8.3	8.4	8.1	8.0

(4)

(b) Calculate the average distance moved in cm by the beetle at 35 °C. Show your working.

Answer cm
(2)

(c) (i) Suggest how you could adapt the apparatus to obtain results at a temperature of 5 °C.

.....

 (1)

(ii) Suggest **one** reason why the student should not collect results above 35 °C.

.....

 (1)

(Total 8 marks)

Q7

8. Different types of cells may contain different structures.

Complete the table to show the structures contained in the different cells. If the cell contains the structure put a tick (✓) in the box. If the cell does not contain the structure put a cross (✗).

Some have been done for you.

Cell	Structure			
	Nucleus	Cytoplasm	Cell wall	Chloroplast
neurone (an animal cell)		✓		
<i>Pneumococcus</i> (a bacterial cell)			✓	✗
yeast (a fungal cell)	✓			

(Total 3 marks)

Q8

9. Describe and explain the consequences of smoking on human lungs.

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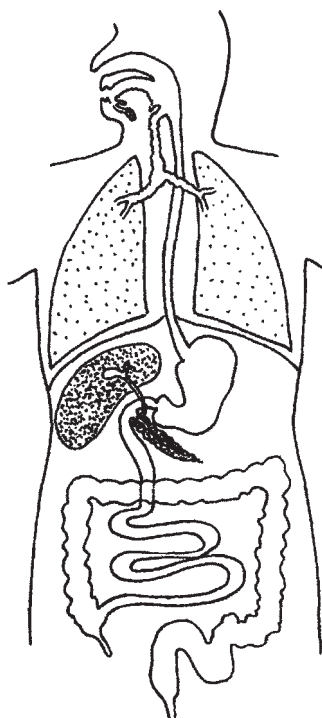
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(Total 5 marks)

Q9

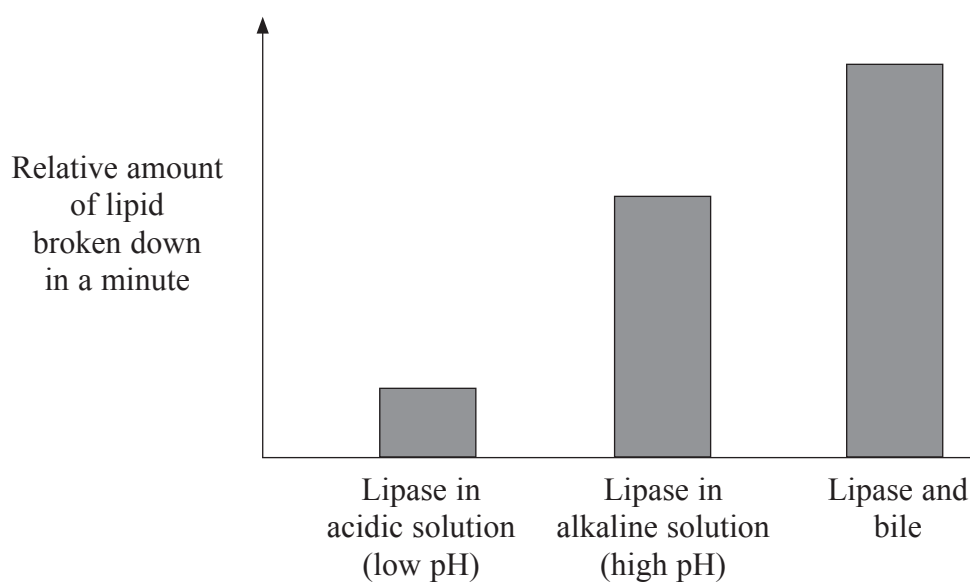
10. Lipase is an enzyme that breaks down lipids (fats) to fatty acids and glycerol. Lipase is produced in the pancreas and in the small intestine.

(a) On the diagram, label the pancreas and the small intestine.



(2)

(b) The graph shows the relative amount of lipid broken down by lipase under different conditions.



Describe and explain the results shown by the graph.

.....

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.....

.....

(4)

(c) Two other digestive enzymes are amylase and maltase. Complete the table to show the food molecule and the product of digestion for these enzymes.

Enzyme	Food molecule	Product of digestion
amylase		maltose
maltase	maltose	

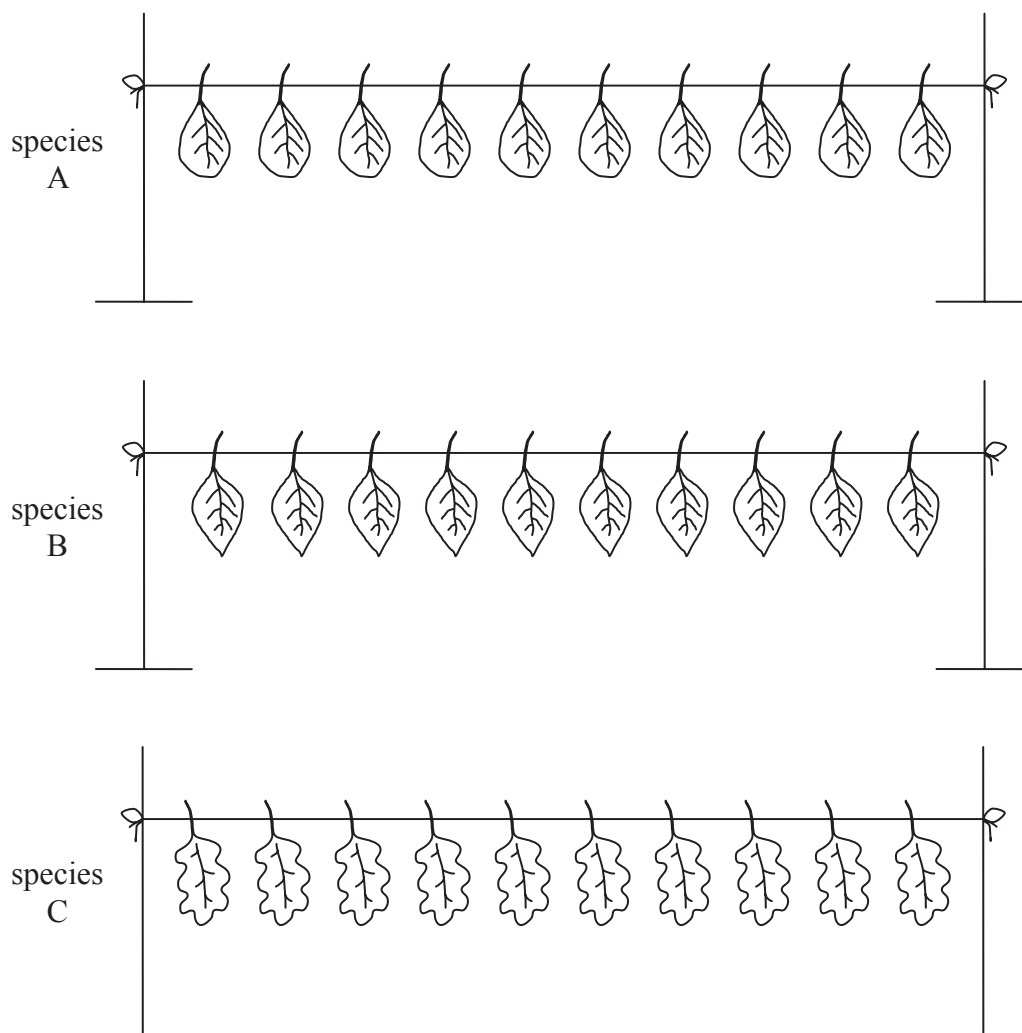
(2)

Q10

(Total 8 marks)

11. Plants lose water from the surface of their leaves.

A student did an experiment to compare the loss of water from leaves of three different species of plant A, B and C. He weighed 10 leaves of similar size of each species and hung them on a wire for three hours. Then he weighed the leaves again.



(a) Name the process in which water is lost from the surface of a leaf.

..... (1)

(b) The table shows the student's results.

Species	Mass of 10 leaves in g	
	At start	After three hours
A	2.25	2.23
B	2.37	2.36
C	2.51	2.51

State which species appeared to lose most water. Give a reason for your answer.

.....

.....

.....

(2)

(c) Suggest **two** reasons why leaves of different plants lose water at different rates.

1

2

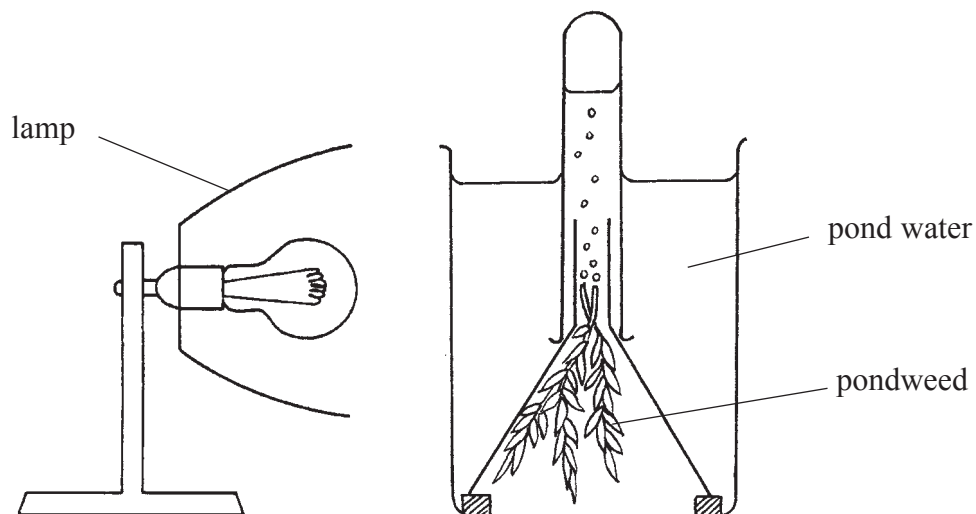
(2)

(Total 5 marks)

Q11

12. Lee wanted to investigate the effect of different light intensities on photosynthesis.

He set up the apparatus shown in the diagram.



(a) Name the gas that the pondweed gives off during photosynthesis.

..... (1)

(b) Using this apparatus, suggest how Lee could change the light intensity.

.....
 (1)

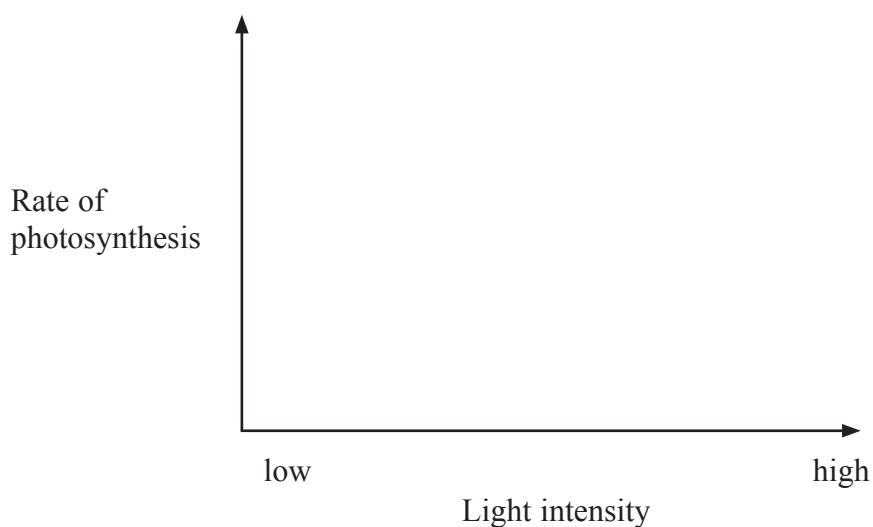
(c) Describe how the apparatus could be used to measure how quickly photosynthesis was occurring.

.....

 (2)

(d) Lee carried out the experiment at a range of light intensities, from low to very high light intensities.

Sketch a line to show what results you would expect.



(2)

(e) State **two** factors other than light intensity that can affect the rate of photosynthesis.

1

2

(2)

(Total 8 marks)

Q12

13. Bread is made from dough. The dough contains yeast, sugar, flour and water. As the yeast respire, it releases a gas that helps the dough to rise.

An experiment was carried out to investigate the effect of temperature and of vitamin C on the rising of dough.

(a) 50 cm³ of the dough with no vitamin C was put into different measuring cylinders at six different temperatures. There were three measuring cylinders at each temperature.

In a similar way, measuring cylinders were set up using dough with vitamin C. All the measuring cylinders were left for one hour. The table shows the volumes of dough after one hour in each measuring cylinder.

Temperature in °C	Volume of dough in cm ³ after one hour	
	With no vitamin C	With vitamin C
15	50 50 50	50 50 50
25	55 54 56	58 57 51
35	63 64 65	69 71 70
45	80 82 80	86 87 85
55	65 66 66	67 68 69
65	53 52 52	52 53 52

(i) State the number of measuring cylinders used in this experiment.

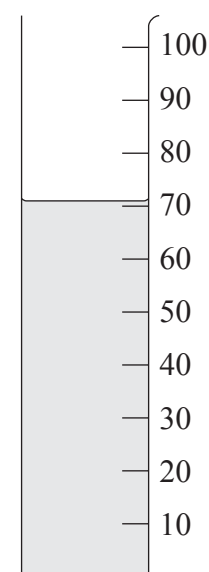
.....
(1)

(ii) Identify **one** anomalous (unexpected) result in the table and suggest a reason for this result.

.....

(2)

(iii) The diagram shows one of the measuring cylinders from the experiment.



Use the diagram and the information in the table to complete the following sentence.

This measuring cylinder was kept at °C and contained dough vitamin C. (2)

(b) (i) The yeast cells contain enzymes used in respiration. Use this information to explain the effect of temperature on the rising of dough with no vitamin C.

.....

(3)

(ii) Describe the effect of adding vitamin C on the rising of the dough.

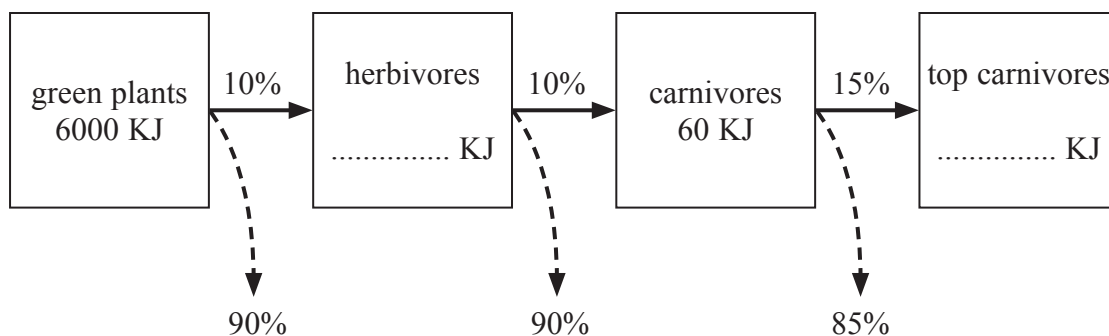
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(2)

(Total 10 marks)

Q13

14. The boxes in the diagram show the amount of energy in different trophic levels of a food chain. The numbers on the solid arrows show the percentage of energy transferred between the organisms in the different trophic levels. The numbers on the dotted arrows show the percentage of energy not transferred from one trophic level to the next.



(a) Complete the diagram by showing the amount of energy in the box for the herbivores and in the box for the top carnivores. (2)

(b) All organisms respire. One reason why 90% of the energy is not transferred from the herbivores to the carnivores is because of respiration by the herbivores.

(i) Give the balanced chemical symbol equation for respiration.

..... (3)

(ii) Suggest **two** reasons, other than respiration, why 90% of the energy in herbivores is not transferred to the carnivores.

1

.....

2

..... (2)

(c) Name the group of organisms in this food chain which are secondary consumers.

..... (1)

(Total 8 marks)

Q14

15. The passage below describes stages involved in the process of micropropagation in plants.

Use suitable words to complete the sentences in the passage.

Very small pieces are cut from the tips of stems or side shoots of a plant.

When these pieces have been removed they are called

..... . They are cut to a size

of about 0.5 to 1 mm. They are then placed

in medium

containing and

....., which help the pieces to

grow into small plants. When the small plants have grown roots they are

transferred to a glasshouse. They are grown in pots containing

....., and

conditions such as and

..... can be controlled. The small

plants produced are called,

which means they are genetically

(Total 9 marks)

Q15

16. DNA is a double helix with each strand linked by a series of paired bases. There are four bases in DNA.

The table below shows the percentage of each base found in a sample of DNA taken from a mammal. Only two of the bases have been named in the table.

(a) Complete the table to give the names of the other two bases.

Percentage of base in DNA sample	Name of base
30	thymine (T)
20	guanine (G)
30	
20	

(2)

(b) The sample of DNA contained 2000 bases. State the number of thymine bases in the sample of DNA.

.....

(1)

(c) Human DNA contains the gene to make insulin. Bacteria can be modified to contain this gene. Describe the steps used to do this.

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(5)

(Total 8 marks)

Q16

17. Huntington’s disease is a genetic condition that affects the nervous system. Huntington’s disease is caused by a dominant allele, **H**. The condition does not develop until middle age (around 40 years old).

(a) A couple plan to have children. The father is heterozygous for Huntington’s disease and the mother is homozygous recessive.

(i) Draw a genetic diagram to show the genotypes of the parents, the gametes and the possible genotypes and phenotypes of their children. Use **H** to represent the allele for Huntington’s disease and **h** to represent the normal allele.

(4)

(ii) State the probability of this couple producing a child who will not develop the disease.

.....
(1)

(b) The symptoms of the disease do not appear until middle age. Suggest why this makes it unlikely that Huntington’s disease will disappear from the population.

.....
.....
.....
(2)

(Total 7 marks)

Q17

18. Design an experiment you could carry out to find out how temperature affects the rate of decomposition of plant leaves.

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Q18

(Total 6 marks)

TOTAL FOR PAPER: 120 MARKS

END

THE PERIODIC TABLE

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Period	Group																																																	
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7	Li Lithium 3	9	Be Beryllium 4		11	B Boron 5	12	C Carbon 6	13	Al Aluminium 13	14	N Nitrogen 7	15	O Oxygen 8	16	F Fluorine 9	17	Ne Neon 10																																
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23	Na Sodium 11	24	Mg Magnesium 12																																															
4		<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">39</td> <td style="text-align: center;">K Potassium 19</td> <td style="text-align: center;">40</td> <td style="text-align: center;">Ca Calcium 20</td> <td style="text-align: center;">45</td> <td style="text-align: center;">Sc Scandium 21</td> <td style="text-align: center;">46</td> <td style="text-align: center;">Ti Titanium 22</td> <td style="text-align: center;">47</td> <td style="text-align: center;">V Vanadium 23</td> <td style="text-align: center;">51</td> <td style="text-align: center;">Cr Chromium 24</td> <td style="text-align: center;">52</td> <td style="text-align: center;">Mn Manganese 25</td> <td style="text-align: center;">55</td> <td style="text-align: center;">Fe Iron 26</td> <td style="text-align: center;">56</td> <td style="text-align: center;">Co Cobalt 27</td> <td style="text-align: center;">59</td> <td style="text-align: center;">Ni Nickel 28</td> <td style="text-align: center;">63.5</td> <td style="text-align: center;">Cu Copper 29</td> <td style="text-align: center;">65</td> <td style="text-align: center;">Zn Zinc 30</td> <td style="text-align: center;">70</td> <td style="text-align: center;">Ga Gallium 31</td> <td style="text-align: center;">71</td> <td style="text-align: center;">Ge Germanium 32</td> <td style="text-align: center;">72</td> <td style="text-align: center;">As Arsenic 33</td> <td style="text-align: center;">73</td> <td style="text-align: center;">Se Selenium 34</td> <td style="text-align: center;">74</td> <td style="text-align: center;">Br Bromine 35</td> <td style="text-align: center;">75</td> <td style="text-align: center;">Kr Krypton 36</td> </tr> </table>								39	K Potassium 19	40	Ca Calcium 20	45	Sc Scandium 21	46	Ti Titanium 22	47	V Vanadium 23	51	Cr Chromium 24	52	Mn Manganese 25	55	Fe Iron 26	56	Co Cobalt 27	59	Ni Nickel 28	63.5	Cu Copper 29	65	Zn Zinc 30	70	Ga Gallium 31	71	Ge Germanium 32	72	As Arsenic 33	73	Se Selenium 34	74	Br Bromine 35	75	Kr Krypton 36					
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Key

Relative atomic mass
Symbol
Name
Atomic number

Answer ALL questions

1. Use the Periodic Table on page 2 to help you answer this question.

(a) State the symbol of the element that has the atomic number of 12.

..... (1)

(b) State the symbol of the element that has a relative atomic mass of 12.

..... (1)

(c) State the number of the group that contains the noble gases.

..... (1)

(d) Which group contains elements whose atoms form ions with a 2+ charge?

..... (1)

(e) Which group contains elements whose atoms form ions with a 1- charge?

..... (1)

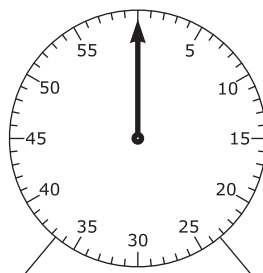
(Total 5 marks)

Q1

2. The diagrams show some pieces of apparatus you can find in a chemistry laboratory.



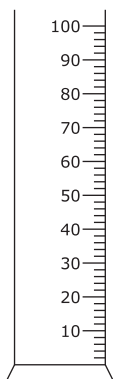
A



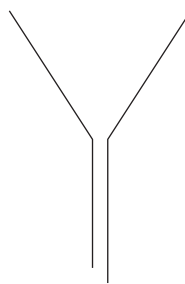
B



C



D



E

(a) Name the pieces of apparatus, **B** and **E**. Use only names from the box.

funnel	measuring cylinder	thermometer
pipette	stop clock	

B

E

(2)

(b) **Two** of the pieces shown can be used to measure the volume of a liquid. State the letters of these two pieces.

..... and

(2)

(c) **One** of the pieces shown cannot be used to make a measurement. State the letter of this piece.

.....

(1)

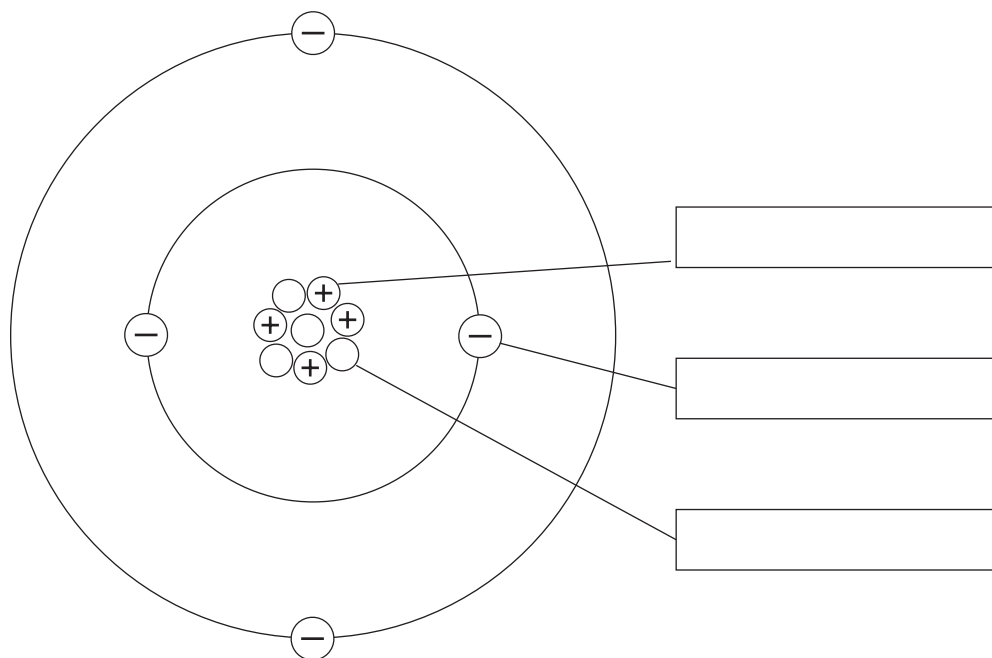
(Total 5 marks)

Q2

3. This question is about atoms.

(a) (i) Choose words from the box to label the diagram of an atom.

electron	ion
neutron	proton



(3)

(ii) State the mass number of this atom.

..... (1)

(iii) The diagram above represents the atom of an element. State the name of the element. Use the Periodic Table on page 2 to help you.

..... (1)

(b) Chlorine has two isotopes. State one way in which atoms of the two isotopes are

the same

.....

different

.....

(2)

(Total 7 marks)

Q3

4. A piece of iron is left in damp air for some time.
A brown layer forms on the iron.

(a) Name the **two** substances in damp air that are needed for the iron to react.

1

2

(2)

(b) Name the substance in the brown layer.

.....

(1)

(c) The reaction between iron and damp air can be prevented by covering the iron with another material. Name **two** materials that can be used.

1

2

(2)

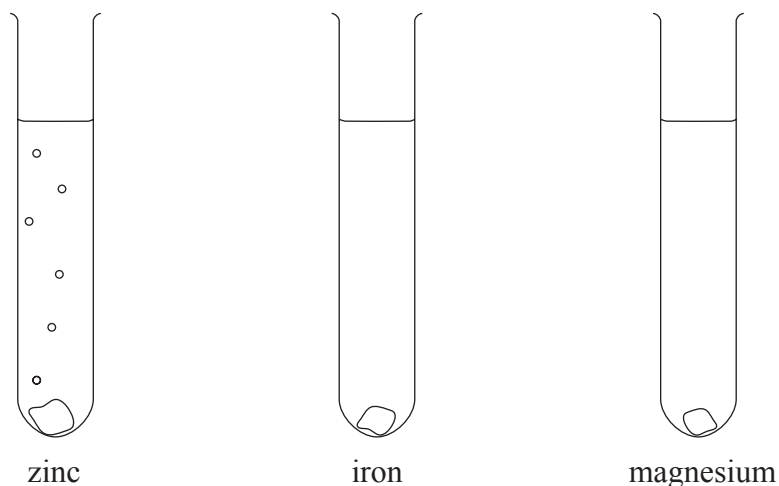
(Total 5 marks)

Q4

5. The reactivity of metals can be compared by comparing their reactions with dilute hydrochloric acid.
 Three different metals of identical size are added to separate test tubes containing this acid.

The diagram already shows bubbles of hydrogen gas forming when a piece of zinc is added to dilute hydrochloric acid.

- (a) Complete the diagram to show the bubbles forming in the other two test tubes.



(2)

- (b) Write a word equation to show the reaction between zinc and dilute hydrochloric acid.

..... (1)

- (c) Name **one** metal that does not react when it is added to dilute hydrochloric acid.

..... (1)

- (d) Suggest **two** substances, other than acids, that can be used in reactions to compare the reactivity of metals.

1

2

(2)

(Total 6 marks)

Q5

6. (a) A molecule of hydrogen contains a covalent bond.

(i) What is a covalent bond?

..... (1)

(ii) Draw a dot and cross diagram to show the covalent bond in a hydrogen molecule.

(1)

(b) State a test for hydrogen gas and the result.

Test

Result

(2)

(c) State **one** industrial use of hydrogen.

..... (1)

(d) The only product of the combustion of hydrogen is water. Write a word equation for the combustion of hydrogen.

..... (1)

(e) Anhydrous copper(II) sulphate can be used to test for water.

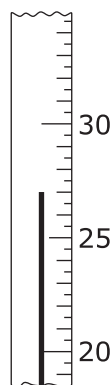
(i) Use words from the box to complete the sentence.

blue	brown	colourless
green	pink	white

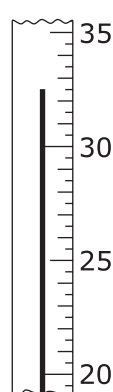
Water is a liquid which changes the colour of the copper(II) sulphate from to
(3)

(ii) The diagrams show the thermometer readings of some water before and after the addition of anhydrous copper(II) sulfate. Write the temperature shown on each thermometer in the space below each diagram.

Before



After



Temperature before °C Temperature after °C
(2)

(iii) Calculate the temperature change that occurred.

(1)

Leave
blank

(iv) What type of reaction occurs in this test? Put a cross (☒) in the correct box.

- A endothermic
- B exothermic
- C neutralisation

(1)

Q6

(Total 13 marks)

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7. The equation below shows the decomposition of ammonium chloride. It is a reversible reaction.

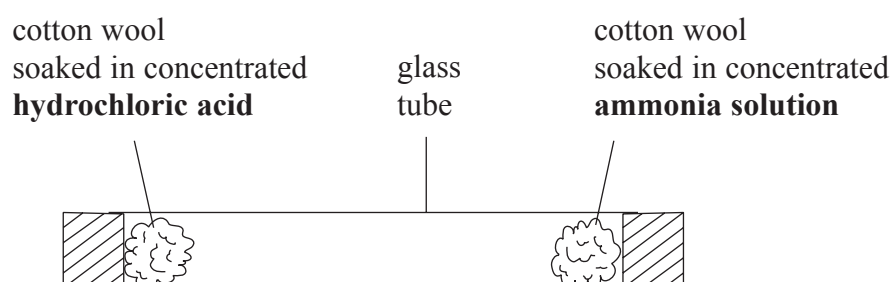


- (a) How is this reaction made to go in the **forward** direction?

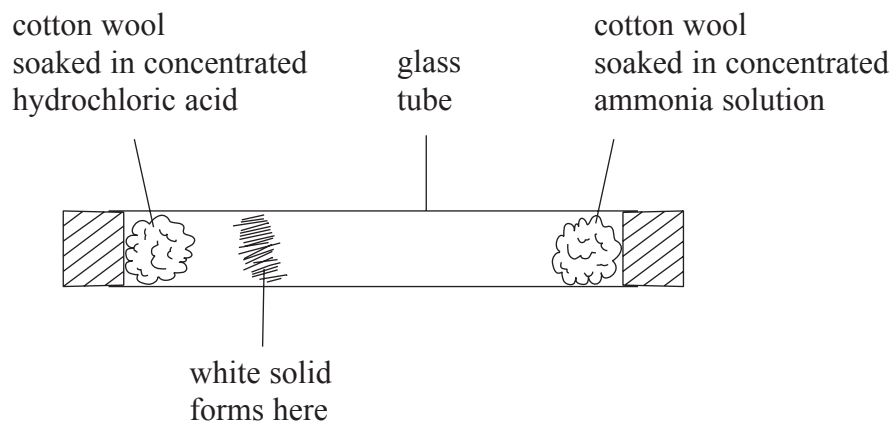
..... (1)

- (b) Concentrated hydrochloric acid gives off hydrogen chloride gas.
Concentrated ammonia solution gives off ammonia gas.

An experiment is set up.



After a few minutes a white solid forms inside the tube. The solid forms when ammonia gas reacts with hydrogen chloride gas.



- (i) Name the process by which the ammonia and hydrogen chloride particles move inside the tube.

..... (1)

- (ii) Name the white solid that forms inside the tube.

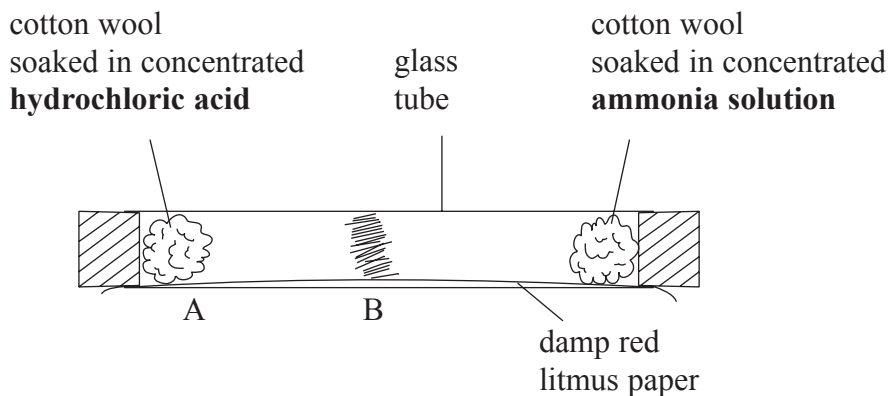
..... (1)

(iii) Suggest what the position of the white solid tells you about the relative speeds at which the ammonia and hydrogen chloride particles move.

.....

(1)

(iv) The experiment is repeated with a strip of damp red litmus paper placed along the inside of the tube.



State the colour of the litmus paper at A and B when the white solid forms.

A

B

(2)

(Total 6 marks)

Q7

8. The alkenes are a **homologous series** of **unsaturated** hydrocarbons.

(a) (i) Place a cross (☒) in the **two** boxes that indicate which statements about members of a homologous series are correct.

A They have similar chemical properties ☒

B They have the same displayed formula ☒

C They have the same general formula ☒

D They have the same physical properties ☒

E They have the same relative formula masses ☒

(2)

(ii) State the meaning of the term **unsaturated**.

.....
.....

(1)

(b) Alkenes react with bromine water. Ethene is the simplest alkene.

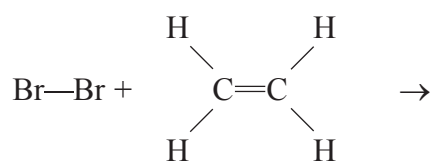
(i) Bromine water is added to ethene. State the colours of the reaction mixture at the start and the finish.

Colour at start

Colour at finish

(2)

(ii) Complete the equation by drawing the displayed formula of the product.



(1)

- (c) Isomers are compounds that have the same molecular formula but different displayed formulae.

Draw the displayed formulae of **two** isomers that have the molecular formula C_4H_8 .

(2)

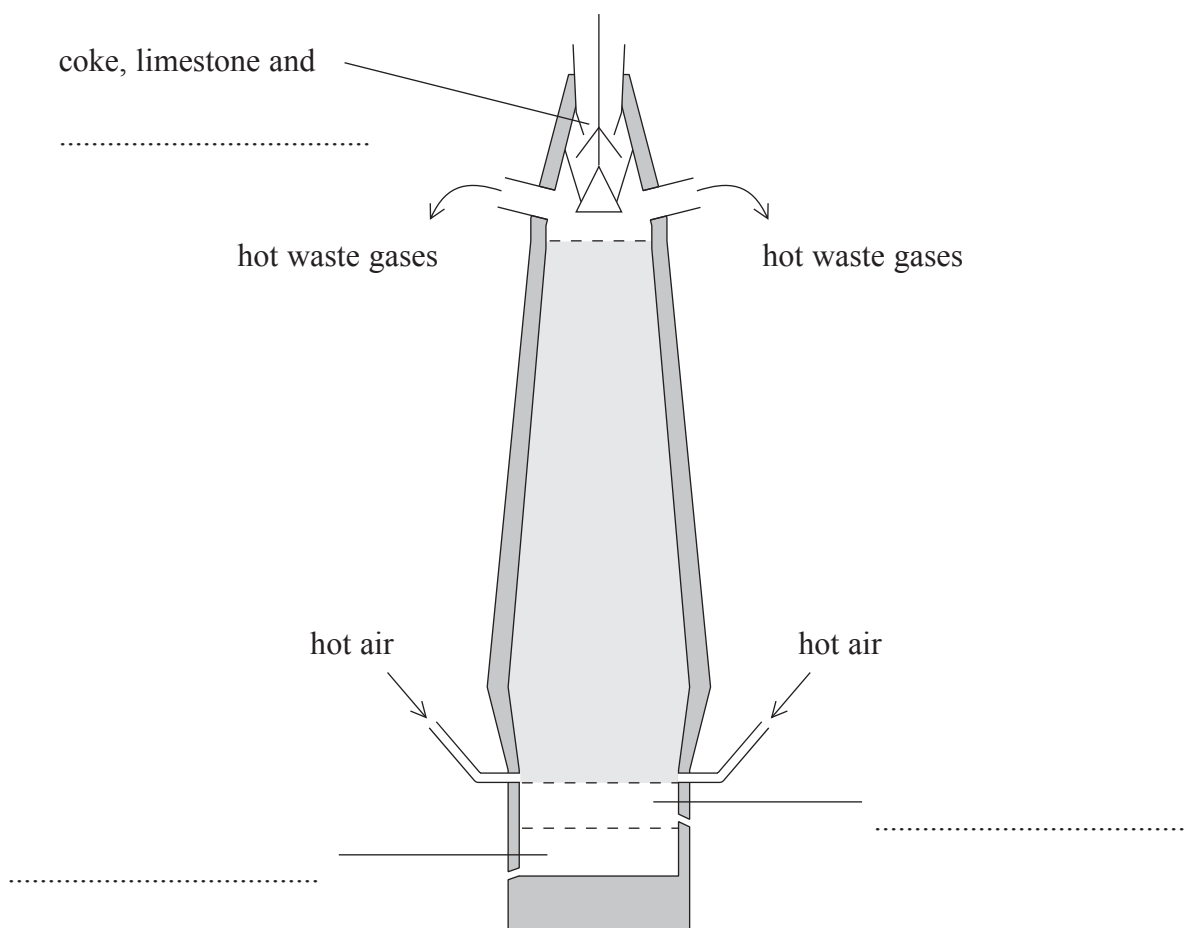
Q8

(Total 8 marks)

9. Iron is extracted from iron ore in a blast furnace.

(a) Label the diagram of the blast furnace. Use only words from the box. Each word may be used once, more than once or not at all.

bauxite	cryolite	haematite
molten iron	sand	slag



(3)

(b) Coke is composed mainly of carbon. Coke burns in the oxygen in the hot air.

(i) Write a chemical equation for the reaction which occurs when carbon burns completely in oxygen.

.....
(1)

(ii) State why this reaction is important in the blast furnace.

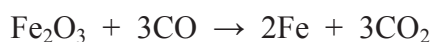
.....
.....
(1)

- (c) Limestone is mainly calcium carbonate. In the blast furnace limestone decomposes to give carbon dioxide and calcium oxide.

Write a chemical equation for this reaction.

.....
(1)

- (d) Iron is produced by the reduction of iron(III) oxide. An equation for the reaction is



Suggest why this reaction is described as the reduction of iron(III) oxide.

.....
(1)

- (e) Aluminium is another important metal.

- (i) Unlike iron, aluminium cannot be extracted from its ore using a blast furnace. Explain why.

.....
(1)

- (ii) State **one** large-scale use of aluminium, and a property of aluminium on which this use depends.

Use

Property

(2)

Q9

(Total 10 marks)

--	--

10. Sodium is a very reactive metal. When a small piece of sodium is added to a trough of water it floats and reacts rapidly, giving off hydrogen gas.

A small piece of sodium is placed in a trough of water. A reaction takes place and hydrogen gas is given off.

(a) (i) State **two** observations, other than the sodium floating, that you could make during the reaction.

1

2

(2)

(ii) Write a word equation for the reaction.

.....

(1)

(b) A piece of platinum wire is dipped into the solution in the trough and then held in a roaring Bunsen flame. The Bunsen flame becomes coloured.

(i) State the colour that the flame becomes.

.....

(1)

(ii) Name the method of identification.

.....

(1)

(c) After the reaction with sodium, universal indicator is added to the solution remaining in the trough. State what colour it turns and explain why.

Colour

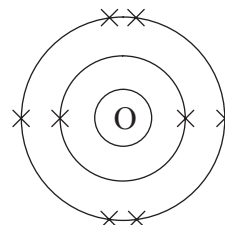
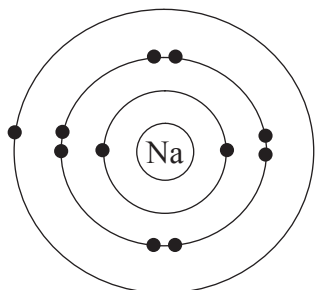
Explanation

.....

(2)

- (d) A piece of sodium is heated in a Bunsen flame. The sodium catches fire and reacts with the oxygen in the air. The product is sodium oxide.

The diagrams show the electron arrangement in an atom of sodium and an atom of oxygen.



Sodium oxide contains ionic bonds. Describe what happens, in terms of electrons, when sodium reacts with oxygen.

.....

.....

.....

.....

.....

.....

(3)

Q10

(Total 10 marks)

--	--

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11. Dilute hydrochloric acid reacts with solid calcium carbonate. The equation below shows this equation.



Some students investigate the effect on the rate of the reaction of changing the temperature of the hydrochloric acid. The method is:

- use a measuring cylinder to pour 50 cm³ of dilute hydrochloric acid into a conical flask
- heat the acid to the required temperature
- place the flask on a balance
- add 10 g (an excess) of calcium carbonate chips to the flask
- time how long it takes for the mass to decrease by 1.00 g
- the experiment is repeated at different temperatures.

The table shows the students' results.

Temperature of acid (°C)	Time to lose 1.00 g (s)
22	93
35	68
46	65
57	40
65	33
78	26

(a) (i) On the grid opposite, draw a graph of these results. The axes and scales have been provided for you.

(3)

(ii) One of the points is anomalous. Circle this point on your graph.

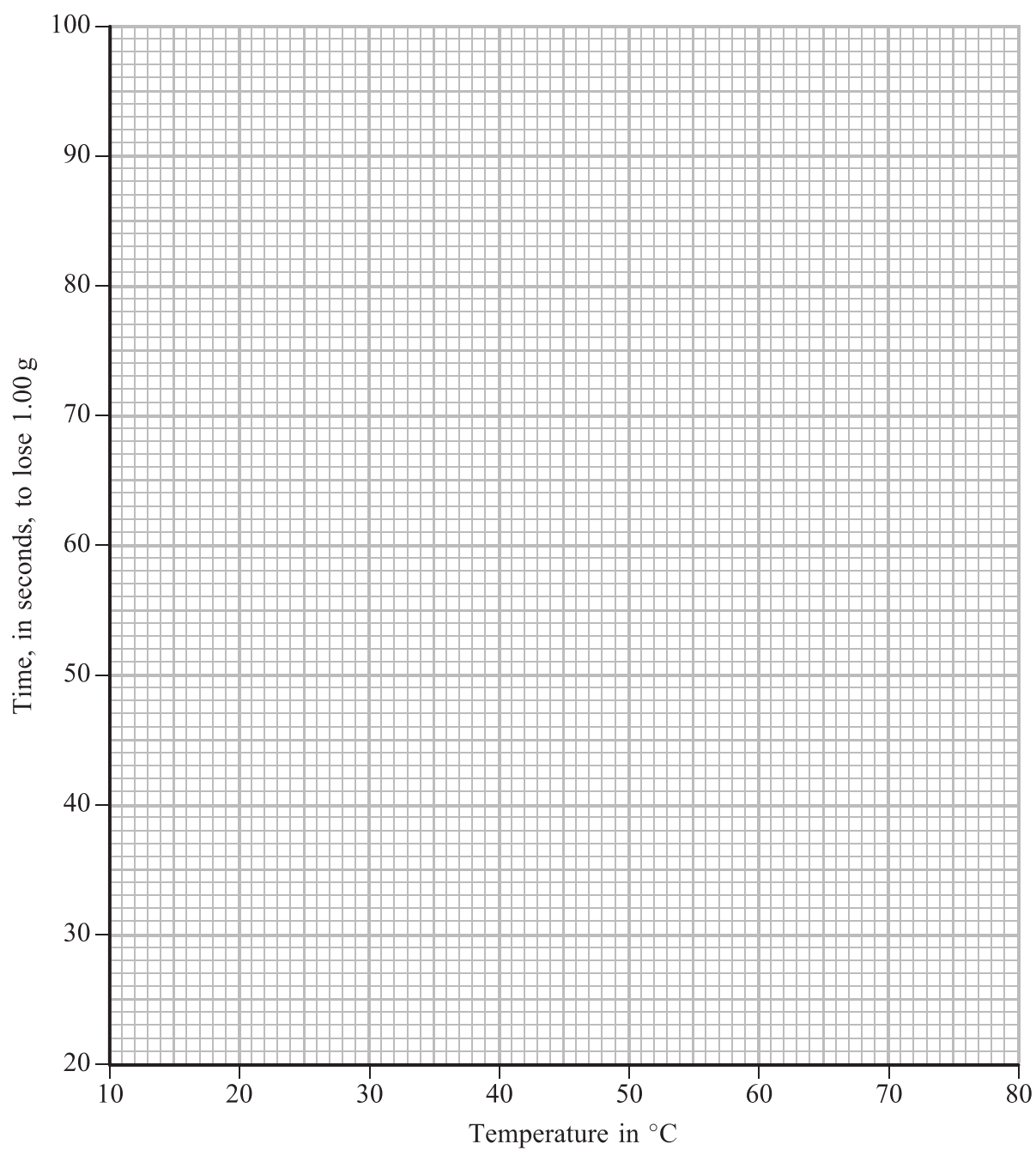
(1)

(iii) The students did not make an error in reading the stopwatch. Suggest a possible cause of this anomalous result.

.....

.....

(1)



QUESTION 11 CONTINUES OVERLEAF

(b) (i) Use your graph to find the time taken to lose 1.00 g at 30 °C and at 52 °C.

Time at 30 °C s

Time at 52 °C s

(2)

(ii) The rate of the reaction can be found using the equation:

$$\text{rate of reaction} = \frac{\text{mass lost}}{\text{time taken to lose this mass}}$$

Use this equation and your results from (b)(i) to calculate the rate of reaction at 30 °C and at 52 °C.

Rate at 30 °C g/s

Rate at 52 °C g/s

(2)

(iii) State how the rate of reaction changes when the temperature increases.

.....

(1)

(iv) Explain, in terms of particles and collisions, why the rate of reaction changes.

.....

(3)

(c) The students did **not** obtain any results at temperatures below room temperature, 22 °C. Describe how the method could be changed to obtain results below room temperature.

.....

(1)

Q11

(Total 14 marks)

--	--

12. Many useful substances are produced by the fractional distillation of crude oil.

- (a) Bitumen, fuel oil and gasoline are three fractions obtained from crude oil. There are several differences between these fractions.

Name the fraction that has the following property.

the highest boiling point range

molecules with the fewest carbon atoms

the darkest colour

(3)

- (b) Some long-chain hydrocarbons are converted into more useful products by a chemical process. Name this process and describe how it is carried out.

.....

(3)

- (c) Some hydrocarbons, such as methane, are used as fuels. When methane undergoes incomplete combustion, carbon monoxide is formed.

(i) Write a balanced chemical equation for this reaction.

.....

(2)

(ii) Explain why it is dangerous to breathe air containing carbon monoxide.

.....

(2)

(Total 10 marks)

Q12

13. Three of the elements in Group 7 of the Periodic Table are chlorine, bromine and iodine.

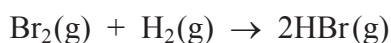
(a) State the electronic configuration of chlorine.

..... (1)

(b) State the number of electrons present in the outer shell of an atom of iodine.

..... (1)

(c) Bromine reacts with hydrogen to form hydrogen bromide. The chemical equation for the reaction is



Describe the colour change occurring during the reaction.

Colour change (2)

(d) Hydrogen bromide and hydrogen chloride have similar chemical properties.

(i) A sample of hydrogen bromide is dissolved in water.

A piece of blue litmus paper is placed in the solution. State, with a reason, the final colour of the litmus paper.

Colour

Reason

..... (2)

(ii) A sample of hydrogen bromide is dissolved in methylbenzene.

A piece of blue litmus paper is placed in the solution. State, with a reason, the final colour of the litmus paper.

Colour

Reason

..... (2)

(Total 8 marks)

Q13

14. (a) A solution was made by dissolving 1.62 g of hydrogen bromide, HBr, in 250 cm³ of water.

(i) Calculate the relative formula mass of hydrogen bromide. Use data from the Periodic Table on page 2.

.....

 (1)

(ii) Calculate the amount, in moles, of hydrogen bromide in a 1.62 g sample.

.....

 (2)

(iii) Calculate the concentration, in mol dm⁻³, of the hydrogen bromide solution.

.....

 (2)

(iv) Calculate the concentration, in g dm⁻³, of the hydrogen bromide solution.

.....

 (2)

(b) Hydrogen bromide solution can be neutralised by adding sodium hydroxide solution.

(i) Write a chemical equation for this neutralisation reaction.

.....
(1)

(ii) Explain, with reference to ions, why this reaction is described as a neutralisation reaction.

.....

(1)

(c) A 20.0 cm³ sample of a solution of hydrogen bromide had a concentration of 0.200 mol dm⁻³.

(i) Calculate the amount, in moles, of hydrogen bromide in 20.0 cm³ of 0.200 mol dm⁻³ solution.

.....

(2)

(ii) Calculate the volume of 0.100 mol dm⁻³ sodium hydroxide solution needed to neutralise this sample of hydrogen bromide solution.

.....

(2)

Q14

(Total 13 marks)

TOTAL FOR PAPER: 120 MARKS

END

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Centre No.								Paper Reference						Surname	Initial(s)
Candidate No.						4	S	C	0	/	1	P	Signature		

Paper Reference(s)

4SC0/1P

**Edexcel IGCSE
Science (Double Award)
Physics Paper 1**

Sample Assessment Material

Time: 2 hours

Materials required for examination
Ruler, protractor, calculator

Items included with question papers
Nil

Examiner's use only

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Team Leader's use only

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Question Number	Leave Blank
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
Total	

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initial(s) and signature. Check that you have the correct question paper. Answer ALL the questions. Write your answers in the spaces provided in this question paper. Show all the steps in any calculations and state the units. Calculators may be used.

Information for Candidates

The marks for individual questions and the parts of questions are shown in round brackets: e.g. (2). There are 16 questions in this question paper. The total mark for this paper is 120. There are 28 pages in this question paper. Any blank pages are indicated.

Advice to Candidates

Write your answers neatly and in good English.

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Turn over



EQUATIONS

You may find the following equations useful.

$$\text{energy transferred} = \text{current} \times \text{voltage} \times \text{time}$$

$$E = I \times V \times t$$

$$\text{pressure} \times \text{volume} = \text{constant}$$

$$p_1 \times V_1 = p_2 \times V_2$$

$$\text{frequency} = \frac{1}{\text{time period}}$$

$$f = \frac{1}{T}$$

$$\text{power} = \frac{\text{work done}}{\text{time taken}}$$

$$P = \frac{W}{t}$$

$$\text{power} = \frac{\text{energy transferred}}{\text{time taken}}$$

$$P = \frac{W}{t}$$

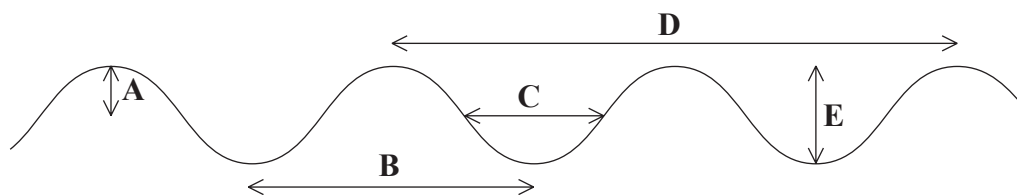
$$\text{orbital speed} = \frac{2\pi \times \text{orbital radius}}{\text{time period}}$$

$$V = \frac{2 \times \pi \times r}{T}$$

Where necessary, assume the acceleration of free fall, $g = 10 \text{ m/s}^2$.

Answer ALL questions

1. The diagram shows waves on the surface of a lake.



(a) State which letter, **A**, **B**, **C**, **D** or **E**, shows the following

(i) the amplitude of the waves **(1)**

(ii) the wavelength of the waves **(1)**

(b) Choose words from the box to complete the sentences.

amplitude frequency longitudinal period transverse wavelength

(i) The number of waves per second is the **(1)**

(ii) The time taken for each wave is its **(1)**

(c) (i) Water waves are transverse waves. State **two** other examples of transverse waves.

1

2

(2)

(ii) Some waves are not transverse waves. Name these types of waves.

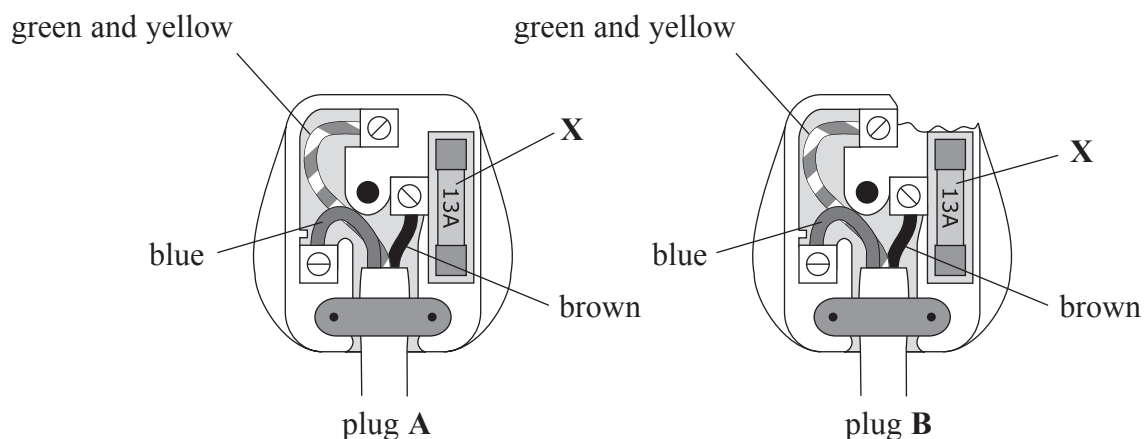
.....

(1)

(Total 7 marks)

Q1

2. (a) The covers are removed from two plugs, **A** and **B**. The diagram shows the inside of the plugs.



- (i) Identify a problem with plug **B**.

.....

 (1)

- (ii) Suggest why this makes plug **B** unsafe.

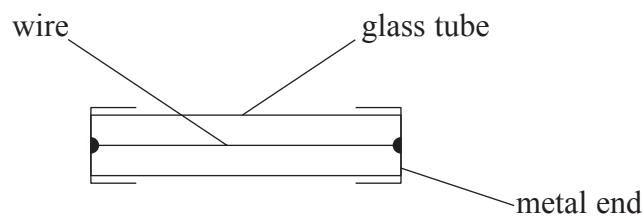
.....

 (1)

- (iii) Name part **X**.

.....
 (1)

- (iv) The diagram below shows the structure of part **X**.

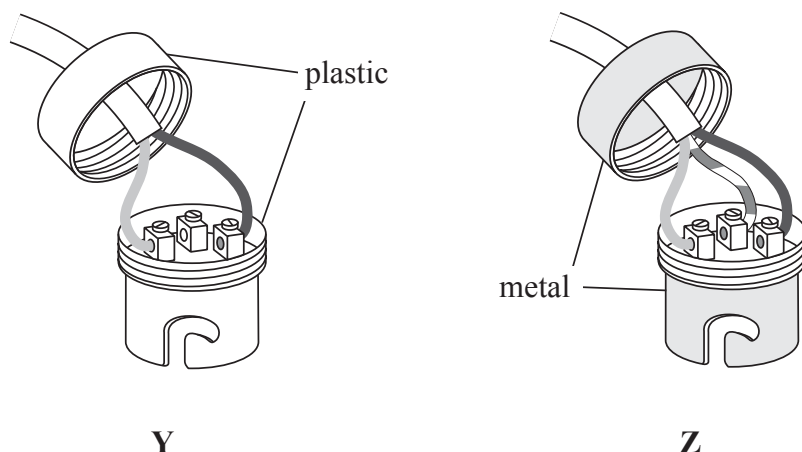


State **one** change which occurs in part **X** when the current is too large.

.....

 (1)

(b) The diagram shows two light fittings, **Y** and **Z**.



When the tops are screwed on, each fitting is safe to use.

(i) State why light fitting **Y** is safe to use.

.....

 (1)

(ii) Why is light fitting **Z** safe to use?

.....

 (1)

(Total 6 marks)

Q2

3. The table gives information about a journey made by a cyclist.

Time (hours)	Distance (km)
0	0
1	15
2	30
3	45
4	60
5	75
6	90

(a) Plot these points on the grid on the next page. (3)

(b) (i) Use your graph to find the distance in kilometres which the cyclist travelled in 4.5 hours.

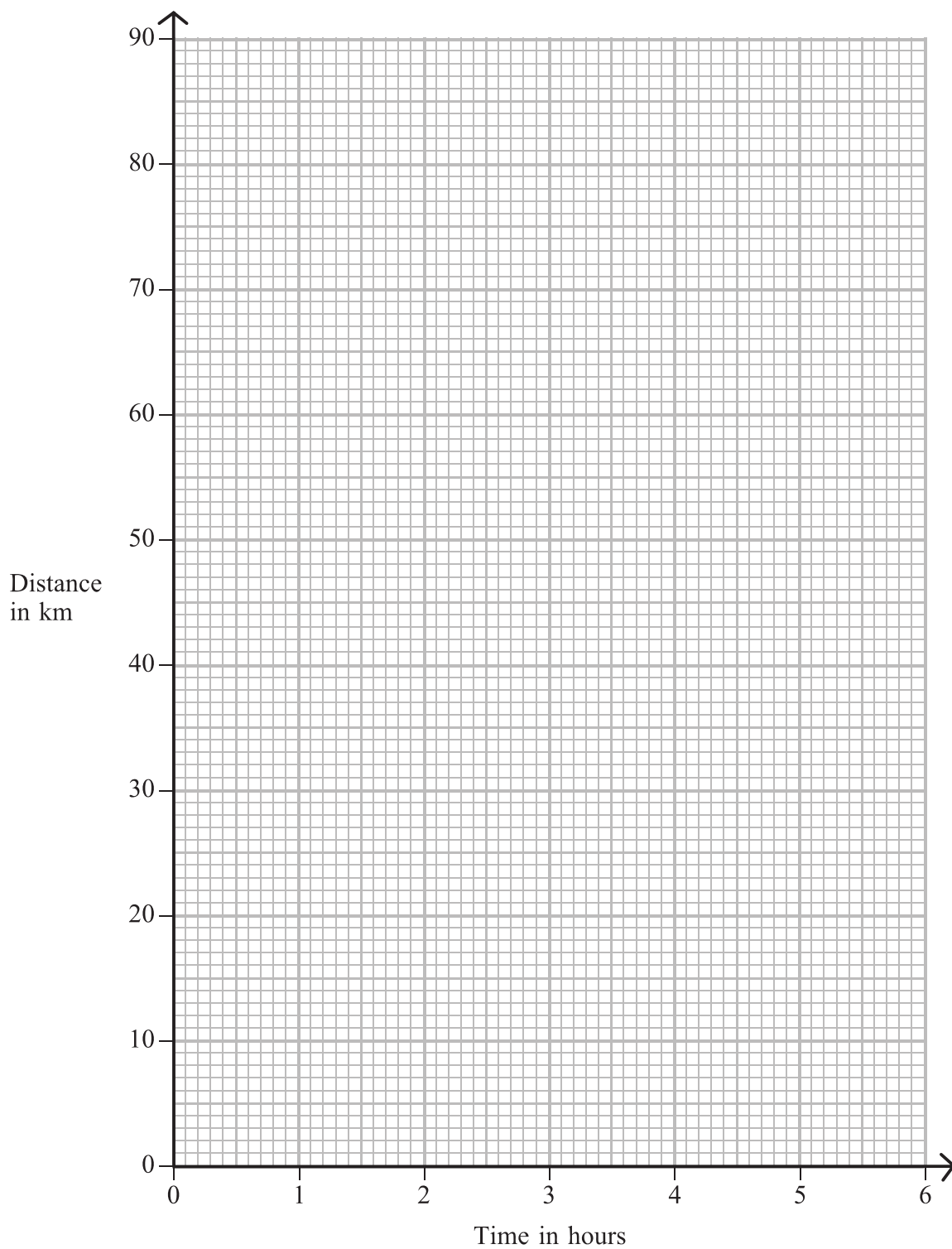
Distance = km
(1)

(ii) Use your graph to find the time in hours taken by the cyclist to travel 35 kilometres.

Time = hours
(1)

(c) State the equation which relates **average speed**, **distance moved** and **time taken**.

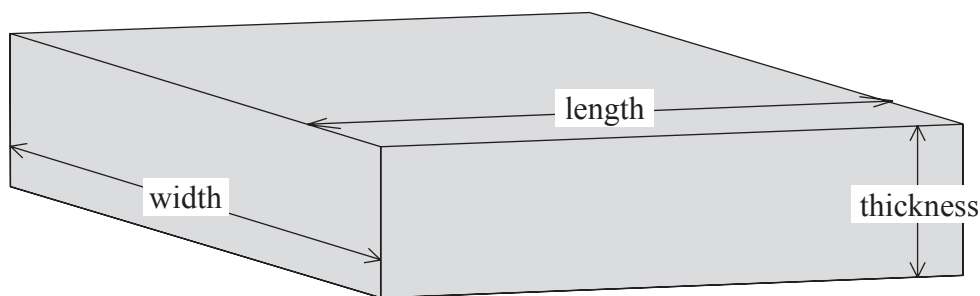
.....
(1)



(Total 6 marks)

Q3

4. The diagram shows a rectangular **glass** block.



(a) A student wants to calculate the volume in mm^3 . Name the units he should use to measure the length, the thickness and the width.

..... (1)

(b) The density of the **wood** in a block is 0.8 g/cm^3 . A student cuts the block into four equal pieces. Suggest what effect this has on the density.

..... (1)

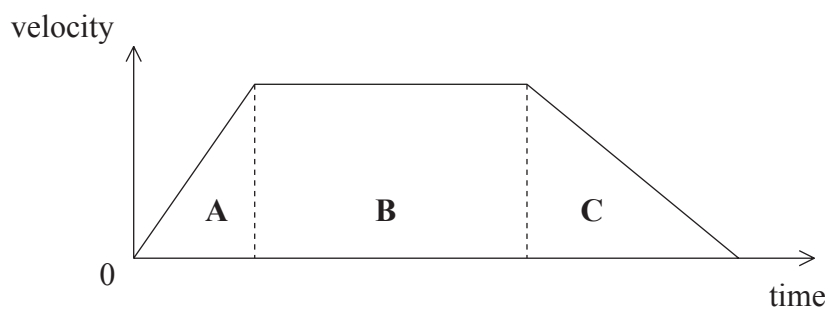
(c) The density of the **metal** in a block is 2.7 g/cm^3 . Another block of the same metal has twice the mass. Calculate the density of the metal in this larger block?

Density = g/cm^3 (1)

(Total 3 marks)

Q4

5. A train travels between two stations. The velocity–time graph shows the train’s motion.



(a) How do you know that the train is decelerating in part C?

.....

 (1)

(b) State the features of the graph that represent the distance travelled between the two stations.

.....
 (1)

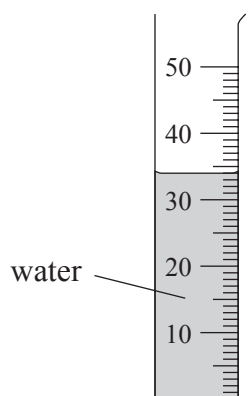
(c) A second train travels between the two stations at a constant velocity and does not stop. It takes the same time as the first train. On the axes above, draw a line showing the motion of the second train.

(2)

(Total 4 marks)

Q5

6. (a) The diagram shows a 50 cm³ measuring cylinder.



State the volume of the water, in cm³.

Volume = cm³ **(1)**

(b) (i) A student has some glass marbles. They are all the same size and shape and they are all made from the same sort of glass.

The student puts some water in a 100 cm³ measuring cylinder. She adds the marbles one at a time. Every time she adds a marble she makes a note of the number of marbles in the water and the reading on the measuring cylinder.

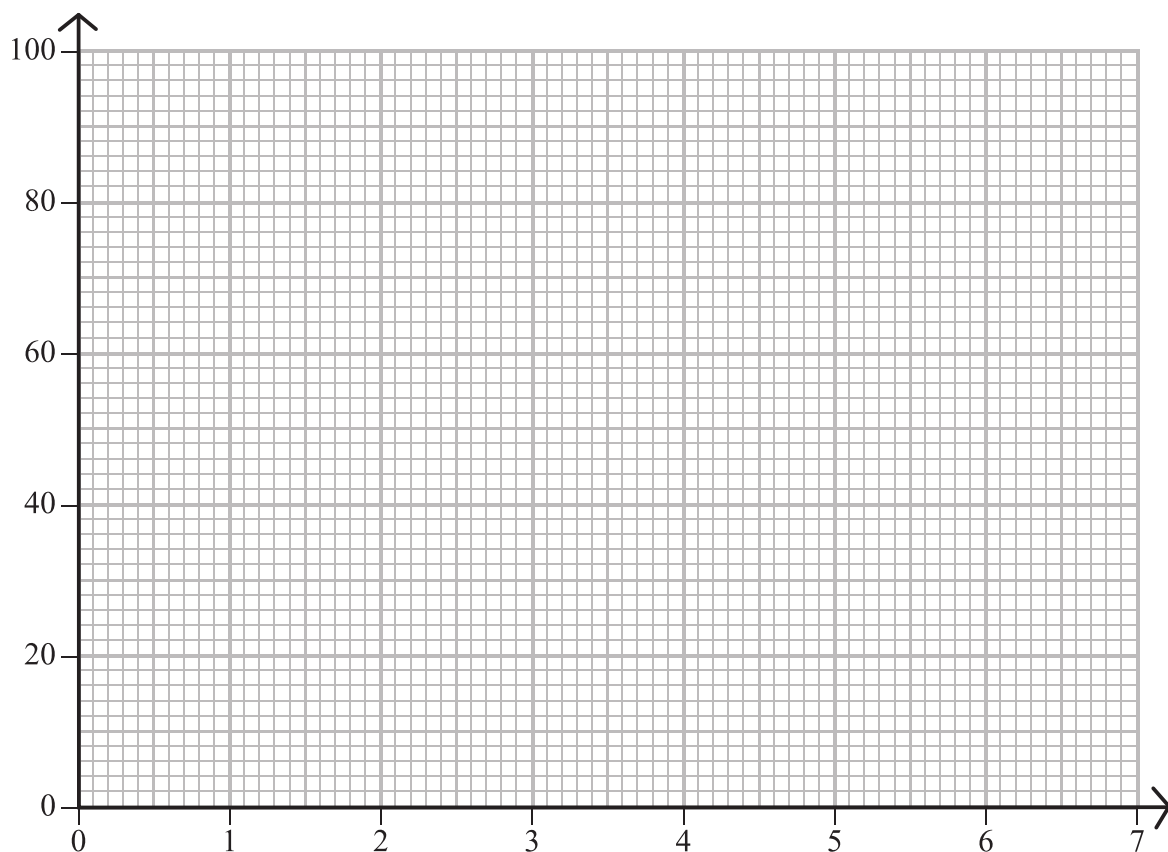
Her notes are shown below.

<i>5 marbles, 91</i>	<i>3, 61</i>	<i>2, 50</i>
<i>1, 39</i>	<i>6, 94</i>	<i>4, 72</i>

Put these results in a table with column headings and units where appropriate.

(3)

(ii) Add labels to the axes. Plot the results.



(3)

(iii) Identify the anomalous (unexpected) result.

..... (1)

(iv) Draw the straight line of best fit on the graph.

(1)

(v) Use your graph to find the volume of water in cm^3 in the measuring cylinder before the student adds any marbles.

Volume of water = cm^3
(1)

(vi) Suggest what the total volume in cm^3 will be if the student adds another marble to the measuring cylinder.

Total volume = cm^3
(1)

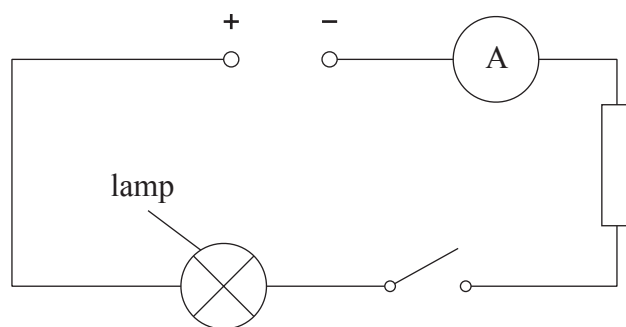
(c) State the equation which relates density, mass and volume.

..... (1)

Q6

(Total 12 marks)

7. A student connects a series circuit as shown.



(a) (i) The student closes the switch. Name **two** components in the circuit, other than the lamp, which affect the size of the current.

1

2

(2)

(ii) The current is 0.40 A. Calculate the charge, in coulombs, that flows during a time of 20 s.

.....

.....

Charge =C

(2)

(b) The student was asked to connect a second lamp so that each lamp can be switched on and off independently. Show, by drawing on the circuit above, how this can be done.

(2)

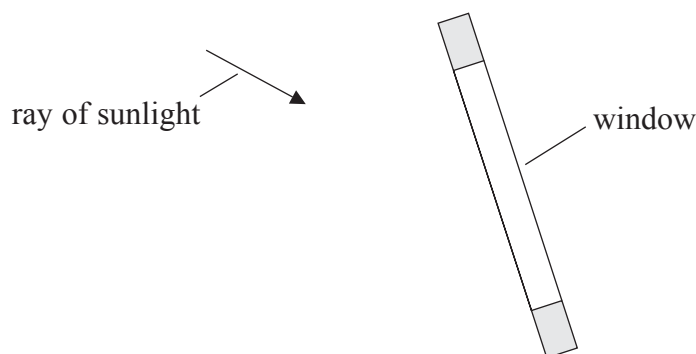
(Total 6 marks)

Q7

8. (a) State the law of reflection.

..... (1)

(b) A student is playing in goal in a football match. The window of a nearby building reflects sunlight into his eyes.



(i) Complete the diagram to show the reflection of the ray from the front of the window. (2)

(ii) Suggest how you could stop sunlight being reflected into your eyes from this window.

..... (1)

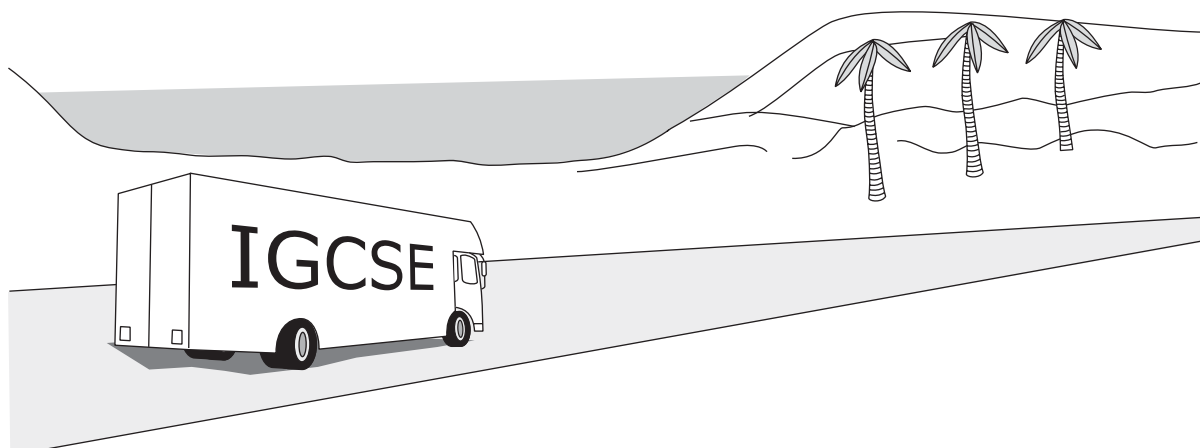
(c) Light is part of the electromagnetic spectrum. State a feature that all parts of the electromagnetic spectrum have in common.

..... (1)

(Total 5 marks)

Q8

9. (a) The diagram shows a lorry. It is travelling in a straight line and it is accelerating. The total forward force on the lorry is F and the total backward force is B .



- (i) Which is larger, force F or force B ? Explain your answer.

.....

 (1)

- (ii) State an equation which relates acceleration, mass and unbalanced force.

.....
 (1)

- (iii) An unbalanced force of 15 000 N acts on the lorry. The mass of the lorry is 12 500 kg. Calculate the lorry's acceleration and give the unit.

.....

Acceleration =
 (3)

(b) The **thinking distance** is the distance which a vehicle travels in the driver's reaction time. The **braking distance** is the distance which a vehicle travels when the brakes are applied.

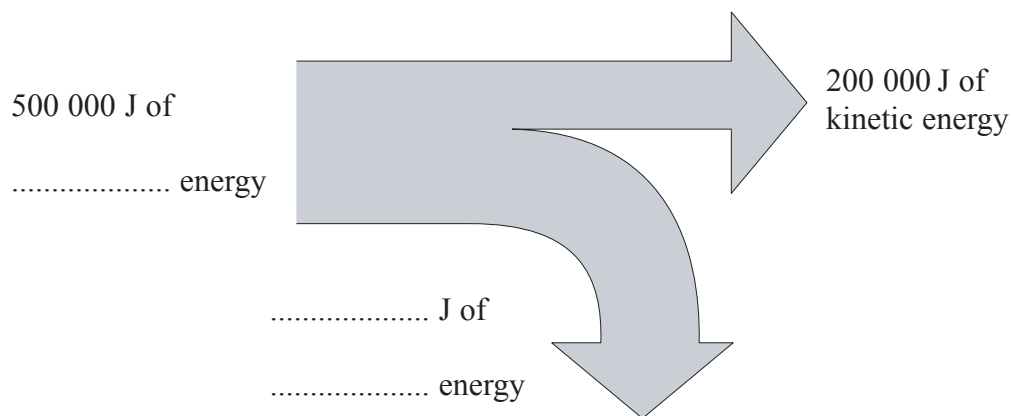
(i) State **one** factor which increases the thinking distance.

.....
 (1)

(ii) State **one** factor which increases the braking distance.

.....
 (1)

(c) (i) The diagram shows an energy flow for another lorry. Fill in the gaps in the diagram.



(3)

(ii) The lorry travels 2.0 km. The driving force is 70 kN. Calculate the work done in kilojoules by this driving force.

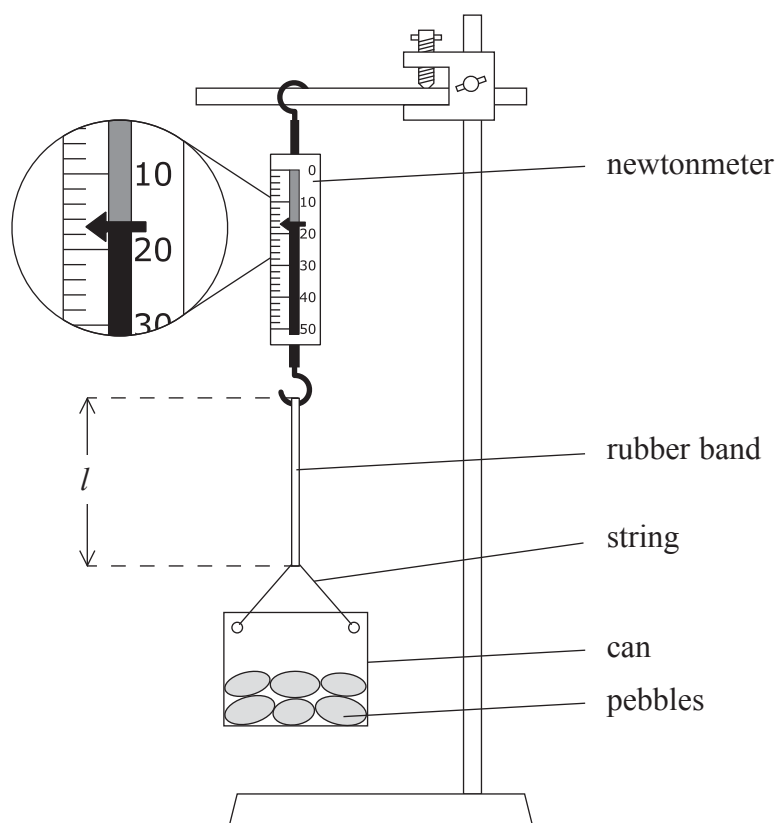
.....

Work done = kJ (3)

(Total 13 marks)

Q9

10. A student sets up the equipment shown.



(a) What is the reading, in Newtons, on the newtonmeter?

Reading = N
(1)

(b) (i) Name the apparatus the student would use to measure the length of the rubber band.

.....
(1)

(ii) Measure, in mm, the distance l shown in the diagram.

l = mm
(1)

(c) Another rubber band is 120 mm long when it is not stretched. It is 250 mm long when it is stretched.

Calculate the extension in millimetres of this rubber band.

Extension = mm
(1)

(d) The student carries out a similar experiment but this time he uses a spring in place of the rubber band.

(i) Complete the space in his results table below.

Load (N)	Length (mm)	Extension (mm)
0.0	50	0
2.3	60	10
5.0	69	19
6.8		25

(1)

(ii) Suggest, with a reason, **one** improvement which could be made to this experiment.

.....

.....

.....

.....

(2)

(e) (i) State Hooke's Law.

.....

.....

(1)

(ii) State the term for the point beyond which a spring no longer obeys Hooke's Law.

.....

(1)

(Total 9 marks)

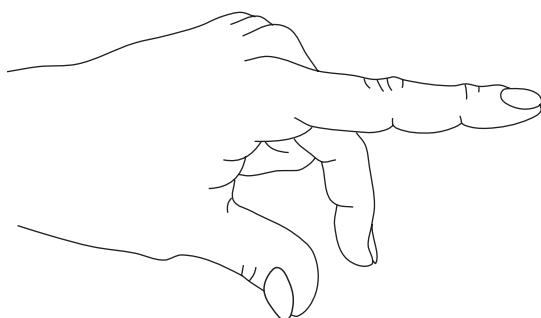
Q10

11. A wire carries a current. The wire is perpendicular to a magnetic field. A force acts on the wire and the wire moves.

(a) This effect is used in a d.c. motor. State what the abbreviation **d.c.** stands for.

..... (1)

(b) Professor J A Fleming invented a rule to describe the directions involved in this effect. It is known as Fleming's left-hand rule.



Complete the sentences.

The first finger points in the direction of the which is from to

The second finger points in the direction of the which is from to

The thumb points in the direction of the

(3) Q11

(Total 4 marks)

12. (a) A lunar landing module weighs 60 kN on Earth but only about 10 kN on the Moon.

Explain why an object weighs less on the Moon than it does on Earth.

.....
.....
.....

(2)

(b) Comets such as Halley's comet orbit the Sun.

(i) State what causes a comet to orbit the Sun.

.....

(1)

(ii) Describe the orbit of a comet around the Sun.

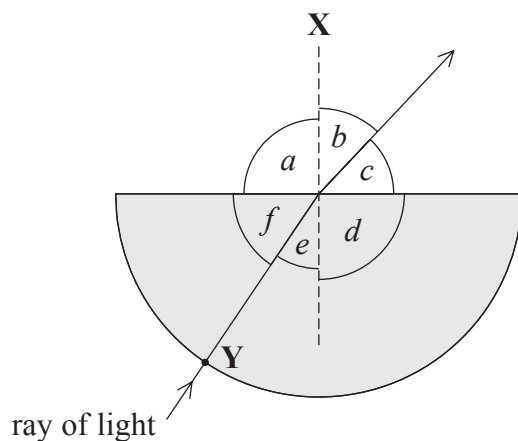
.....
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.....
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.....

(3)

(Total 6 marks)

Q12

13. (a) The diagram shows a ray of light directed at a semicircular glass block.



(i) Name line X.

..... (1)

(ii) State which letter, *a*, *b*, *c*, *d*, *e* or *f*, is an angle of incidence.

..... (1)

(iii) Name angle *b*.

..... (1)

(iv) State an equation which relates angle of incidence, angle of refraction and refractive index of glass.

.....
 (1)

(v) At point Y light passes from air to glass but refraction does not take place.

How can you tell this from the diagram?

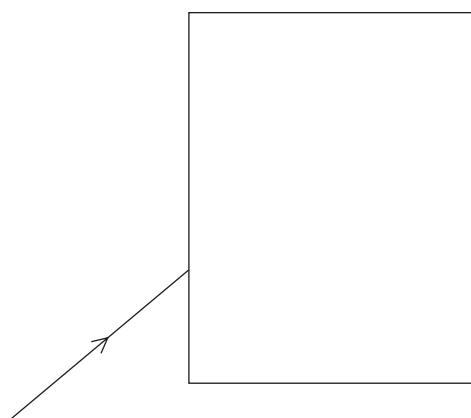
.....
 (1)

(vi) Why does refraction not take place at point Y?

.....
 (1)

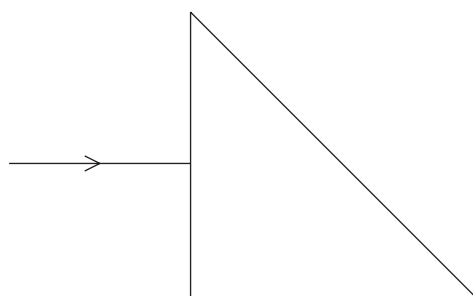
(b) Glass with a critical angle of 42° was used to make the blocks shown below.

(i) Complete the diagram to show how the ray of light passes through the rectangular glass block and out into the air.



(3)

(ii) Complete the diagram to show how the ray of light passes through the triangular glass block and out into the air.

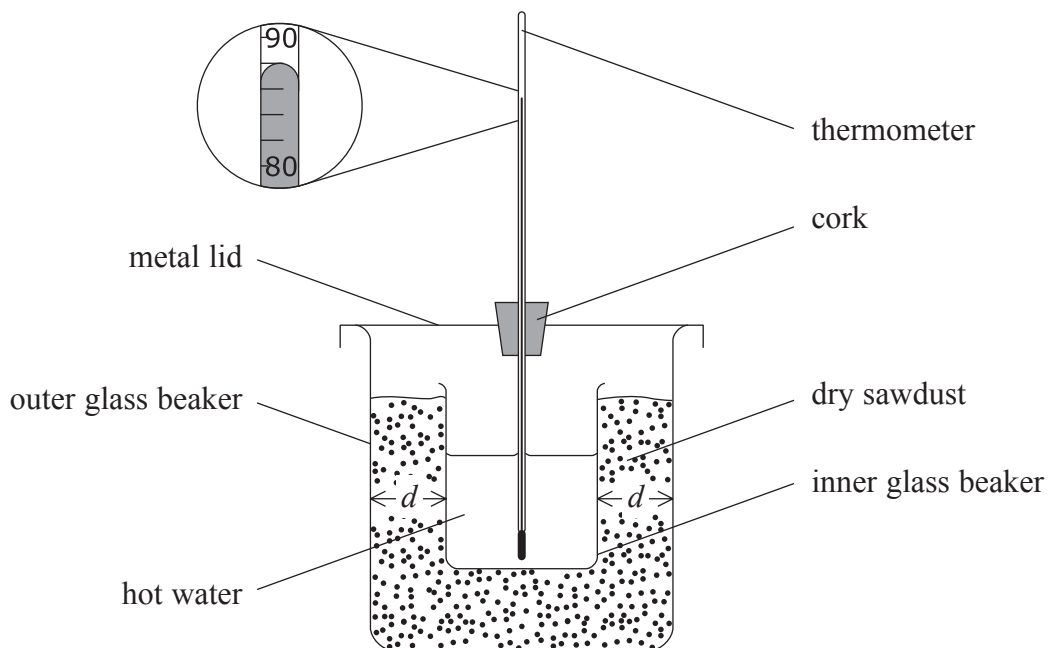


(2)

Q13

(Total 11 marks)

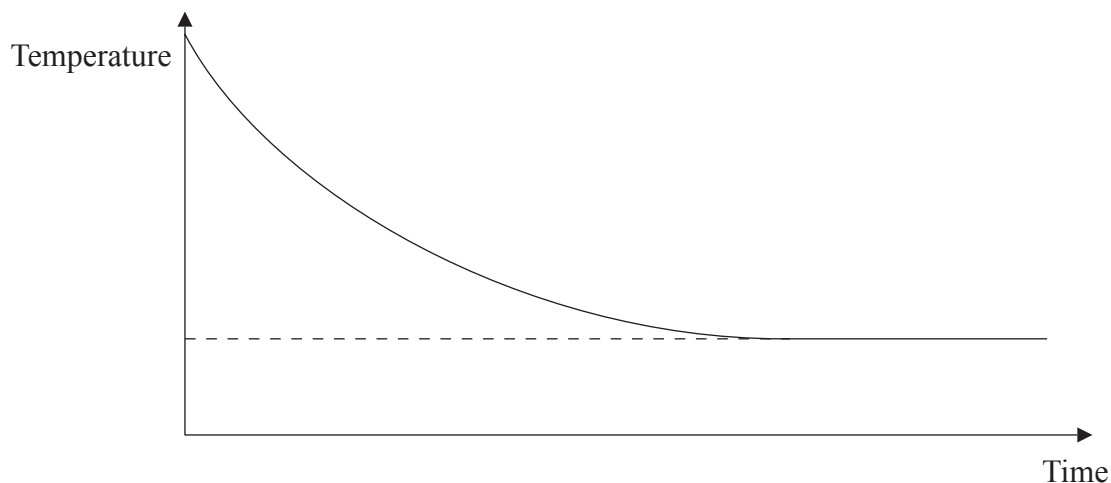
14. A student uses dry sawdust to insulate a glass beaker which contains hot water. The diagram shows how she sets up her equipment.



(a) Write down the reading on the thermometer.

Reading = °C
(1)

(b) The student records the temperature of the water every five minutes for one hour. The sketch graph shows the pattern of her results.



Another student keeps everything else the same but uses a smaller outer beaker. This means that the distance d is less.

(i) Sketch on the graph the curve for this student's results.

(3)

(ii) Suggest why the student keeps everything else the same.

.....
.....

(1)

(c) Suggest, with a reason, **one** improvement which can be made to the experiment.

.....
.....
.....

(2)

(d) Suggest, with a reason, what happens to the results if the sawdust gets wet.

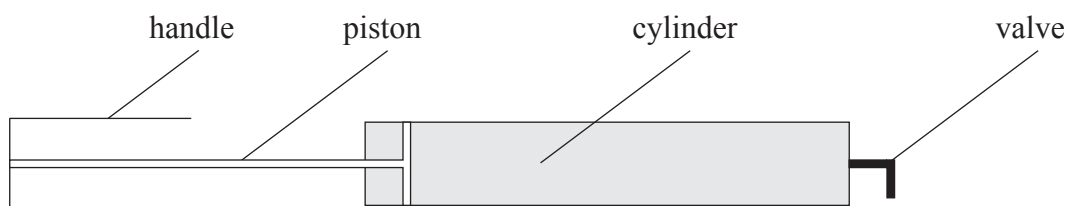
.....
.....
.....
.....

(2)

(Total 9 marks)

Q14

15. The diagram shows the structure of one type of bicycle pump.



(a) Circle **two** words in the box which best describe the motion of the molecules in the air in the cylinder.

backwards	constant	fast	forwards
random	regular	slow	steady

(1)

(b) Explain how the molecules exert a pressure on the inside of the cylinder.

.....

.....

.....

.....

.....

(3)

(c) (i) The pressure inside the pump is 150 kPa when the volume of air in the cylinder is 90 cm³. Use the equation

$$p_1V_1 = p_2V_2$$

to calculate the pressure in kPa when the air is compressed to a volume of 50 cm³.

.....

.....

Pressure = kPa
(2)

(ii) State two assumptions you needed to make in order to answer (c)(i).

1

.....

2

.....

(2)

(iii) Name the unit which is represented by the symbol kPa.

.....

(1)

Q15

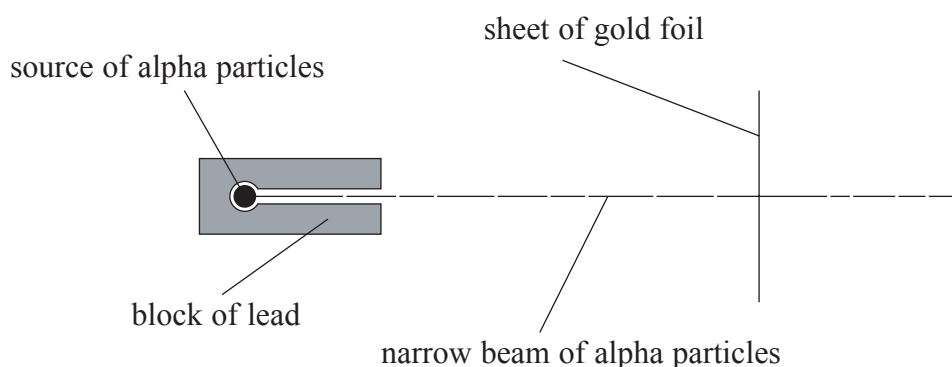
(Total 9 marks)

QUESTION 16 IS ON THE NEXT PAGE

16. (a) Uranium-234 is radioactive. It emits alpha particles and decays to thorium-230. Complete the nuclear equation for this decay.



- (b) Geiger and Marsden studied the structure of atoms. The diagram shows part of the equipment which they used.



- (i) The block of lead helped to shield the scientists from radiation. State another purpose of the block of lead.

.....

 (1)

- (ii) Most of the alpha particles went straight through the gold foil. State another purpose of the block of lead.

.....

 (1)

- (iii) Some of the alpha particles were deflected. What explanation did the scientists suggest for the deflection?

.....

 (2)

(iv) Only a small proportion of the alpha particles deflected through a large angle. What explanation did the scientists suggest for the proportion being small?

.....
.....
(1)

(v) Some alpha particles were deflected less than others. What **two** reasons did the scientists suggest for this?

1

.....

2

.....
(2)

(vi) The alpha particles were detected when they hit a zinc sulphide screen. How did the scientists know that an alpha particle had hit the screen?

.....
.....
(1)

Q16

(Total 10 marks)

TOTAL FOR PAPER: 120 MARKS

END

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Sample mark schemes

General Marking Guidance	89
Biology Paper 1	91
Chemistry Paper 1	99
Physics Paper 1	109

General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Biology Paper 1

Question Number	Answer	Mark
1(a)	Six	1

Question Number	Answer	Mark
1(b)	Any two from: <ul style="list-style-type: none"> • glucose • amino acid • fatty acid • glycerol 	2

Question Number	Answer	Mark
1(c)	A – cell membrane	3
	B – cytoplasm	
	C – nucleus	

Question Number	Answer		Mark
2(a)	Name of cell	Number of chromosomes in cell	3
	<i>neurone</i>	46	
	sperm	23	
	red blood cell	0	
	skin	46	

Question Number	Answer	Mark
2(b)(i)	testis	1

Question Number	Answer	Mark
2(b)(ii)	egg/ovum	1

Question Number	Answer		Mark
3(a)	Sentence	Number	3
	<i>The number of organisms is</i>	5	
	The number of producers is	2	
	The number of animals is	3	
	The number of food chains is	4	

Question Number	Answer	Mark
3(b)(i)	decrease/eq	1

Question Number	Answer	Mark
3(b)(ii)	(ii) increase/eq	1

Question Number	Answer	Mark
4(a)(i)	X on middle arrow	1

Question Number	Answer	Mark
4(a)(ii)	spinal cord	1

Question Number	Answer	Mark
4(b)(i)	light	1

Question Number	Answer	Mark
4(b)(ii)	retina	1

Question Number	Answer	Mark
4(b)(iii)	optic nerve/sensory neurone electrical/impulses	2

Question Number	Answer	Mark
4(c)	Two marks for one sense organ + one stimulus. eg nose: smell skin: touch/pressure/temperature ears: sound/noise/balance tongue: taste	2

Question number	Answer	Mark														
5	<table border="0"> <tr> <td>Function</td> <td>Donated body part</td> </tr> <tr> <td><i>breaks down toxic chemicals</i></td> <td><i>liver</i></td> </tr> <tr> <td>produces urine</td> <td>kidney</td> </tr> <tr> <td>pumps blood around the body</td> <td>heart</td> </tr> <tr> <td>fills with air during breathing</td> <td>lung(s)</td> </tr> <tr> <td>bends light as it enters the eye</td> <td>cornea</td> </tr> <tr> <td>secretes insulin</td> <td>pancreas</td> </tr> </table>	Function	Donated body part	<i>breaks down toxic chemicals</i>	<i>liver</i>	produces urine	kidney	pumps blood around the body	heart	fills with air during breathing	lung(s)	bends light as it enters the eye	cornea	secretes insulin	pancreas	5
Function	Donated body part															
<i>breaks down toxic chemicals</i>	<i>liver</i>															
produces urine	kidney															
pumps blood around the body	heart															
fills with air during breathing	lung(s)															
bends light as it enters the eye	cornea															
secretes insulin	pancreas															

Question number	Answer	Mark
6(a)	A-left ventricle B-tricuspid/atrioventricular valve	2

Question Number	Answer	Mark
6(b)	arrow into the right atrium arrow out of right ventricle through pulmonary artery	2

Question Number	Answer	Mark
6(c)	stop backflow of blood	1

Question Number	Answer	Mark
6(d)	One from: <ul style="list-style-type: none"> • more oxygen/oxygenated/brighter red • less carbon dioxide • greater pressure 	1

Question number	Answer	Mark
7(a)	6.2; 6.0; 6.0; 5.8	4

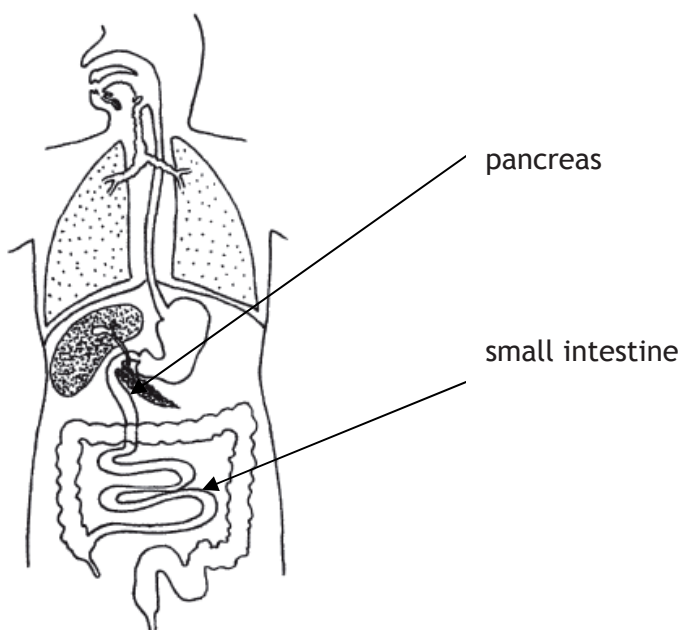
Question number	Answer	Mark
7(b)	8.2; Allow one for number divided by 4 in working	2

Question number	Answer	Mark
7(c)(i)	ice; Ignore fridge	1

Question number	Answer	Mark
7(c)(ii)	kill/cruel/unethical/cause harm/eq Ignore denatured	1

Question number	Answer	Mark																
8	1 mark for each pair of Answers in each column	3																
	<table border="1"> <thead> <tr> <th>Nucleus</th> <th>Cytoplasm</th> <th>Cell wall</th> <th>Chloroplast</th> </tr> </thead> <tbody> <tr> <td>✓</td> <td>(✓)</td> <td>x</td> <td>x</td> </tr> <tr> <td>x</td> <td>✓</td> <td>(✓)</td> <td>(x)</td> </tr> <tr> <td>(✓)</td> <td>✓</td> <td>✓</td> <td>x</td> </tr> </tbody> </table>		Nucleus	Cytoplasm	Cell wall	Chloroplast	✓	(✓)	x	x	x	✓	(✓)	(x)	(✓)	✓	✓	x
	Nucleus		Cytoplasm	Cell wall	Chloroplast													
	✓		(✓)	x	x													
x	✓	(✓)	(x)															
(✓)	✓	✓	x															

Question number	Answer	Mark
9	<p>One mark for each point from the following to a maximum of five:</p> <ul style="list-style-type: none"> • tar • coughing • effect on cilia • mucus build up • bronchitis • bacteria/microorganisms/infection • lung cancer/carcinogens • blockage to tubes/difficulty breathing/ventilation • emphysema • reduced surface area/less/damaged alveoli/less gas exchange • less diffusion 	5

Question number	Answer	Mark
10(a)	 <p>pancreas</p> <p>small intestine</p>	2

Question number	Answer	Mark
10(b)	<p>1 mark for each of the following, maximum 4</p> <ul style="list-style-type: none"> • lipase works best with bile • (lipase works) least well in acidic solution/better in alkaline solutions • bile is alkaline/neutralizes/optimum pH/eq • bile emulsifies fat • larger surface area • denature/affect active site 	4

Question number	Answer			Mark
10(c)	Enzyme	Food Molecule	Product of digestion	2
	<i>amylase</i>	starch	<i>maltose</i>	
	<i>maltase</i>	<i>maltose</i>	glucose	

Question number	Answer	Mark
11(a)	transpiration/evaporation	1

Question number	Answer	Mark
11(b)	A Lost 0.02g + compared with B or C	2

Question number	Answer	Mark
11(c)	1 mark for each, maximum 2 from: <ul style="list-style-type: none"> • number of stomata • stomata size/opening • waxy cuticle; • hairs on surface • surface area/size/wider/eq • thickness • wind • light intensity • humidity • temperature (do not credit environment/climate) 	2

Question number	Answer	Mark
12(a)	oxygen	1

Question number	Answer	Mark
12(b)	move lamp different distances/different wattage bulbs/less voltage	1

Question number	Answer	Mark
12(c)	count bubbles/measure volume per unit time	2

Question number	Answer	Mark
12(d)	line going up from origin line leveling at maximum rate of photosynthesis	2

Question number	Answer	Mark
12(e)	1 mark for each of the following, maximum 2: <ul style="list-style-type: none"> • temperature • carbon dioxide • size of pondweed 	2

Question number	Answer	Mark
13(a)(i)	36	1

Question number	Answer	Mark
13(a)(ii)	1 mark for each of the following, maximum 2: <ul style="list-style-type: none"> • 51/3rd result at 25 °C with vitamin C • not given long enough to warm up to 25 °C • not enough Vit C/not enough yeast 	2

Question number	Answer	Mark
13(a)(iii)	35 °C with (vitamin C)	2

Question number	Answer	Mark
13(b)(i)	1 mark for each of the following, maximum 3: <ul style="list-style-type: none"> • low kinetic energy/eq • high temp + denatured/destroyed • optimum/best/ideal/eq • ref to gas/carbon dioxide bubbles/eq 	3

Question number	Answer	Mark
13(b)(ii)	more rise/faster rise no difference at lowest/15 and/or highest/65/at some temperatures	2

Question number	Answer	Mark
14(a)	600 9	2

Question number	Answer	Mark
14(b)(i)	LHS RHS balanced	3

Question number	Answer	Mark
14(b)(ii)	1 mark for each of the following, maximum 2: <ul style="list-style-type: none"> • not eaten/inedible • not digested/indigestible/egested • excreted/urine/sweating • movement • heat loss • death/decomposers 	2

Question number	Answer	Mark
14(c)	carnivores	1

Question number	Answer	Mark
15	<ul style="list-style-type: none"> • explants • agar/nutrient/growth • nutrients/minerals/growth regulators/glucose/H₂O/vitamins • nutrients/minerals/growth regulators/glucose/H₂O/vitamins • compost/soil/eq • temperature/carbon dioxide/light/humidity/water • temperature/carbon dioxide/light/humidity/water • clones • identical 	9

Question number	Answer	Mark
16(a)	adenine cytosine	2

Question number	Answer	Mark
16(b)	600	1

Question number	Answer	Mark
16(c)	Any five from: <ul style="list-style-type: none"> • restriction enzyme/endonuclease • cut DNA/gene • ligase • join/insert/stick/put into DNA/eg • plasmid(s) • vector • recombinant DNA/recombinant bacteria 	5

Question number	Answer	Mark
17(a)(i)	Parent genotypes: male + Hh female + hh Gametes: H h (h) h Offspring genotypes: Hh and hh Offspring phenotypes: Huntingdon's disease normal	4

Question number	Answer	Mark
17(a)(ii)	$\frac{3}{4}$ /eq	1

Question number	Answer	Mark
17(b)	would have children already/gene already passed on wouldn't know they had Huntington's	2

Question number	Answer	Mark
18	Any six from: <ul style="list-style-type: none"> • C – low/high temperatures/different temperatures • O – named species of leaves/eq • R – idea of replication • M1 – mass of leaves/eq • M2 –stated time period • S1 – moisture/oxygen supply/decomposers/eq • S2 – moisture/oxygen supply/decomposers/eq 	6

Chemistry Paper 1

Question number	Answer	Mark
1(a)	Mg	1

Question number	Answer	Mark
1b)	C	1

Question number	Answer	Mark
1(c)	O (accept 8)	1

Question number	Answer	Mark
1(d)	2/alkaline earth	1

Question number	Answer	Mark
1(e)	7/halogen	1

Question number	Answer	Mark
2(a)	B – Stop clock E – funnel	2

Question number	Answer	Mark
2(b)	C/pipette D/measuring cylinder (answers in either order)	2

Question number	Answer	Mark
2(c)	E/funnel	1

Question number	Answer	Mark
3(a)(i)	From top to bottom Proton Electron Neutron	3

Question number	Answer	Mark
3(a)(ii)	8	1

Question number	Answer	Mark
3(a)(iii)	Be/Beryllium	1

Question number	Answer	Mark
3(b)	<ul style="list-style-type: none"> • Same number of protons/atomic number • Different number of neutrons/mass number/nucleon number 	2

Question number	Answer	Mark
4(a)	1 Oxygen 2 Water	2

Question number	Answer	Mark
4(b)	Iron oxide/rust	1

Question number	Answer	Mark
4(c)	1 mark for each, maximum 2 <ul style="list-style-type: none"> • Oil • grease/polish • paint • plastic • zinc • Accept chrome/chromium Reject copper/magnesium	2

Question number	Answer	Mark
5(a)	Iron tube diagram completed with 5 or fewer bubbles Magnesium diagram completed with 7 or more bubbles	2

Question number	Answer	Mark
5(b)	Zinc + hydrochloric acid → zinc chloride + hydrogen	1

Question number	Answer	Mark
5(c)	Copper/silver/gold/platinum	1

Question number	Answer	Mark
5(d)	1 mark for each, maximum 2, eg <ul style="list-style-type: none"> • Water/H₂O/steam • Oxygen/O₂/air • Metal salt (solutions) • Allow metal oxides Allow suitable alternatives	2

Question number	Answer	Mark
6(a)(i)	Shared pair of electrons	1

Question number	Answer	Mark
6(a)(ii)	H × H (accept two × or two ·)	1

Question number	Answer	Mark
6(b)	Test – lighted/lit splint Result – (squeaky) pop/explosion	2

Question number	Answer	Mark
6(c)	(manufacture of) ammonia/margarine/HCl	1

Question number	Answer	Mark
6(d)	Hydrogen + oxygen → water	1

Question number	Answer	Mark
6(e)(i)	Colourless White Blue	3

Question number	Answer	Mark
6(e)(ii)	Before – 27 After – 32.5	2

Question number	Answer	Mark
6(e)(iii)	5.5 (ecf)	1

Question number	Answer	Mark
6(e)(iv)	B	1

Question number	Answer	Mark
7(a)	Heat	1

Question number	Answer	Mark
7(b)(i)	Diffusion	1

Question number	Answer	Mark
7(b)(ii)	Ammonium chloride/NH ₄ Cl	1

Question number	Answer	Mark
7(b)(iii)	Ammonia faster/hydrogen chloride slower	1

Question number	Answer	Mark
7(b)(iv)	A: Red B: Blue	2

Question number	Answer	Mark
8(a)(i)	A and C	2

Question number	Answer	Mark
8(a)(ii)	Contains a (carbon to carbon) double/multiple bond/can undergo addition reactions	1

Question number	Answer	Mark
8(b)(i)	Orange/yellow (1) - colourless (1)	2

Question number	Answer	Mark
8(b)(ii)	Correct structure of 1,2 - dibromoethane	1

Question number	Answer	Mark
8(c)	Correct structures for two isomers of C ₄ H ₈ But - 1 - ene, but - 2 - ene (cis + trans) Cyclobutane, cyclomethylpropane, methylpropene	2

Question number	Answer	Mark
9(a)	Anticlockwise from top: Haematite Molten iron Slag	3

Question number	Answer	Mark
9(b)(i)	C + O ₂ → CO ₂ , ignore state symbols	1

Question number	Answer	Mark
9(b)(ii)	Heats it up/raises temperature/exothermic	1

Question number	Answer	Mark
9(c)	$\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$	1

Question number	Answer	Mark
9(d)	Loss of oxygen/ Fe^{3+} gains electrons/Fe ions gains electrons/Fe (III) gains oxygen (reject – Fe gains electrons)	1

Question number	Answer	Mark
9(e)(i)	Aluminium too reactive/more reactive than carbon/accept Al very high in the reactivity series	1

Question number	Answer	Mark
9(e)(ii)	Any suitable use, eg airplanes PLUS Property must be related, eg low density eg Specified transport - low density (not light) Cooking foil/drink cans - easily moulded/malleable Power cables - good conductor of electricity Window frames/cars - does not corrode Credit any other suitable Answers	2

Question number	Answer	Mark
10(a)(i)	Any two from: Fizz/bubble Move/darts around Melts/forms a ball/ Gets smaller/disappears (reject dissolves)	2

Question number	Answer	Mark
10(a)(ii)	Sodium + water \rightarrow sodium hydroxide + hydrogen (accept correct formulae equation)	1

Question number	Answer	Mark
10(b)(i)	Orange/yellow	1

Question number	Answer	Mark
10(b)(ii)	Flame test	1

Question number	Answer	Mark
10(c)	Blue/purple (solution made is) alkaline/(contains) hydroxide ions OH ⁻ /not just 'alkali metal' pH 11→14 (any in range)	2

Question number	Answer	Mark
10(d)	<ul style="list-style-type: none"> Electrons being transferred between oxygen and sodium (can be wrong way round) Idea of sodium losing electron(s) and oxygen gaining electron(s) Correct number of electrons involved (sodium lose 1, oxygen gain 2) (sharing = 0 marks) 	3

Question number	Answer	Mark
11(a)(i)	All points plotted correctly (-1 per error) -2 marks Smooth curve – 1 mark	3

Question number	Answer	Mark
11(a)(ii)	Point at (46,65) circled	1

Question number	Answer	Mark
11(a)(iii)	Any one from: <ul style="list-style-type: none"> Marble chips bigger/surface less Acid too cool Volume of acid too small Mass of chips too small Acid more dilute - or reason that could cause this 	1

Question number	Answer	Mark
11(b)(i)	Read values from graph: 76±1 cq 45±1	2

Question number	Answer	Mark
11(b)(ii)	cq on (i): 0.013 0.022 min 2 significant figures	2

Question number	Answer	Mark
11(b)(iii)	(the higher the temperature the) faster (the reaction) cq on (ii)	1

Question number	Answer	Mark
11(b)(iv)	<ul style="list-style-type: none"> • Particles have more energy • Move faster/more have energy greater than activation energy • More collisions per second/more frequent collisions greater proportions of collisions are successful 	3

Question number	Answer	Mark
11(c)	Any suitable way of cooling flask/contents, eg an ice bath Do not accept ideas based on doing the reaction somewhere else.	1

Question number	Answer	Mark
12(a)	Bitumen Gasoline Bitumen	3

Question number	Answer	Mark
12(b)	Cracking Heat/400-1000 °C/high temperature (reject boil) Steam/catalyst/(high) pressure/5-100 atm	3

Question number	Answer	Mark
12(c)(i)	$2\text{CH}_4 + 3\text{O}_2 \rightarrow 2\text{CO} + 4\text{H}_2\text{O}$ All formula correct (1 mark) Formula balances (1 mark)	2

Question number	Answer	Mark
12(c)(ii)	Toxic/poisonous/death/fatal (reject suffocate) Correct reference to blood or haemoglobin	2

Question number	Answer	Mark
13(a)	2.8.7	1

Question number	Answer	Mark
13(b)	7	1

Question number	Answer	Mark
13(c)	Brown/orange (to) colourless	2

Question number	Answer	Mark
13(d)(i)	Red/pink (hydrobromic acid formed/H ⁺ ions present)	2

Question number	Answer	Mark
13(d)(ii)	Blue No acid formed/no reaction/no H ⁺ ions	2

Question number	Answer	Mark
14(a)(i)	(1 + 80 +) 81	1

Question number	Answer	Mark
14(a)(ii)	1.62 ÷ 81 = 0.02 (ALLOW ecf)	2

Question number	Answer	Mark
14(a)(iii)	0.02 ÷ 0.25 = 0.08 (ALLOW ecf)	2

Question number	Answer	Mark
14(a)(iv)	0.08 × 81 = 6.5/6.48 OR 1.62 × 4 = 6.5/6.48 (ALLOW ecf)	2

Question number	Answer	Mark
14(b)(i)	HBr + NaOH → NaBr + H ₂ O	1

Question number	Answer	Mark
14(b)(ii)	Any from: H ⁺ (ions) react with OH ⁻ (ions) OH ⁻ (ions) gain protons	1

Question number	Answer	Mark
14(c)(i)	0.02×0.2 $= 0.004$ $(20 \times 0.2$ $= 4 (=1 \text{ ecf})$	2

Question number	Answer	Mark
14(c)(ii)	$0.004 \div 0.1$ OR $20 \times (0.2 \div 0.1)$ $= 0.04 \text{ dm}^3$ OR $= 40 \text{ cm}^3$ Units needed ALLOW ecf	2

Physics Paper 1

Question Number	Answer	Mark
1(a)(i)	A	1

Question Number	Answer	Mark
1(a)(ii)	B	1

Question Number	Answer	Mark
1(b)(i)	frequency	1

Question Number	Answer	Mark
1(b)(ii)	period	1

Question Number	Answer	Mark
1(c)(i)	any two from: <ul style="list-style-type: none"> • waves on rope • waves on a spring shaken from side to side • radio/TV (waves) • microwaves • infra-red • light • ultraviolet • X-rays • gamma (rays) 	2

Question Number	Answer	Mark
1(c)(ii)	longitudinal (waves) accept examples <ul style="list-style-type: none"> • sound (waves) • waves on a spring given a 'push and pull' 	1

Question Number	Answer	Mark
2(a)(i)	piece missing (accept hole in case/cracked/broken or words to that effect)	1

Question Number	Answer	Mark
2(a)(ii)	access to live part(s) (accept – could get a shock)	1

Question Number	Answer	Mark
2(a)(iii)	Fuse (ignore any reference to rating e.g. 13 A)	1

Question Number	Answer	Mark
2(a)(iv)	Fuses/melts/will not conduct (electricity) (allow 'gets hotter')	1

Question Number	Answer	Mark
2(b)(i)	plastic does not conduct (electricity)/is an insulator (of electricity)	1

Question Number	Answer	Mark
2(b)(ii)	it is earthed/there is an earth wire	1

Question Number	Answer	Mark
3(a)	either all seven points correctly plotted (2) (each to within 1 mm and not as 'blobs') or five or six points correctly plotted (1) + appropriate line for the candidate's points drawn with a ruler (1)	3

Question Number	Answer	Mark
3(b)(i)	answer in the range 67 to 68 inclusive or correct from candidate's graph	1

Question Number	Answer	Mark
3(b)(ii)	2 hours 20 minutes or 140 minutes or 2.3 or 2.35	1

Question Number	Answer	Mark
3(c)	distance (moved) = (average) speed × time (taken) or any correctly transposed version	1

Question Number	Answer	Mark
4(a)	millimeters/mm	1

Question Number	Answer	Mark
4(b)	nothing/no change/zero/it is (still) 0.8 g/cm ³	1

Question Number	Answer	Mark
4(c)	(the) same/2.7 g/cm ³	1

Question Number	Answer	Mark
5(a)	graph (line) sloping downwards or its velocity/speed is falling/getting less or graph has negative slope	1

Question Number	Answer	Mark
5(b)	area under the graph (accept A+B+C)	1

Question Number	Answer	Mark
5(c)	horizontal line from the velocity axis and beneath the maximum on the printed graph (1) finishing vertically (by eye) above the time end on the printed graph (1)	2

Question Number	Answer	Mark
6(a)	34 (no tolerance)	1

Question Number	Answer	Mark
6(b)(i)	table with appropriate headings (1) in numerical order (either ascending or descending) (1) <u>all</u> data correctly entered (1) (example of a fully correct response number of marbles total volume* in cm ³ “ 1 39 2 50 3 61 4 72 5 91 6 94 or ‘reading on the measuring cylinder’ “ or may be shown after each entry in this column)	3

Question Number	Answer	Mark
6(b)(ii)	both axes correctly labelled (1) all six points correct each to within 1 mm and not as 'blobs' (1) four or five points correct (1)	3

Question Number	Answer	Mark
6(b)(iii)	5 (marbles) 91 (cm ³) or unambiguously identified	1

Question Number	Answer	Mark
6(b)(iv)	straight line through other points (Should not go through the origin)	1

Question Number	Answer	Mark
6(b)(v)	28 (cm ³)	1

Question Number	Answer	Mark
6(b)(vi)	105 (cm ³)	1

Question Number	Answer	Mark
6(c)	density = mass ÷ volume or any correctly transposed version	1

Question Number	Answer	Mark
7(a)(i)	(electrical) supply/battery/cell/power source (1) resistor (accept 'resistance' do not credit wire/wiring) (1)	2

Question Number	Answer	Mark
7(a)(ii)	8 (C) (2) or credit 'charge = current × time' or '0.40 × 20' with (1)	2

Question Number	Answer	Mark
7(b)	lamp parallel to printed lamp shown clearly on the circuit diagram (1) with independent switch (1)	2

Question Number	Answer	Mark
8(a)	angle of incidence = angle of reflection accept $\angle i = \angle r$	1

Question Number	Answer	Mark
8(b)(i)	ray continued in a straight line to front face of window but not beyond (1) then reflected so that, judged by eye, angle of reflection = angle of incidence (1)	2

Question Number	Answer	Mark
8(b)(ii)	any one of <ul style="list-style-type: none"> • move the window (so as to change its angle or the effect) or words to that effect eg student moves to change the angle • cover the outside of the window (eg with a shutter) do not credit 'close the blinds/curtains) do not credit 'student should wear a hat etc.'	1

Question Number	Answer	Mark
8(c)	all travel at the same speed/speed of light /300 million metres per second or (they are all) transverse waves or (they all) transfer energy (from one place to another) or (they all) travel through a vacuum	1

Question Number	Answer	Mark
9(a)(i)	(force) F (is bigger) because the lorry is accelerating do not credit just '... is moving forward'	1

Question Number	Answer	Mark
9(a)(ii)	(unbalance) force = mass \times acceleration accept $F = ma$ or $F - B = \text{mass} \times \text{acceleration}$	1

Question Number	Answer	Mark
9(a)(iii)	1.2 (2) allow acceleration = (unbalanced) force \div mass or 15 000 \div 12 500 for (1) m/s ² (1) or m/s/s or ms ⁻² or metres per second per second	3

Question Number	Answer	Mark
9(b)(i)	driver tired/ill/drunk/has taken drugs/poor reaction(s)/inexperienced/faster speed etc or words to that effect	1

Question Number	Answer	Mark
9(b)(ii)	poor/worn brakes/loose/slippery/poor road surface/faster speed etc or words to that effect	1

Question Number	Answer	Mark
9(c)(i)	chemical (1) 300 000 (1) wasted/heat/heat and sound (and chemical) (1)	3

Question Number	Answer	Mark
9(c)(ii)	140 000 kJ (3) or work (done) = force \times distance (1) either 2 km = 2000 m or 70 kN = 70 000 N (1)	3

Question Number	Answer	Mark
10(a)	17 (N) do not credit '23 (N)'	1

Question Number	Answer	Mark
10(b)(i)	ruler/rule accept 'metre rule' accept 'tape measure'	1

Question Number	Answer	Mark
10(b)(ii)	17 (mm)	1

Question Number	Answer	Mark
10(c)	130 (mm)	1

Question Number	Answer	Mark
10(d)(i)	75	1

Question Number	Answer	Mark
10(d)(ii)	more (pairs of) readings (1) to improve reliability/to allow a line to be drawn on the graph with greater certainty/to make the pattern clearer (or words to that effect) (1)	2

Question Number	Answer	Mark
10(e)(i)	extension is proportional to load	1

Question Number	Answer	Mark
10(e)(ii)	elastic limit	1

Question Number	Answer	Mark
11(a)	direct current	1

Question Number	Answer	Mark
11(b)	(first finger) (magnetic) field North/N to South/S (1) (second finger) current from positive(+) to negative (-)(1) (thumb) movement/motion/force/thrust (1)	3

Question Number	Answer	Mark
12(a)	mass of the Moon is less than the mass of the Earth (1) and gravitational field strength/g is less on the Moon (or gravitational field strength/g is about six times greater on Earth than on the Moon) (1) accept any other suitable correct answer	2

Question Number	Answer	Mark
12(b)(i)	gravitational force/attraction accept 'gravity'	1

Question Number	Answer	Mark
12(b)(ii)	any three points (1) each <ul style="list-style-type: none"> • ellipse/elliptical (accept minor misspelling but not anything which could just as well be 'eclipse') • with the Sun at one focus • period of more than one (Earth) year • from the far side of the Solar System/outer Solar System (or 'from the Kuiper belt (short-period comets)' or 'from the Oort cloud(long-period comets)')	3

Question Number	Answer	Mark
13(a)(i)	Normal do not credit 'vertical' or 'perpendicular'	1

Question Number	Answer	Mark
13(a)(ii)	e	1

Question Number	Answer	Mark
13(a)(iii)	(angle of) refraction accept minor misspellings but not anything which could be 'reflection'	1

Question Number	Answer	Mark
13(a)(iv)	refractive index (of glass) = sine of the angle of incidence ÷ sine of the angle of refraction or $\eta = \frac{\sin i}{\sin r}$	1

Question Number	Answer	Mark
13(a)(v)	(ray of light) does not change direction/(continues in) a straight line	1

Question Number	Answer	Mark
13(a)(vi)	any one of <ul style="list-style-type: none"> angle of incidence is zero ray on the normal ray is perpendicular to the surface 	1

Question Number	Answer	Mark
13(b)(i)	diagram shows that <ul style="list-style-type: none"> refraction occurs, ray continues in a straight line to the opposite face (1) angle of refraction is less than 90° (1) ray emerges and continues in a straight line so that (by eye) it is parallel to the original direction (1) 	3

Question Number	Answer	Mark
13(b)(ii)	diagram shows that <ul style="list-style-type: none"> ray continues in a straight line to the opposite face then downwards (1) at right angles then outwards through the base without deviation (1) 	2

Question Number	Answer	Mark
14(a)	90°C	1

Question Number	Answer	Mark
14(b)(i)	starts at same temperature and falls (1) more steeply (1) to room temperature and then stays constant (1)	3

Question Number	Answer	Mark
14(b)(ii)	so that the (two sets of) results can be compared (fairly/reliably)	1

Question Number	Answer	Mark
14(c)	Any suitable correct answer, examples are: <ul style="list-style-type: none"> • have a non metallic/wooden/plastic etc lid (1) to reduce heat loss by conduction (1) • have a larger outer beaker (1) so that distance 'd' can be increased/more sawdust can be used/insulation will be improved/heat loss (by conduction) will be reduced (1) 	2

Question Number	Answer	Mark
14(d)	the (hot) water will cool (to room temperature) more rapidly/the temperature (of the water) will fall more quickly (1) (because) wet sawdust is not such a good insulator/is a better heat conductor than dry sawdust (1) or (because) (trapped) water is not such a good insulator/is a better heat conductor than (trapped) air (1)	2

Question Number	Answer	Mark
15(a)	random fast (both unambiguously indicated and no others)	1

Question Number	Answer	Mark
15(b)	molecules exert a force (1) when they hit/collide with the (inside) walls (of the container) (1) force acting on a surface/area results in pressure (or pressure = force ÷ area) (1)	3

Question Number	Answer	Mark
15l(i)	270 (kPa) or $150 \times 90 = \text{pressure} \times 50$ (1) or any correctly transposed version of the above equation (1)	2

Question Number	Answer	Mark
15(c)(ii)	no change in temperature (1) no change in mass/no gas escapes/leaks (from the cylinder) (1) (either order)	2

Question Number	Answer	Mark
15(c)(iii)	kilopascal(s) (allow minor misspellings such as 'kiloPascal(s)')	1

Question Number	Answer	Mark
16(a)	230 above 90 for thorium (both in correct positions) (1) 4 above 2 for helium (both in correct positions) (1)	2

Question Number	Answer	Mark
16(b)(i)	(so that the only alpha) particles (which escape/leave) go in the same/one direction	1

Question Number	Answer	Mark
16(b)(ii)	(the gold) foil/it is mostly empty space or 'most of a gold atom is empty space'	1

Question Number	Answer	Mark
16(b)(iii)	repelled (by the nucleus of an atom of gold) (1) (because) an alpha particle and a nucleus both have the same/positive charge (1)	2

Question Number	Answer	Mark
16(b)(iv)	(relative to the rest of the atom) the nucleus is very small (so the change of hitting it is very small)	1

Question Number	Answer	Mark
16(b)(v)	(these alpha particles) were not so close to the nucleus (as those which were deflected more) (1) (these alpha particles) were faster (than those which were deflected more) (1)	2

Question Number	Answer	Mark
16(b)(vi)	(there was a tiny) flash of light or scintillation (observed)	1

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