Surname	Centre Number	Candidate Number
Other Names		0

GCSE – NEW

3445UA0-1

S18-3445UA0-1

APPLIED SCIENCE (Double Award)

UNIT 1: Energy, Resources and the Environment

HIGHER TIER

WEDNESDAY, 13 JUNE 2018 – MORNING

1 hour 30 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**10**	
2.	**9**	
3.	**13**	
4.	**13**	
5.	**9**	
6.	**11**	
7.	**10**	
Total	**75**	

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ADDITIONAL MATERIALS

In addition to this paper you will require a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

Question 7*(a)* is a quality of extended response (QER) question where your writing skills will be assessed.

You are reminded to show all your workings. Credit is given for correct workings even when the final answer given is incorrect.

A periodic table is printed on page 20.

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Answer **all** *questions.*

1. Students are making the fertiliser potassium nitrate in the laboratory. Most fertilisers are formed by the reaction of an acid and an alkali.

(a) Complete the word equation for the formation of potassium nitrate. [2]

..... + potassium hydroxide ⟶ potassium nitrate + ...

(b) To make the fertiliser, it is important that the students are able to exactly neutralise the acid with alkali. To do this the students carefully measured 25 cm^3 of acid into a flask and titrated just enough alkali to neutralise the acid.

The results of the experiment are shown below.

Trial	Volume of alkali added at endpoint (titre) (cm^3)
1	20.5
2	20.8
3	18.5
4	20.0
5	19.9

(i) The reading for trial 3 was considered to be an anomalous result. Give a reason why. [1]

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(ii) Calculate the mean titre. [1]

Mean titre = ... cm^3

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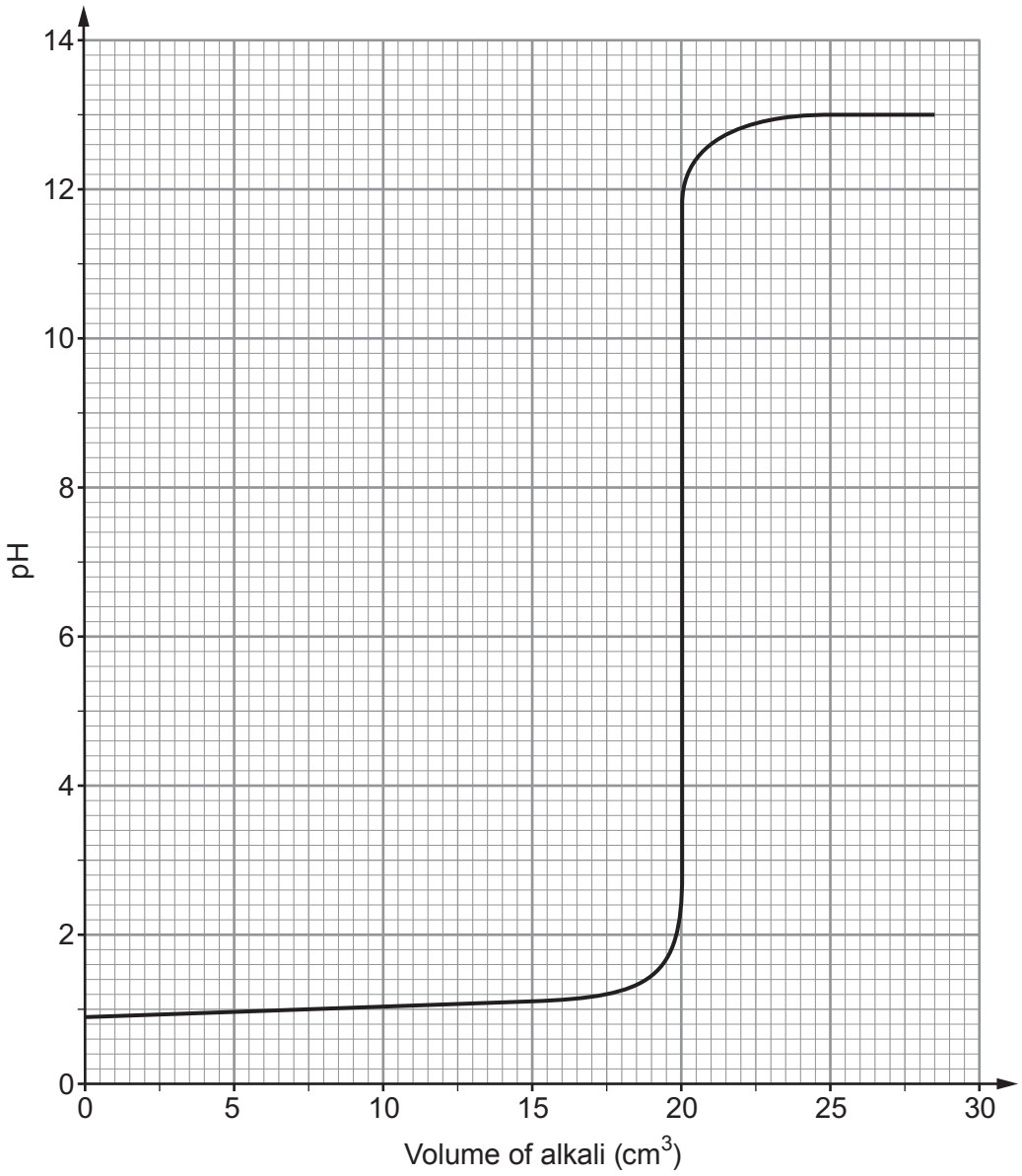
(c) The graph below shows the pH changes, measured by a pH probe, that occurred during trial 4 of the experiment.



Explain the pH changes shown on the graph. [3]

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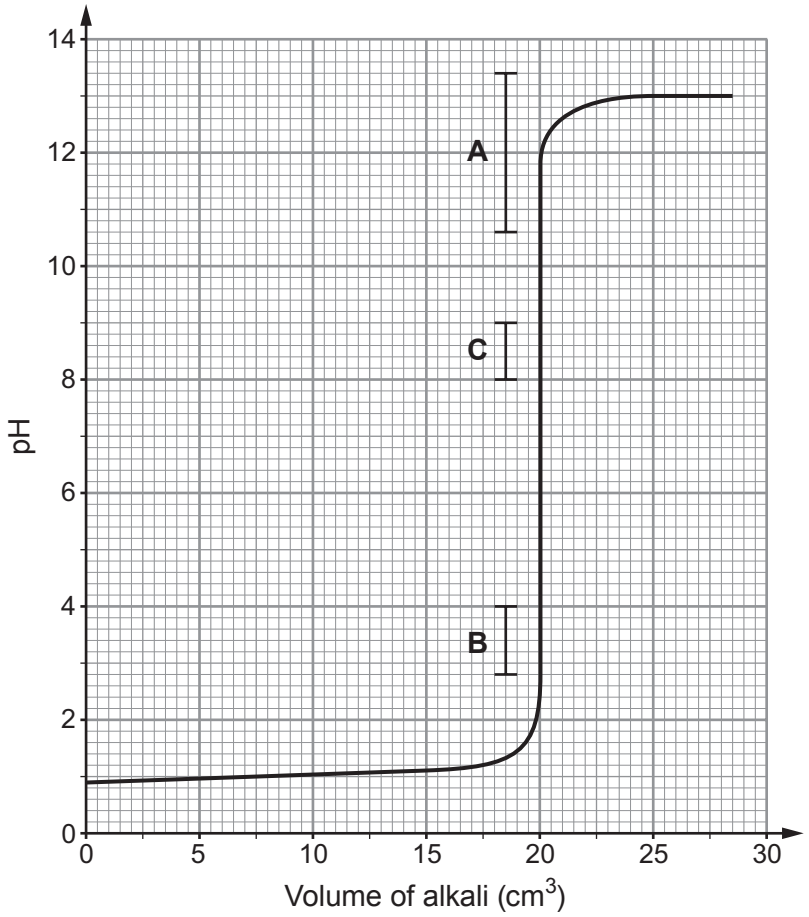
(d) Not all the students had a pH probe. Some had to use an indicator. The pH range of three different indicators is marked on the graph as **A**, **B**, and **C**.



(i) Use the information in the table below to match the range to each indicator. [1]

Indicator	pH range	Colour change	Range on the graph (**A**, **B**, or **C**?)
methyl blue	10.6 - 13.4	blue to violet	.....
phenolphthalein	8.0 - 9.0	colourless to pink	.....
dinitrophenol	2.8 - 4.0	colourless to yellow	.....

(ii) Explain which indicator is not suitable for this experiment. [2]

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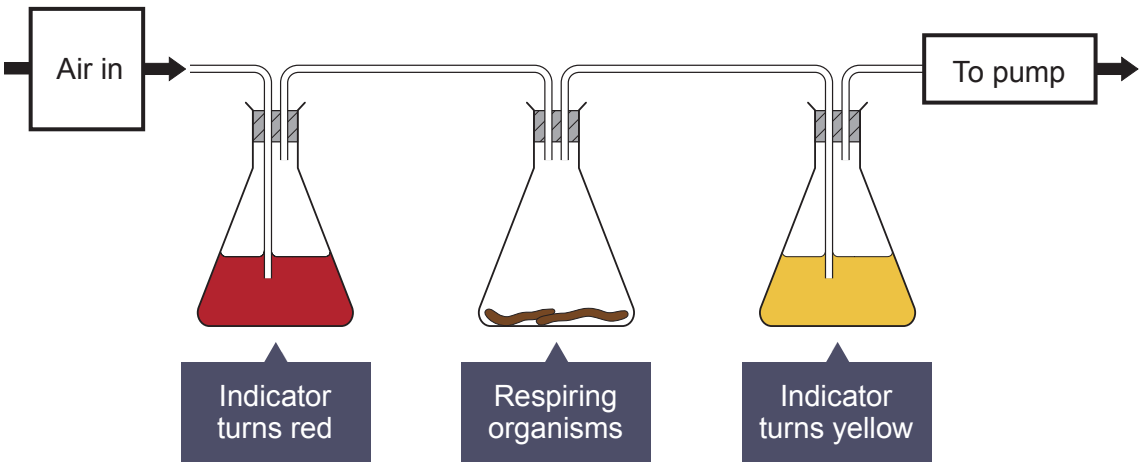
2. Hydrogen carbonate indicator can be used to measure the rate of respiration.

Concentration of carbon dioxide (%)	Colour of hydrogen carbonate indicator
less than 0.04	purple
0.04 (normal concentration in air)	red
greater than 0.04	yellow

The apparatus below can be used to compare the rate of respiration in small animals.



A group of students used different respiring organisms and recorded the time taken for the hydrogen carbonate indicator to turn yellow. The apparatus was kept at a constant temperature of 20 °C.
The results are shown in the table below.

Organism	Time taken for the hydrogen carbonate indicator to turn yellow (min)
earthworm	22
woodlouse	18
grasshopper	10
mouse	3

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(a) Explain why the hydrogen carbonate indicator changed colour in this experiment. [2]

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(b) Give **two** reasons why the hydrogen carbonate indicator turned yellow fastest with the mouse. [2]

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(c) The experiment was performed at a temperature of 20 °C. [2]

State **two** other variables that need to be controlled when comparing the respiration rates of different organisms.

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(d) Describe how you would set up a control for this experiment and state the expected result. [3]

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Turn over.

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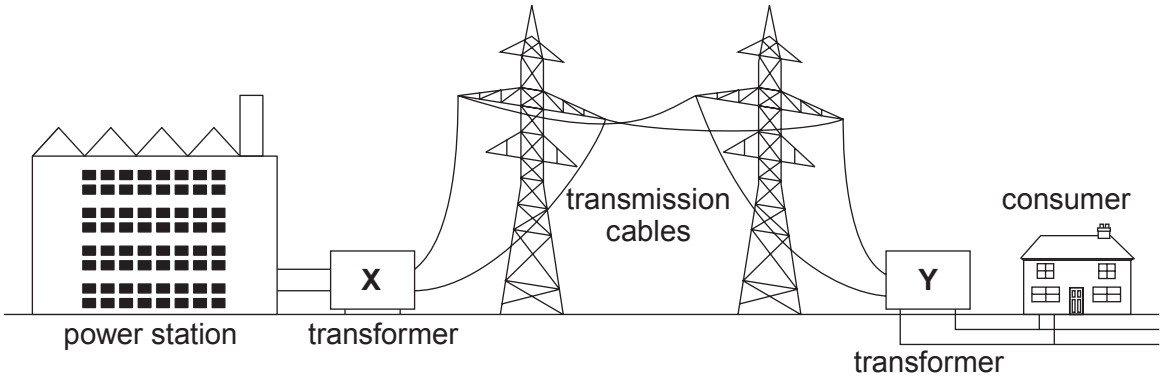
3. A diagram of part of the National Grid is shown below.



(a) Describe the role of the National Grid. [2]

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(b) Explain why transformers **X and Y** are used in the National Grid. [4]

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(c) Not all consumers can access the National Grid. An isolated farm with 5 sheds, in a rural part of mid-Wales is not connected to the National Grid.

The farmer needs to generate electricity for his sheds and he chooses a biomass generator that uses wood chips and pellets as an energy source and has a capacity of 100 kW.

Each of the sheds is supplied with 230 V with a maximum current of 80 A.

The farmer thinks that this generator will supply enough power for his 5 sheds.

(i) Use the equation:

$$\text{current} = \frac{\text{power}}{\text{voltage}}$$

to determine if the 100 kW generator will be able to supply the 5 sheds. [4]

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(ii) Explain the environmental advantages of using the biomass generator. [3]

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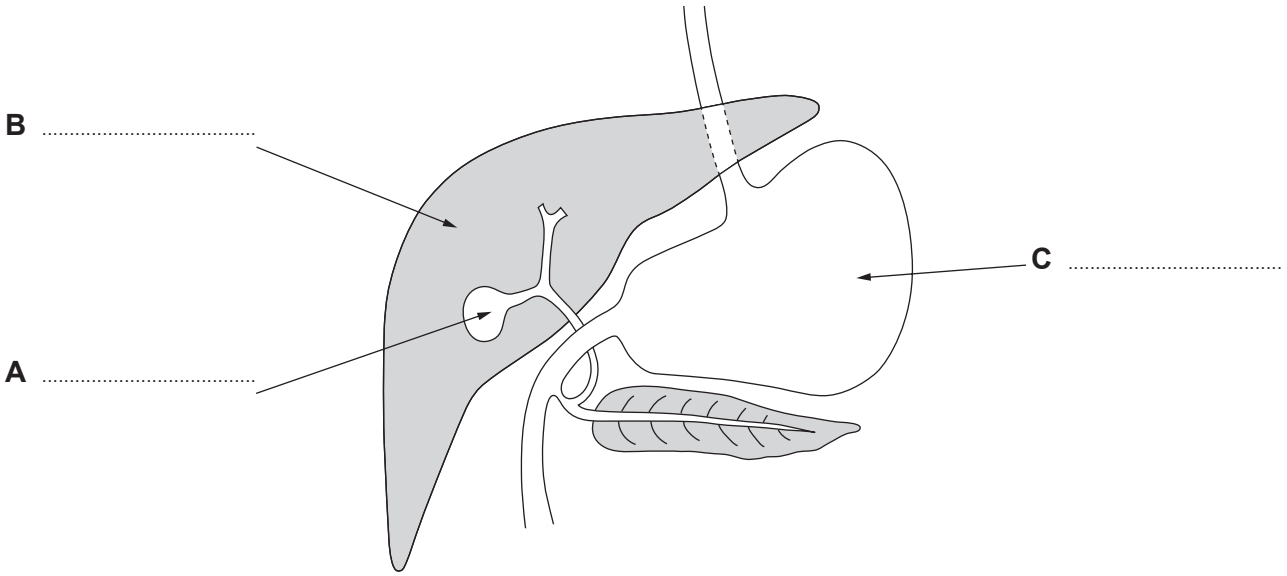
4. Food provides energy for the body. The digestive system is adapted to break down and absorb food. Parts of the digestive system are responsible for the digestion of foods by specific enzymes. The pH varies in these parts to aid the action of these enzymes in the digestion of the food.

(a) The diagram below shows part of the digestive system.



(i) Label parts **A**, **B** and **C**. [3]

(ii) Name the organ that secretes the enzyme lipase. [1]

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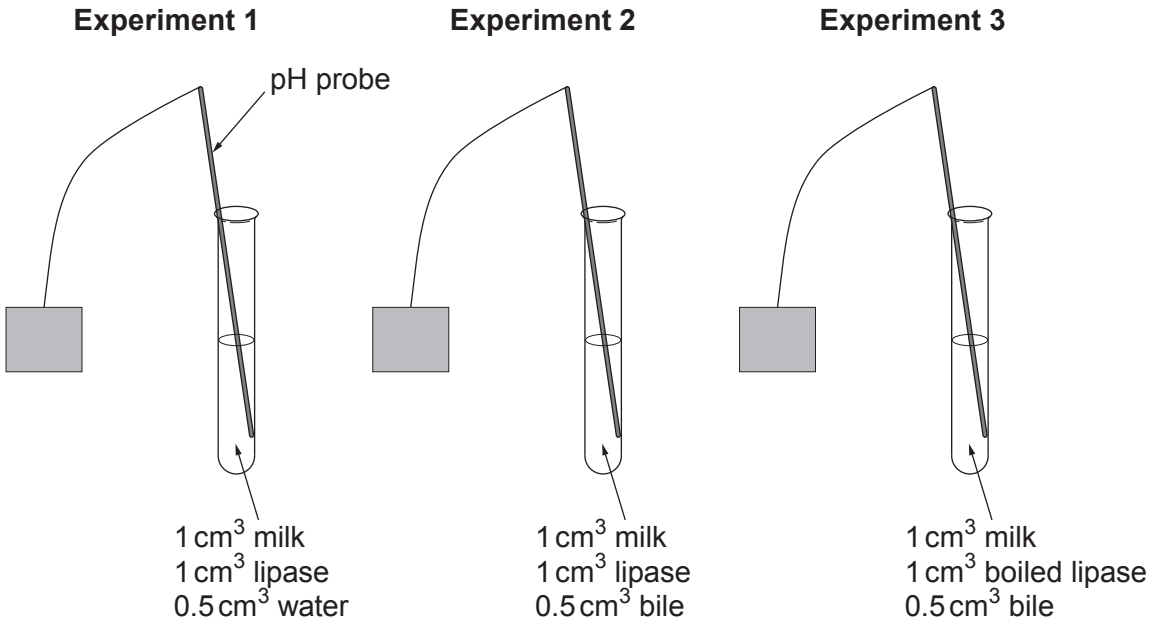
(b) A group of students was investigating the digestion of milk fat by the enzyme lipase. Lipase has an optimum pH of 10.

The students set up three experiments.

- In each experiment they mixed an alkaline solution of milk with lipase and either bile or water.
- They used the same volume of milk, lipase and bile or water in each experiment.
- They recorded the pH after mixing for 5, 10 and 20 minutes.



In each experiment the pH was recorded. The results of the experiments are shown in the table below.

Time (minutes)	pH		
	Experiment 1	Experiment 2	Experiment 3
0	10	10	10
5	10	8	10
10	9	7	10
20	8	6	10

Examiner only

(i) Explain the pH changes in experiments **1** and **2**. [4]

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(ii) Explain the pH recorded in experiment **3**. [2]

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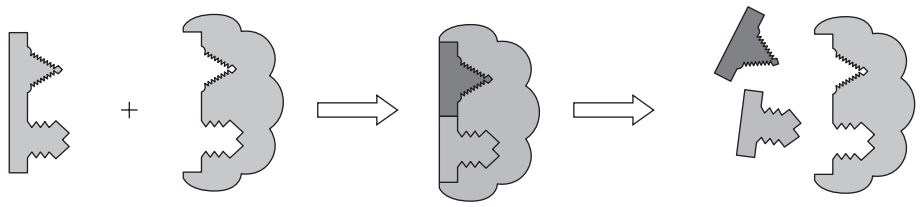
(c) The diagram below shows a model used to explain enzyme action.



Explain how this model works in relation to the digestion of lipids. [3]

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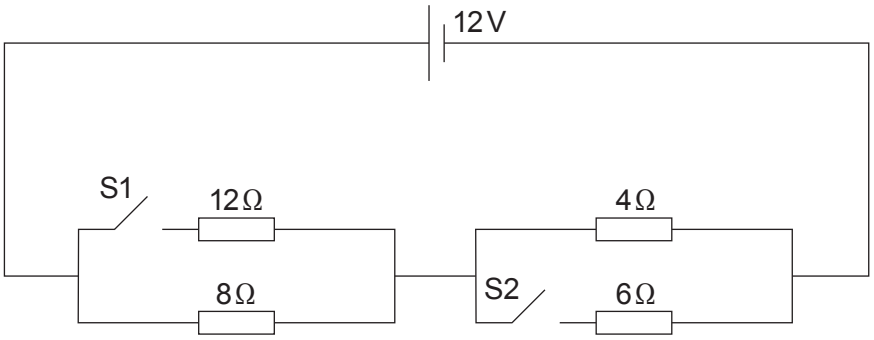
5. Students investigated the following electrical circuits.



Select the appropriate equations to answer the following questions.

voltage = current × resistance

$R = R_1 + R_2$

power = current^2 × resistance

$$\frac{1}{\text{total resistance}} = \frac{1}{\text{total resistance X}} + \frac{1}{\text{total resistance Y}}$$

(a) Calculate the current supplied when both switches are open. [3]

Current = ... A

(b) (i) Calculate the total resistance in the circuit when both switches are closed. [3]

Total resistance = ... Ω

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(ii) Calculate the power dissipated as heat by the 12 Ω resistor. [3]

Power = ... W

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6. Water treatment is an important process in producing water for drinking. Temporary hard water contains calcium hydrogen carbonate $Ca(HCO_3)_2$ and magnesium hydrogen carbonate $Mg(HCO_3)_2$. Boiling breaks down the hydrogen carbonate to form insoluble carbonates. It is an inexpensive method used to soften temporary hard water.

(a) (i) Complete the equation below to show this process. [2]

$Ca(HCO_3)_2 \longrightarrow$ ..... + ... + H_2O

(ii) Explain why permanent hard water cannot be softened by boiling. [2]

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(b) The addition of sodium carbonate or passing water through an ion exchange column can be used to soften temporary and permanent hard water.

Explain how the following methods soften water.

(i) Addition of sodium carbonate. [2]

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(ii) Passing water through an ion exchange column. [2]

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(c) State **one** disadvantage other than cost associated with an ion exchange column. [1]

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(d) Describe the effects of hard water on the central heating system in a house. [2]

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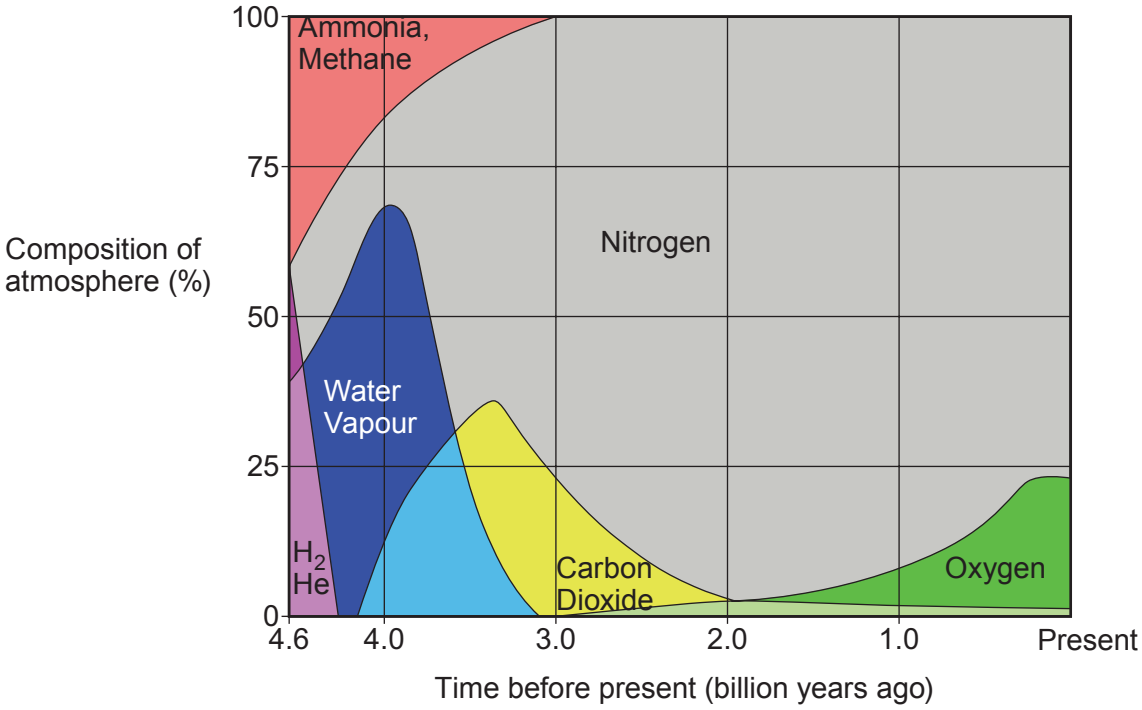
7. The graph below shows how the composition of the atmosphere has changed over time, since the formation of the Earth 4.6 billion years ago.



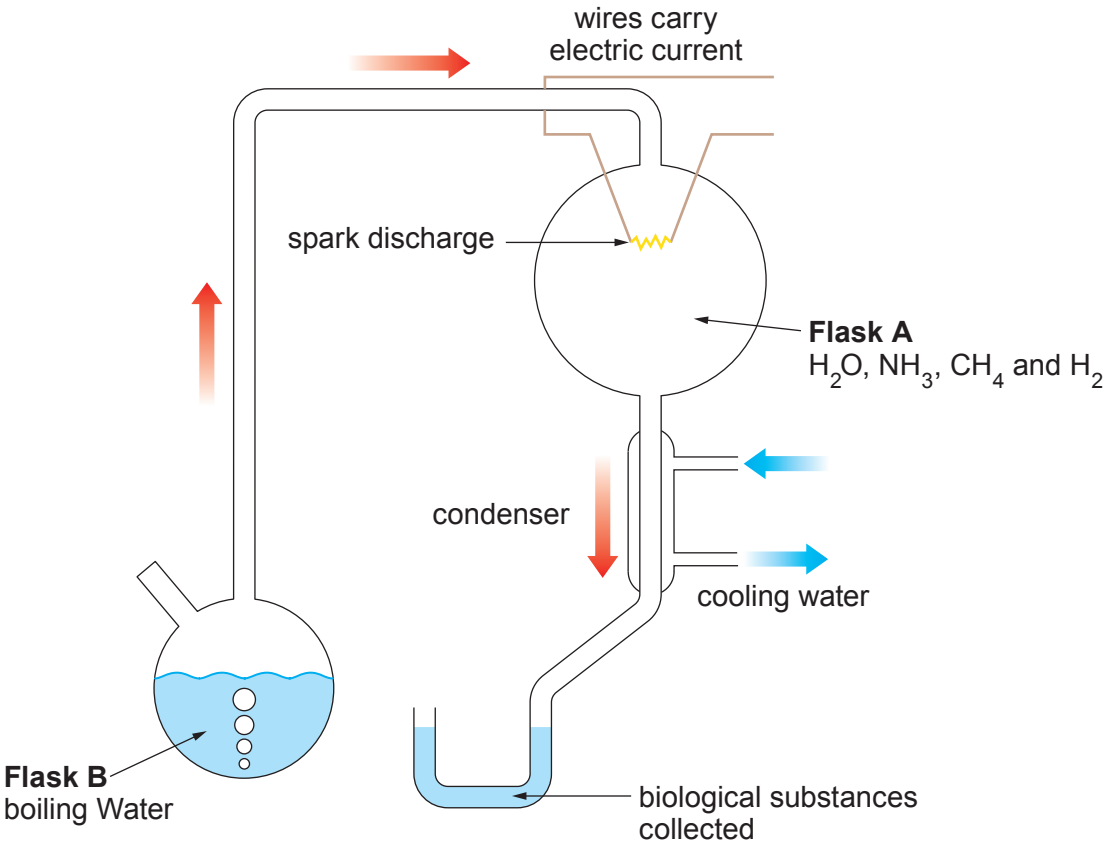
(a) Describe and explain how the composition of the atmosphere has changed over time. [6 QER]

Examiner only

Examiner only

(b) In 1952 two scientists, Stanley Miller and Harold Urey, carried out experiments to see if the building blocks of common biological substances like carbohydrates (e.g. $C_6H_{12}O_6$), fatty acids (e.g. $CH_3(CH_2)_{17}COOH$), and amino acids (e.g. H_2NCH_2COOH) could be formed in the atmosphere of early Earth.

The scientists set up the apparatus shown below.



(i) Explain why Miller and Urey, chose the gases in **Flask A**. [2]

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(ii) Use the information in the diagram to state **two** assumptions that Miller and Urey made about the early Earth other than the composition of the atmosphere. [2]

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END OF PAPER

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THE PERIODIC TABLE

1	2	Group										3	4	5	6	7	0
							1 H Hydrogen 1										4 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	63.5 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
86 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57	179 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89															

Key