Surname	Centre Number	Candidate Number
Other Names		0

GCSE – NEW

3445U10-1

S18-3445U10-1

APPLIED SCIENCE (Double Award)

UNIT 1: Energy, Resources and the Environment

FOUNDATION TIER

WEDNESDAY, 13 JUNE 2018 – MORNING

1 hour 30 minutes

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

3445U101
01

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 **3***(b)*(i) 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 24.

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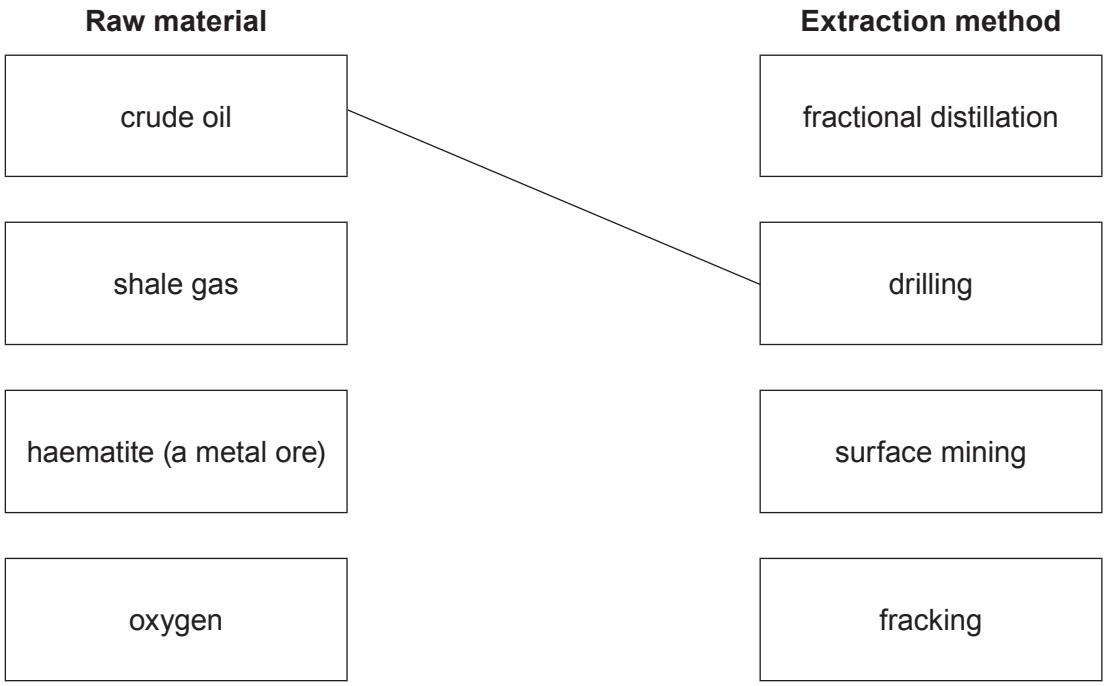
Examiner only

Answer **all** *questions.*

1. Raw materials are extracted from the Earth's crust or atmosphere by different methods.

(a) Identify the correct extraction method for each raw material by drawing a line. *One has been done for you.* [2]



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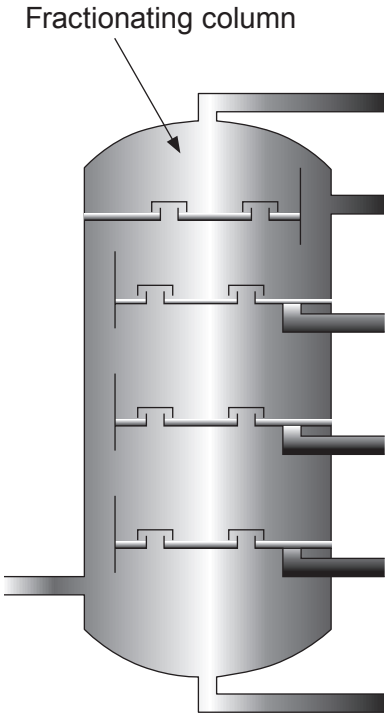
(b) A fractionating column is used to separate the hydrocarbons in crude oil. The table shows information about some of the fractions obtained.



Fraction	Carbon chain length	Boiling range (°C)
Refinery gases	1-4	<40
Petrol	5-8	40-110
Naphtha	8-10	110-180
Kerosene	10-16	.....
Diesel	16-20	260-320
Fuel oil	20-50	320-400
Bitumen	>50	>400

(i) **Complete** the table. [1]

(ii) Name the process which is used to separate crude oil into its fractions. [1]

.....

(iii) State what happens to the crude oil immediately before it enters the column. [1]

.....

(iv) State the fraction that a hydrocarbon with a boiling point of 290 °C will belong to. [1]

.....

Examiner only

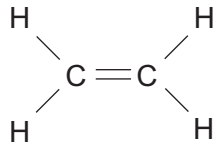
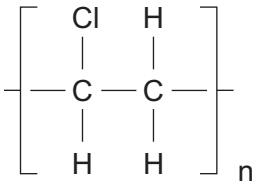
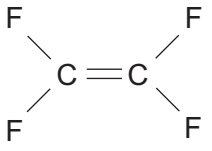
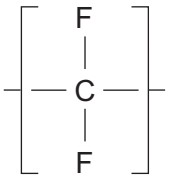
(c) Compete the statements below by underlining the correct term in the brackets.

(i) The temperature (***increases, stays the same, decreases***) going up the fractionating column. [1]

(ii) The boiling point of a hydrocarbon (***increases, decreases, stays the same***) as the chain length increases. [1]

(d) The fractionating column produces hydrocarbons that can be further processed and used to make plastics.

Complete the table to show how polyethene, polychloroethene (PVC) and polytetrafloroethene (PTFE) are made. [3]

Monomer			Polymer	
Name	Molecular formula	Structural formula	Name	Structure
Ethene	C_2H_4		polyethene	
Chloroethene	C_2H_3Cl		PVC	
Tetrafloroethene			PTFE	

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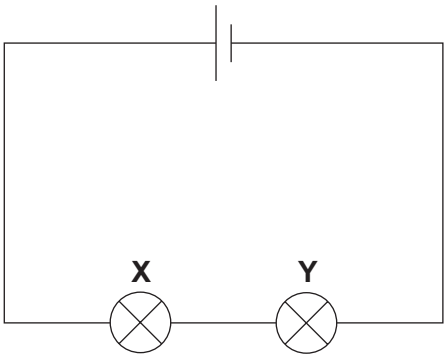
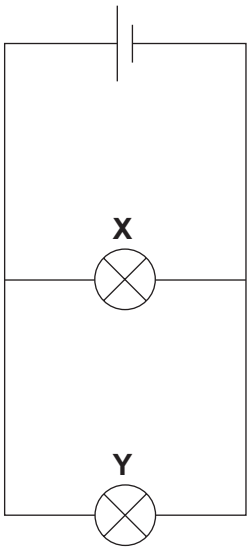
2. A student is studying the properties of different electrical circuits. **X** and **Y** are identical lamps.

The student built the following circuits.

Circuit 1



Circuit 2



(a) Complete the sentences using the terms in the box.
The terms can be used once, more than once or not at all.

series	less than	parallel	the same as
greater than	simple	current	voltage

(i) The lamps in **circuit 1** are connected in ..... .

The current through lamp **X** is .....the current through lamp **Y**. [2]

(ii) The lamps in **circuit 2** are connected in ..... .

The current through lamp **X** is .....the current through lamp **Y**. [2]

Examiner only

(b) In **circuit 1** the voltage supplied is 9 V. Each lamp has a resistance of 3 Ω.

(i) Use the equation:

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

to calculate the current in this circuit. [3]

Current = ... A

(ii) State what would happen to the current in **circuit 1** if lamp **Y** is removed and the circuit was built with only lamp **X**. [1]

.....

(c) In **circuit 2** the voltage supplied is also 9 V and each bulb has a current of 3 A.

Use the equation

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

to calculate the power of lamp **X**. [2]

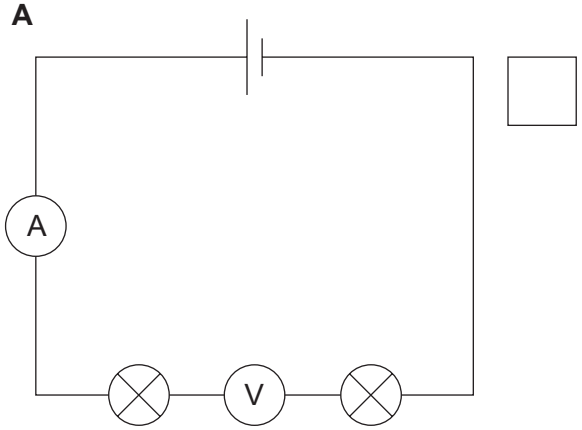
Power = ... W

Examiner only

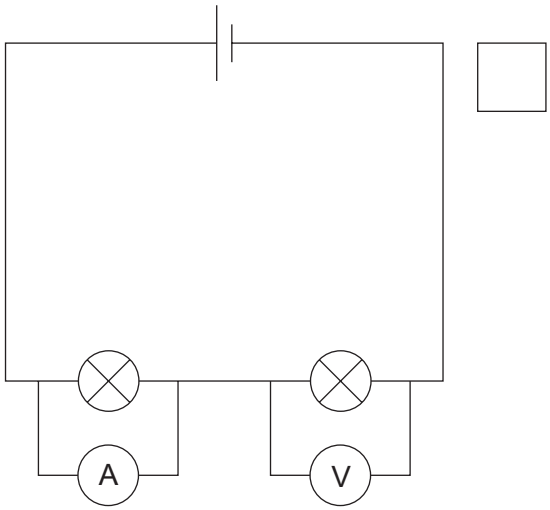
(d) The student set up a circuit to measure the current and voltage correctly.

Use a tick (✓) to identify the circuit diagram that should have been used to measure the voltage. [1]

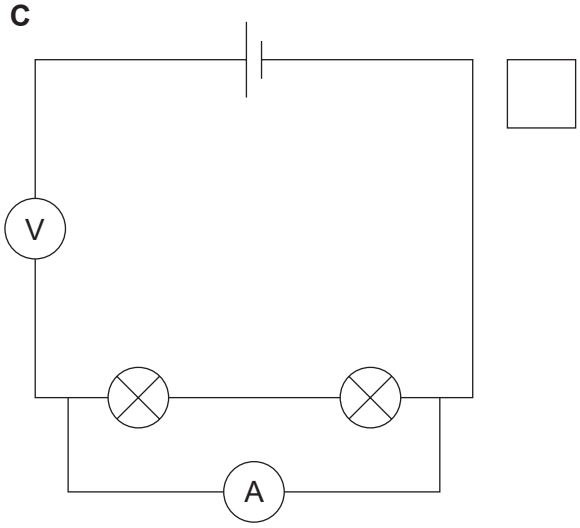
A



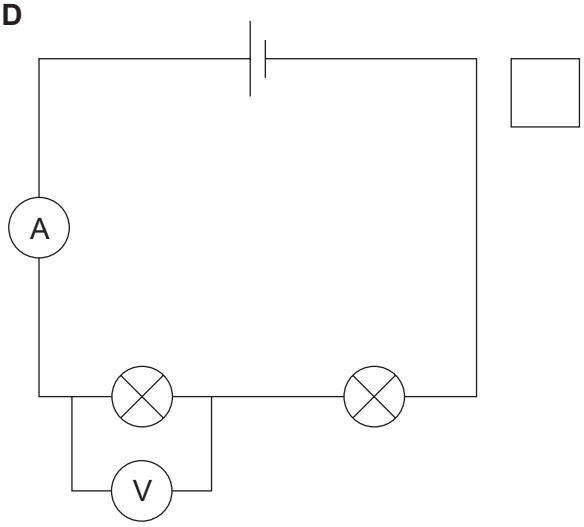
B



C



D



(e) State **two** reasons why lamps are connected in parallel rather than in series in the home. [2]

1. .....

2. .....

13

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3. Water treatment in the UK is an important process in making water safe to drink.

(a) In an experiment to determine the hardness of water in different parts of the country, different technicians tested water samples from Bristol, Birmingham, Manchester and Southampton.

They divided the water samples from each city into two and carried out Test A and Test B on each portion.

Test A

For the **first** portion they followed the method below.

1. Measure 15 cm^3 of water sample into a boiling tube.
2. Add 1 cm^3 of soap solution, insert a stopper then shake vigorously for 5 seconds.
3. Repeat step 2 until lather forms that lasts for 30 seconds. Record the total volume of soap solution added.
4. Repeat steps 1-3 with 15 cm^3 of the other samples of water.

Test B

For the **second** portion they followed the method below.

- Boil the water for 10 minutes.
- Then follow steps 1-4 in **Test A**.

(i) State the dependent variable in the experiment. [1]

.....

(ii) How could the reproducibility of the experiment be checked? [1]

.....

Examiner only

(b) The results of the experiment are shown below.

Sample	Volume of soap used to form lather (cm^3)	
	Test A (without boiling)	Test B (after boiling)
Birmingham	1	1
Southampton	11	1
Bristol	12	12
Manchester	1	1

(i) Explain how the technicians used the results to make conclusions about the type of water in **each city**. [6 QER]

(ii) Hard water can cause problems in the home.

State **two** problems hard water can cause. [2]

1. .....

2. .....

10

Turn over.

Examiner only

4. Enzymes are involved in all metabolic reactions.

(a) (i) State the **type** of biological molecule that all enzymes are made of. [1]

.....

Enzymes can break down larger molecules into smaller units in the digestive system.

mouth	amylase	lipase	liver
large intestine	amino acids	fibre	stomach

Enzyme	Larger molecules	Smaller units	Site of action
Carbohydrase	Starch	Glucose	..... and small intestine
.....	Fats and oils	Fatty acids and glycerol	small intestine
Protease	Protein	.....	..... and small intestine

(ii) **Complete the table** using only the words in the box. [4]

Examiner only

(b) Students investigated the effect of temperature on the digestion of starch.

The students mixed starch and amylase (a carbohydrase) at different temperatures.

They used iodine to test for the presence of starch. Iodine changes colour from brown to blue-black if starch is present.

The results of the students' investigation are shown below.

Temperature of the solution (°C)	Colour of the solution					
	at start	after 1 min	after 2 min	after 3 min	after 4 min	after 5 min
20	blue-black	blue-black	blue-black	blue-black	blue-black	blue-black
30	blue-black	blue-black	blue-black	blue-black	blue-black	brown
40	blue-black	brown	brown	brown	brown	brown
50	blue-black	blue-black	brown	brown	brown	brown
60	blue-black	blue-black	blue-black	brown	brown	brown
70	blue-black	blue-black	blue-black	blue-black	brown	brown
80	blue-black	blue-black	blue-black	blue-black	blue-black	blue-black

(i) Describe how temperature affects the digestion of starch between **20 °C** and **70 °C**. [3]

.....

.....

.....

.....

.....

.....

(ii) Explain the results at **80 °C**. [2]

.....

.....

.....

Examiner only

(c) When starch is completely broken down by amylase the final product is glucose.

(i) Describe the test that the students need to perform to show the presence of glucose. [2]

.....

.....

.....

(ii) State the colour **change** that shows that glucose is present. [1]

.....

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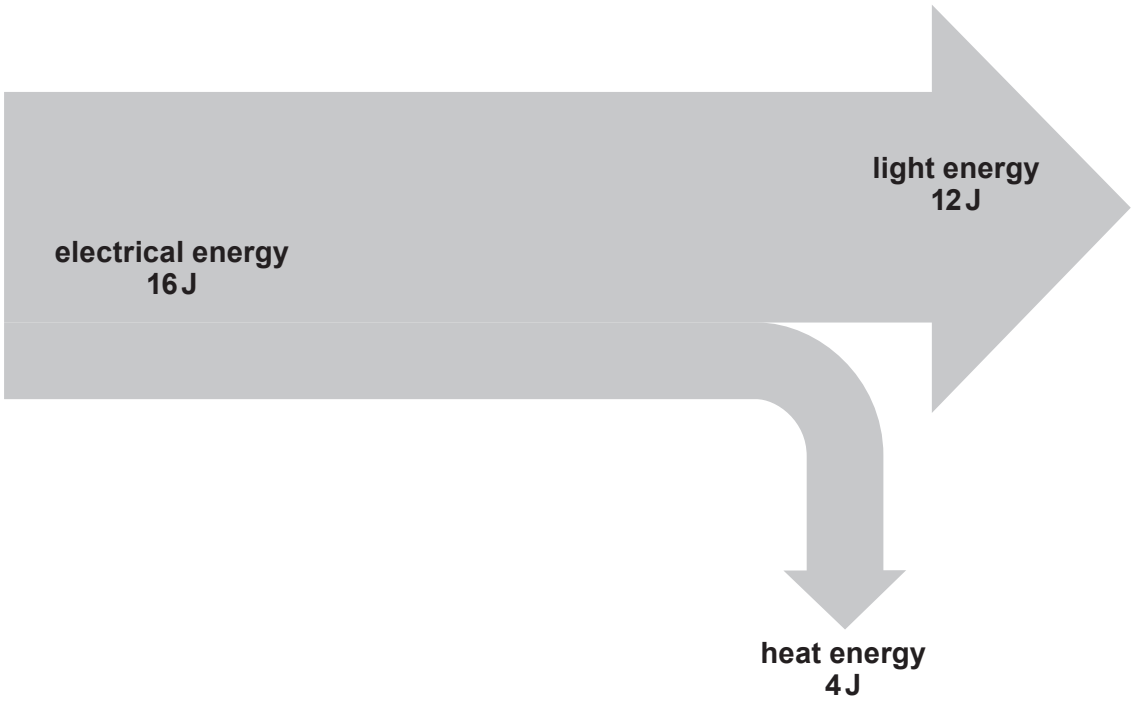
5. Lighting a home accounts for 18 % of a typical house's electricity bill.

(a) The diagram below shows energy flow through a LED lamp.



Use the equation:

$$\% \text{ Efficiency} = \frac{\text{energy usefully transferred}}{\text{total energy}} \times 100$$

to calculate the efficiency of the LED lamp. [2]

% Efficiency = ...

Examiner only

(b) The Energy Trust is an organisation in the UK that encourages householders to become more efficient in their energy use and to help to reduce their energy costs. The table below compares traditional filament and LED lamps.

	LED	Traditional filament lamp
cost of 1 lamp	£2.50	£1
lamp lifespan (hours)	50 000	1000
number of lamps used in 50 000 hours	1	.....
cost of lamps used in 50 000 hours	£2.50	£ .....
power per lamp (kW)	0.01	0.06
units used in 50 000 hours (units = power × 50 000)	.....	3 000
cost of one unit	20p	20p
cost of electricity for light for 50 000 hours = units used × cost of unit	£	£600
total cost of light for 50 000 hours	£102.50	£ .....

(i) **Complete** the table. [5]
(space for working)

(ii) The homeowner refuses to buy LED lamps because they are more expensive and he thinks he will lose money compared to using traditional filament lamps.

Explain whether you agree with the homeowner. [2]

.....

.....

.....

Examiner only

6. 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]

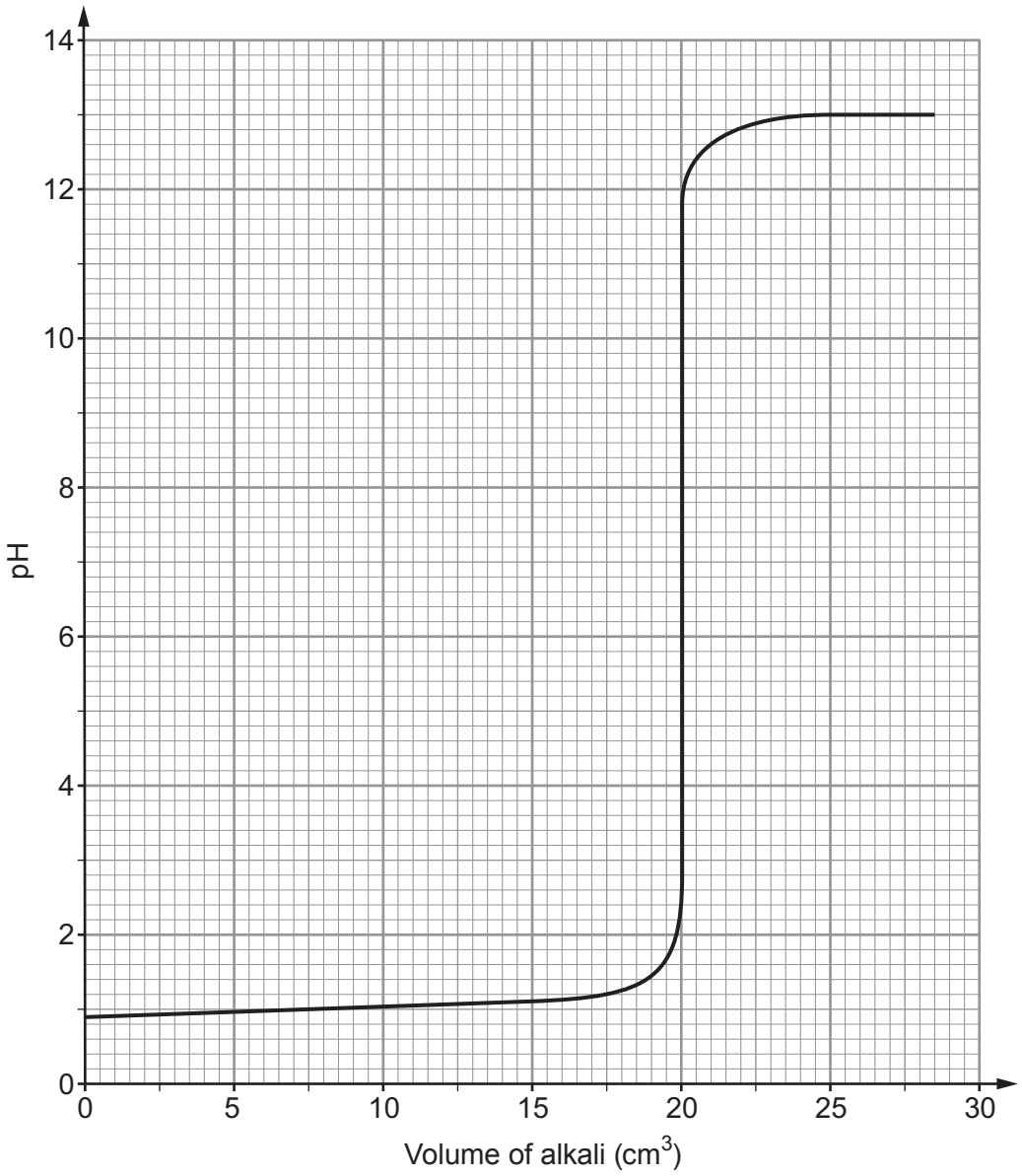
.....

(ii) Calculate the mean titre. [1]

Mean titre = ... cm^3

Examiner only

(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]

.....

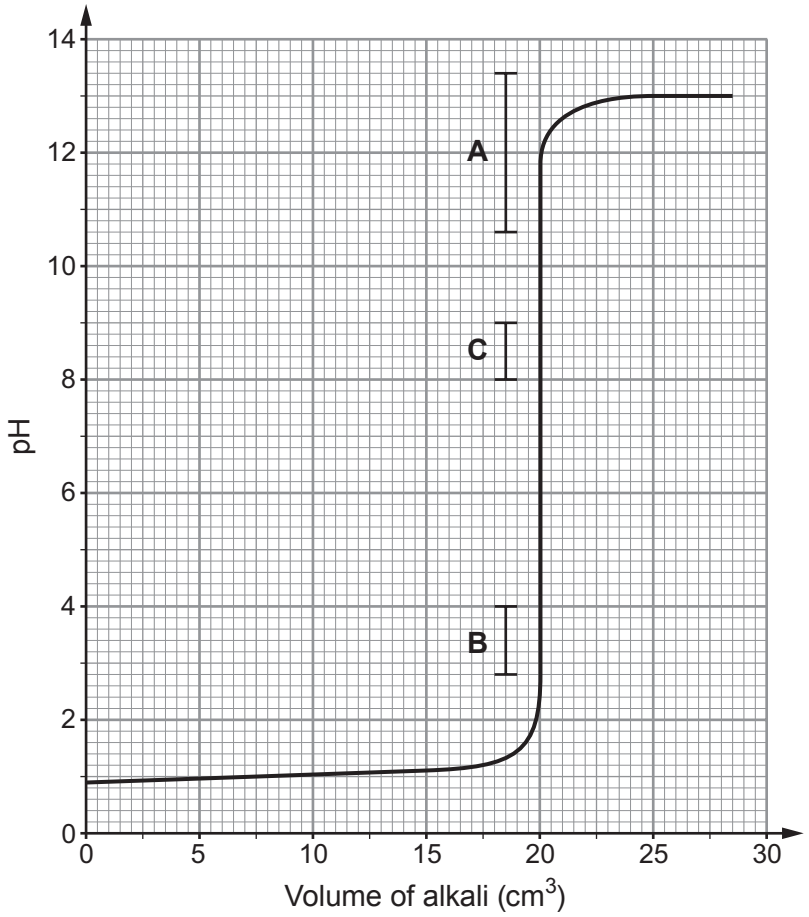
.....

.....

.....

Examiner only

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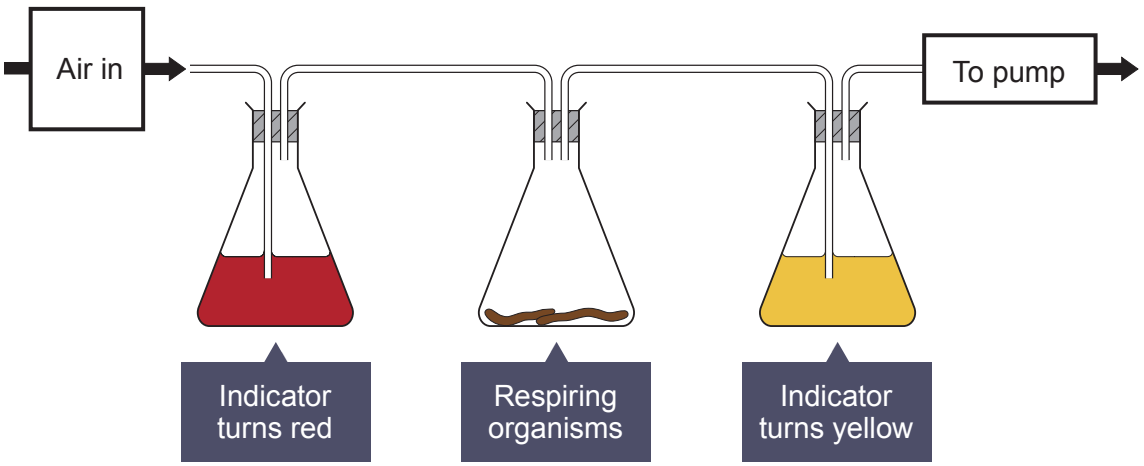
7. Hydrogen carbonate indicator can be used to measure the rate of respiration.

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

Examiner only

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

.....

.....

.....

.....

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

.....

.....

.....

.....

(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.

.....

.....

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

.....

.....

.....

.....

.....

.....

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END OF PAPER

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