Surname	Centre Number	Candidate Number
Other Names		0

GCSE – NEW

3445U10-1

S17-3445U10-1

APPLIED SCIENCE (Double Award)
Unit 1: Energy, Resources and the Environment
FOUNDATION TIER

WEDNESDAY, 14 JUNE 2017 – MORNING

1 hour 30 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**3**	
2.	**8**	
3.	**13**	
4.	**14**	
5.	**18**	
6.	**19**	
Total	**75**	

3445U101
01

ADDITIONAL MATERIALS

In addition to this paper you will require a calculator, pencil 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 5*(a)*(ii) is a quality of extended response (QER) question where your writing skills will be assessed.

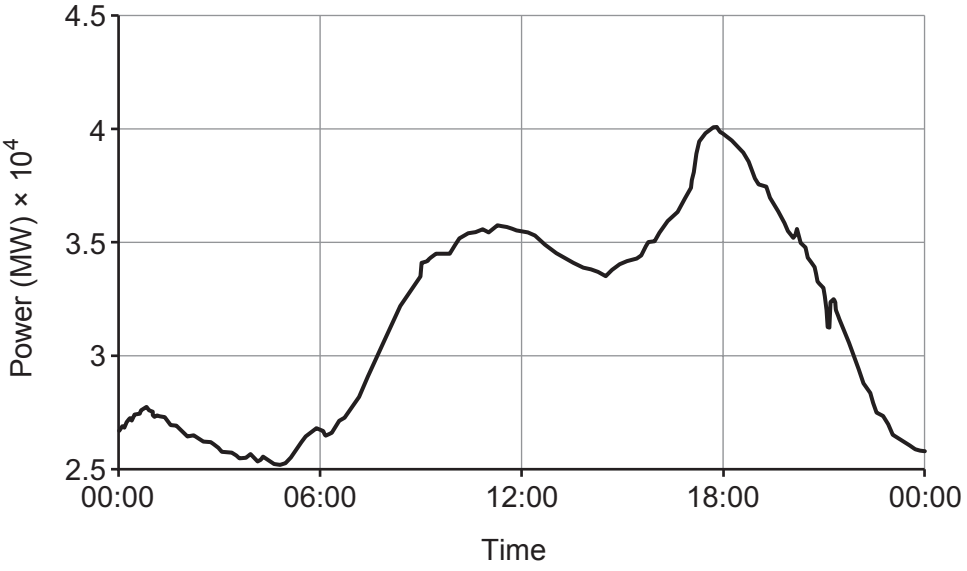
You are reminded to show all your workings. Credit is given for correct workings even when the final answer given is incorrect.

A periodic table is printed on page 20.

Examiner only

Answer **all** *the questions in the spaces provided.*

1. The graph below shows how demand for electricity from the National Grid changed over a 24 h period on 23rd October 2011.



(a) Describe how demand changed between 12:00 and 18:00. [2]

.....

.....

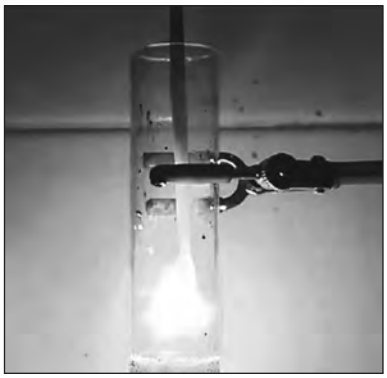
(b) Hydroelectric power stations only produce electricity when there is a surge in demand. However water needs to be pumped back up at some time during the 24 h period when demand is below 3×10^4 MW and falling. Mark an **X** on the graph to show where this could be done. [1]

3

Examiner only

2. Magnesium oxide helps prevent scale formation in boilers, heat exchangers, and piping.

Burning magnesium in a gas jar of oxygen produces magnesium oxide on a small scale.



(a) The symbol for oxygen is $^{16}_{8}O$.

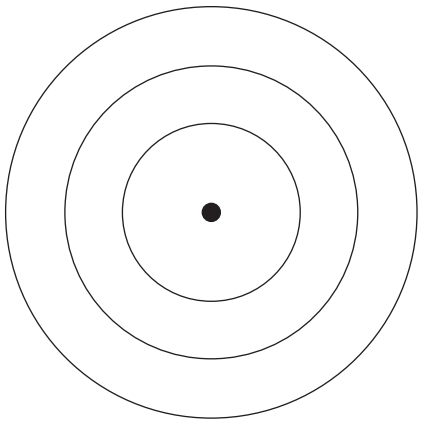
Complete the following statements about an atom of oxygen. [3]

An oxygen atom contains ..... electrons.

An oxygen atom contains ..... neutrons.

An oxygen atom contains ..... protons.

(b) An atom of magnesium contains 12 electrons. Complete the diagram to show the electronic structure of a magnesium atom. [1]



3445U101 03

Examiner only

(c) State what happens to a magnesium atom when it becomes a magnesium ion. [1]

.....

(d) **Complete** the balanced symbol equation for the following reaction. [3]

magnesium + oxygen ⟶ magnesium oxide

□ ..... + O_2 ⟶ □ .....

8

BLANK PAGE

Examiner only

3. The halogens are a group of elements found in group 7 of the periodic table. The table below gives some information about the elements in this group.

Halogen	Atomic number	Melting point (°C)	Boiling point (°C)	Radius of the atom (units)
fluorine	9	–219	–188	(0.64 / 1.1 / 1.7)
chlorine	17	**(–5 / –101 / –220)**	–34	0.99
bromine	35	–7	59	**(1.14 / 1.45 / 1.56)**
iodine	**(22 / 31 / 53)**	114	184	1.33
astatine	85	302	380	1.40

(a) **Complete** the table above by **circling** the correct value in each of the brackets. One has been done as an example. [3]

(b) Use the information in the table and your own knowledge to answer the following questions.

(i) The boiling points of the alkali metals (group 1) decreases from the top to the bottom of their group. Describe whether the halogens follow the same trend. [2]

.....

.....

.....

(ii) State the **two** halogens in the table which are gases at 20°C. [2]

..... and .....

(iii) State which halogen is a liquid at 20°C. [1]

.....

(iv) State what happens to the size of the halogen atoms as you go down from the top to the bottom of the group. [1]

.....

Examiner only

(v) **Tick** (✓) the box next to the correct statements about halogens. [3]

Fluorine has the highest melting point	☐
The most reactive halogen is fluorine	☐
Astatine has the most electrons	☐
Iodine is a solid at 20°C	☐
The most reactive halogen is astatine	☐
Chlorine boils at a lower temperature than fluorine	☐

(c) Sodium chloride can be made by burning sodium in chlorine gas. However it is found naturally in rock salt, which can be obtained from the Earth's crust. **Tick** (✓) the box next to the correct process for extraction of rock salt from the Earth's crust. [1]

fracking	☐
deep shaft mining	☐
fractional distillation	☐
drilling	☐

3445U101
07

13

Examiner only

4. Rising gas prices are affecting many households. The government can help households keep their gas bills as low as possible.

Data for a typical house are shown below. The table also shows government estimates for the current usage of each method.

Part of house	Heat loss before insulation is fitted (%)	Method of reducing heat loss	Cost of method (£)	Annual saving on gas bills (£)	% of homes already using this method
roof	25	loft insulation	450	150	91
windows & doors	10	double glazing	3900	90	70
walls	40	cavity wall insulation	1200	250	42
floor	15	carpets	800	40	90
draughts	10	draught excluders	60	5	85

(a) A heating engineer estimates keeping the house with no insulation at 20°C results in gas bills of £2000 per year.

Use the information above to answer the following questions.

(i) Calculate the cost of the heat lost **through the roof**. [2]

cost = £ .....

(ii) State how the engineer's estimate will change if the home is kept at 22°C. [1]

.....

(iii) State how the engineer's estimate will change if the price of gas drops. [1]

.....

(iv) The engineer recommends that loft insulation should be installed first.

Calculate the payback time for loft insulation. [2]

payback time = ... years

Examiner only

(v) Which method of reducing heat loss should the government help people install by giving them a grant? Give **one** reason for your choice. [2]

.....

.....

.....

(b) At present, many homes with central heating lack a timer, sufficient hot water tank insulation, room thermostat and thermostatic radiator valves. Upgrading all homes so they have these four features could make savings of over 25% of the energy used for heating and hot water.

Fitting new hot water tank insulation, a room thermostat and thermostatic radiator valves reduces the annual gas bill for a house from £2000 to £1400.

(i) Calculate the percentage saving made to the gas bill. [2]

% saving = ...

3445U101 09

(ii) Use the equation:

$$\text{decrease in the number of units used} = \frac{\text{savings}}{\text{cost of one unit}}$$

to calculate the decrease in the number of units used. [2]
Assume each unit costs £0.20.

decrease in the number of units used = ... kWh

(c) State **two** ways in which using less gas to heat the house will benefit the environment. [2]

1. .....

2. .....

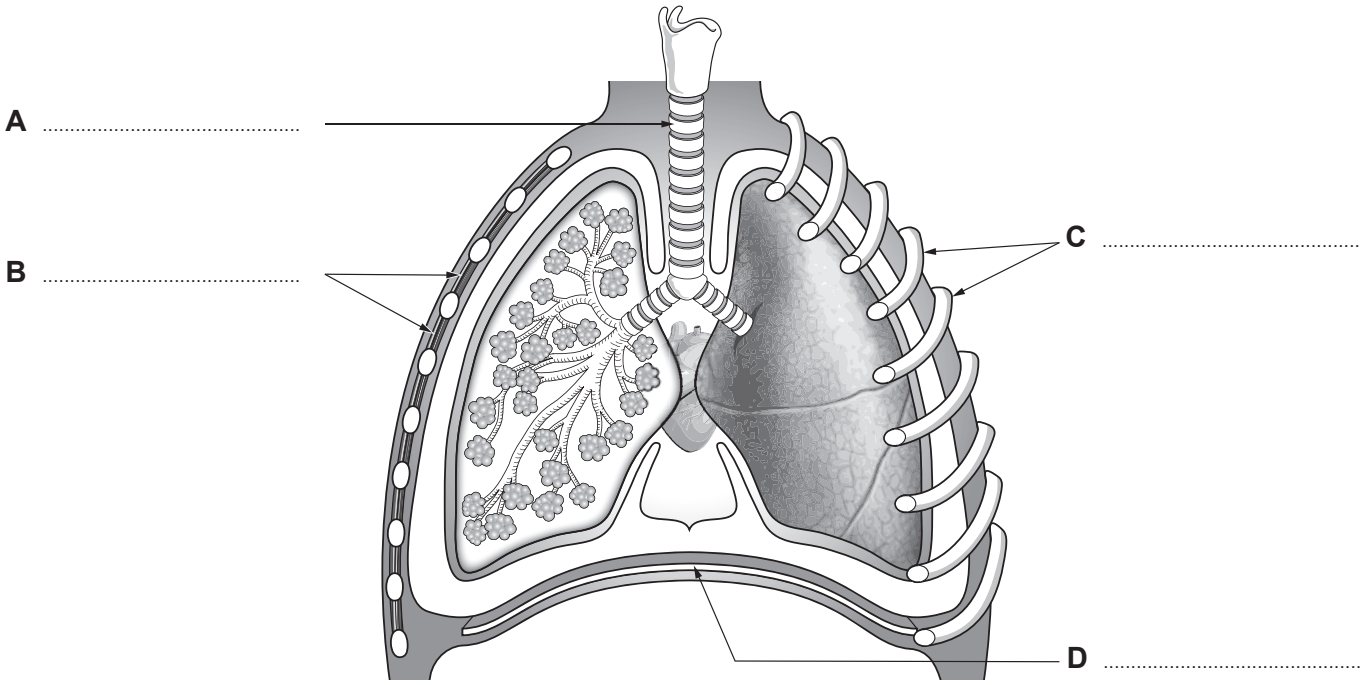
14

Examiner only

5. Sports science students are learning about the respiratory system.

(a) (i) Label the diagram below using words from the box. [4]

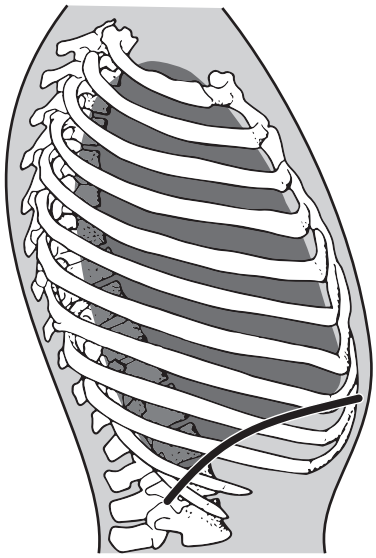
ribs	intercostal muscles	diaphragm	lung	trachea



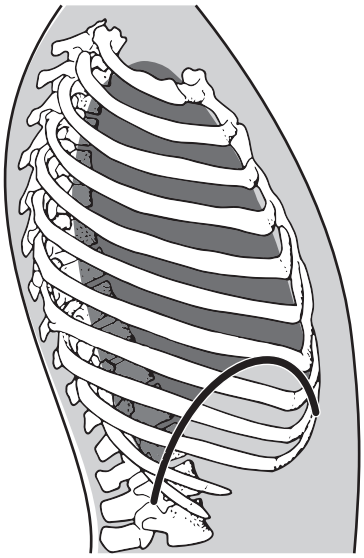
Examiner only

(ii) Use your knowledge and the diagrams below to describe how the changes in the diaphragm, ribcage and intercostal muscles allow you to breathe in and out.

[6 QER]



breathing in



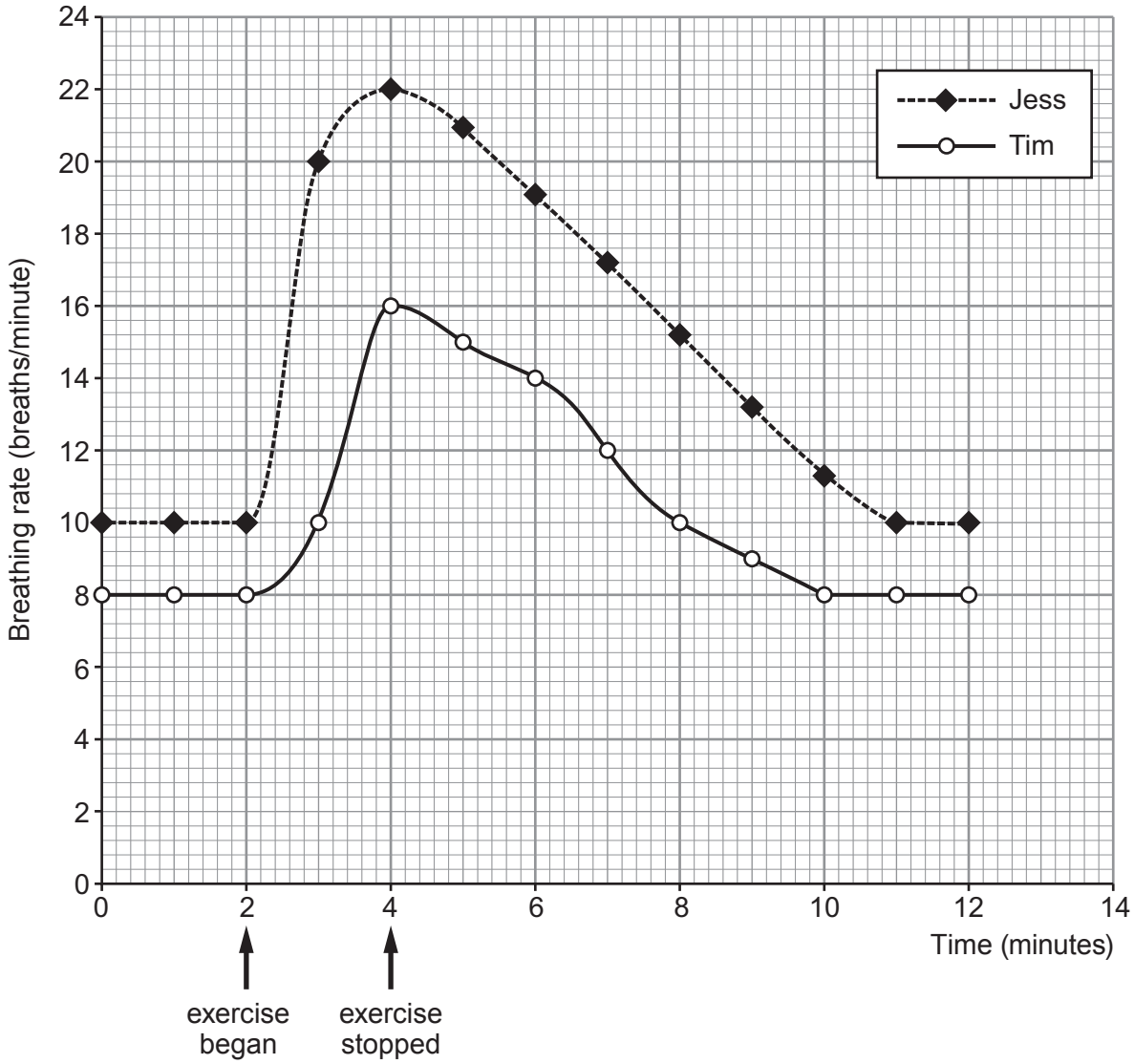
breathing out

Examiner only

(b) Two students, Tim and Jess, studied the effect of exercise on breathing rate. They followed the method below:

1. record breathing rate before exercising
2. exercise for 2 minutes by running on a treadmill
3. measure the breathing rates during and after exercise up until 12 minutes

Their results are shown on the graph below.



Use the graph to complete the following sentences. [3]

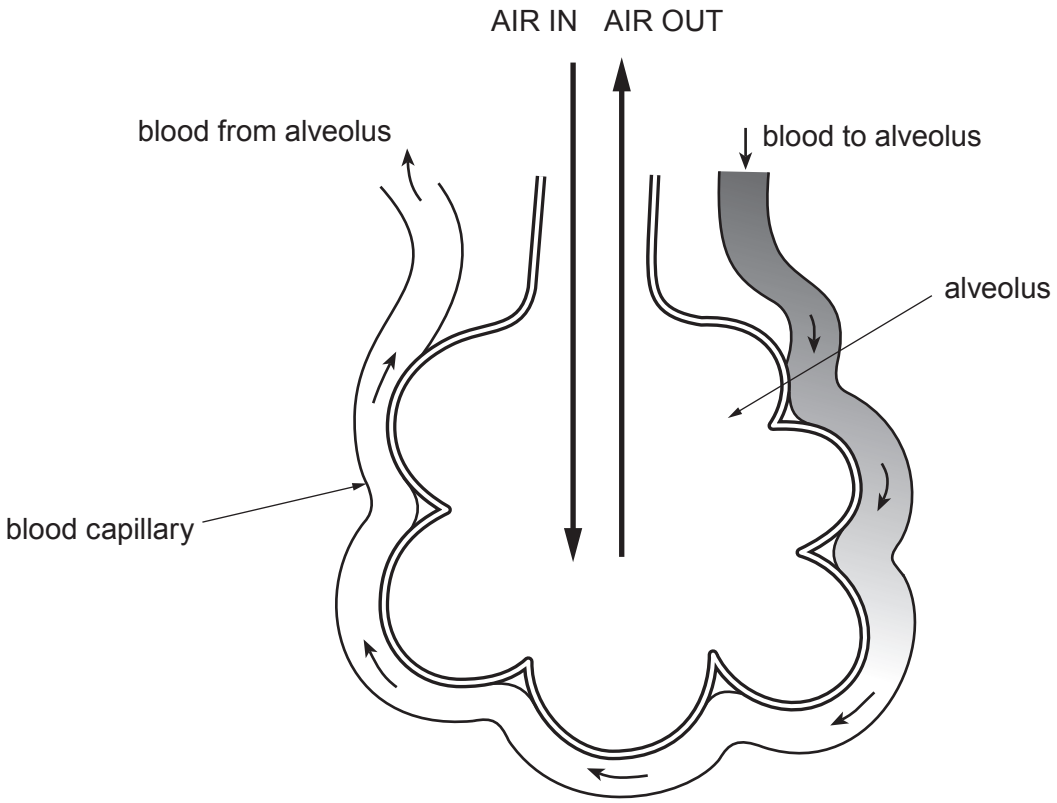
At 2 minutes, the difference between Tim and Jess' breathing rate is ..... breaths per minute.

Between 8 and 10 minutes Tim's breathing rate drops ..... than Jess' breathing rate.

Tim's breathing rate returns to normal at ..... minutes.

Examiner only

(c) The diagram below is of an alveolus within the lung where gases are exchanged.



(i) State which gases are exchanged. [2]

..... and .....

(ii) Name the process by which these gases move between the alveolus and the capillary. [1]

.....

(iii) State **two** ways in which the alveoli are adapted for gas exchange. [2]

1. .....

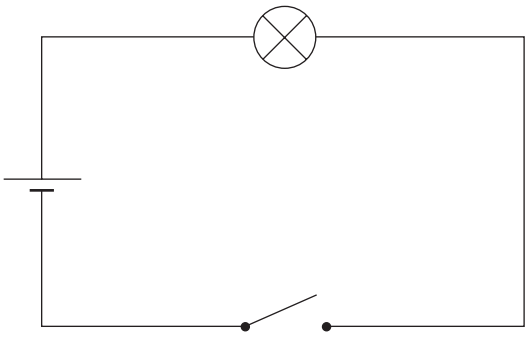
2. .....

18

Turn over.

Examiner only

6. Students are investigating how the current through a lamp varies with the voltage across it.



(a) (i) Part of the circuit used is shown above. **Add** a variable resistor, ammeter and voltmeter to the circuit diagram. [3]

(ii) Describe the method you would use to take a range of results. [3]

.....

.....

.....

.....

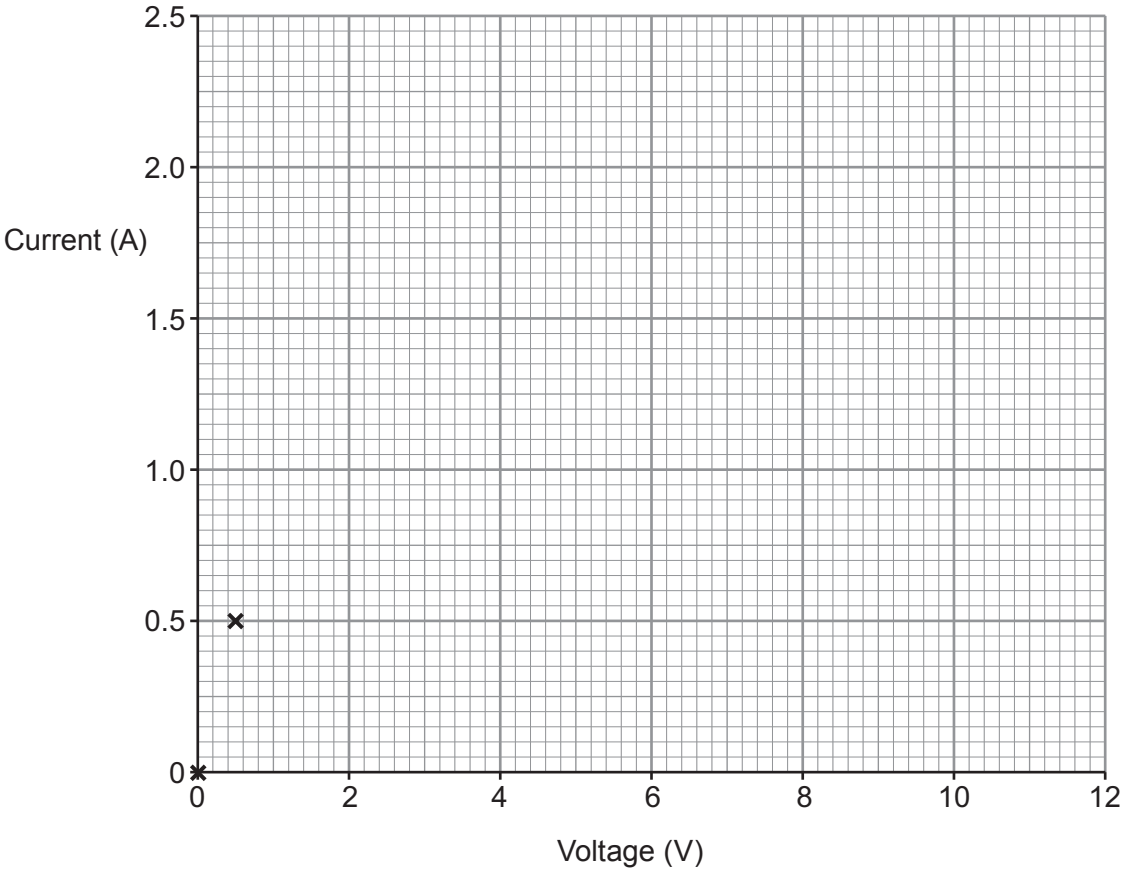
(b) Results from the experiment are shown below.

Voltage (V)	Current (A)
0.0	0.0
0.5	0.5
2.0	0.8
4.0	1.1
6.0	1.4
8.0	1.6
10.0	1.8
12.0	1.9

Examiner only

(i) Plot the data on the grid below and draw a suitable line. [3]

The first two points have been plotted for you.



(ii) Describe the relationship between current and voltage for the lamp. [2]

.....

.....

.....

(c) (i) Use the equation:

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

to calculate the resistance of the lamp at 0.5 V. [2]

resistance = ... Ω

Examiner only

(ii) State how the resistance of the lamp varies between 0.5 V and 12 V. [1]

.....

(d) (i) Use the equation:

power = voltage × current

to calculate the power of the lamp at 0.5 V. [2]

power = ... W

(ii) State how the power of the lamp varies between 0.5 V and 12 V. [1]

.....

(e) The experiment was repeated with a length of wire at constant temperature. The current through the wire was 1.5 A when the voltage across it was 12 V.

Add a line to your graph to show how current varies with voltage for this wire. [2]

19

END OF PAPER

BLANK PAGE

BLANK PAGE

BLANK PAGE

THE PERIODIC TABLE