Surname	Centre Number	Candidate Number
Other Names		0

GCSE – NEW

3440U10-1

S18-3440U10-1

APPLIED SCIENCE (Single Award)
UNIT 1: Science in the Modern World

FOUNDATION TIER

MONDAY, 11 JUNE 2018 – MORNING

1 hour 30 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**5**	
2.	**3**	
3.	**11**	
4.	**11**	
5.	**10**	
6.	**9**	
7.	**7**	
8.	**19**	
Total	**75**	

3440U101
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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 **6***(b)* 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** *questions.*

1. Chemical companies prepare compounds in their factories.

(a) Complete the general word equations for the reactions below. [3]

acid + metal ⟶ ..... + ...

acid + metal oxide ⟶ ..... + ...

(b) On an industrial scale, large quantities of solution need to be evaporated so that dry compounds can be collected. This is an expensive part of the process. During **one day**, an electric heater with a power of 15 kW is used for 7 hours.

(i) Use the equation:

units used = power (kW) × time (h)

to calculate the number of units used in one day. [1]

Units used = ... kWh

(ii) Use your answer in (i) and the equation:

total cost = cost of one unit × units used

to calculate the cost of using the heater for one day. [1]

One unit of electricity costs 20 p.

Cost = ... p

5

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2. Grey Treefrogs *(Hyla versicolor)* and Green Treefrogs *(Hyla cinerea)* are found in the United States of America. Grey Treefrogs prefer wooded areas while Green Treefrogs prefer more open wetland areas with leafy vegetation. Snakes and birds are predators of the two types of frog.

The photograph shows Grey and Green Treefrogs on the bark of a tree.

The distribution of the different types of Treefrog is due to natural selection. The process of natural selection is described by the statements below **but not in the correct order**.

Number	Statement
1	A Green Treefrog on the bark of a tree is easier to see
2	The number of Green Treefrogs decrease
3	Fewer Green Treefrogs have offspring
4	Less competition for Grey Treefrogs and fewer are eaten so their numbers increase
5	Green Treefrogs are more likely to be eaten by predators as they are not camouflaged

Sort the statements into the correct order by placing the numbers in the boxes below. [3]
One has been completed for you.

1	.....	.....	.....	.....

3

Examiner only

3. Theories about the origin of the Universe have changed over time. The Steady State theory of the Universe was widely accepted until the mid-20th century. It is now rejected by most astronomers.

(a) According to the Steady State theory the Universe always looks the same. State what this theory suggests happens as galaxies move further apart. [1]

.....

(b) An absorption spectrum from a star has a pattern of black lines on a coloured background.

wavelength (nm) ⟶

The boxes on the left list features of the spectrum.
The boxes on the right list the causes of these features.

(i) **Draw a line** from each feature to its cause. [3]

Feature	Cause
Pattern of black lines	Due to the gases in the star
Coloured background	Due to expansion of the Universe
Red shift of the black lines	Due to light emitted by the star
Each black line	Due to one wavelength being absorbed

(ii) Name the theory supported by red shift. [1]

.....

Examiner only

(c) The absorption spectra are observed using visible light. Visible light is one part of the electromagnetic (em) spectrum.

(i) Choose words from the box to complete the em spectrum shown below. [3]

microwaves	sound waves	infra-red waves	X-rays	cosmic rays

gamma rays	.....	ultraviolet	visible light	.....	.....	radio waves

(ii) Complete the sentences below by underlining the correct term in each of the brackets. [3]

Ultraviolet light travels (**slower than / at the same speed as / faster than**) radio waves in a vacuum.

Ultraviolet light has wavelengths that are (**shorter than / the same size as / longer than**) radio waves.

Ultraviolet light has frequencies (**lower than / the same as / higher than**) radio waves.

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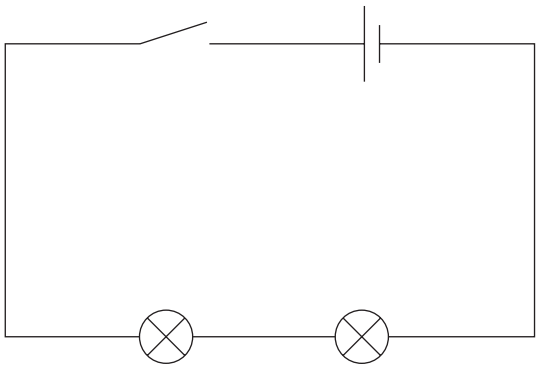
11

Turn over.

Examiner only

4. Electricians need to understand the differences between series and parallel circuits and how they behave.

(a) (i) **Add** a variable resistor to the series circuit below which can act as a dimmer to control the brightness of the lamps. [1]



(ii) Draw a circuit diagram to show two lamps connected in parallel to a battery. [1]

(b) Tick (✓) the boxes next to the **three** correct statements about these circuits. [3]

Connecting lamps in parallel instead of in series does not change the current ☐

As current passes through each lamp in series it gets smaller ☐

The voltage across each lamp in parallel is the same ☐

Connecting extra lamps in series decreases the current ☐

The current through the battery in the parallel circuit is the sum of the currents through each lamp ☐

The voltage across each lamp in series is the same as the battery voltage ☐

Examiner only

(c) A **series** circuit is set up using a battery and two lamps.
The battery voltage is 6 V and each lamp has a resistance of 12 Ω.

(i) Use the equation:

$$R = R_1 + R_2$$

to calculate the total resistance (R) of the two lamps. [1]

R = ... Ω

(ii) Use the equation:

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

to calculate the current in this series circuit. [2]

Current = ... A

(d) It is suggested that connecting two 12 Ω lamps **in parallel** causes the circuit resistance to be half as much as when there is only one 12 Ω lamp in the circuit.

Use the equation:

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

to explain whether this statement is true. [3]

.....

.....

.....

11

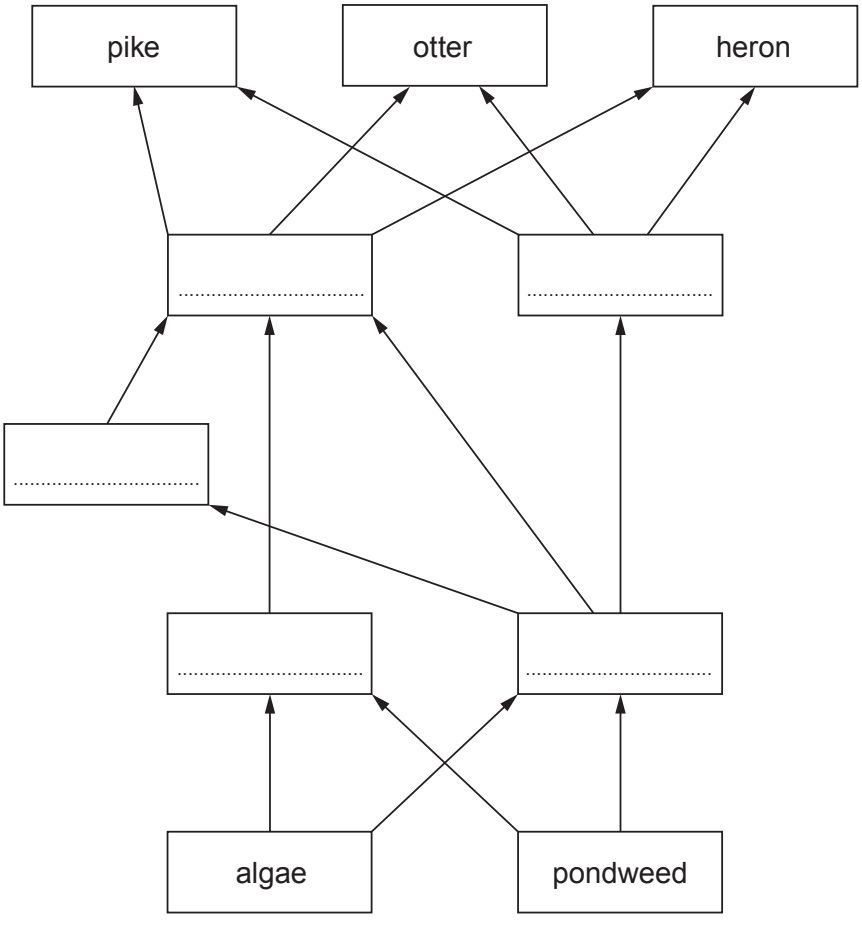
Examiner only

5. Natural Resources Wales is responsible for managing and monitoring water quality in Wales.

The number of organisms present in water is one indicator of pollution levels.
The feeding relationships in a healthy river are given in the table below.

Food source	Eaten by
pondweed	tadpole insect
algae	tadpole insect
insect	stickleback perch frog
tadpole	perch
stickleback	perch
frog	heron otter pike
perch	heron otter pike

(a) Use the information above to complete the food web below. [4]



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(b) (i) Name the source of energy for the food web. [1]

.....

(ii) Name **one** primary consumer in the food web. [1]

.....

(iii) Name **one** herbivore in the food web. [1]

.....

(iv) Name **one** carnivore that competes with herons. [1]

.....

(v) It is suggested that if all the frogs died from a disease then the number of perch would not be affected because they do not feed on frogs.

Explain whether you agree with this statement. [2]

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10

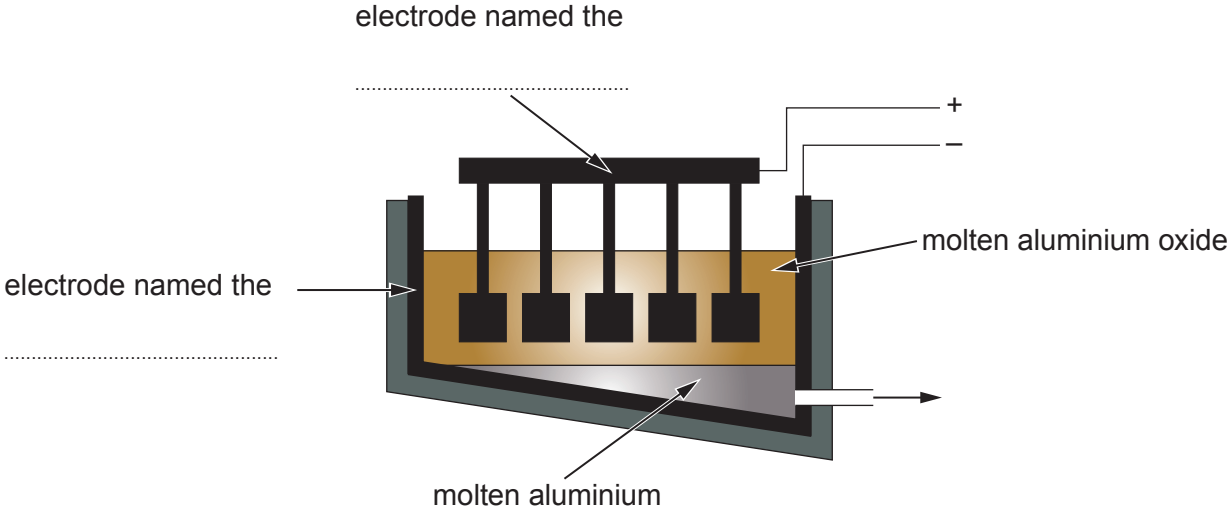
Turn over.

Examiner only

6. Population growth adds to pressure on the environment and an increasing demand on natural resources.

(a) Aluminium is expensive to produce. It is a very reactive metal and cannot be extracted by reducing with carbon. It is therefore extracted using electrolysis from aluminium oxide.

The diagram below shows how electrolysis of aluminium oxide is carried out.



(i) **Complete** the labelling of the electrodes on the diagram. [1]

(ii) Identify the electrode at which aluminium forms. Give **one** reason for your choice. [2]

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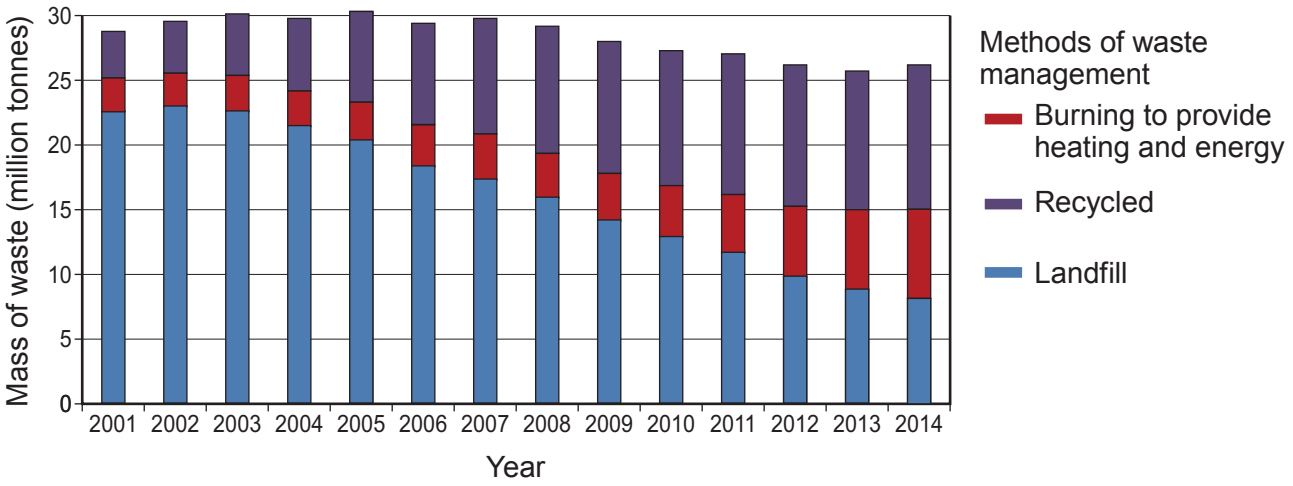
.....

Examiner only

(b) Local authorities have to dispose of their waste carefully. The chart below shows how one local authority dealt with waste between 2001 and 2014.



Describe the trends of waste management over the time period shown **and** explain the environmental and economic benefits of these changes. [6 QER]

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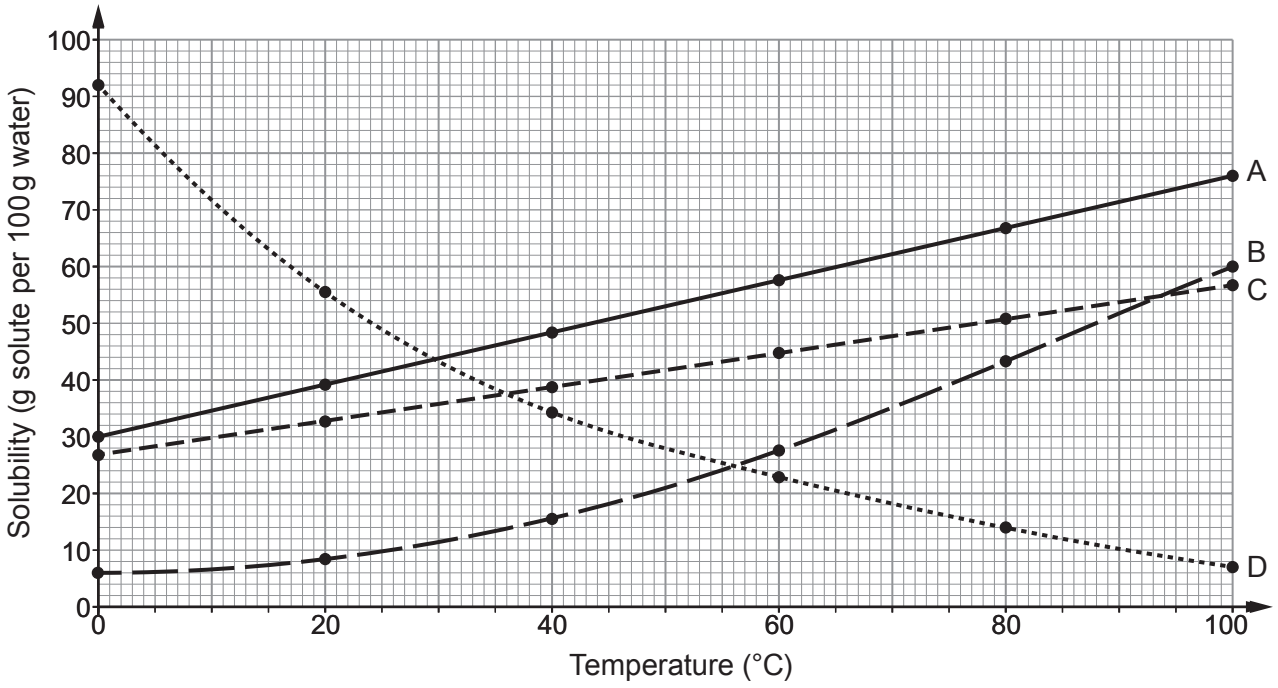
9

Examiner only

7. A hot spring is formed when geothermally heated groundwater rises from the Earth's crust. There are thermal springs in many locations all over the world. Taffs Well spring is the only thermal spring in Wales. The temperature of water at Taffs Well spring is **20 °C**. This is 10 °C warmer than the groundwater temperature in Wales.

(a) The concentration of dissolved compounds in spring water depends on temperature. The solubility of different compounds, **A**, **B**, **C** or **D**, in water at different temperatures is shown in the graph below.



Use the information in the graph above to answer the following questions.

(i) State which compound is least soluble in the Taffs Well spring. [1]

.....

(ii) State which compound is more soluble in groundwater in Wales than in the Taffs Well spring water. [1]

.....

(iii) State which compound shows the largest change in solubility from 0 °C to 100 °C. [1]

.....

(iv) A 100 g sample of water at 30 °C is found to contain 20 g of compound **C**. State why this is not a saturated solution. [1]

.....

Examiner only

(b) Describe an experiment to measure the solubility of sodium chloride in water. [3]

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7

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8. To get the greatest output from solar panels, they need to point in the direction that captures the most sun.

The Northern Alberta Institute of Technology (NAIT) in Canada has designed a solar photovoltaic (PV) array consisting of six pairs of solar PV panels. They provide installers with information about how tilt angles and snow cover affects electrical output.

After snowfall, the left hand side of the system is cleared of snow as shown below.

Points of interest from 2013-2014

- highest single panel output energy for one day = 1.82 kWh
- highest array output energy for one month = 442 kWh

A group of students investigate how the power output from a solar PV cell depends on its tilt angle. The manufacturer of the solar cells makes the following claims.

maximum power output = 4 W
performance = 60%
area = 0.01 m^2

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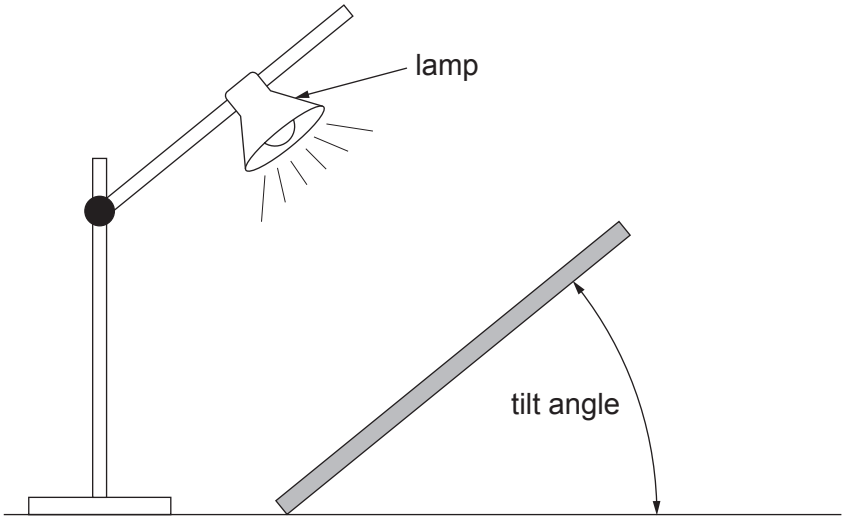


The results of their investigation are shown below.

Solar cell tilt angle (degrees)	Output voltage (V)	Output current (A)	Actual power output (W)
90	0.66	1.30	0.86
75	0.80	1.60	1.28
60	0.84	1.70	1.43
45	0.90	1.80	1.62
30	0.88	1.75	.....
15	0.72	1.45	1.04
0	0.58	1.15	0.67

(a) Use the information above to answer the following questions.

(i) Use the equation:

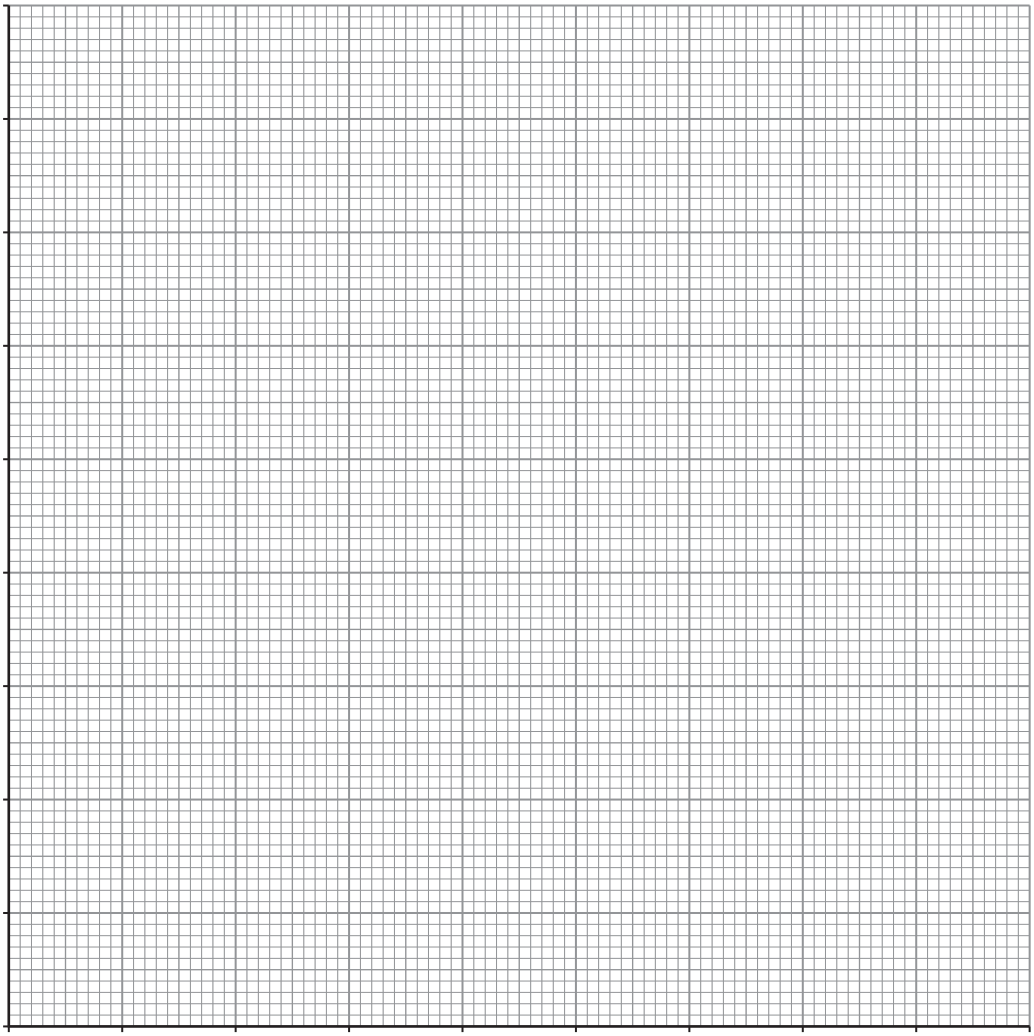
power = voltage $\times$ current

to **complete** the table. [2]

Examiner only

(ii) Use the data in the table to plot a graph on the grid below and draw a suitable line. [4]

Actual power output (W)



Tilt angle (degrees)

(iii) Use your graph to answer the following questions.

I. Estimate the power output for a tilt angle of 55°. [1]

Power output = ... W

II. Describe the relationship between the actual power output of the PV cell and the tilt angle. [2]

.....

.....

.....

Examiner only

(b) (i) The manufacturer's claims about its solar panels are shown below.

maximum power output = 4 W
performance = 60%
area = 0.01 m^2

Use the table on page 16, the information above and the equation:

$$\% \text{ performance} = \frac{\text{actual power output}}{\text{claimed maximum power output}} \times 100$$

to decide whether the manufacturer's claim about the performance of the solar cell is valid. [3]

.....

.....

(ii) The area of PV cells on the roof of a house is 5 m^2.
Calculate the maximum power output based on the manufacturer's claims. [2]

Maximum power output = ... W

(c) Suggest how the students could extend the investigation to study the effects of snow on the PV cells. [1]

.....

.....

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(d) Silicon (Si) is used in the production of solar PV cells. After oxygen, silicon is the second most abundant element in the Earth's crust. It is found as silica (silicon dioxide SiO_2). Silicon is produced by heating silica with carbon at a high temperature.

(i) Silica is reduced by heating with carbon. State what happens to silica during reduction. [1]

.....

(ii) State in terms of electrons, what happens to the ions in silica during reduction. [1]

.....

(iii) The word equation for the reaction is given below.

silicon dioxide + carbon ⟶ silicon + carbon monoxide

Complete the **balanced** symbol equation below for this reaction. [2]

SiO_2 + ☐ ..... ⟶ Si + ☐ .....

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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