

Surname	Centre Number	Candidate Number
First name(s)		0



GCSE

3440U10-1



S23-3440U10-1-R1

TUESDAY, 13 JUNE 2023 – MORNING

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

FOUNDATION TIER

1 hour 30 minutes

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	9	
2.	9	
3.	12	
4.	14	
5.	6	
6.	6	
7.	19	
Total	75	

ADDITIONAL MATERIALS

In addition to this paper you may require a calculator, pencil and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

You may use a pencil for graphs and diagrams only.

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. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

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

Question **5** 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.

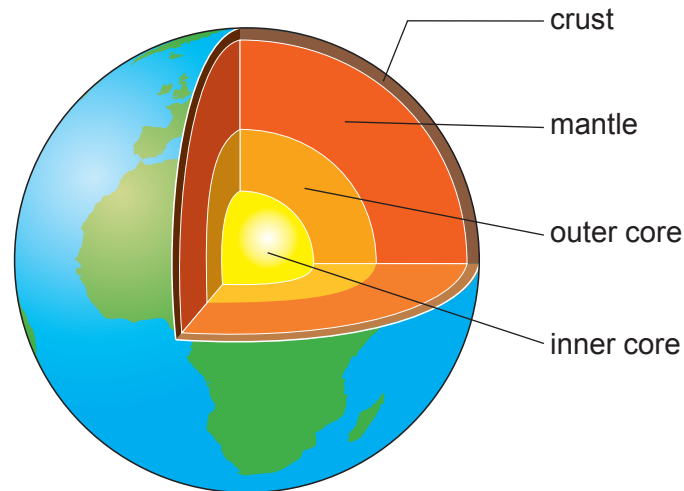
A Periodic Table is printed on page 20.



JUN233440U10101

Answer **all** questions.

1. (a) The diagram shows the structure of the Earth.



Use the diagram to answer the following questions.

- (i) State the part of the Earth that contains solid iron. [1]

.....

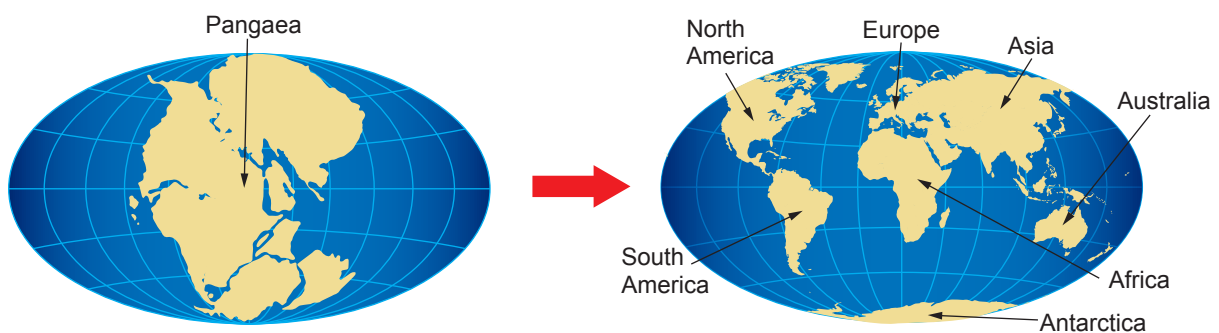
- (ii) State the part of the Earth that contains molten iron. [1]

.....

- (iii) State the part of the Earth that is broken into plates. [1]

.....

- (b) The diagrams below show how the Earth has changed over a long period of time.



Alfred Wegener suggested that all the continents present today were once joined in one supercontinent called Pangaea.

Tick (✓) the boxes next to the **three** pieces of evidence that support this idea. [3]

Jigsaw-like fit of the edges of continents

☐

The oceans divided equally

☐

Similar rocks of the same age found on facing sides of continents

☐

The crust moved equally in all directions

☐

Similar plant and animal fossils found on facing sides of continents

☐

The solid inner core divided into seven continents

☐

- (c) (i) Select **two** methods, from the list in the box, of obtaining raw materials from within the Earth's crust. [2]

chromatography

fishing

mining

distillation

fracking

1.

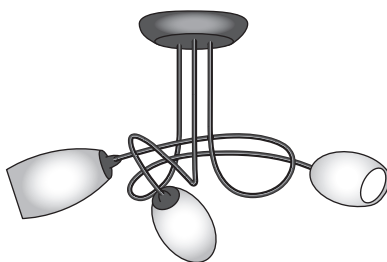
2.

- (ii) Complete the sentence by underlining the correct word in the brackets. [1]

An ore is a rock that contains a useful (**metal** / liquid / plastic).



2. A homeowner replaces a fluorescent lamp fitting with one that requires three lamps.



The homeowner decides to buy replacement LED lamps.

The table gives information about one LED lamp.

Power (kW)	0.005
Lifetime (h)	15 000

- (a) (i) Use the equation

$$\text{units used (kWh)} = \text{power (kW)} \times \text{time (h)}$$

to calculate the units used during the lifetime of **one** LED lamp.

[2]

units used = kWh

- (ii) Use your answer above to calculate the units used by the **three** LED lamps in the light fitting during their lifetime.

[1]

units used = kWh

- (iii) Use your answer from part (ii) and the equation:

$$\text{cost} = \text{units used} \times \text{cost per unit}$$

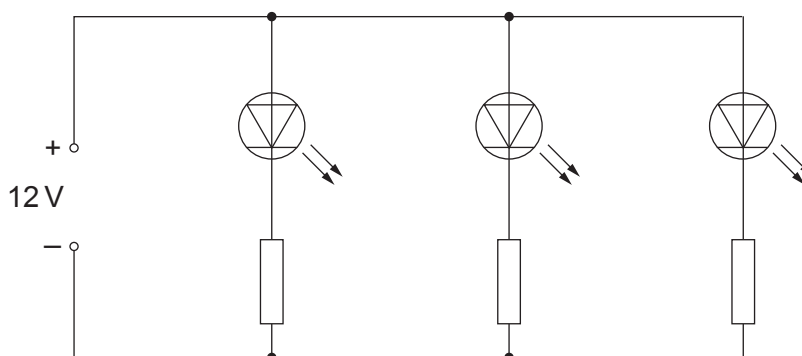
to calculate the cost of using the **three** LED lamps for their lifetime.
One unit of electricity costs 30p.

[2]

cost = p



- (b) The LED lamps are connected in parallel as shown below. Each LED is connected to a resistor.



- (i) State **one** advantage of connecting the LED lamps in parallel. [1]

.....

.....

- (ii) Use the equation:

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

to calculate the current through one branch of the circuit. The resistance of each branch is 240Ω . [2]

current = A

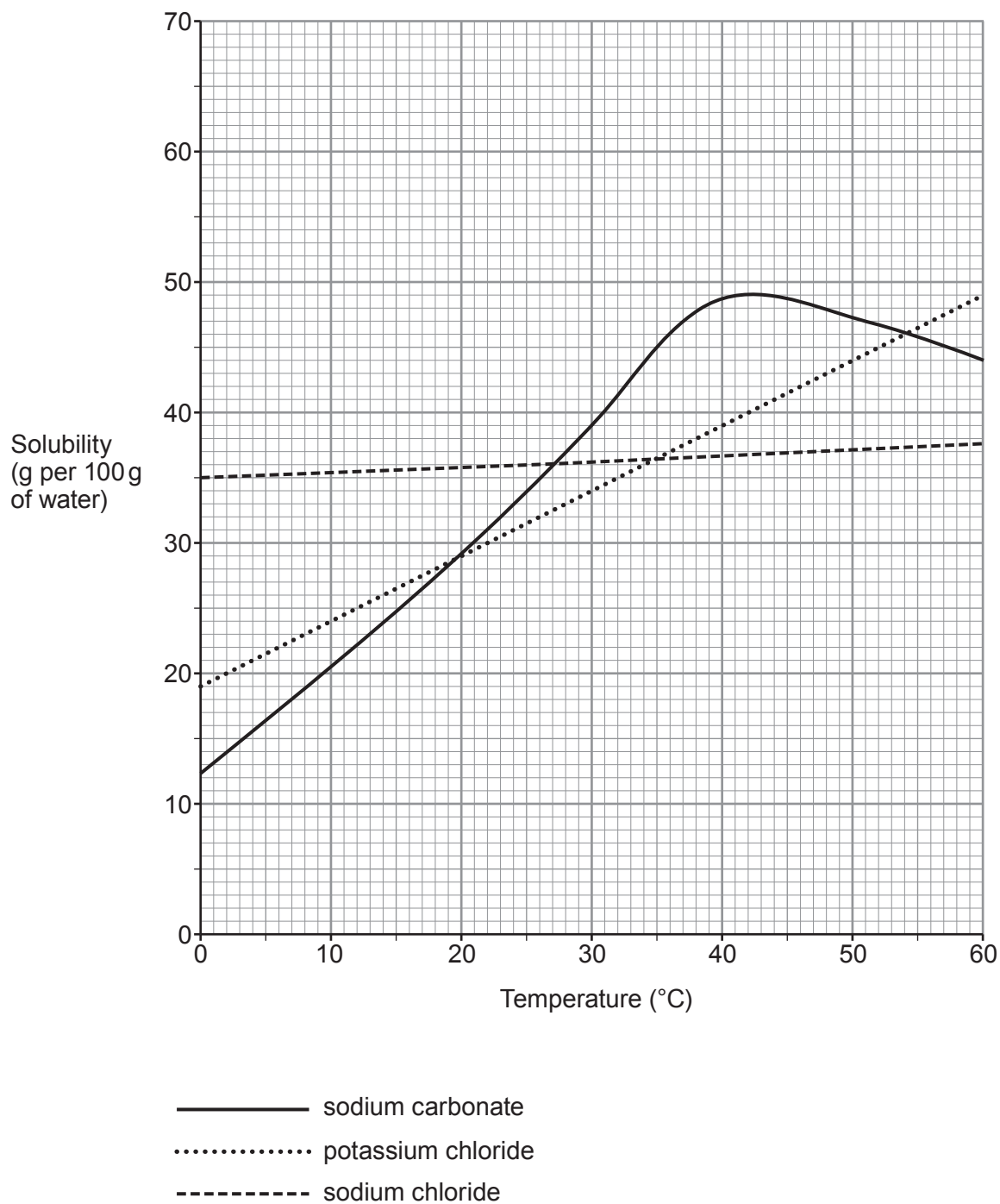
- (iii) Calculate the total current through the power supply. [1]

total current = A



3. Students are investigating how the solubilities of different compounds depend on water temperature.

The graph below shows their results for the solubilities of potassium chloride, sodium chloride and sodium carbonate at different temperatures.



Use the information in the graphs to answer the following questions.

- (a) (i) Describe how the solubility of sodium carbonate varies as the temperature increases from 30 °C to 60 °C. [3]

.....

.....

.....

- (ii) Circle the temperature at which the solubilities of sodium carbonate and sodium chloride are the same. [1]

20 °C 27 °C 34 °C

- (b) (i) They repeated the experiment for ammonium chloride. The table below shows their results.

Temperature (°C)	0	10	20	30	40	50	60
Solubility (g per 100 g of water)	30	34	38	42	46	50	54

Plot the results on the graph opposite and draw a suitable straight line. [3]

- (ii) List the **four** compounds in order of solubility at **40 °C**. *One has been done for you.* [2]

Most soluble

Ammonium chloride

.....

Least soluble

- (c) One student suggests that the solubility of potassium chloride doubles as the temperature doubles because the graph is a straight line. Use data from the graph to explain whether you agree. [3]

.....

.....



4. Both sodium nitrate and potassium nitrate are used in agriculture.

- Sodium nitrate is used to make fertilisers and pesticides.
- Potassium nitrate is used to make fertilisers.

Use your knowledge and information from the Periodic Table on page 20 to answer the following questions.

(a) The electronic configuration of **potassium** is 2,8,8,1.

(i) Draw a **diagram** to show the electronic structure of **sodium**.

[2]

(ii) A student claims “sodium and potassium atoms contain the same number of protons because they are in the same group of the Periodic Table”. Explain whether you agree with the student’s claim.

[1]

.....

.....

(b) Calculate the relative formula mass of sodium nitrate, NaNO_3 .

[2]

$$A_r(\text{Na}) = 23$$

$$A_r(\text{N}) = 14$$

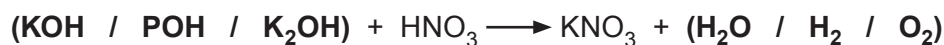
$$A_r(\text{O}) = 16$$

$$M_r = \dots\dots\dots$$

(c) Potassium nitrate can be made by neutralising nitric acid with potassium hydroxide.

Circle the correct formula in each bracket to complete the symbol equation for this reaction.

[2]



- (d) Potassium is an element and potassium nitrate is a compound.
Describe the difference between an element and a compound.

[2]

.....

.....

.....

- (e) Eutrophication and bioaccumulation are environmental problems caused by pesticides and fertilisers.

- (i) Eutrophication is caused when fertilisers such as sodium nitrate and potassium nitrate leak into waterways.

The stages in eutrophication are listed below, but in the wrong order.

1	Addition of nitrates
2	Death of plants
3	Increased numbers of bacteria
4	Lack of oxygen
5	Growth of plants
6	Suffocation of fish

Arrange the stages in the correct order in the boxes below. *The first and last stage have been completed.*

[3]

1					6
---	-------	-------	-------	-------	---

- (ii) Underline the correct term in brackets to complete the following sentences about bioaccumulation of pesticides.

[2]

Bioaccumulation occurs when pesticides build up in

(**producers / food chains / the ground**).

These pesticides reach a (**safe / toxic / low**) level in predators which can result in their death.



Examiner
only

5. Daisies are a common plant species that can be found on a school field. Using quadrats for random sampling allows you to estimate the numbers of daisy plants growing in an area of 20 m × 20 m. Describe how you would carry out this investigation using the apparatus given below. [6 QER]

2 x 20 m tape measures
2 x 20 sided dice
1m² quadrat



6. The following diagrams show absorption line spectra of hydrogen in a laboratory (**Diagram A**), from a distant galaxy 1 (**Diagram B**) and from another distant galaxy 2 (**Diagram C**).

Diagram A: Laboratory spectrum of hydrogen

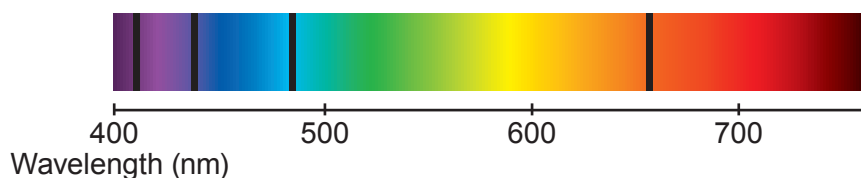


Diagram B: From galaxy 1

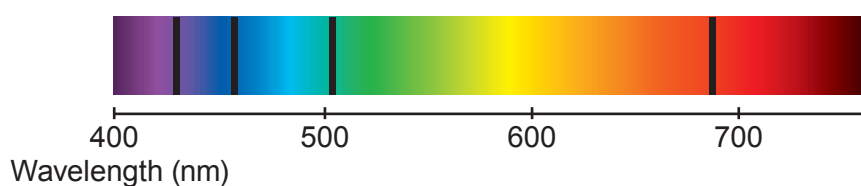
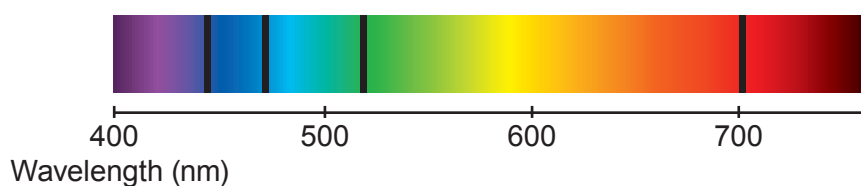


Diagram C: From galaxy 2



- (a) (i) Compare the absorption line spectra in **Diagram B** with **Diagram C**. [2]

.....

.....

.....

- (ii) State how the speed of galaxy 1 compares with the speed of galaxy 2. [1]

.....

- (iii) State how the distance of galaxy 1 from Earth compares with the distance of galaxy 2 from Earth. [1]

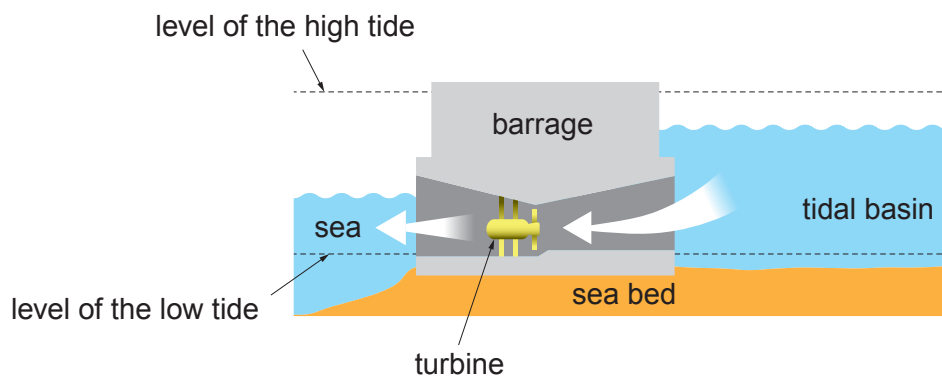
.....

- (b) Underline the correct word(s) in the brackets to complete the sentences. [2]

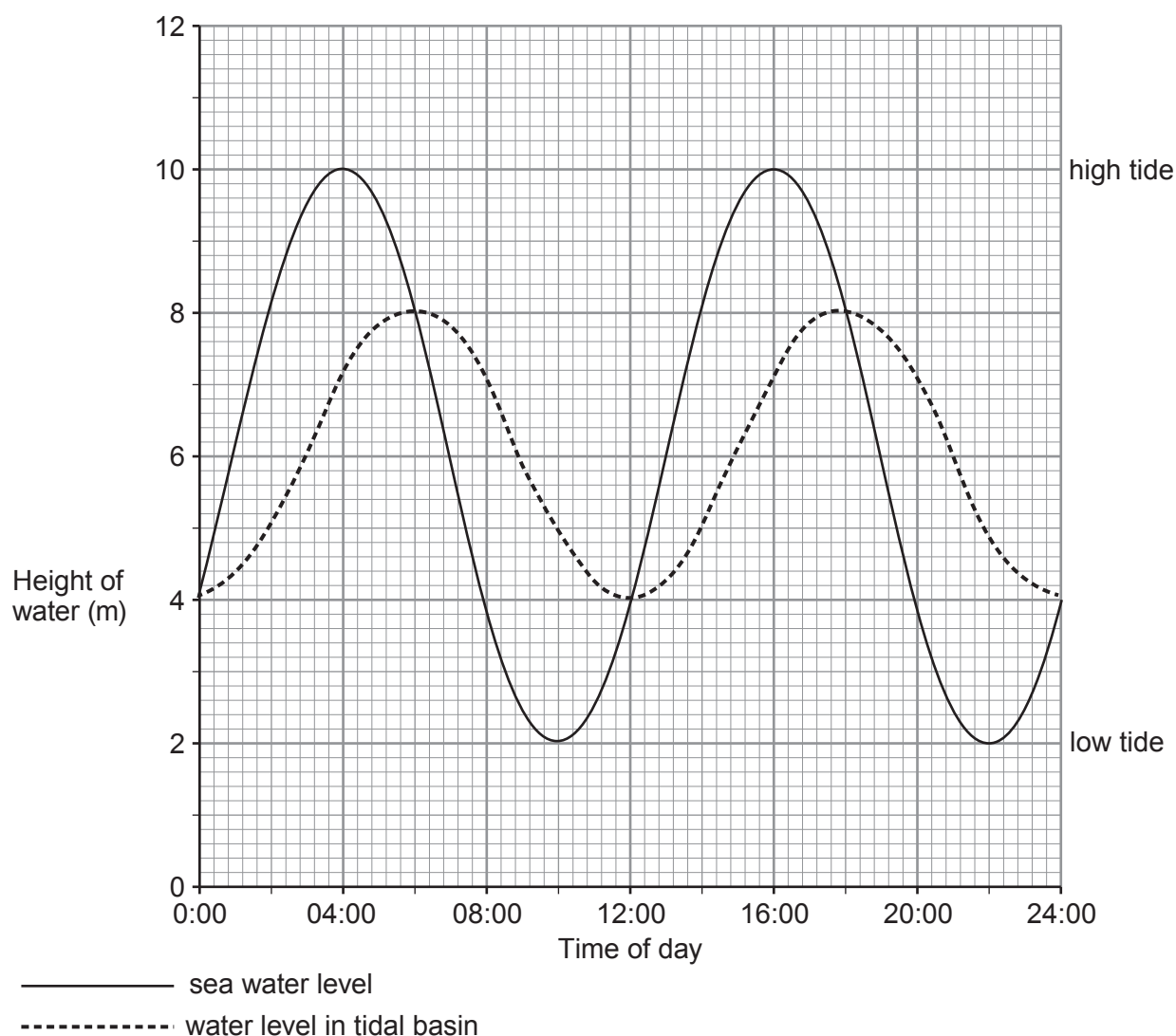
The black lines occur because light from a star is (**blocked** / **absorbed** / **emitted**) by (**other stars** / **atoms of gas** / **planets**).



7. There are proposals to build a tidal barrage between Wales and England across the River Severn. Water flows into the barrage when the sea is at a higher level than the water in the tidal basin. The water flows out again when the sea level is lower than the water in the tidal basin.



- (a) On one particular day, the water levels each side of the barrage are predicted to change in the way shown by the lines on the graph below.



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

- (i) Calculate the difference in height of the sea water between high tide and low tide. [1]

height = m

- (ii) State the time of the first sea water high tide of the day. [1]

time =

- (iii) Calculate the time between the sea water low tides. [1]

time = hours

- (iv) It is claimed that the barrage will produce electrical power 24 hours a day. Explain, using information from the graph, whether you agree with this claim. [3]

.....

.....

.....

.....

.....



- (b) One engineer suggests the barrage could include **25** turbines. Information about **each** turbine is given in the table.

For each turbine	
Water flow volume through each turbine per second	200 to 800 m ³ /s
Mean water power input	3125 kW
Maximum water power input	15 000 kW
Mean electrical power output	2500 kW
Maximum electrical power output	12 000 kW
Maximum output voltage	4.8 kV

Use the information in the table to answer the following questions.

- (i) It is claimed that the use of a barrage is four times as efficient as using solar panels. The generation of electricity using solar panels is 20% efficient. Use the equation:

$$\% \text{ efficiency} = \frac{\text{maximum electrical power output}}{\text{maximum water power input}} \times 100$$

to explain whether you agree.

[3]

.....

.....

- (ii) Use the following equation:

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

to calculate the maximum output current for **each** turbine.

[3]

current = A



- (iii) The **mean** electrical power used by each UK household is 0.4 kW. Assuming all 25 of the turbines are operating, it has been calculated that this barrage could supply more than 150 000 homes with electrical power. Explain whether you agree with this calculation. [3]

.....

.....

- (c) 410 kg of carbon dioxide is produced by the manufacture of 1 m³ of concrete. There are no accurate figures for the volume needed to construct the Severn barrage. On a smaller scale, 135 000 m³ of concrete was used to build the Cardiff Bay barrage. Calculate the carbon footprint of making 135 000 m³ of concrete. Equivalent mass of carbon dioxide is given by the equation: [2]

equivalent mass of carbon dioxide = mass of gas × global warming potential of the gas

(Global warming potential of carbon dioxide = 1)

equivalent mass of carbon dioxide = kgCO₂eq

- (d) Apart from initial costs, state **one advantage** and **one disadvantage** of using a tidal barrage rather than wind turbines to generate electricity. [2]

Advantage:

.....

Disadvantage:

.....

END OF PAPER



[illegible]

[illegible]

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THE PERIODIC TABLE

Group 1 2 3 4 5 6 7 0

1H Hydrogen 1																	
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														

Key

relative atomic mass

Ar	Symbol
Name	Z

atomic number