

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS  
GCSE**

**B712/02**

**GATEWAY SCIENCE  
SCIENCE B**

**Science modules B2, C2, P2  
(Higher Tier)**

**FRIDAY 10 JUNE 2016: Morning**

**DURATION: 1 hour 30 minutes  
plus your additional time allowance**

**MODIFIED ENLARGED 24pt**

<b>Candidate forename</b>		<b>Candidate surname</b>	
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<b>Centre number</b>						<b>Candidate number</b>				
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**Candidates answer on the Question Paper.  
A calculator may be used for this paper.**

**OCR SUPPLIED MATERIALS:**

**A copy of the Periodic Table  
Loose Sheet Question 16**

**OTHER MATERIALS REQUIRED:**

**Pencil  
Ruler (cm/mm)**

**READ INSTRUCTIONS OVERLEAF**



# **INSTRUCTIONS TO CANDIDATES**

**Write your name, centre number and candidate number in the boxes on the first page. Please write clearly and in capital letters.**

**Use black ink. HB pencil may be used for graphs and diagrams only.**

**Answer ALL the questions.**

**Read each question carefully. Make sure you know what you have to do before starting your answer.**

**Write your answer to each question in the space provided. If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.**

## **INFORMATION FOR CANDIDATES**

**The quality of written communication is assessed in questions marked with a pencil ()**.

**A list of equations can be found on pages 4–5.**

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

**The total number of marks for this paper is 85.**

**Any blank pages are indicated.**

## EQUATIONS

**energy = mass × specific heat capacity × temperature change**

**energy = mass × specific latent heat**

**efficiency =  $\frac{\text{useful energy output} (\times 100\%)}{\text{total energy input}}$**

**wave speed = frequency × wavelength**

**power = voltage × current**

**energy supplied = power × time**

**average speed =  $\frac{\text{distance}}{\text{time}}$**

**distance = average speed × time**

$$s = \frac{(u + v)}{2} \times t$$

**acceleration =  $\frac{\text{change in speed}}{\text{time taken}}$**

**force = mass × acceleration**

**weight = mass × gravitational field strength**

**work done = force × distance**

**power =  $\frac{\text{work done}}{\text{time}}$**

**power = force × speed**

**KE =  $\frac{1}{2}mv^2$**

**momentum = mass × velocity**

**force =  $\frac{\text{change in momentum}}{\text{time}}$**

**GPE = mgh**

**mgh =  $\frac{1}{2}mv^2$**

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

**Answer ALL the questions.**

**SECTION A – Module B2**

**1 (a) Sperm whales were once hunted.**

**Hunting of sperm whales was made illegal to prevent the number falling to a critical level.**

**(i) Explain why it is important that the number of sperm whales does not fall to a critical level.**

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**[1]**

**(ii) Describe TWO reasons why it is difficult to prevent whales being hunted.**

**1** \_\_\_\_\_

\_\_\_\_\_

**2** \_\_\_\_\_

\_\_\_\_\_

**[2]**

**(b) Some other species of whales are still being hunted as SUSTAINABLE RESOURCES.**

**Explain how whale populations can be sustained.**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**[2]**

**[TOTAL: 5]**

**2 Jack reads this information about relationships between organisms.**

<b>ORGANISMS INVOLVED</b>	<b>INFORMATION ABOUT THE RELATIONSHIP BETWEEN THE ORGANISMS</b>
<b>bees and flowers</b>	<b>Bees transfer pollen from one flower to another.  Bees make less honey in years when there are fewer flowers.</b>
<b>acacia trees and ants</b>	<b>Ants feed on nectar from the trees.  The ants kill trees next to the acacia tree they live on.</b>
<b>mistletoe plants and birch trees</b>	<b>The mistletoe plant gets nutrients from the tree.  Trees with mistletoe growing on them are usually smaller than those with no mistletoe.</b>

**(a) Jack makes a statement about the relationships.**

**He says ‘All of the relationships describe examples of mutualism.’**

**Is Jack correct? \_\_\_\_\_**

**Explain your answer.**

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**[2]**

**(b) Jack finds out about another type of mutualism.**

**Leguminous plants have root nodules with bacteria living inside the nodule.**

**Explain why this is an example of mutualism.**

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**[2]**

**[TOTAL: 4]**

- 3 (a) Limestone formed millions of years ago at the bottom of a shallow sea.**

**Acid rain is now weathering the rock.**

**Explain how carbon became locked up in the limestone and how weathering contributes to global warming.**

**[6]**



**(b) Acid rain is one type of air pollution.**

**Some organisms living on trees and rocks can be used to indicate the levels of air pollution.**

**These organisms are one of many different types of indicator species.**

**Write down the name of this type of indicator species that lives on trees and rocks.**

\_\_\_\_\_ [1]

**[TOTAL: 7]**

**4 Matt and Ellie are investigating the animals living in a lake.**

**They collect some of the animals.**

**(a) Ellie identifies some of the beetles they collect and writes their names in a table.**

<b>BEETLE</b>	<b>COMMON NAME</b>	<b>BINOMIAL NAME</b>
<b>A</b>	<b>whirligig beetle</b>	<b><i>Gyrinus natator</i></b>
<b>B</b>	<b>hairy whirligig beetle</b>	<b><i>Orectochilus villosus</i></b>
<b>C</b>	<b>great diving beetle</b>	<b><i>Dytiscus marginalis</i></b>
<b>D</b>	<b>there is no common name for this beetle</b>	<b><i>Dytiscus latissimus</i></b>

**Ellie makes this statement about the beetles.**

**She says ‘Beetles A and B are more closely related than the other beetles because they are both called whirligig beetles.’**

**Is Ellie correct? \_\_\_\_\_**

**Explain your answer.**

\_\_\_\_\_

\_\_\_\_\_

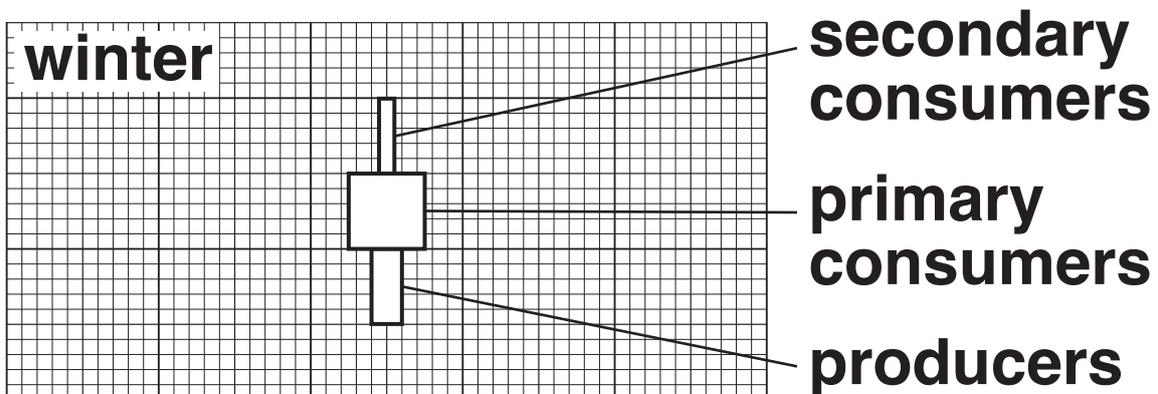
**[1]**

**(b) Matt finds some information about the biomass values for the lake in winter and spring.**

**Look at the table.**

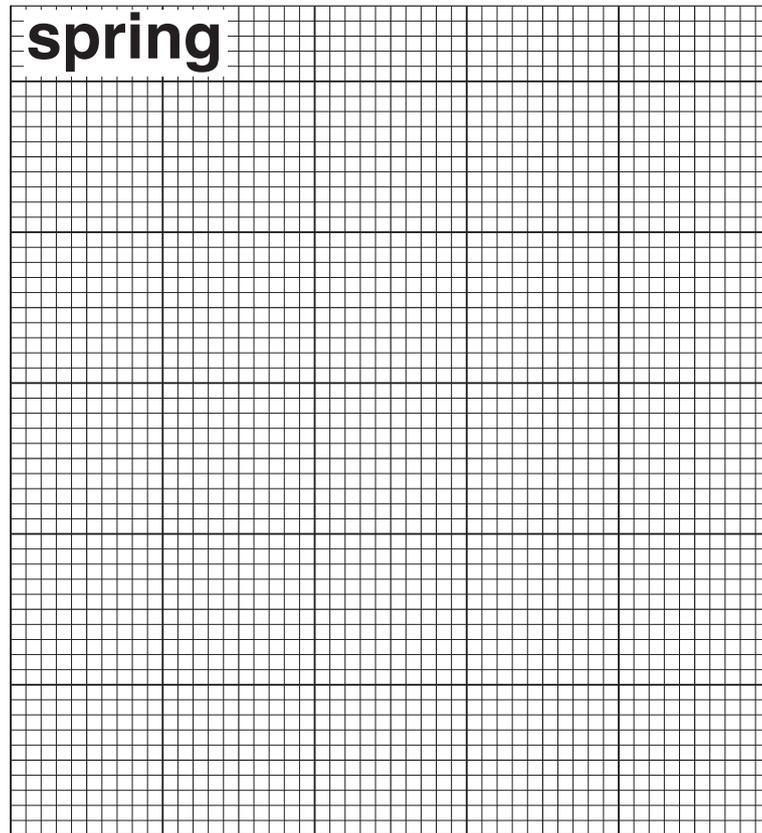
<b>TROPHIC LEVEL</b>	<b>BIOMASS IN mg DRY MASS PER m<sup>3</sup></b>	
	<b>Winter</b>	<b>Spring</b>
<b>producers</b>	<b>4</b>	<b>100</b>
<b>primary consumers</b>	<b>10</b>	<b>12</b>
<b>secondary consumers</b>	<b>2</b>	<b>6</b>

**The diagram below shows the pyramid of biomass for winter.**



**(i) Draw the pyramid of biomass for spring on the grid below.**

**Make sure the bars are drawn to the SAME scale and LABELLED.**



**[2]**

**(ii) The pyramid of biomass for winter is a different shape to the spring pyramid of biomass.**

**Describe ONE way the winter pyramid is different in shape and suggest a reason for the difference.**

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**[2]**

**[TOTAL: 5]**

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**5 Look at the pictures of different birds.**



**puffin**



**herring gull**



**penguin**

**(a) Classifying these birds as seabirds is an ARTIFICIAL classification.**

**Explain why.**

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[1]

**(b) Puffins live in the Arctic.**

**Penguins live in the Antarctic.**

**Suggest reasons why puffins and penguins are both similar and different.**

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**[3]**

**[TOTAL: 4]**

## SECTION B – Module C2

6 Look at the diagram of the structure of the Earth.



**(a) The surface of the Earth is made up of tectonic plates.**

**This was first suggested by a scientist called Wegener in 1914.**

**The theory of tectonic plates is now widely accepted.**

**Explain why theories proposed by scientists like Wegener take some time to become widely accepted.**

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**[2]**

**(b) The theory of plate tectonics can be used to explain SUBDUCTION.**

**What is subduction and how does it happen?**

**You may wish to draw a LABELLED diagram.**

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**[3]**

**[TOTAL: 5]**

**7 Rachel is making some fertilisers by neutralising acids with alkalis.**

**Complete the table.**

<b>NAME OF FERTILISER</b>	<b>NAME OF ALKALI USED</b>	<b>NAME OF ACID USED</b>
<b>ammonium phosphate</b>	<b>ammonia</b>	<b>phosphoric acid</b>
<b>potassium nitrate</b>	<b>potassium hydroxide</b>	
	<b>ammonia</b>	<b>sulfuric acid</b>

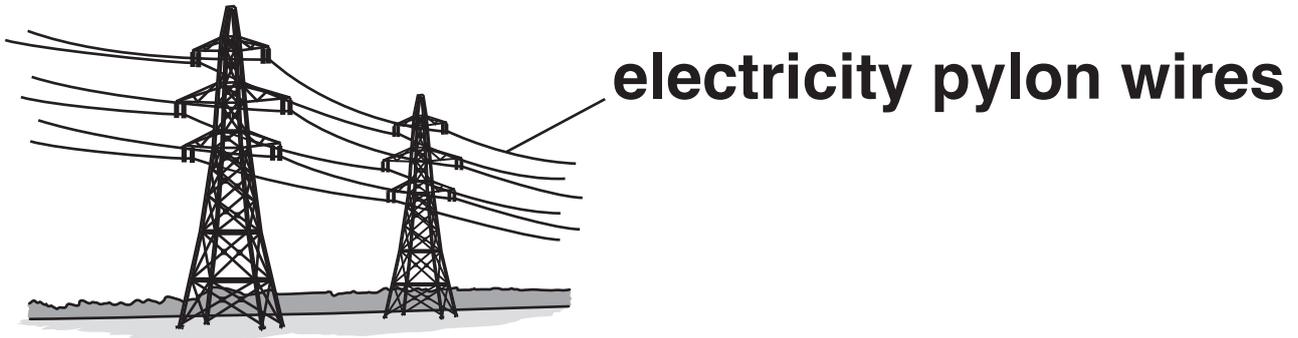
**[2]**

**[TOTAL: 2]**

**8 Look at the table opposite. It shows some properties of different metals.**

<b>Metal</b>	<b>Density in g/cm<sup>3</sup></b>	<b>Relative electrical conductivity</b>	<b>Relative strength</b>	<b>Melting point in °C</b>	<b>Cost per tonne in £</b>
<b>A</b>	<b>8.9</b>	<b>64</b>	<b>13</b>	<b>1083</b>	<b>3800</b>
<b>B</b>	<b>7.7</b>	<b>11</b>	<b>21</b>	<b>1510</b>	<b>440</b>
<b>C</b>	<b>2.7</b>	<b>40</b>	<b>15</b>	<b>660</b>	<b>1350</b>

**(a) Look at the diagram. It shows electricity pylon wires.**



**Jo says that metal A is the best for making electricity pylon wires.**

**Dave says that metal C is the best.**

**Evaluate metals A and C for making electricity pylon wires. [3]**

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**(b) Metals A, B and C can be used to make the body of a bus.**



**body of bus**

**Describe the advantages and disadvantages of metals A, B and C for making the body of a bus.**

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**[3]**

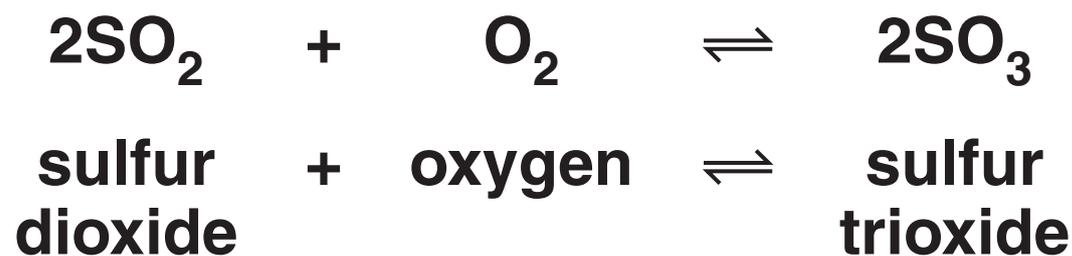
**[TOTAL: 6]**

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**9 Sulfur trioxide, SO<sub>3</sub>, is made in a chemical factory.**

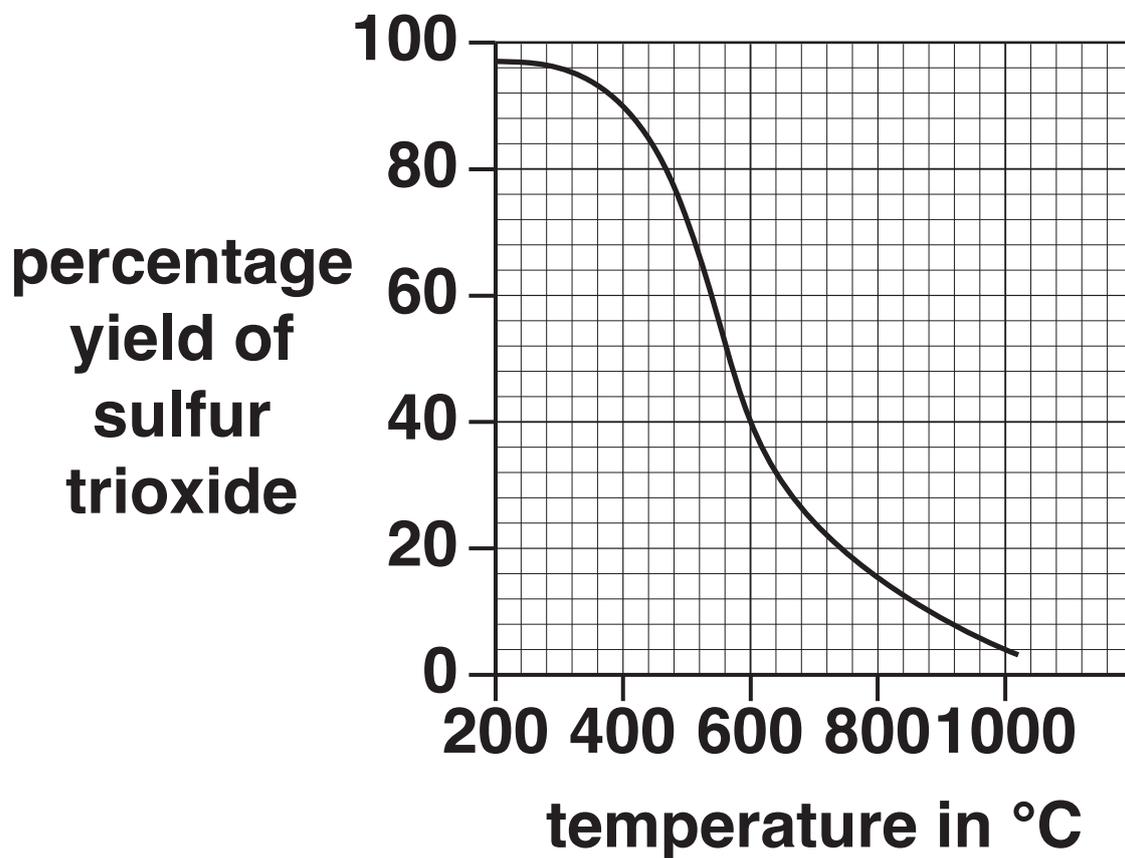
**It is used to make sulfuric acid.**

**The equations show how sulfur trioxide is made.**



**Look at the graph opposite.**

**It shows how the percentage yield of sulfur trioxide changes as the temperature changes.**



**(a) How does INCREASING the temperature affect the percentage yield?**

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[1]

**(b) The conditions used in the reaction are**

**450 °C**

**low pressure**

**catalyst of vanadium(V) oxide.**

**(i) Suggest why a catalyst is used.**

\_\_\_\_\_ [1]

**(ii) Suggest why a temperature of 450 °C rather than 200 °C is used.**

**Use ideas about rate of reaction and percentage yield.**

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ [2]

**(c) In another industrial process, nitrogen,  $N_2$ , reacts with hydrogen,  $H_2$ , to make ammonia,  $NH_3$ .**

**Write a BALANCED SYMBOL equation for this reaction.**

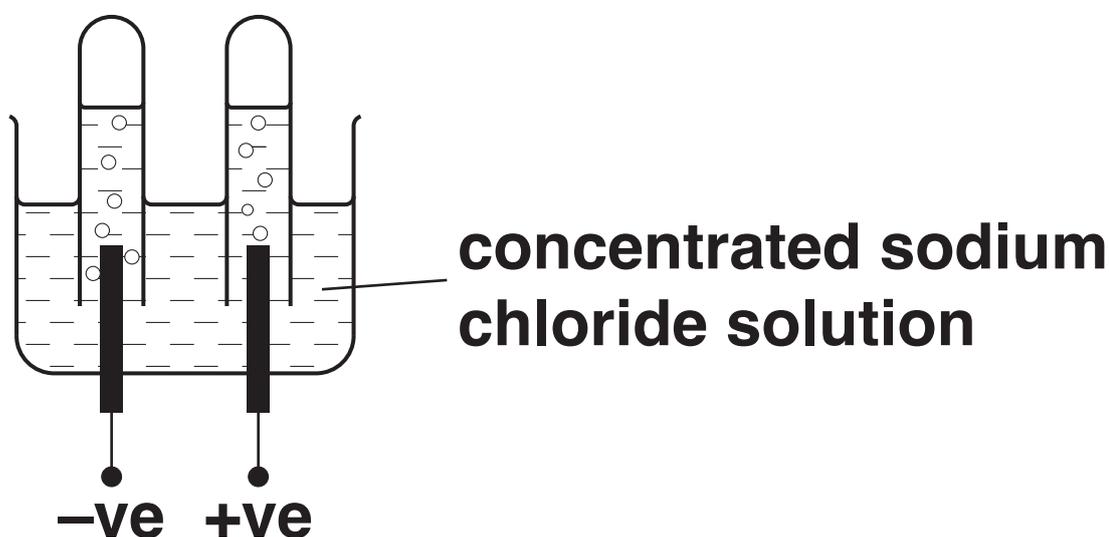
\_\_\_\_\_ [2]

**[TOTAL: 6]**

## 10 Sodium chloride (salt) is a very important chemical.

Concentrated sodium chloride solution can be electrolysed to make useful products.

Look at the diagram below. It shows how this can be done in the laboratory.



Sodium chloride solution contains the ions  $\text{Na}^+$ ,  $\text{Cl}^-$ ,  $\text{H}^+$  and  $\text{OH}^-$ .

What happens during the electrolysis of concentrated sodium chloride solution?

Your answer should include equations for the reactions at each electrode.

Use  $\text{e}^-$  to represent an electron. [6]



## SECTION C – Module P2

11 Nuclear radiation can be alpha, beta or gamma radiation.

(a) Draw one line from each RADIATION on the left to its correct USE on the right.

### RADIATION

alpha

beta

gamma

### USE

paper thickness gauge

non-destructive testing

smoke detector

[2]

**(b) Polly and Oliver were talking about the factory that is near their home.**

**Polly said that the factory produces dangerous radioactive waste.**

**Oliver said that if the waste was put into thick aluminium cans it could be stored safely.**

**Is Oliver correct? \_\_\_\_\_**

**Explain your answer.**

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\_\_\_\_\_ **[2]**

**[TOTAL: 4]**

**12 (a) Most of our electrical energy is produced in large power stations.**

**A large power station produces up to 2000 MW of power.**

**Some of our electrical energy is now produced by wind farms.**



**A wind farm is made up of several wind turbines.**

**Each turbine produces up to 2 MW of power.**

**Suggest one reason why some people are FOR more wind farms and one reason why others are AGAINST.**

**reason for** \_\_\_\_\_

\_\_\_\_\_

**reason against** \_\_\_\_\_

\_\_\_\_\_

**[2]**

**(b) Some companies are now designing and heating their offices using passive solar heating.**

**Explain how passive solar heating works and suggest why the position of the windows is important.**

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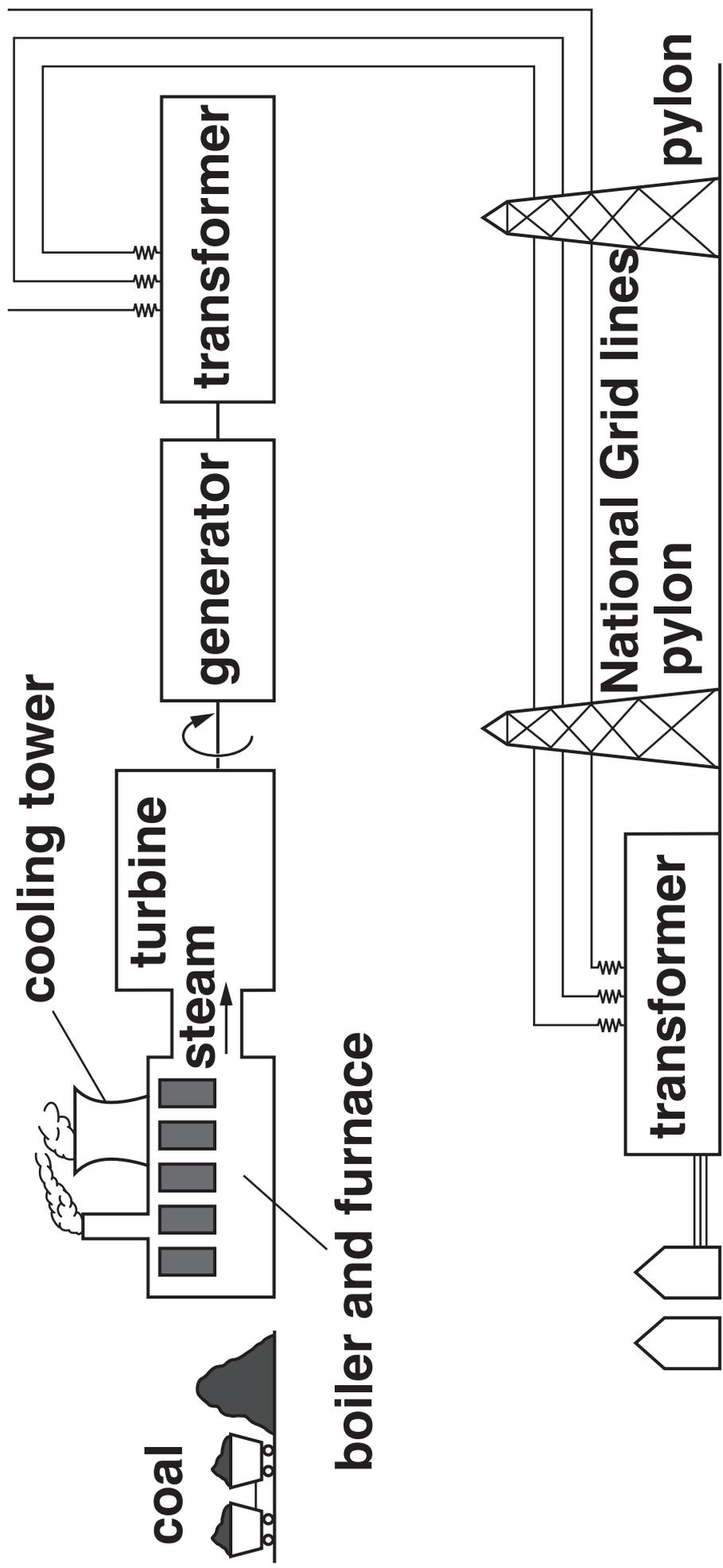
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**[3]**

**[TOTAL: 5]**

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### 13 Power stations generate electricity.

Look at the data for a coal-fired power station.

<b>efficiency of power station</b>	<b>30%</b>
<b>average electrical energy generated each second</b>	<b><math>1.5 \times 10^6 \text{ J}</math></b>
<b>heat energy produced by 1 kg of coal</b>	<b><math>2 \times 10^4 \text{ J}</math></b>

- (a) Describe in detail the different stages in the production of electricity from this power station and use the information to calculate the mass of coal (in kg) burnt each second. [6]**



**The quality of written communication will be assessed in your answer to this question.**

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**(b) Ruth investigates the output of a model a.c. generator.**

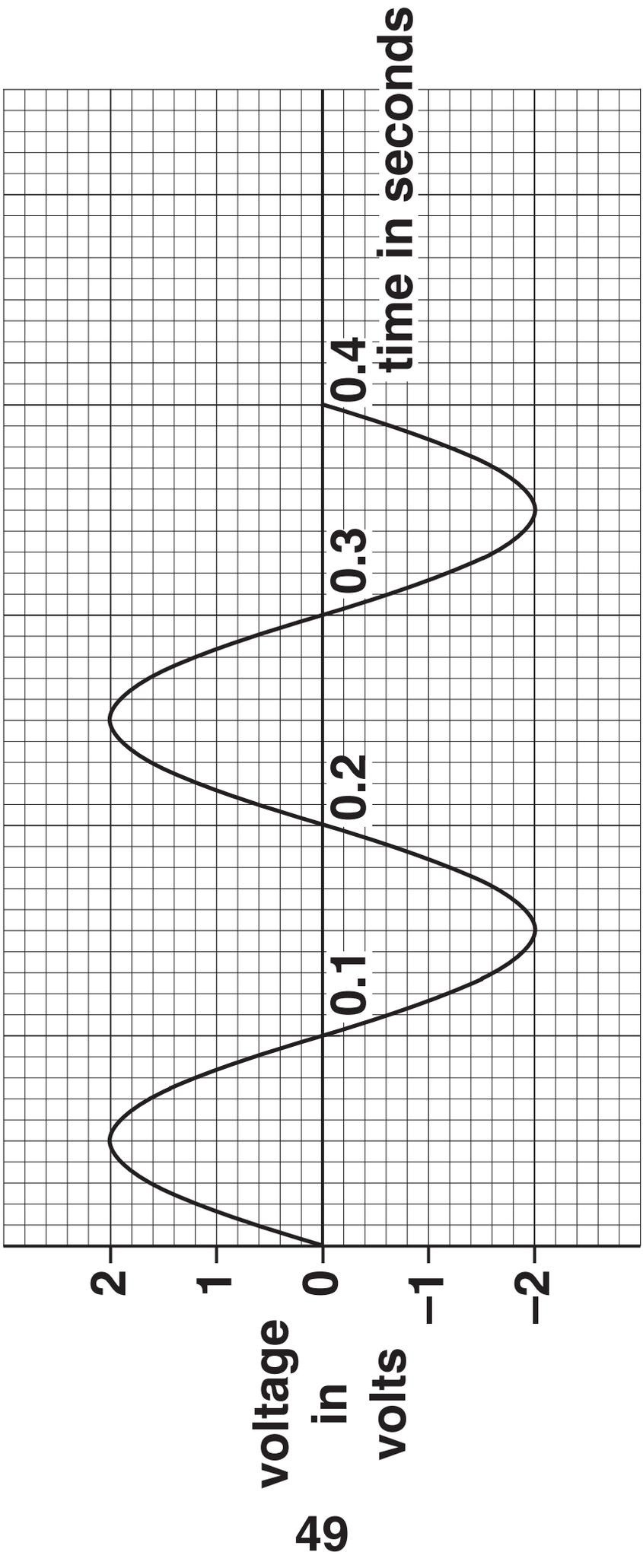
**Look at the graph opposite showing the voltage output of the generator.**

**She increases the number of rotations of the coil each second.**

**How will this affect the output of this generator?**

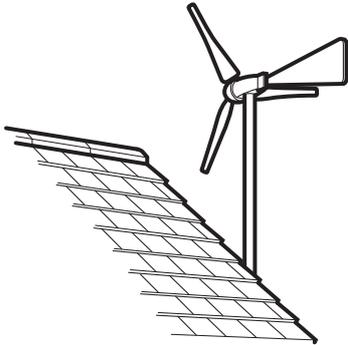
**DRAW your answer on the graph. [2]**

**[TOTAL: 8]**



**14 Sam wants to reduce his energy costs.**

**He fits a wind generator to his house.**



**The generator produces 1.8 kWh (kilowatt hour) of energy each day (24 hours).**

**(a) Calculate the average power output of the generator in kW.**

**answer \_\_\_\_\_ kW [2]**

**(b) Electricity costs 16p per kWh.**

**How much money will Sam save on his electricity bills each day?**

**answer \_\_\_\_\_ pence [1]**

**(c) A factory needs 100 kW of electrical power to operate its machinery.**

**Energy is wasted in transmitting the electricity from the power station to the factory.**

**Look at the data showing the effect of using different transmission voltages for the power cables to the factory.**

<b>Transmission voltage in volts</b>	<b>1000</b>	<b>2000</b>	<b>5000</b>	<b>10 000</b>
<b>Energy wasted per second for each km of cable in W/km</b>	<b>8000</b>	<b>2000</b>	<b>320</b>	<b>80</b>

**10 000 volts is the most efficient voltage for the transmission of 100 kW of electricity.**

**Explain why.**

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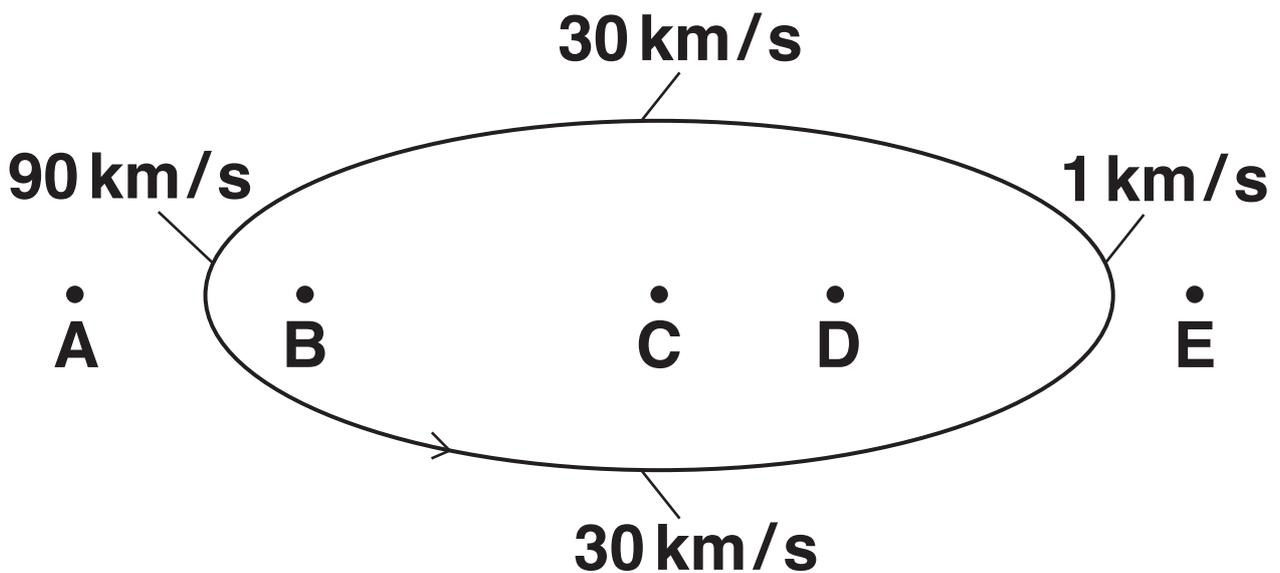
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**[2]**

**[TOTAL: 5]**

**15 Comets are objects in our solar system that orbit the Sun with highly elliptical orbits.**

**Look at the diagram below showing the path of a comet and its speed at different points on the path.**



**(a) Where is the Sun on the diagram?**

**Choose from:**

**A            B            C            D            E**

**answer \_\_\_\_\_**

**Use information from the diagram  
and ideas about forces to explain  
your answer.**

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**[2]**

**(b) There is an asteroid belt between Mars and Jupiter.**

**Some people think that some asteroids in this belt could join together to form a new planet.**

**There is no sign of this happening.**

**Explain why.**

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**[1]**

**[TOTAL: 3]**

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## **SECTION D**

**16 (a) Look at GRAPH 1 on the loose sheet. This bar chart shows how electricity was produced in different parts of the world.**

**The WIDTH of each bar is a measure of the total amount of electricity produced in 2008.**

**(i) Look at the percentage of electricity produced from COAL in each part of the world.**

**Put these parts of the world in the correct order. Put the highest first.**

**highest percentage from coal**

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**lowest percentage from coal**

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**[2]**

**(ii) China, USA and the rest of Europe generated the largest amounts of electricity in 2008.**

**Suggest why they need to produce the largest amounts of electricity.**

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**[1]**

**(iii) What OTHER conclusions can you make from this bar chart about electricity production in different parts of the world?**

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**[3]**

**(b) The production of electricity from nuclear fuels changed between 1971 and 2010.**

**Look at GRAPH 2 opposite.**

**The bars show the TOTAL world electricity produced from nuclear fuels (in TWh).**

**The line shows the PERCENTAGE of world electricity produced from nuclear fuels.**

**What conclusions can you make from GRAPH 2?**

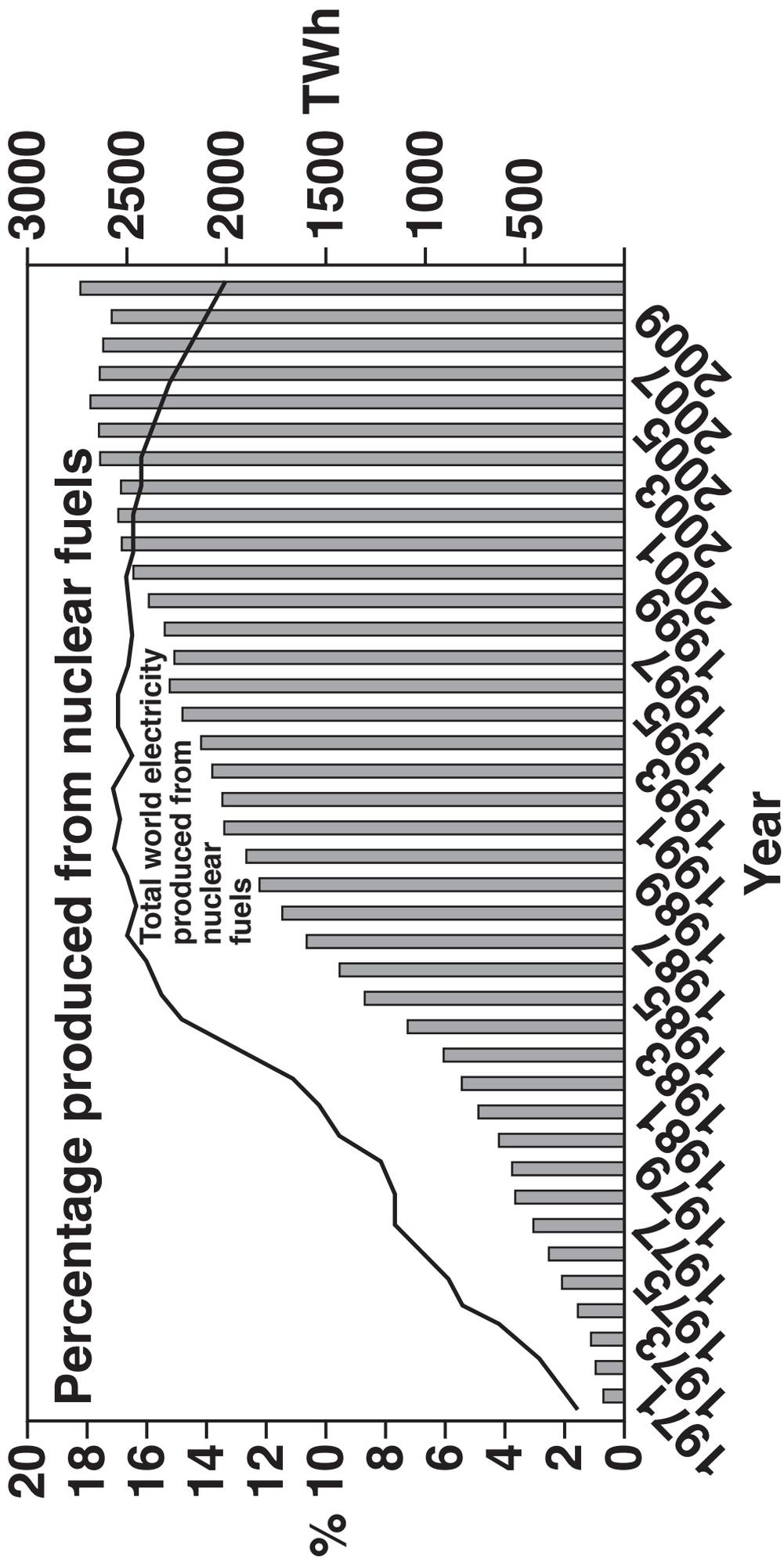
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**[2]**

**GRAPH 2**



**(c) Using GRAPHS 1 and 2, suggest what problems may arise for electricity production during the next 30 years.**

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**[2]**

**[TOTAL: 10]**

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