



**ADVANCED SUBSIDIARY GCE**  
**SCIENCE**  
Science and Human Activity

**G642**

Candidates answer on the question paper

**OCR Supplied Materials:**  
None

**Other Materials Required:**

- Electronic calculator

**Thursday 21 May 2009**  
**Afternoon**

**Duration: 1 hour 45 minutes**



Candidate Forename		Candidate Surname	
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Centre Number						Candidate Number				
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**INSTRUCTIONS TO CANDIDATES**

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

**INFORMATION FOR CANDIDATES**

- 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 **100**.
- You are advised to show all the steps in any calculations.



Where you see this icon you will be awarded marks for the quality of written communication in your answer.

This means for example you should:

- ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear;
- organise information clearly and coherently, using specialist vocabulary when appropriate.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.
- This document consists of **16** pages. Any blank pages are indicated.

<b>FOR EXAMINER'S USE</b>		
<b>Qu.</b>	<b>Max.</b>	<b>Mark</b>
<b>1</b>	<b>11</b>	
<b>2</b>	<b>15</b>	
<b>3</b>	<b>10</b>	
<b>4</b>	<b>9</b>	
<b>5</b>	<b>12</b>	
<b>6</b>	<b>14</b>	
<b>7</b>	<b>12</b>	
<b>8</b>	<b>17</b>	
<b>TOTAL</b>	<b>100</b>	

**AS SCIENCE RELATIONSHIPS SHEET**

pressure = force  $\div$  area

energy transferred = mass  $\times$  specific heat capacity  $\times$  temperature rise

density = mass  $\div$  volume

wavenumber = 1 / wavelength

speed = frequency  $\times$  wavelength

energy = Planck constant  $\times$  frequency

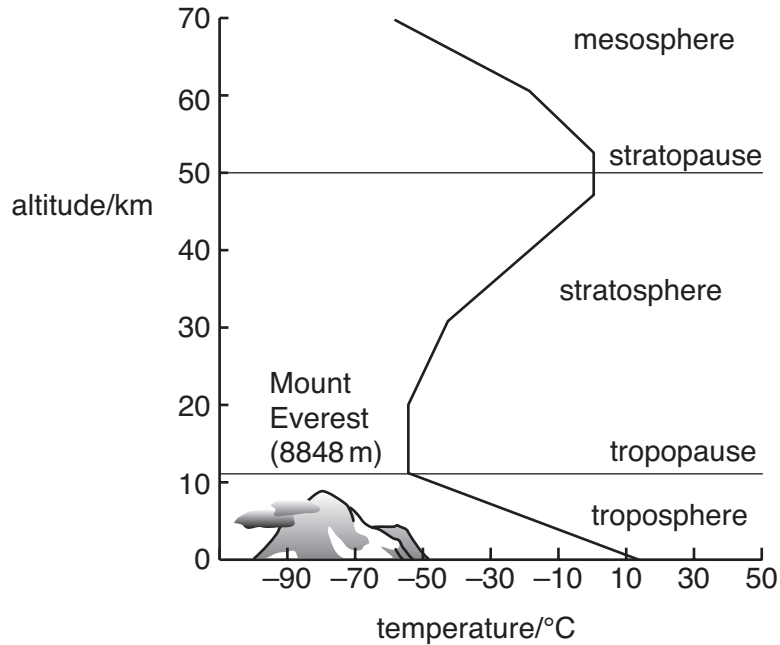
current = charge  $\div$  time

power = voltage  $\times$  current

power loss = (current)<sup>2</sup>  $\times$  resistance

Answer **all** the questions.

1 This question is about the Earth's atmosphere.



**Fig. 1.1**

(a) Use Fig. 1.1 to help answer the questions.

(i) Estimate the temperature at altitude 50 km.

..... [1]

(ii) Estimate any **two** different altitudes at which the temperature is  $-30^{\circ}\text{C}$ .

..... km and ..... km [2]

(b) (i) Charles' Law states that for a fixed mass of gas, volume ( $V$ ), is proportional to temperature ( $T$ ).

Give the unit of  $T$  in this relationship.

..... [1]

(ii) Describe what happens to the volume of a fixed mass of air, at constant pressure, when its temperature is raised by heat energy from the sun.

..... [1]

(iii) Explain why.

Use the molecular kinetic theory of gases in your answer.

.....  
.....  
..... [3]

(c) Use Charles' law to suggest why air rises rapidly in the middle of the day over the equator.

.....  
.....  
.....  
.....  
..... [3]

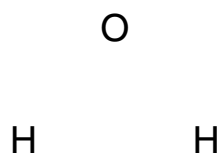
[Total: 11]

2 Approximately 71% of the Earth's surface is covered by water. The special properties of water are important in understanding the Earth's climate.

(a) One unusual property of water is its high boiling point. Give **two** other unusual properties of water.

1. ....  
2. .... [2]

(b) (i) Complete the 'dot and cross' diagram of a water molecule.



[2]

(ii) On the dot and cross diagram, clearly label each of the following.

1 a covalent bond

2 a non bonding pair of electrons

[2]

(c) The high boiling point of water can be explained in terms of hydrogen bonding.

(i) Draw a diagram to show hydrogen bonding between two water molecules.

[1]

(ii) Suggest why this accounts for the high boiling point of water.

.....  
.....  
.....  
..... [2]

(d) The specific heat capacity of water is  $4.2 \text{ kJ kg}^{-1} \text{ }^\circ\text{C}^{-1}$ .

Explain what is meant by the term *specific heat capacity*.

.....  
..... [1]

(e) The Gulf stream is an important factor in determining the climate of the UK.

Use ideas about the specific heat capacity of water to explain why.



In your answer, you should make clear how your explanation links with the evidence.

.....  
.....  
.....  
.....  
.....  
.....  
.....  
..... [5]

[Total: 15]  
Turn over

3 The burning of fossil fuels that contain sulfur impurities can give rise to acid rain.

(a) (i) Write a balanced symbol equation for the reaction of sulfur with oxygen to produce sulfur dioxide.

[2]

(ii) What is the oxidation number of sulfur in the compound sulfur dioxide?

oxidation number = .....

[1]

(b) Another oxide of sulfur dissolves in water to form sulfuric acid.  
Finish the equation below for the **complete** ionisation of sulfuric acid in water.



[3]

(c) Describe **two** effects of acid rain on the environment.

1. ....

.....

.....

.....

2. ....

.....

.....

..... [4]

[Total: 10]

- 4 The graphs below show the percentage of carbon dioxide in the atmosphere from the year 1700 until the year 2000 (Fig. 4.1) and the 5 year global temperature average from the year 1860 until the year 2000 (Fig. 4.2).

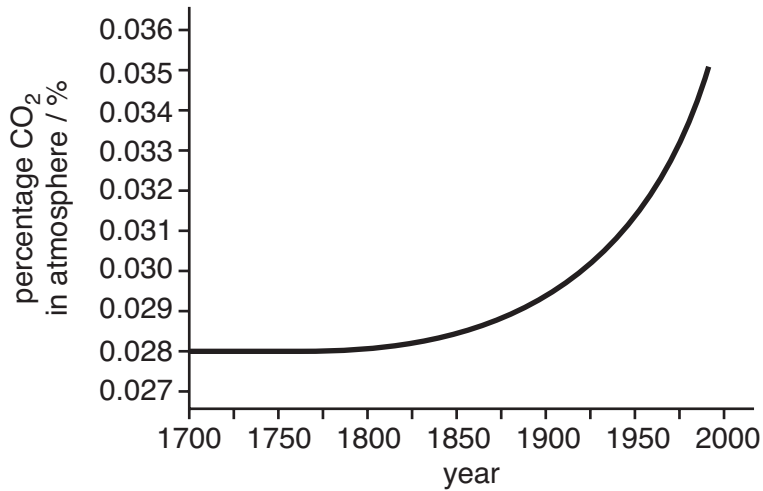


Fig. 4.1

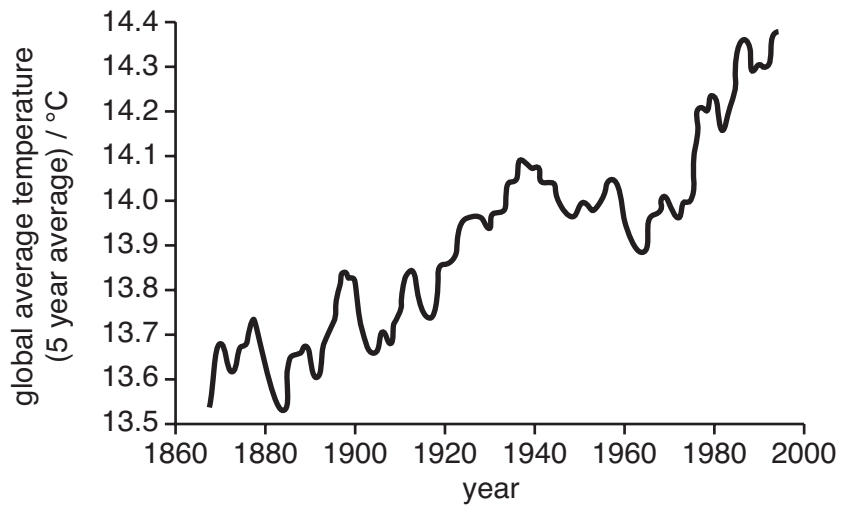


Fig. 4.2

- (a) A research team concludes that **the evidence shown** in Figs. 4.1 and 4.2 provides 'A very strong case for humans being the cause of global warming'.

Describe the shapes of the graphs in Figs. 4.1 and 4.2.

.....

.....

.....

.....

.....

.....

[4]

(b) Discuss the **reliability** of these data and the **validity** of the team's conclusion.



In your answer, you should make clear how the validity of the conclusion links with the data provided.

.....  
.....  
.....  
.....  
.....  
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.....  
.....  
..... [5]

[Total: 9]

5 Proteins are important components of all living systems.

(a) State **three** roles that proteins can play in a cell.

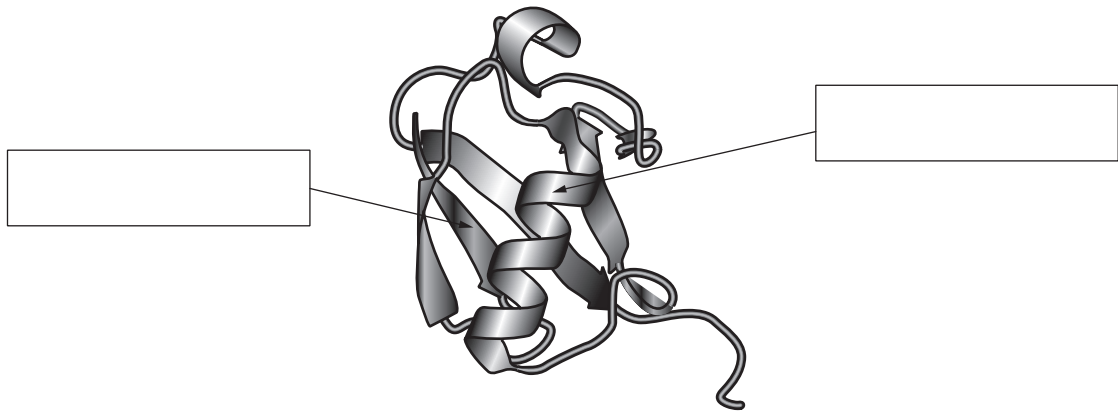
1. ....  
2. ....  
3. .... [3]

(b) Explain what is meant by the **primary** structure of a protein.

..... [1]



- (c) Fig. 5.1 shows a ribbon diagram of the protein Ubiquitin. Complete the diagram by labelling the two types of **secondary structures** in the boxes provided.



**Fig. 5.1**

**[2]**

- (d) Describe **three** types of bond that help to maintain the **tertiary** structure of a protein molecule.

You may use diagrams to help illustrate your answer.

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**[6]**

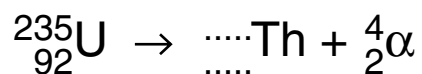
**[Total: 12]**  
**Turn over**

- 6 One method of generating electrical energy in a power station is to use a **nuclear fission** reaction. The fuel for this reaction is the isotope Uranium-235.

(a) Explain what is meant by the term *isotope*.

.....  
 .....  
 ..... [2]

(b) Uranium-235 decays by  $\alpha$ -emission to generate an isotope of the element Thorium. Complete the following equation for this process.



[2]

(c) (i) Uranium-235 has a radioactive half life of  $700 \times 10^6$  years.

Explain what is meant by the term *half life*.

.....  
 .....  
 ..... [2]

(ii) Calculate how long it would take 1.000 g of Uranium-235 to decay to 0.125 g.

time = ..... [2]

(d) The product of the decay of Uranium-235 is also radioactive.

Suggest why radioactive waste from this reaction is a problem.

.....  
.....  
.....  
..... [3]

(e) The process of generating energy by nuclear fission is carbon neutral.

(i) Suggest what is meant by the term *carbon neutral*.

.....  
..... [1]

(ii) Why is this seen as an important feature of nuclear powered electricity generation?

.....  
.....  
..... [2]

[Total: 14]

7 Energy produced by coal fired power stations in the UK is supplied to the National Grid.

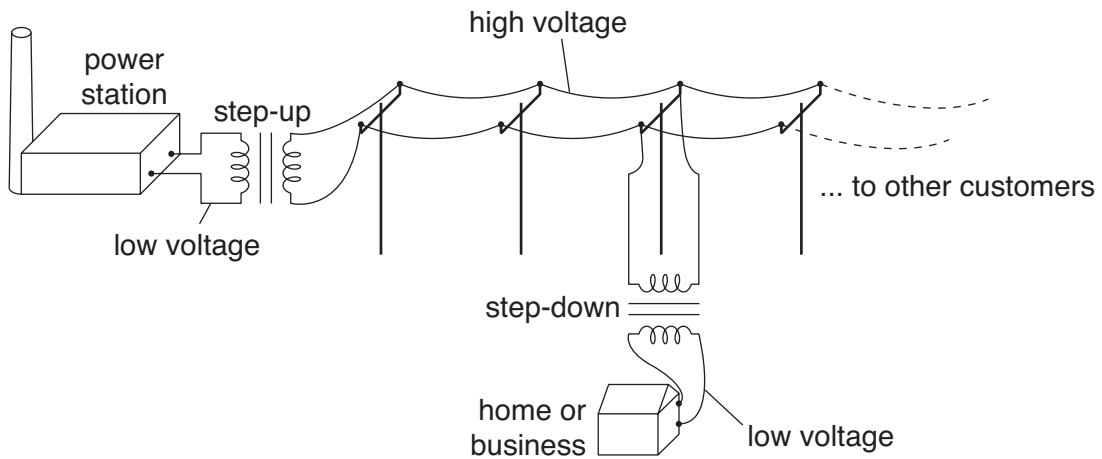


Fig. 7.1

(a) The voltage generated in the power station is stepped up before being transferred to the National Grid.

(i) Explain the meaning of *stepped up*.

.....  
 ..... [1]

(ii) Explain why it is done.

.....  
 .....  
 ..... [2]

- (b) (i) Power loss during the transmission of electricity through electricity cables across the country can be a problem.

$$\text{power loss} = (\text{current})^2 \times \text{resistance}$$

Using the equation above, explain why transmission cables with a low resistance are necessary.

.....  
..... [1]

- (ii) Calculate the power loss in a section of cable given the following values.

current = 1450 A.

resistance of cable section = 0.025 Ω

power loss = ..... unit ..... [3]

- (c) (i) Mains power supply in a typical UK house is rated as 240V ac.

What is meant by the term *ac*?

..... [1]

- (ii) An electric kettle has a power rating of 3000 W.

Assuming the household electrical supply is 240 V, what current will need to be supplied to the kettle?

Show your working.

current = ..... unit ..... [4]

[Total: 12]

8 This question is about protein synthesis.

Table 8.1 shows how some of the codons in DNA will code for particular amino acids.

Use the table to help answer this question.

Codon	Amino acid
ATG	Methionine
TCT	Serine
GGT	Glycine
CAT	Histidine
GCT	Alanine
AGT	Serine
CGA	Arginine
TAT	Tyrosine

Table 8.1

(a) (i) Using the information in the table above, which amino acid can be coded for by two different triplet base codons?

..... [1]

(ii) Use the table above to translate the following DNA base sequence into an amino acid sequence.

ATGCATGCTGCTGCT

.....  
 ..... [2]

(iii) What is the name given to a natural polymer made from a sequence of amino acids?

..... [1]

- (iv) As a result of a **mutation**, the sequence above is copied incorrectly and the following sequence of bases is generated. The mutation is shown in **bold**.

ATGCATGCTG**G**TGCT

With reference to Table 8.1 describe, in detail, how this mutation would affect the structure of the translated protein.

.....  
.....  
.....  
.....  
..... [3]

- (v) Suggest how a mutation in DNA can result in the production of an inactive enzyme.

.....  
.....  
.....  
..... [3]

- (b) Scientists can now genetically engineer crops by manipulating DNA.

- (i) Describe how the genetic modification of a plant crop can be carried out.

.....  
.....  
.....  
.....  
..... [4]

- (ii) Outline some of the potential benefits of using this technique.

.....  
.....  
..... [3]

[Total: 17]

END OF QUESTION PAPER

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