

**Wednesday 30 May 2012 – Afternoon**

**AS GCE SCIENCE**

**G642** Science and Human Activity

Candidates answer on the Question Paper.

**OCR supplied materials:**

None

**Other materials required:**

- Electronic calculator
- Ruler (cm/mm)

**Duration:** 1 hour 45 minutes




Candidate forename		Candidate surname	
--------------------	--	-------------------	--

Centre number										Candidate number				
---------------	--	--	--	--	--	--	--	--	--	------------------	--	--	--	--

**INSTRUCTIONS TO CANDIDATES**

- Write your name, centre number and candidate number in the boxes above. 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. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

**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.
- This document consists of **20** pages. Any blank pages are indicated.

**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

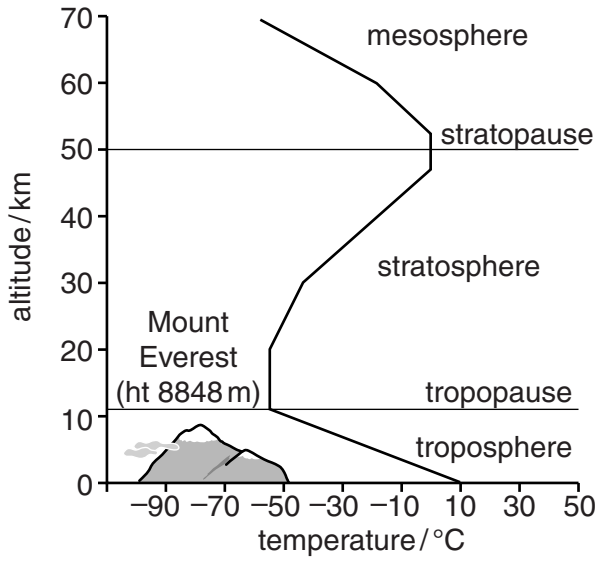
power loss = (current)<sup>2</sup>  $\times$  resistance

**BLANK PAGE**

**PLEASE DO NOT WRITE ON THIS PAGE**

Answer **all** the questions.

1 This question concerns the Earth's atmosphere.



**Fig. 1.1**

(a) Use Fig. 1.1 to estimate the temperature 30 km above the Earth's surface.

temperature = ..... °C [1]

(b) When sunlight hits an area on the Earth's surface energy is absorbed. Some of this energy is re-emitted in the form of infrared radiation.

(i) Explain what happens to the air above this area on the Earth's surface.

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

(ii) Describe what would happen to a fixed mass of air once it reaches the tropopause.

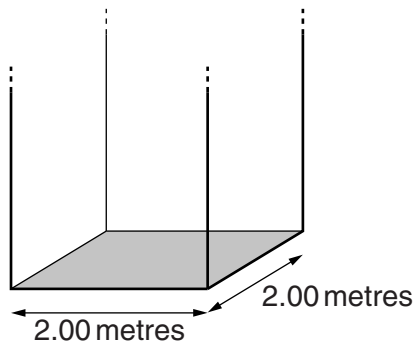
.....  
.....  
.....  
..... [2]

(iii) State **two** factors that give rise to the horizontal movement of air currents in the troposphere.

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

(c) A column of air above a square area of ground exerts a force of 396 000 N, due to its weight, see Fig. 1.2.

Calculate the pressure acting on the square area.



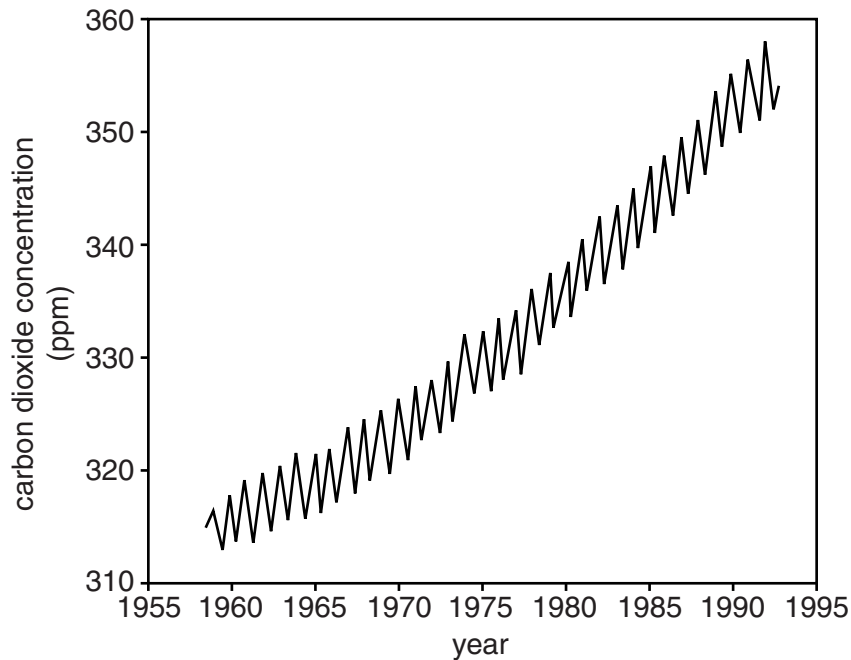
**Fig. 1.2**

total pressure = ..... unit ..... [4]

**[Total: 12]**

- 2 This question concerns the evidence behind the science of climate change.

The carbon dioxide measurements shown in Fig. 2.1 have been taken from Mauna Loa which is part of the Hawaiian islands. These islands are in the middle of the Pacific Ocean.



**Fig. 2.1**

The graph, Fig. 2.1, shows the concentration of carbon dioxide measured in parts per million (ppm) at Mauna Loa in Hawaii and its variation since the late 1950s.

- (a) (i) Suggest why the line has a regular peak and trough pattern every year.

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

- (ii) Suggest a reason for sampling carbon dioxide levels at high altitude in Hawaii.

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

(b) (i) Tree ring data is used to gain information about climate change.

Suggest how this data can be used to give evidence of past climate.

.....

.....

.....

..... [2]

(ii) Another method of looking at evidence for climate change is to carry out isotopic analysis on samples of water in polar ice cores.

State what is meant by *isotopes*.

.....

.....

.....

..... [2]

(iii) Complete the table below for isotopes of oxygen. Oxygen has atomic number 8.

isotope	number of		
	neutrons	protons	electrons
$^{18}\text{O}$	.....	.....	.....
$^{16}\text{O}$	.....	.....	.....

[3]

(iv) Why is it reasonable to assume that both isotopes of oxygen are chemically identical?

.....

..... [1]

[Total: 10]

3 The burning of fossil fuels results in the production of a number of gaseous products.

(a) (i) Name the type of chemical process occurring.

..... [1]

(ii) Two of the gases produced are carbon dioxide (CO<sub>2</sub>) and sulfur dioxide (SO<sub>2</sub>). The carbon and sulfur have the same oxidation number.

What is the oxidation number?

oxidation number = ..... [1]

(b) When these gases dissolve in water they produce acidic solutions. One of the gases produces a strong acid, the other a weak acid.

(i) State what is meant by an *acid*.

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

(ii) Complete the symbol equations when carbon dioxide and sulfur dioxide dissolve separately in water.



(iii) Explain why the solution of sulfur dioxide in water is a stronger acid. Use ideas about ions in your answer.

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





4 In recent years, scientists have begun to genetically modify crops such as rice and maize.

(a) (i) Give **two** reasons for genetically modifying crops.

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

(ii) In order to introduce a new characteristic into a target organism, the DNA that codes for that characteristic must be identified. The target sequence can be removed using a DNA **restriction enzyme**.

Describe how a *restriction enzyme* works.

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

(iii) Once the target sequence is removed it is introduced into a vector.

Identify **two** vectors that can be used for this technique and for **one** of these vectors outline how the new genetic material is introduced into the target organism.

- vector 1 .....  
.....  
.....
- vector 2 .....  
.....  
..... [3]



5 This question is about water and its special physical and chemical properties.

(a) (i) One unusual property of water is its high boiling point.

Give **two** other unusual properties shown by water.

1. ....

2. .... [2]

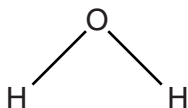
(ii) The density of water at 30 °C is 996 kg m<sup>-3</sup>.

Calculate the volume occupied by 3.50 kg of water at this temperature.

Give your answer in standard form.

volume = ..... unit ..... [4]

(b) A water molecule is shown in Fig. 5.1.



**Fig. 5.1**

(i) Complete Fig. 5.1 to show all of the bonding pairs and the lone pairs of electrons.

Use dots and crosses to represent electrons.

[3]

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

Using an appropriate diagram, explain why hydrogen bonding occurs in water and how this accounts for the high boiling point of water.

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

(c) The condensation of water is an exothermic process.

(i) State what is meant by the term *exothermic*.

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

(ii) Explain why the condensation of water is an exothermic process.

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

[Total: 16]

- 6 This question is about the structure of the atom and radioactive processes.

Approximately 20% of electrical energy in the UK is generated by nuclear reactors that use enriched uranium in a nuclear fission reaction.

- (a) Explain what is meant by *nuclear fission*.

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

- (b) There are three types of radiation: alpha ( $\alpha$ ), beta ( $\beta$ ) and gamma ( $\gamma$ ).

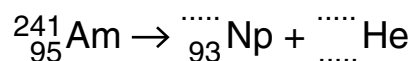
- (i) Some nuclear waste emits gamma radiation.

State and explain **one** precaution that should be taken for the safe storage of this nuclear waste.

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

- (ii) Alpha ( $\alpha$ ) radiation is emitted by the radioactive decay of americium-241 according to the following equation.

Complete the equation below.



[3]

- (c) The discovery of radiation by Marie Curie in the late 19th Century was to prove vital in the later development of the model of the atom.

Describe how the ' $\alpha$  scattering experiment' was used to develop the Rutherford model of the atom. You may wish to illustrate your answer with a diagram.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [6]

[Total: 13]

7 This question is about electrical energy generation in the UK.

A typical power station in the UK will generate electrical energy with a voltage of 25 000V. Before transmission this voltage is changed.

(a) (i) What happens to the voltage before transmission?

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

(ii) Why is this done?

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

(iii) The electricity supply in the UK is rated as 50Hz ac.

Explain the difference between *ac* and *dc* electric current.

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

(iv) An electric oven draws a current of 20 A at a voltage of 230V.

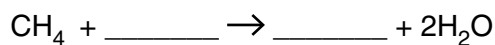
Calculate the total amount of energy transferred by the oven in 10 minutes.

energy transferred = ..... unit ..... [5]



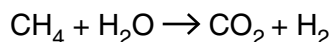
(b) Much of the electrical energy generated in the UK uses fossil fuels as an energy source. One of these fossil fuels is natural gas which is mostly methane gas.

(i) Complete the equation below for the complete combustion of methane.



[3]

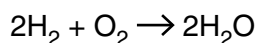
(ii) Another fuel that is being considered is hydrogen. Hydrogen can be produced from the reaction of methane and steam.



Steam is reduced. State how you can tell this from the equation.

..... [1]

(iii) The hydrogen can then be reacted to release energy with water as the only product.



Some people suggest that using hydrogen as a fuel does not contribute to global warming because it is carbon neutral.

Explain why hydrogen produced in this way **cannot** be described as carbon neutral.

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

[Total: 14]

- 8 The ozone layer is responsible for filtering out most of the ultraviolet light emitted from the Sun. The wavelength bands of ultraviolet light are shown in Table 8.1.

ultraviolet band	UV-A	UV-B	UV-C
wavelength / nm	400-315	315-280	280-100

**Table 8.1**

- (a) Of the three wavelength bands of ultraviolet light, UV-C is the most dangerous.

- (i) Suggest why UV-C is the most dangerous.

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

- (ii) A photon of UV-C radiation has energy of  $1.3 \times 10^{-18}$  Joules.

Calculate the frequency of this radiation in Hz.

Planck constant ( $h$ ) =  $6.63 \times 10^{-34}$  Js

frequency = ..... Hz [2]

- (iii) Hence calculate the wavelength of this frequency of radiation.

$1 \text{ nm} = 1 \times 10^{-9} \text{ m}$   
 $c = 3.0 \times 10^8 \text{ m s}^{-1}$

wavelength = ..... unit ..... [3]

- (b) In attempting to show a link between exposure to ultraviolet light and the incidence of skin cancer a team of scientists carried out a cohort study.

Describe the main features of a cohort study and suggest **one** possible limitation of such a study.

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

[Total: 11]

**END OF QUESTION PAPER**

**PLEASE DO NOT WRITE ON THIS PAGE**



**Copyright Information**

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download from our public website ([www.ocr.org.uk](http://www.ocr.org.uk)) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact the Copyright Team, First Floor, 9 Hills Road, Cambridge CB2 1GE.

OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.