

Monday 1 June 2015 – Morning

AS GCE SCIENCE

G642/01 Science and Human Activity

Candidates answer on the Question Paper.

OCR supplied materials:

None

Other materials required:

- Electronic calculator
- Ruler

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, 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. If additional space is required, you should use the lined pages at the end of this booklet. The question number(s) must be clearly shown.
- 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 **24** 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)² \times resistance

voltage = current \times resistance

Answer **all** the questions.

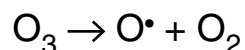
- 1 This question concerns two types of catalysed reactions.

On the 6th April 2011, the United Nations reported:

'The ozone layer that protects life from the Sun's ultraviolet radiation has thinned to record low levels over the Arctic.'

This occurred despite the fact that the Montreal Protocol banned the use of chlorofluorocarbons (CFCs) in 1996.

Ozone depletion can be represented by the following equation:



- (a) (i) The equation shows the generation of an oxygen radical.

Define the term *radical*.

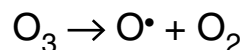
..... [1]

- (ii) The formation of O^\bullet and O_2 requires energy.

Give a reason why.

..... [1]

- (iii) Radiation of frequency 1.0×10^{15} Hz is absorbed as ozone is broken down.



Calculate the wavelength of this light in nanometres (nm).

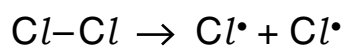
Show your working.

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

$$1 \text{ nm} = 1 \times 10^{-9} \text{ m}$$

wavelength of light = nm [3]

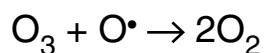
- (iv) The splitting of a chlorine molecule by homolytic fission is shown below.



Suggest what is meant by homolytic fission.

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

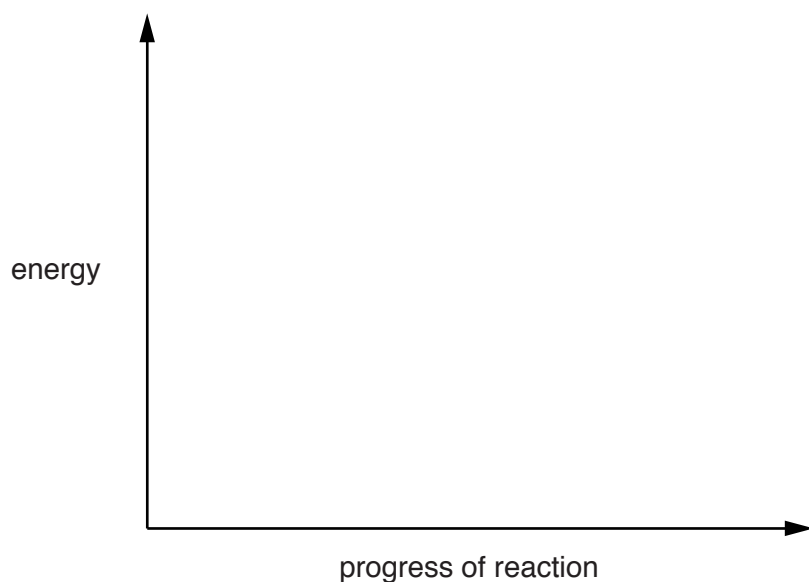
- (v) The main reaction that removes ozone from the atmosphere is shown below.



This reaction releases energy and can be catalysed by chlorine radicals.

Draw a labelled energy profile for this reaction showing both the catalysed and uncatalysed profile on the same axes.

Clearly mark the activation energy for both reactions.



[4]

2 This question is about the Earth's atmosphere.

Fig. 2.1 shows the temperature of the Earth's atmosphere at different altitudes.

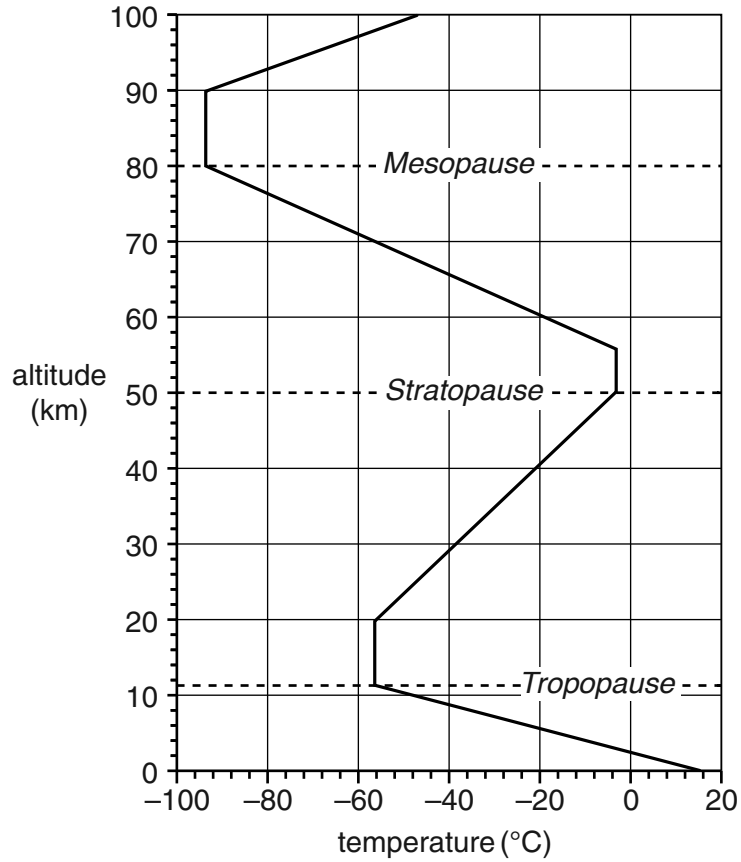


Fig. 2.1

(a) Using Fig. 2.1, give the altitudes at which the temperature is -20°C .

1 2 3

[1]

(b) (i) A fixed mass of air rises in the atmosphere when it is heated.

Use the kinetic theory of gases to explain why.

.....

[3]

- (ii) Air currents move from high to low pressure. In the Northern Hemisphere these air currents are deflected in a clockwise direction.

What is the name given to this effect? State the factor that causes it.

name

cause

[2]

- (c) The specific heat capacity of water is $4.18 \text{ kJ kg}^{-1} \text{ }^\circ\text{C}^{-1}$.

- (i) Calculate the temperature rise when 20.0 kJ of energy is transferred to 1.00 kg of water.

Show your working.

temperature rise of water = $^\circ\text{C}$ [2]

- (ii) In an experiment, 20.0 kJ of energy is transferred to 1.00 kg of dry earth. The temperature rises from 20.7°C to 36.6°C .

Calculate the specific heat capacity of dry earth.

specific heat capacity of dry earth = $\text{kJ kg}^{-1} \text{ }^\circ\text{C}^{-1}$ [2]

- (iii) Explain why the high specific heat capacity of water has an impact on the Earth's climate.

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..... [3]

[Total: 13]

Turn over

3 This question is about the process of protein synthesis.

Fig. 3.1 shows a transfer RNA (tRNA) molecule.

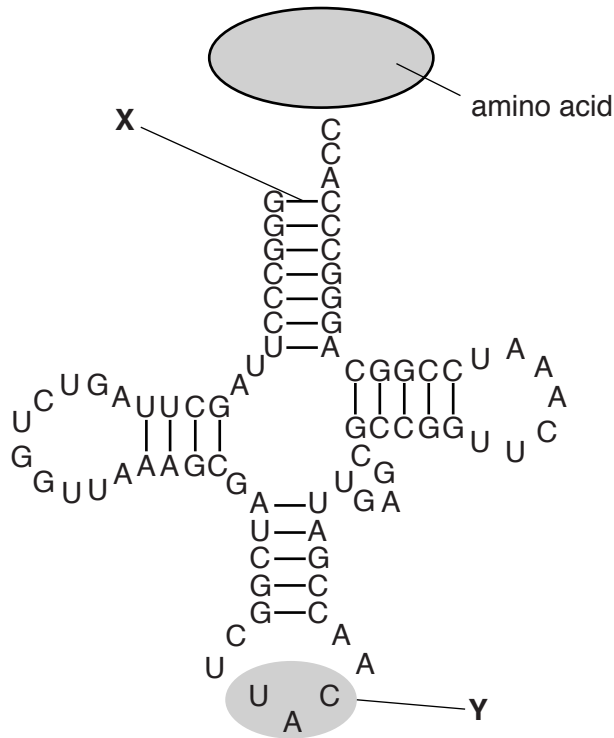


Fig. 3.1

- (a) (i) What is the name given to the sequence of three bases labelled **Y** on Fig. 3.1?
 [1]
- (ii) What is represented by the line between G and C labelled **X** in Fig. 3.1?
 [1]

Table 3.1 shows the messenger RNA (mRNA) base sequences that code for some amino acids.

mRNA base sequence	GCA	GGA	UGC	AUG	AAA	UCU	CCC
Amino acid	alanine	glycine	cysteine	methionine	lysine	serine	proline

Table 3.1

(b) Using Table 3.1, identify the amino acid that is attached to the tRNA molecule shown in Fig. 3.1. Explain your reasoning.

amino acid

explanation

..... [2]

(c) DNA, messenger RNA (mRNA) and transfer RNA (tRNA) are all involved in protein synthesis.

Describe their roles in protein synthesis.



In your answer you should describe the steps in the process clearly.

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..... [7]

11
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Question 4 begins on page 12
PLEASE DO NOT WRITE ON THIS PAGE

- 4 Fig. 4.1 shows a simple electrical circuit with a direct current (dc) power supply. The current in the circuit is measured by an ammeter (shown with an **A**). The voltage across the filament bulb is measured with a voltmeter (shown with a **V**).

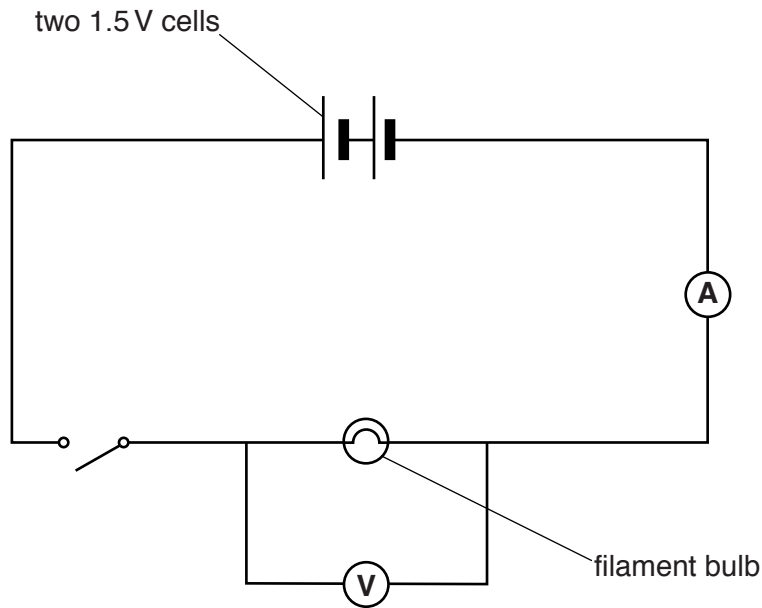


Fig. 4.1

(a) State what is meant by the following terms:

- (i) current
 - (ii) direct current (dc)
-

[2]

(b) In Fig. 4.1 the voltmeter (**V**) reads 2.9V and the ammeter (**A**) reads 250mA.

- (i) Calculate the power developed in the filament bulb. Show your working.

power developed in the bulb = W [2]

- (ii) Calculate the resistance of the filament bulb in this circuit. Show your working.
Give your answer to **two** significant figures.

resistance = Ω [3]

- (iii) Calculate the charge passing through the filament bulb in 1 hour.
Show your working.

total charge = unit [3]

[Total: 10]

(b) Suggest **two** ways in which the design of electrical power lines could minimise the exposure to the magnetic fields.

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..... [2]

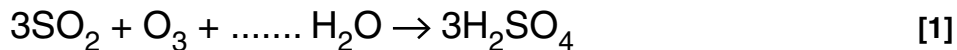
[Total: 10]

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

(a) (i) Complete the equation below for the combustion of sulfur.



(ii) Sulfur dioxide can react with ozone and water in the atmosphere to produce sulfuric acid. Balance the equation below for this reaction.



(iii) Deduce the oxidation number of sulfur in each of the following compounds.

1 SO_2

2 H_2SO_4

[2]

(b) Two students investigated the change in pH of a lake. They took one pH measurement each day over a 10-day period.

Their results are shown in Fig. 6.1.

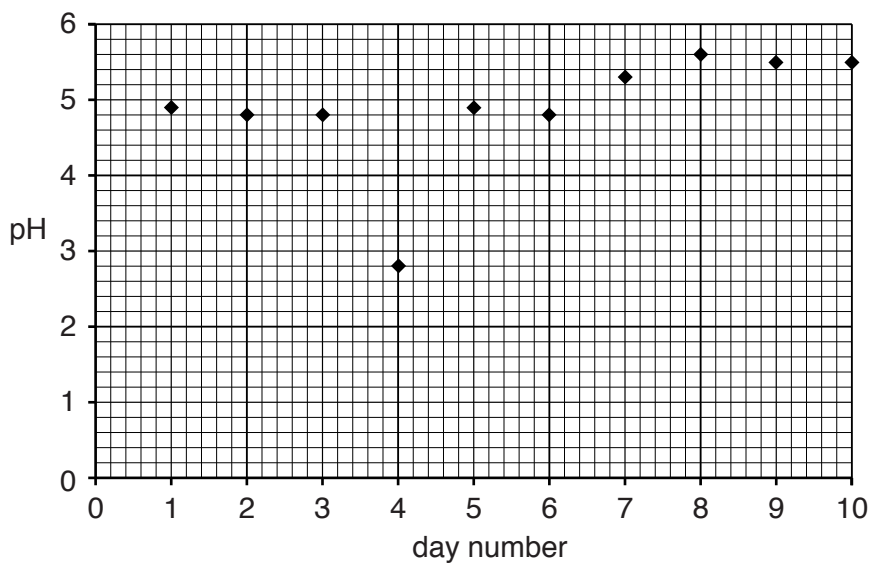


Fig. 6.1

(i) On which day was the lake least acidic?

..... [1]

(ii) State **two** things that the students should have done to ensure that the collection of data in this investigation was reliable.

1

2

[2]

(c) Another gas that causes acid rain is nitrogen dioxide, NO_2 . This gas dissolves in water to form nitric acid, HNO_3 .

(i) Complete the equation for the ionisation of nitric acid.



(ii) The amount of acid in a sample of solution can be measured accurately by titration.

The apparatus used for a titration is shown in Fig. 6.2.

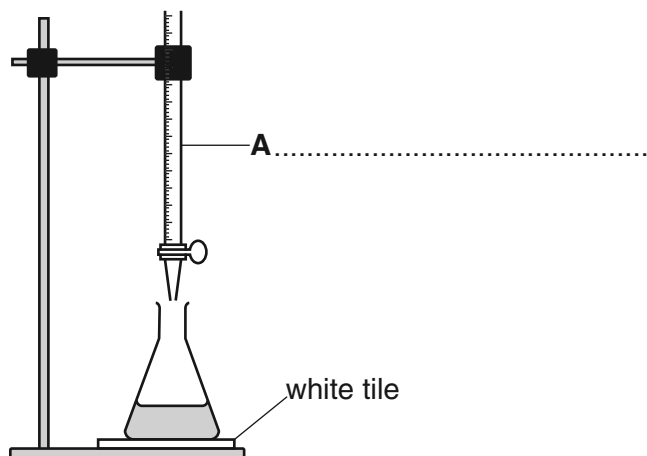


Fig. 6.2

On Fig. 6.2, name the piece of apparatus labelled **A**. [1]

(iii) What is the function of the white tile shown in Fig. 6.2?

.....
 [1]

(d) Oxides of nitrogen produced by car engines can contribute to atmospheric pollution.

Nitrogen dioxide (NO_2) can be removed from exhaust fumes by *reduction* using a *catalyst*.

(i) What is meant by the following terms?

reduction

 catalyst

 [3]

(ii) Suggest the product of the reduction of NO_2 .

..... [1]

[Total: 15]

Turn over

18
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7 This question is about different methods of electricity generation.

Many nuclear power reactors use isotopes of uranium.

(a) (i) State **one** similarity and **one** difference between two isotopes of the same element.

similarity

.....

difference

.....

[2]

(ii) Uranium-235 decays to Thorium-231 by alpha particle emission.

Complete the equation below for this process.



(iii) 'Uranium-235 has a half-life of 704 million years.'

Explain the meaning of this statement.

.....

.....

..... [2]

(b) As an alternative to Uranium-235, Thorium-233 has been proposed as an energy source for nuclear fission reactors.

Complete the following table for an atom of Thorium-233, ${}_{90}^{233}\text{Th}$.

Subatomic particle	Proton	Neutron	Electron
Number of each particle

[3]

Question 7(c) begins on page 20

(c) Electrical energy can also be generated in coal-fired power stations.

Use the words in the box to complete the passage below. You may use each word once, more than once, or not at all.

combustion	current	fossil	hydrogen
	kinetic	nuclear	
power	reduction	renewable	
steam	voltage	wattage	

Coal is an example of a fuel. Coal is burned in a reaction known as , which releases heat energy. This energy is used to turn water into , which can be used to drive a turbine. The turbine turns a generator which converts energy into electrical energy.

Before the energy is transferred to the National Grid, a step-up transformer increases the of the electricity which results in a lower

[4]

ADDITIONAL ANSWER SPACE

If additional answer space is required, you should use the following lined pages. The question number must be clearly shown in the margin.

A large area of lined paper for writing. It consists of a vertical solid line on the left side, creating a margin. To the right of this line, there are numerous horizontal dotted lines spaced evenly down the page, providing space for writing answers.

A large area of the page is reserved for writing, featuring a vertical solid line on the left side and horizontal dotted lines extending across the page.



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