



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

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CANDIDATE
NUMBER

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CO-ORDINATED SCIENCES

0654/21

Paper 2 (Core)

October/November 2012

2 hours

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a soft pencil for any diagrams, graphs, tables or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Answer **all** questions.

A copy of the Periodic Table is printed on page 28.

At the end of the examination, fasten all your work securely together.

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

For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
Total	

This document consists of **28** printed.



- 1 (a) Complete Table 1.1 by choosing one of the words from the list to match each statement.

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ammeter ampere electron insulator
ohm volt voltmeter watt

Table 1.1

statement	word
a particle with a negative electrical charge	
an instrument that measures electrical current	
the unit of potential difference	
a material that does not conduct electricity	

[4]

- (b) The diagram shows two circuits **A** and **B**. All the lamps and both cells are the same.

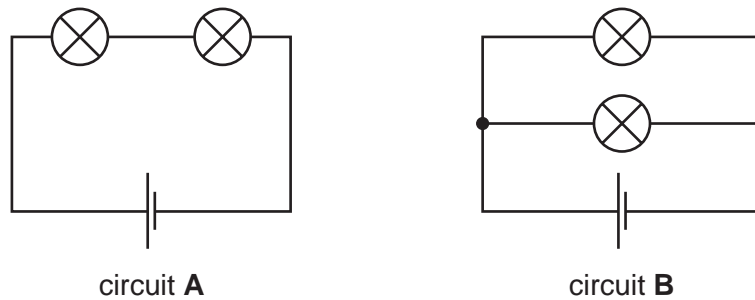


Fig. 1.1

- (i) One lamp is unscrewed from circuit **A**.

State what happens to the other lamp.

Explain your answer.

.....

.....

..... [2]

(ii) Explain why lights in a house are connected as in circuit **B** and **not** as in circuit **A**.

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

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(iii) The resistance of each lamp is $1.2\ \Omega$.

Calculate the combined resistance of the two lamps in circuit **A**.

State the formula that you use and show your working.

formula used

working

..... Ω [2]

2 (a) Fig. 2.1 shows part of the carbon cycle.

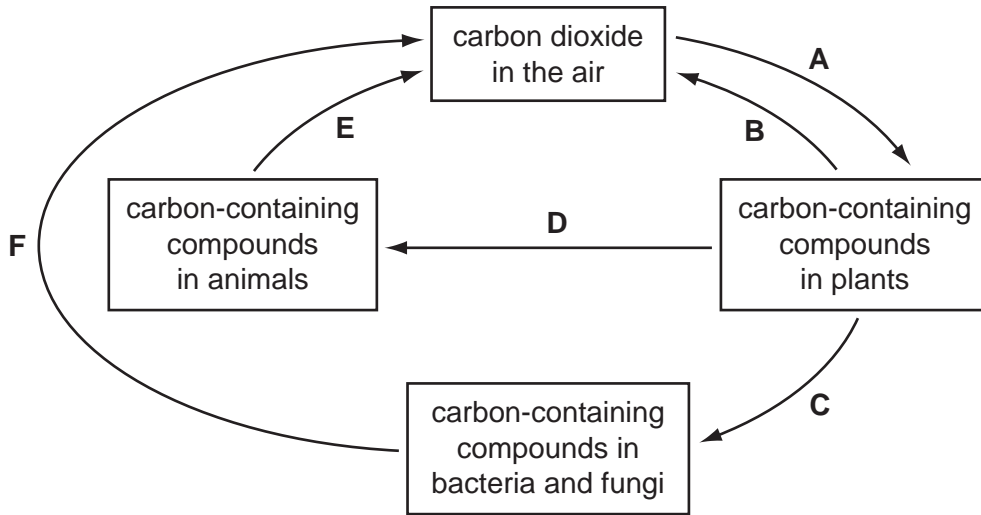


Fig. 2.1

(i) State the letter or letters, **A, B, C, D, E** or **F**, that represent

photosynthesis,

respiration.

[2]

(ii) Name **one** carbon-containing compound in plants.

..... [1]

(iii) State the approximate percentage of carbon dioxide in the air.

..... [1]

(b) Earthworms play an important part in the carbon cycle. They eat dead leaves, and egest material containing plant nutrients into the soil.

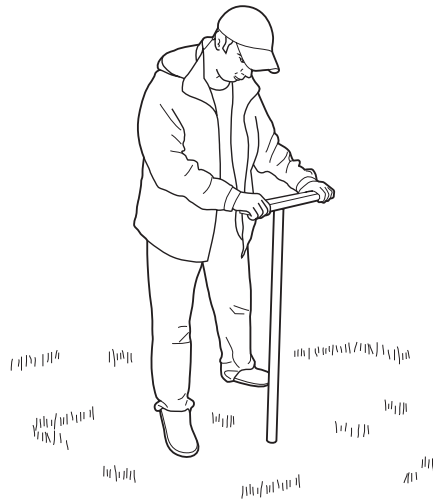
Explain the meaning of the term *egest*.

.....

 [2]

- (c) In Florida, USA, some people collect earthworms by vibrating the soil. Earthworms respond to vibrations in the ground by crawling out of their burrows onto the soil surface.

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A student investigated the effect of different frequencies of vibrations on the numbers of earthworms that emerged from the soil. Fig. 2.2 shows his results.

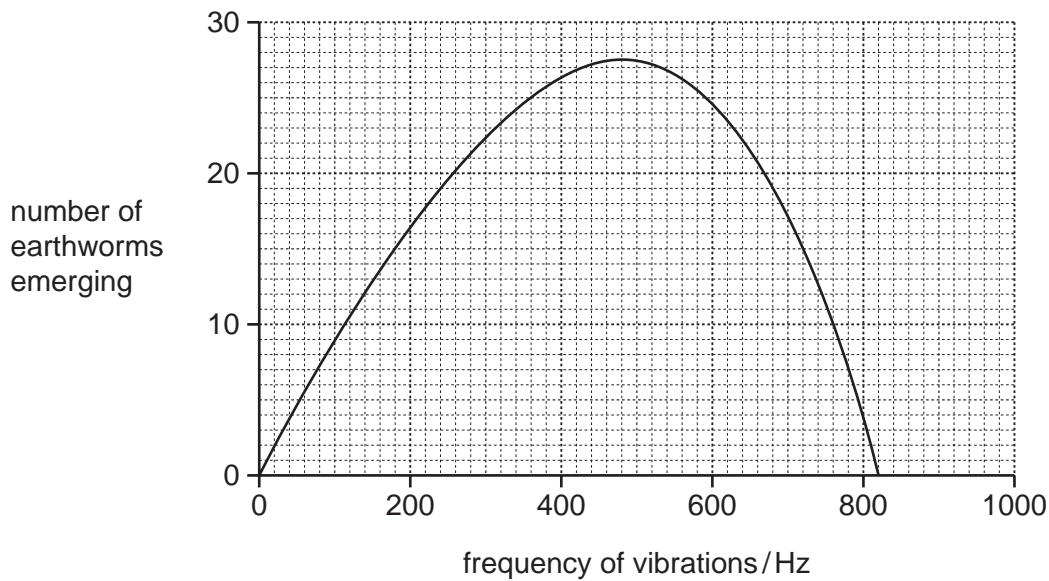


Fig. 2.2

- (i) Describe the effect of different frequencies of vibrations on the numbers of earthworms emerging.

.....

.....

.....

..... [2]

(ii) Fishermen catch large numbers of earthworms to use as bait.

There are concerns that too many worms are being collected in some parts of Florida, USA.

Suggest why it is important to conserve earthworms.

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

(iii) Moles are predators that live underground and eat earthworms. When moles burrow through the ground, they produce vibrations of around 500 Hz.

Explain why the genes of earthworms that respond to vibrations of this frequency have a strong chance of being passed on to the next generation.

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

- 3 (a) Fig. 3.1 shows how a digital pH meter is used to measure the pH of some liquids.

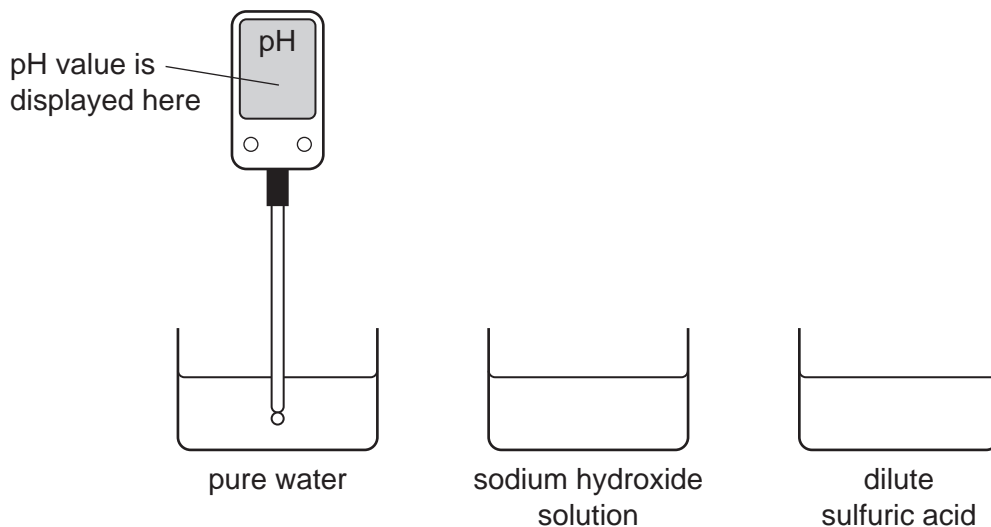


Fig. 3.1

- (i) Complete Table 3.1 by suggesting suitable pH values for the different liquids.

Table 3.1

liquid	pH
pure water	
sodium hydroxide solution	
dilute sulfuric acid	

[2]

- (ii) Suggest **one** advantage of using a digital pH meter rather than a piece of litmus paper to compare the acidity of two different acid solutions.

.....
 [1]

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(iii) Dilute acids are aqueous solutions that contain dissolved ions.

Table 3.2 shows the names of the ions in two common acids.

Table 3.2

name of dilute acid	names of dissolved ions
nitric acid	hydrogen ions and nitrate ions
sulfuric acid	hydrogen ions and sulfate ions

A student is given an unlabelled beaker which is known to contain either dilute nitric acid or dilute sulfuric acid.

Describe how the student could use a solution of acidified barium chloride to find out which acid the beaker contains.

.....

.....

..... [2]

(b) When a reactive metal is added to a dilute acid, the metal reacts and dissolves and a gas is given off.

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Use

(i) Name **one** reactive metal that must **not** be added to a dilute acid.

Explain why this metal should not be added to acid.

metal

explanation

..... [2]

(ii) Fig. 3.2 shows how a student tested the gas given off when magnesium was added to dilute hydrochloric acid.

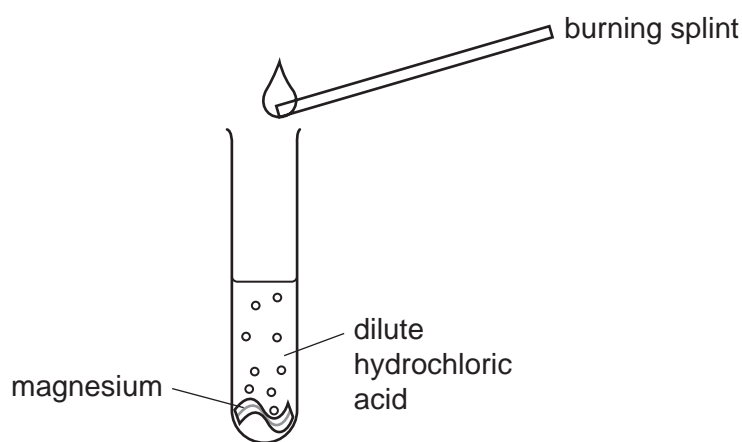


Fig. 3.2

State and explain what the student observed when he carried out this test.

observation

explanation

[2]

(iii) Unreactive metals do **not** react in dilute acid.

A student is given a mixture of powdered magnesium and powdered copper.

Describe and explain how the student could use dilute hydrochloric acid and usual laboratory apparatus to obtain a sample of copper from this mixture.

For
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Use

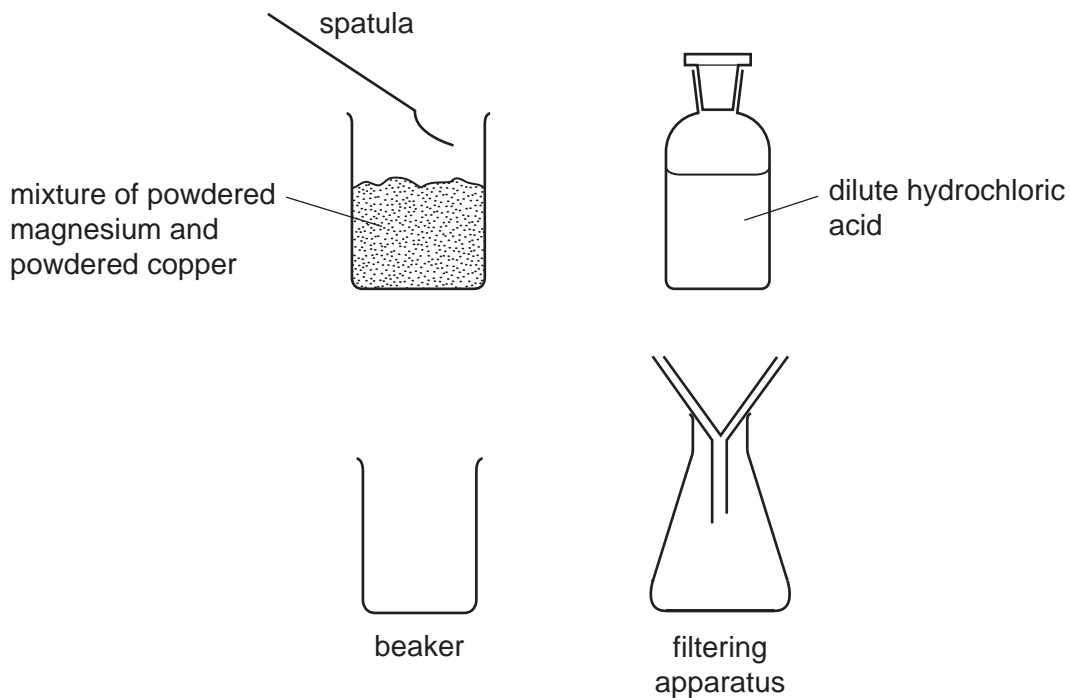


Fig. 3.3

.....

.....

.....

.....

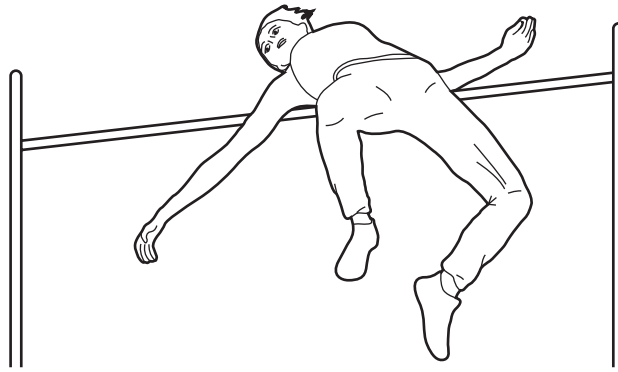
.....

.....

..... [3]

4 An athlete competes in the high jump.

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(a) Describe the energy changes that take place between the athlete taking off and landing after the high jump.

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

(b) As the athlete moves upwards she decelerates.

Name the force causing this deceleration and state its source.

force

source [2]

(c) After jumping, the athlete is sweating.

(i) Describe, in terms of particles, how evaporation occurs from the surface of a liquid.

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

(ii) Explain how this process will cool down the athlete.

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

5 Seeds need oxygen for respiration when they are germinating.

(a) (i) Write the **word** equation for aerobic respiration.

..... [2]

(ii) List **two** environmental conditions, other than a supply of oxygen, that all seeds require for germination.

1

2 [2]

(b) An investigation was carried out to find the effect of temperature on the rate of respiration of germinating seeds.

Four experiments, **A**, **B**, **C** and **D**, were set up. Each experiment used either germinating or dead seeds.

The results are shown in Table 5.1.

Table 5.1

experiment	seeds	temperature / °C	relative rate of respiration
A	germinating seeds	0	1
B	germinating seeds	10	2
C	germinating seeds	20	4
D	dead seeds	20	0

(i) Explain why it was important to include set **D** in the experiment.

.....

 [1]

(ii) With reference to Table 5.1, describe the effect of temperature on the rate of respiration of germinating seeds.

.....

 [2]

(iii) Respiration is controlled by enzymes.

Predict and explain the rate of respiration of germinating seeds at a temperature of 60 °C.

predicted results

explanation

.....

..... [2]

*For
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- 6 Some types of firework are made by filling a cardboard tube with firework mixture. Firework mixture is made from several solid substances which have been powdered and mixed together.

For
Examiner's
Use

Fig. 6.1 shows a typical firework.

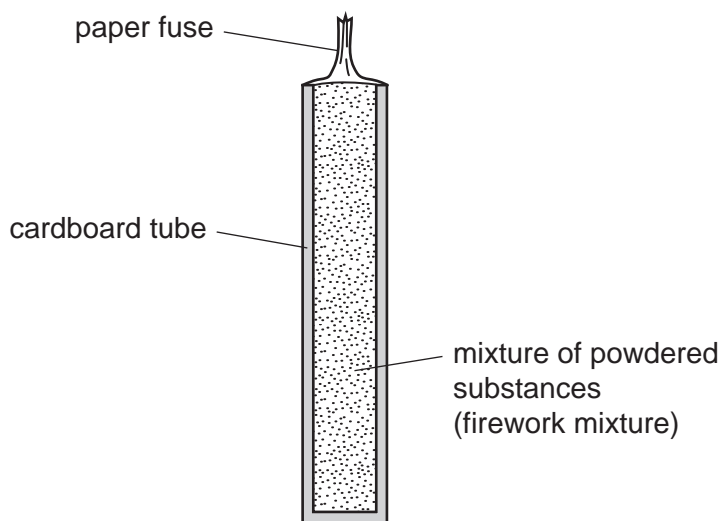


Fig. 6.1

When the paper fuse is lit, exothermic chemical reactions occur inside the firework.

- (a) (i) State **two** forms of energy that are released when the firework mixture reacts.

..... and [1]

- (ii) State the effect on the rate of reaction of using firework mixture in the form of a powder.

..... [1]

- (b) Some firework mixtures contain aluminium which is oxidised when the firework is lit.

Table 6.1 shows the numbers of protons and electrons in four particles, **A**, **B**, **C** and **D**, which are involved in the oxidation of aluminium.

Table 6.1

particle	number of protons	number of electrons
A	8	10
B	13	13
C	8	8
D	13	10

- (i) State and explain which particle, **A**, **B**, **C** or **D**, in Table 6.1 is an **atom** of aluminium.

particle

explanation

..... [3]

- (ii) State and explain which **two** particles in Table 6.1 could be found bonded together in aluminium oxide.

particles and

explanation

.....

..... [3]

- (c) Firework mixtures contain the compound potassium perchlorate, $KClO_4$.

When potassium perchlorate is heated, a colourless gas is given off which re-lights a glowing splint.

- (i) State the name of this gas. [1]

- (ii) Suggest how potassium perchlorate in the firework mixture helps the mixture to burn.

.....

.....

..... [2]

7 (a) Choose phrases from the list to complete the sentences.

- | | | |
|----------------------------|----------------------------|------------------------------|
| gamma radiation | infra-red radiation | visible light |
| microwave radiation | radio radiation | ultraviolet radiation |

The human eye can detect

..... can be felt as heat.

The water in food strongly absorbs [3]

(b) In a nuclear power station, nuclear fuel such as uranium releases energy by the process of nuclear fission.

(i) State what happens to the uranium atoms.

..... [1]

(ii) At a nuclear power station, technicians work close to radioactive sources.

State **one** way in which these workers could be harmed by radiation emitted from radioactive sources.

..... [1]

(iii) State **two** ways in which these workers could be protected from the radiation.

1

.....

2

..... [2]

Please turn over for Question 8.

8 Fig. 8.1 shows the male reproductive system.

For
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Use

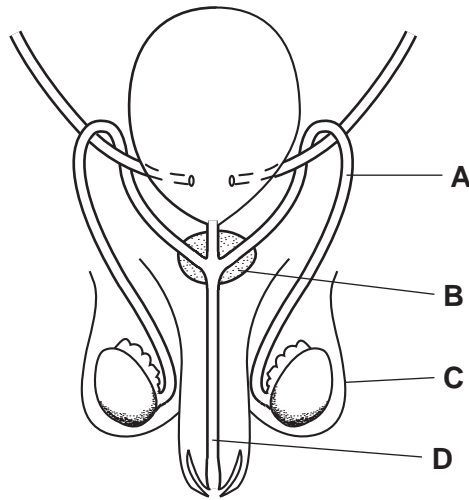


Fig. 8.1

(a) (i) Name parts C and D.

C

D

[2]

(ii) State the functions of parts A and B.

A

B

[2]

(iii) On Fig. 8.1, use a label line and the letter S to indicate where male gametes are made. [1]

(b) The sex of a baby is determined by the X and Y chromosomes.

(i) Name the part of a cell in which the X and Y chromosomes are found.

..... [1]

(ii) Describe how the sex of a human baby is inherited.

.....

 [2]

(c) The human immunodeficiency virus (HIV) can be transmitted during sexual intercourse.

Outline **two** other ways in which HIV can be transmitted.

1

.....

2

..... [2]

*For
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9 Chlorine is released when hydrochloric acid reacts with the compound manganese dioxide.

For
Examiner's
Use

(a) (i) Explain why chlorine is an example of an *element* and **not** a *compound*.

.....

 [2]

(ii) Describe a safe test for chlorine gas.

.....
 [2]

(b) Chlorine is found in Group 7 of the Periodic Table. Two of the other elements in Group 7 are bromine and iodine.

(i) Chlorine is a gas at room temperature.

What are the physical states of bromine and iodine at room temperature?

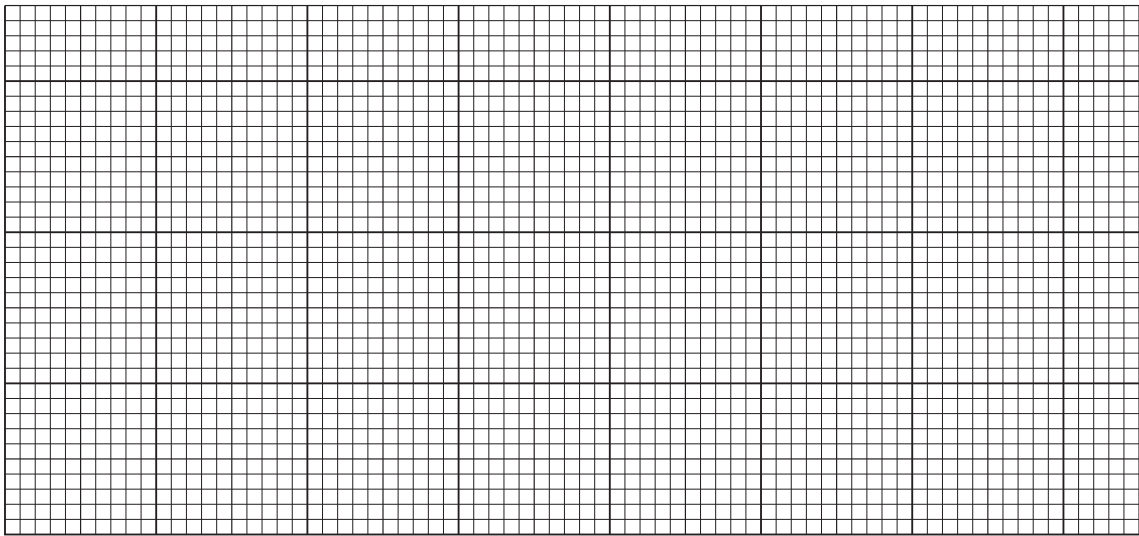
bromine

iodine [2]

(ii) Explain briefly why a solution of sodium bromide turns orange when chlorine is bubbled through it.

.....
 [2]

- 10 (a) On the grid below, draw a wave with an amplitude of 2 cm and a wavelength of 4 cm.
On your diagram, clearly label the amplitude and the wavelength.



[3]

- (b) (i) Two sound waves, **A** and **B**, have the same frequency but **A** has a greater amplitude than **B**.

What difference would you hear?

..... [1]

- (ii) Two sound waves, **X** and **Y**, have the same amplitude but **X** has a greater frequency than **Y**.

What difference would you hear?

..... [1]

- (c) Energy travels to the Earth from the Sun.

State whether this transfer of energy is by conduction, convection or radiation.

Explain your answer.

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

(d) Fig. 10.1 shows parallel rays of light passing through a piece of glass acting as a lens and being focused on the ground.

For
Examiner's
Use

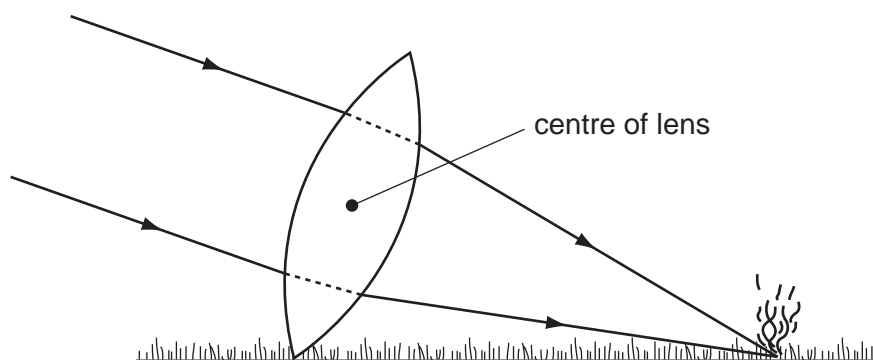


Fig. 10.1

(i) On Fig. 10.1, use the letter **P** to label the principal focus of the piece of glass. [1]

(ii) Measure the focal length of the piece of glass in Fig. 10.1.

..... mm [1]

(iii) The glass acting as a lens produces a real image of the Sun.

Explain what is meant by the term *real image*.

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

(e) The mass of the piece of glass is 10g and the volume is 4 cm³.

Calculate the density of the glass.

State the formula that you use and show your working.

formula used

working

..... g/cm³ [2]

(f) Light is able to travel down optical fibres by total internal reflection.

Complete the diagram to show how the ray of light passes down the optical fibre.



*For
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Use*

[2]

11 Table 11.1 shows some of the nutrients contained in 100 g of five foods.

For
Examiner's
Use

Table 11.1

food	nutrients			
	sugar/g	starch/g	protein/g	fat/g
A	0	0	13	10
B	14	6	7	0
C	0	0	14	6
D	6	8	12	14
E	9	14	3	0

(a) (i) Which **two** nutrients listed in Table 11.1 are carbohydrates?

..... and [1]

(ii) Which nutrient listed in Table 11.1 contains nitrogen atoms in its molecules?

..... [1]

(iii) State the letters of **two** foods in Table 11.1 that could have come from animals.

..... and [1]

(iv) State the letter of **one** food that would appear orange-brown when tested with iodine solution, and give a purple colour when tested with biuret reagent.

..... [1]

(b) Table 11.1 does **not** contain information about vitamins or minerals.

Outline the symptoms that a person may develop if their diet is deficient in

(i) vitamin D,

..... [1]

(ii) iron.

..... [1]

(c) Explain why eating a lot of foods containing sugar can increase the risk of tooth decay.

.....

.....

.....

.....

..... [3]

*For
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- 12 (a) Draw **four** straight lines to connect each term in the left hand column with its meaning in the right hand column.

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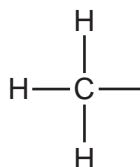
term	meaning
petroleum	raw material for fuels and other chemicals
catalytic cracking	compound containing only the elements hydrogen and carbon
fractional distillation	reaction that produces alkenes
hydrocarbon	process that simplifies a complex mixture

[3]

- (b) Ethanol, C_2H_6O , is a colourless liquid which can be made from ethene, C_2H_4 .

- (i) An incomplete diagram of the structure of one molecule of ethanol is shown below.

Complete the diagram.



[1]

- (ii) Write a **word** chemical equation for the reaction in which ethanol is made from ethene.



[1]

- (c) Fig. 12.1 shows apparatus that a student uses to investigate what happens when ethanol vapour is heated in the presence of a catalyst.

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Ethanol molecules react on the surface of the catalyst. The products of the reaction pass into the bromine solution.

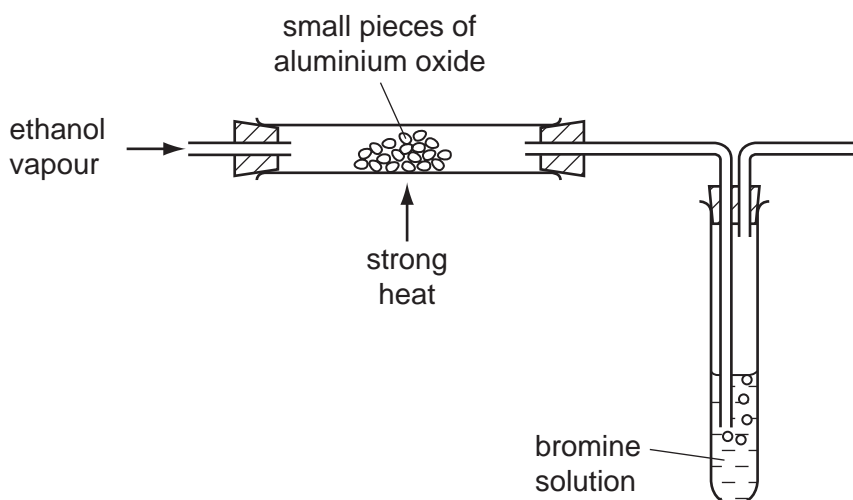


Fig. 12.1

The student observes that the bromine solution rapidly changes colour from orange to colourless.

- (i) State the type of hydrocarbon produced from ethanol in this reaction.

..... [1]

- (ii) Explain why the products of the reaction do **not** include any aluminium compounds.

.....

 [2]

- (d) When ethene is heated and pressurised in the presence of a catalyst, it is converted into a white compound which becomes solid when it cools.

Name the white solid compound and the type of chemical reaction which has occurred.

name of white solid

type of chemical reaction [2]

DATA SHEET
The Periodic Table of the Elements

		Group															
		I	II	III	IV	V	VI	VII	VIII	IX	X						
		1 H Hydrogen 1															
7	9																
Li Lithium 3	Be Beryllium 4																
23	24																
Na Sodium 11	Mg Magnesium 12																
39	40																
K Potassium 19	Ca Calcium 20	45	48	51	52	55	56	59	59	64	65						
		Sc Scandium 21	Ti Titanium 22	V Vanadium 23	Cr Chromium 24	Mn Manganese 25	Fe Iron 26	Co Cobalt 27	Ni Nickel 28	Cu Copper 29	Zn Zinc 30						
85	88	89	91	93	96	101	101	103	106	108	112						
Rb Rubidium 37	Sr Strontium 38	Y Yttrium 39	Zr Zirconium 40	Nb Niobium 41	Mo Molybdenum 42	Ru Ruthenium 44	Rh Rhodium 45	Pd Palladium 46	Ag Silver 47	Cd Cadmium 48							
133	137	139	178	181	184	190	190	192	195	197	201						
Cs Caesium 55	Ba Barium 56	La Lanthanum 57	Hf Hafnium 72	Ta Tantalum 73	W Tungsten 74	Os Osmium 76	Ir Iridium 77	Pt Platinum 78	Au Gold 79	Hg Mercury 80							
	226	227															
Fr Francium 87	Ra Radium 88	Ac Actinium 89															
*58-71 Lanthanoid series †90-103 Actinoid series																	
				140	141	144	144	150	152	157	159	162	165	167	169	173	175
				Ce Cerium 58	Pr Praseodymium 59	Nd Neodymium 60	Pm Promethium 61	Sm Samarium 62	Eu Europium 63	Gd Gadolinium 64	Tb Terbium 65	Dy Dysprosium 66	Ho Holmium 67	Er Erbium 68	Tm Thulium 69	Yb Ytterbium 70	Lu Lutetium 71
				232	232	238	238	238	238	238	238	238	238	238	238	238	238
				Th Thorium 90	Pa Protactinium 91	U Uranium 92	Np Neptunium 93	Pu Plutonium 94	Am Americium 95	Cm Curium 96	Bk Berkelium 97	Cf Californium 98	Es Einsteinium 99	Fm Fermium 100	Md Mendelevium 101	No Nobelium 102	Lr Lawrencium 103

a = relative atomic mass

X = atomic symbol

b = proton (atomic) number

Key

X

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

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