CANDIDATE
NAME

CENTRE
NUMBER

CANDIDATE
NUMBER

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.

UNIVERSITY *of* CAMBRIDGE
International Examinations

[Turn over

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

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.
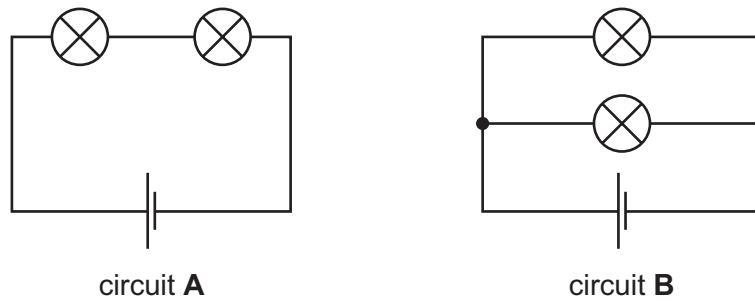
circuit **A**   circuit **B**

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]

(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]

       [Turn over

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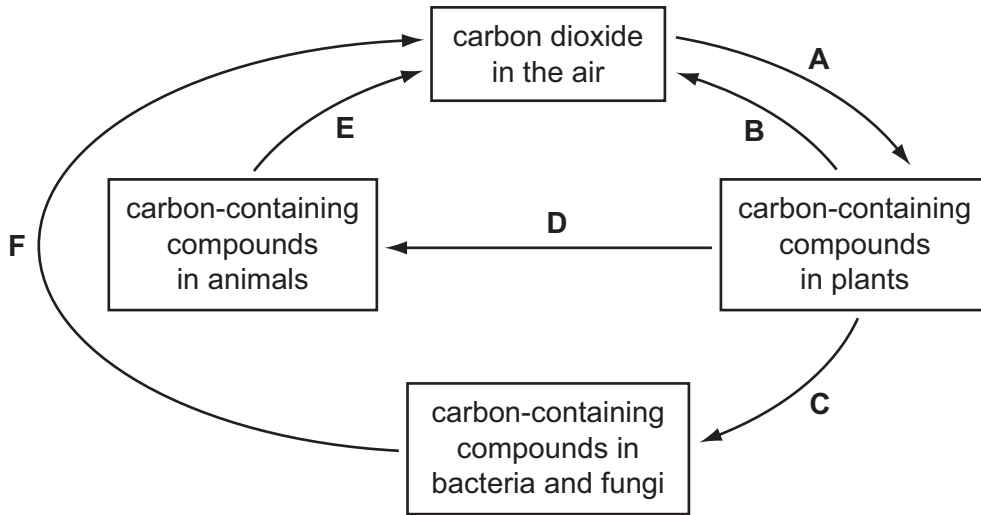
Fig. 2.1

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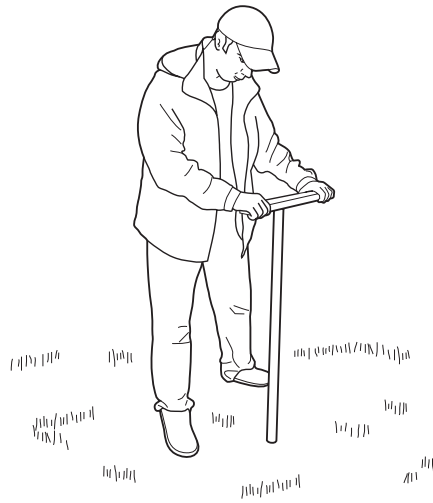
A student investigated the effect of different frequencies of vibrations on the numbers of earthworms that emerged from the soil. Fig. 2.2 shows his results.
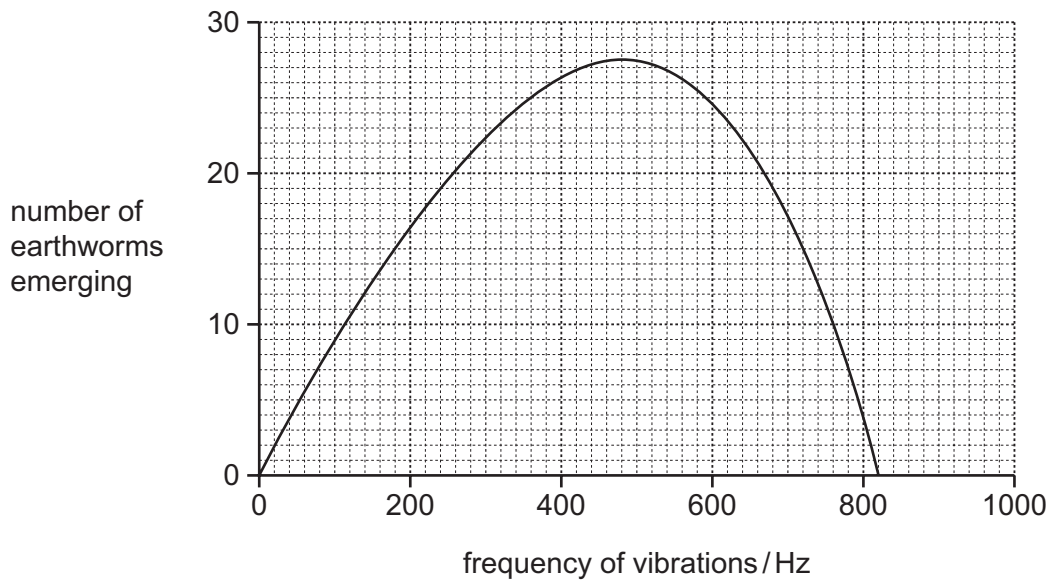
Fig. 2.2

  (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.

pH value is
displayed here

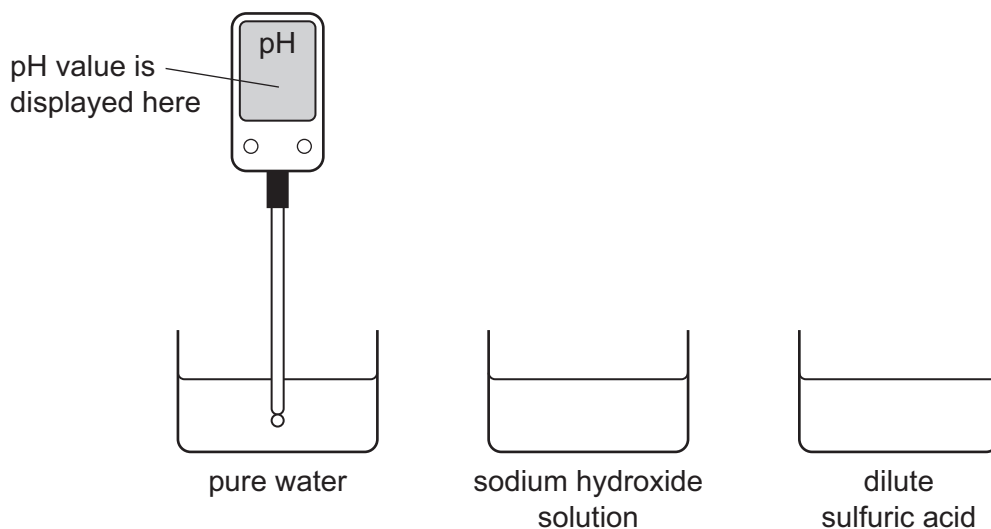pure water   sodium hydroxide   dilute
                         solution   sulfuric acid

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]

(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.

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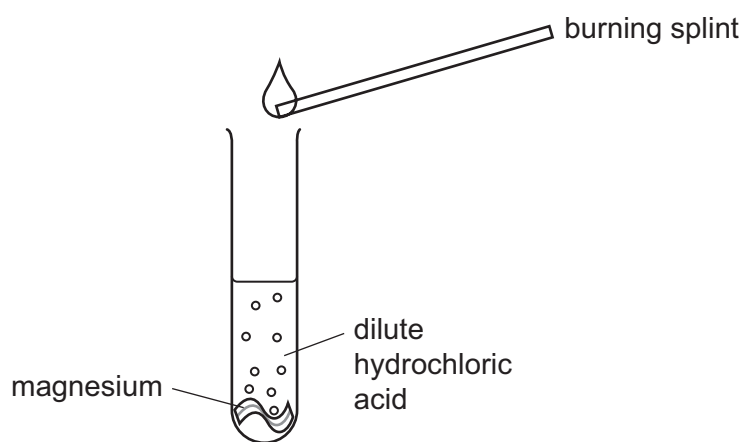
   State and explain what the student observed when he carried out this test.
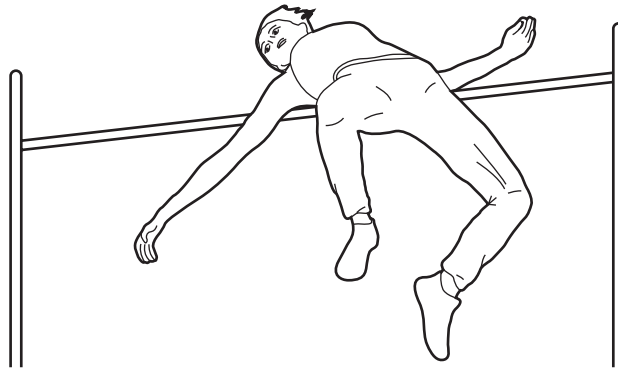
   observation ....

   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.

spatula

mixture of powdered
magnesium and
powdered copper

dilute hydrochloric
acid

beaker

filtering
apparatus

Fig. 3.3

....

....

....

....

....

.... [3]

4 An athlete competes in the high jump.

(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]

   [Turn over

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]

[Turn over

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.

Fig. 6.1 shows a typical firework.
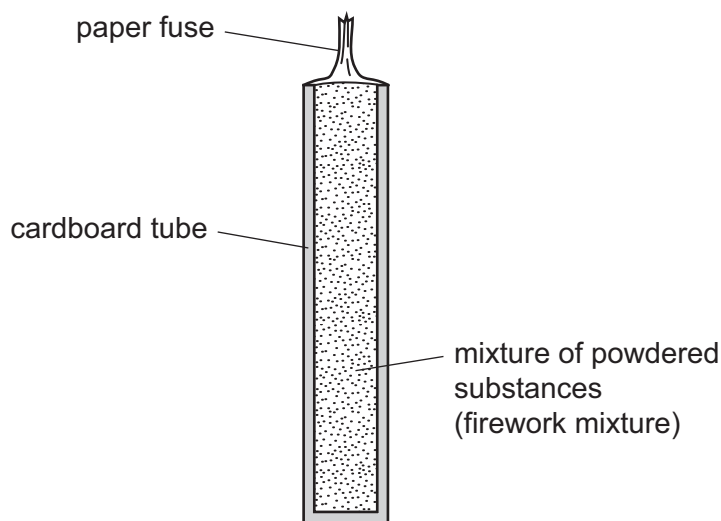
Fig. 6.1

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.

 [Turn over

8 Fig. 8.1 shows the male reproductive system.
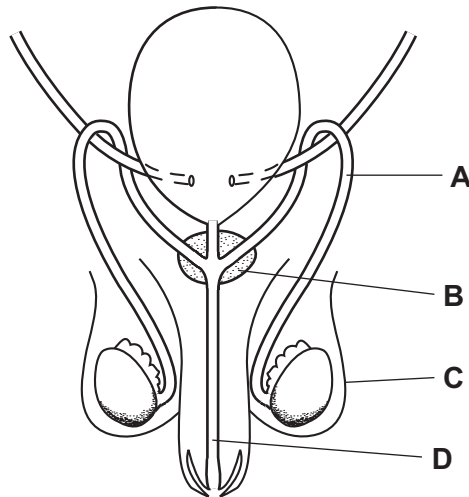
Fig. 8.1

(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 Examiner's Use

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

(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.
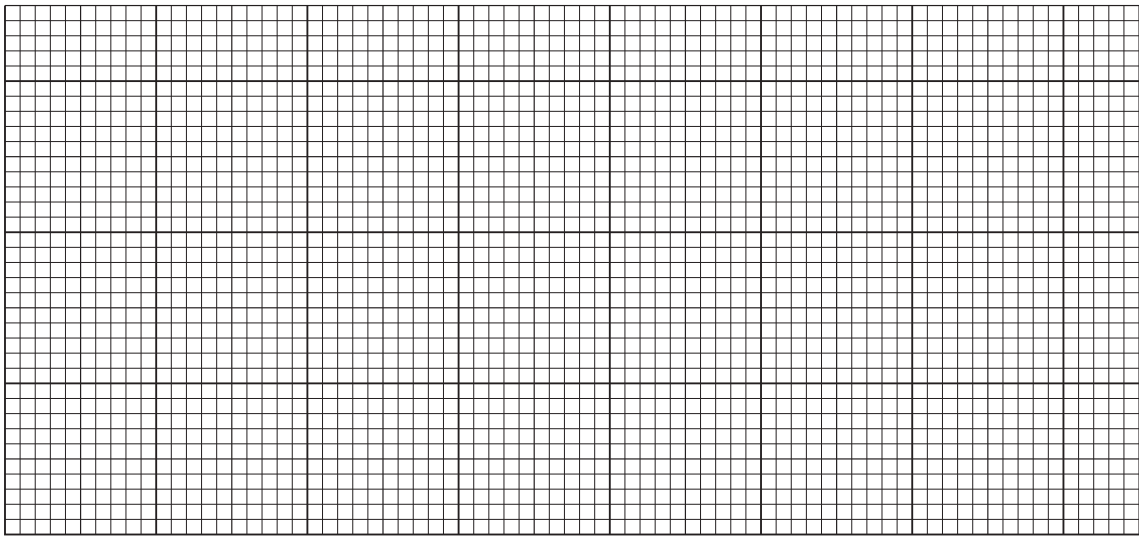
[3]

(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]

         [Turn over

(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.

centre of lens
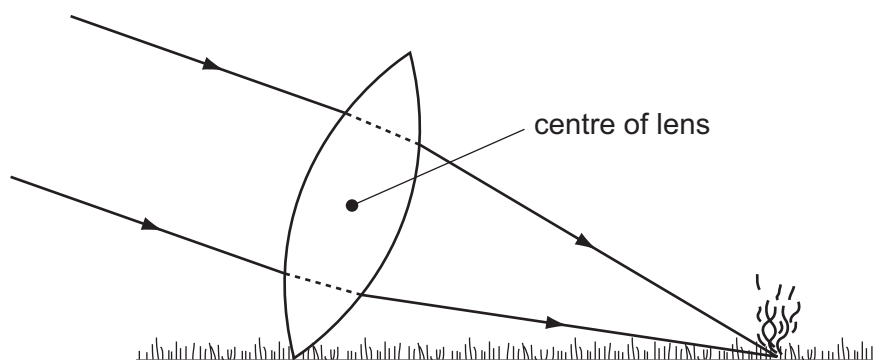
Fig. 10.1

(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 10 g and the volume is 4 cm^3.

Calculate the density of the glass.

State the formula that you use and show your working.

formula used

working

.... g / cm^3 [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.

[2]

 [Turn over

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

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]

[Turn over

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

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.

```
        H
        |
  H —— C ——
        |
        H
```
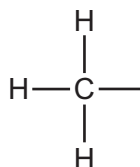
[1]

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

[ ] + [ ] ⟶ [ ]
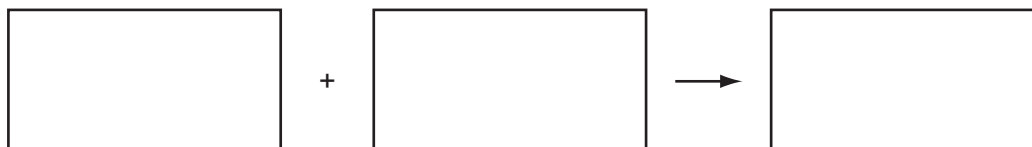
[1]

(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.

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

small pieces of
aluminium oxide

ethanol
vapour →

strong
heat
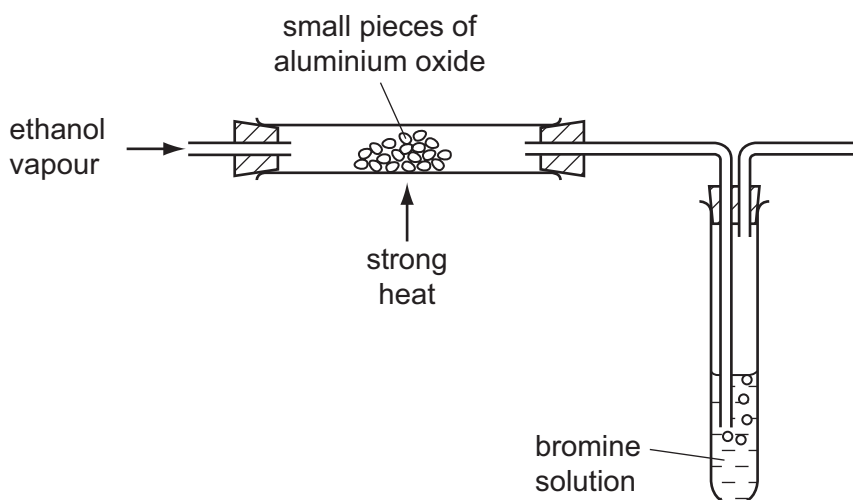
bromine
solution

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	0
																	4 **He** Helium 2
7 **Li** Lithium 3	9 **Be** Beryllium 4											11 **B** Boron 5	12 **C** Carbon 6	14 **N** Nitrogen 7	16 **O** Oxygen 8	19 **F** Fluorine 9	20 **Ne** Neon 10
23 **Na** Sodium 11	24 **Mg** Magnesium 12											27 **Al** Aluminium 13	28 **Si** Silicon 14	31 **P** Phosphorus 15	32 **S** Sulfur 16	35.5 **Cl** Chlorine 17	40 **Ar** Argon 18
39 **K** Potassium 19	40 **Ca** Calcium 20	45 **Sc** Scandium 21	48 **Ti** Titanium 22	51 **V** Vanadium 23	52 **Cr** Chromium 24	55 **Mn** Manganese 25	56 **Fe** Iron 26	59 **Co** Cobalt 27	59 **Ni** Nickel 28	64 **Cu** Copper 29	65 **Zn** Zinc 30	70 **Ga** Gallium 31	73 **Ge** Germanium 32	75 **As** Arsenic 33	79 **Se** Selenium 34	80 **Br** Bromine 35	84 **Kr** Krypton 36
85 **Rb** Rubidium 37	88 **Sr** Strontium 38	89 **Y** Yttrium 39	91 **Zr** Zirconium 40	93 **Nb** Niobium 41	96 **Mo** Molybdenum 42	**Tc** Technetium 43	101 **Ru** Ruthenium 44	103 **Rh** Rhodium 45	106 **Pd** Palladium 46	108 **Ag** Silver 47	112 **Cd** Cadmium 48	115 **In** Indium 49	119 **Sn** Tin 50	122 **Sb** Antimony 51	128 **Te** Tellurium 52	127 **I** Iodine 53	131 **Xe** Xenon 54
133 **Cs** Caesium 55	137 **Ba** Barium 56	139 **La** Lanthanum 57 *	178 **Hf** Hafnium 72	181 **Ta** Tantalum 73	184 **W** Tungsten 74	186 **Re** Rhenium 75	190 **Os** Osmium 76	192 **Ir** Iridium 77	195 **Pt** Platinum 78	197 **Au** Gold 79	201 **Hg** Mercury 80	204 **Tl** Thallium 81	207 **Pb** Lead 82	209 **Bi** Bismuth 83	**Po** Polonium 84	**At** Astatine 85	**Rn** Radon 86
Fr Francium 87	226 **Ra** Radium 88	227 **Ac** Actinium 89 †															

H Hydrogen 1

*58-71 Lanthanoid series
†90-103 Actinoid series

140 **Ce** Cerium 58	141 **Pr** Praseodymium 59	144 **Nd** Neodymium 60	**Pm** Promethium 61	150 **Sm** Samarium 62	152 **Eu** Europium 63	157 **Gd** Gadolinium 64	159 **Tb** Terbium 65	162 **Dy** Dysprosium 66	165 **Ho** Holmium 67	167 **Er** Erbium 68	169 **Tm** Thulium 69	173 **Yb** Ytterbium 70	175 **Lu** Lutetium 71
232 **Th** Thorium 90	231 **Pa** Protactinium 91	238 **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

Key

a	
	X
b	

a = relative atomic mass
X = atomic symbol
b = proton (atomic) number

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).