UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER



**COMBINED SCIENCE** **0653/23**

Paper 2 (Core) **May/June 2012**

**1 hour 15 minutes**

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 24.

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 | |
| Total | |

This document consists of **22** printed pages and **2** blank pages.

**1** Sugar cane is a food crop grown in Australia. It is harvested and then transported o
trains to the processing plant.

Fig. 1.1 shows one of the trains carrying sugar cane.

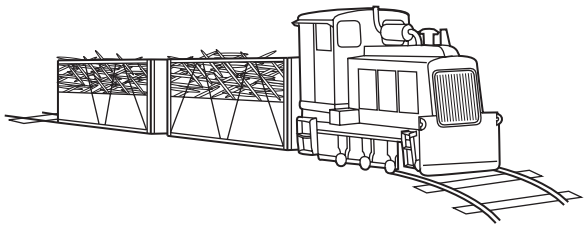

**Fig. 1.1**

**(a)** The train travels a distance of 25 kilometres in 2 hours.

Calculate the average speed of the train.

State the formula that you use and show your working.

formula used

working

..... km / h [2]

**(b)** The train engine is powered by oil. The oil is burned to change water into steam. The steam is used to make parts of the engine move.

**(i)** What kind of energy is stored in the oil?

..... [1]

**(ii)** The engine is 30 % efficient in converting the energy stored in the oil into movement energy. The rest of the stored energy is lost in different ways.

State **one** of these ways.

..... [1]

**(c)** The track for the train is composed of short lengths of steel rails with small ga between them as shown in Fig. 1.2.

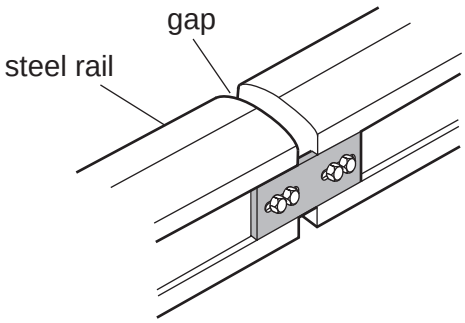


**Fig. 1.2**

Suggest a reason for leaving these small gaps.

.....

.....

..... [2]

**(d)** Sugar can be fermented and turned into ethanol. Ethanol is now used as a fuel for cars.

Give **one** reason, other than cost, why people might use ethanol rather than petrol in their cars.

..... [1]

**(e)** The farm on which the sugar cane is grown uses a wind turbine to produce el power. Table 1.1 shows the electrical power generated for different wind speeds.

**Table 1.1**

| **wind speed / km per hour** | 0 | 3 | 5 | 8 | 10 | 12 | 15 | 20 |
|---|---|---|---|---|---|---|---|---|
| **power generated / W** | 0 | 0 | 150 | 500 | 1000 | 1100 | 1200 | 1200 |

**(i)** Suggest the lowest wind speed needed to generate power.

..... km / h [1]

**(ii)** State the maximum power that this wind turbine can produce.

..... W [1]

**(iii)** State **one** disadvantage of using only a wind turbine as the source of electrical power.

.....

..... [1]

**2** An element is a substance that is made of atoms which have the same proton n
Most atoms contain protons, neutrons and electrons.

The elements are shown in the Periodic Table.

**(a)** The chemical symbol of an atom of the element chlorine is shown below.

$$^{35}_{17}Cl$$

The nucleon number of this atom is 35.

**(i)** Name the part of an atom that contains the protons and neutrons.

..... [1]

**(ii)** State the number of neutrons in this chlorine atom.

Explain your answer.

number of neutrons .....

explanation .....

..... [2]

**(iii)** Name the element whose atoms do **not** usually contain any neutrons.

..... [1]

**(b)** Table 2.1 shows Period 2 of the Periodic Table.

**Table 2.1**

| | I | II | III | IV | V | VI | VII | 0 |
|---|---|---|---|---|---|---|---|---|
| Period 2 | **X** | | | | | | **Y** | **Z** |

The element represented by **X** is a solid at room temperature and the elements represented by **Y** and **Z** are gases.

**(i)** Suggest **one** difference, other than physical state at room temperature, between the properties of elements **X** and **Y**.

.....

..... [1]

**(ii)** Suggest **one** difference between the chemical properties of elements **Y** and **Z**.

.....

..... [1]

**(c)** Fig. 2.1 shows a simple lime kiln which is used to produce lime (calcium oxide) from limestone (calcium carbonate).

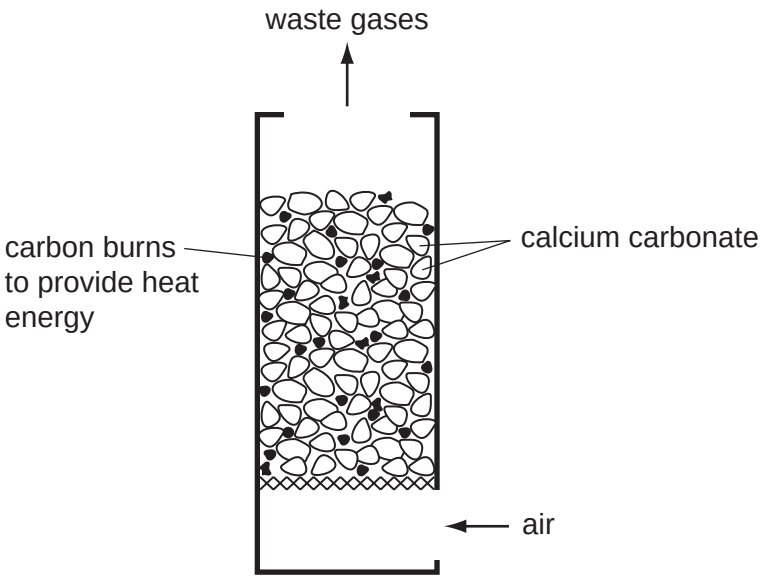


**Fig. 2.1**

In the lime kiln, the pieces of carbon are burnt to provide heat energy.

**(i)** Explain why the burning of carbon is described as an oxidation reaction.

.....

.....

..... [2]

**(ii)** Both calcium oxide and calcium carbonate are sometimes added to the soil by farmers.

Suggest and explain why this is done.

.....

.....

..... [2]

**3** Marmots are herbivorous mammals. Fig. 3.1 shows a marmot.

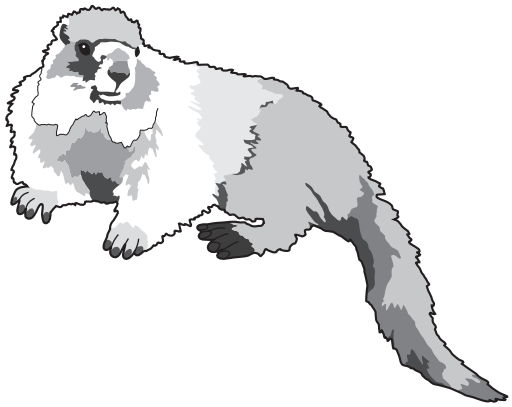

**Fig. 3.1**

**(a)** Define the term *herbivore*.

.....

..... [2]

**(b)** A study has been carried out on the marmots living in Colorado, USA.

The winters in this part of Colorado are very cold. The marmots hibernate (sleep) in burrows in winter. They do not eat while they are hibernating. They wake up in spring.

Before they hibernate, marmots build up large fat stores beneath their skin.

Suggest and explain what marmots must do in order to build up large fat stores in their bodies.

.....

.....

..... [2]

**(c)** Fig. 3.2 shows the percentage of marmots with different body masses that s
through the winter.

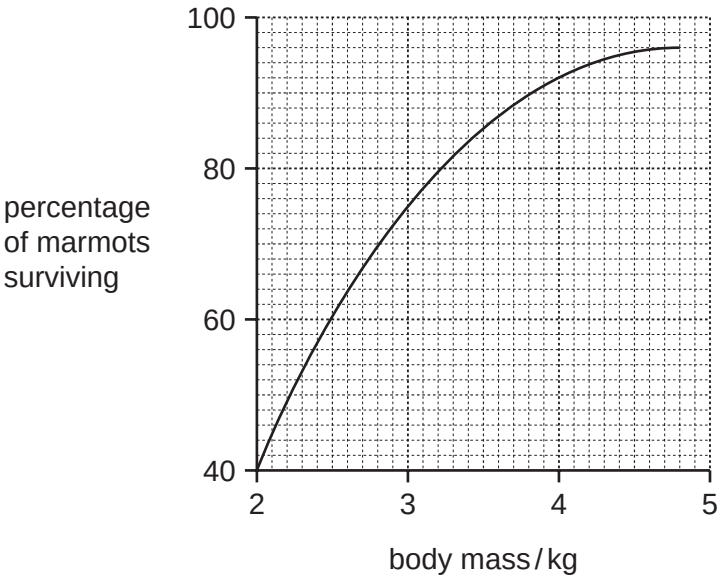


**Fig. 3.2**

**(i)** Describe the relationship between a marmot's body mass and its chance of surviving the winter.

.....

.....

..... [2]

**(ii)** Suggest how a layer of fat beneath the skin can help a marmot to keep warm during cold weather.

.....

..... [1]

**(d)** In the last twenty years, spring has been arriving earlier in the year in Colorado. This is a result of global warming.

Name **two** gases that contribute to global warming.

1 .....

2 ..... [2]

**(e)** Fig. 3.3 shows the mean body mass of the marmots on the first day of August (
summer) between 1976 and 2006.

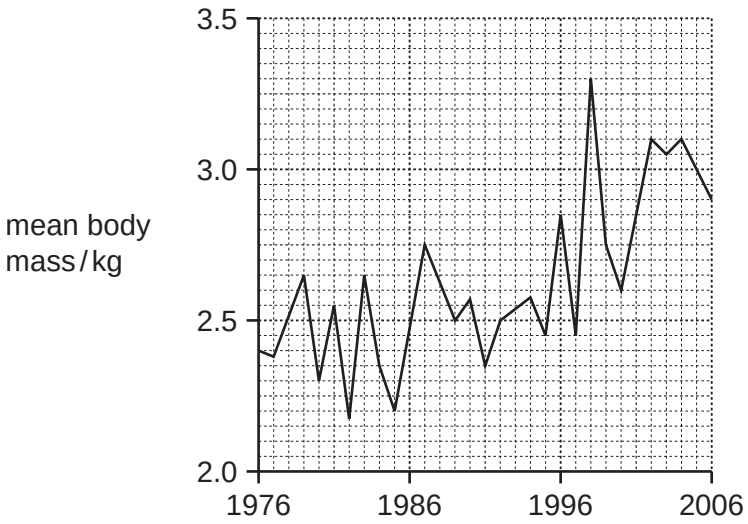


**Fig. 3.3**

**(i)** Describe the general trend shown in Fig. 3.3.

.....

..... [1]

**(ii)** Suggest how the earlier arrival of spring could be responsible for this trend.

.....

..... [1]

**4** Fig. 4.1 shows some of the apparatus and substances a student used to investiga rate of reaction between magnesium and dilute hydrochloric acid. In this reaction a ga given off and bubbles up into the measuring cylinder.

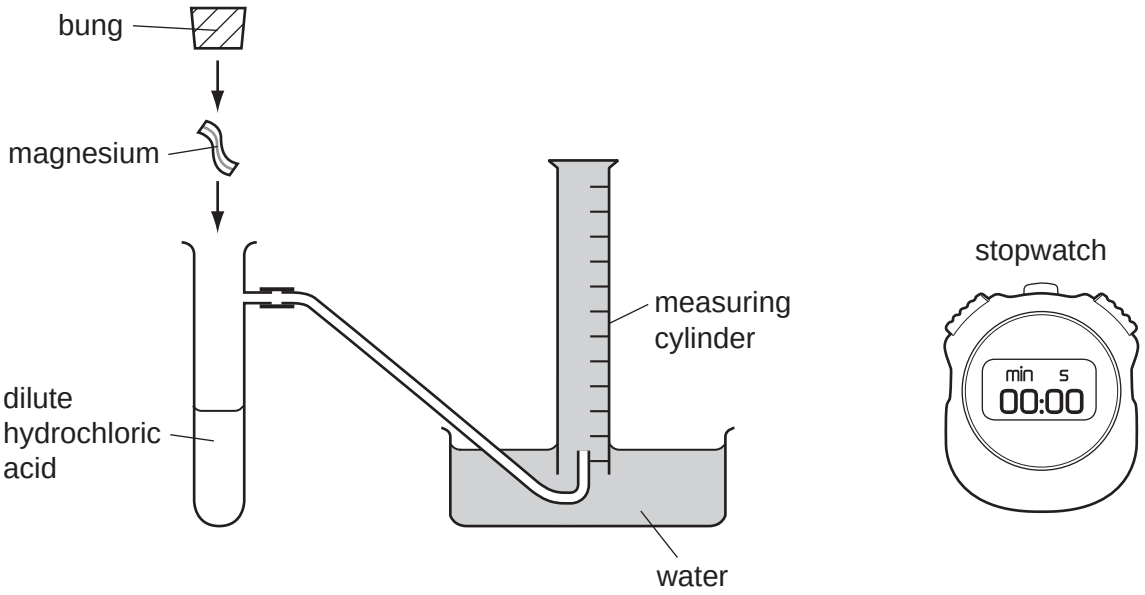


**Fig. 4.1**

**(a)** Fig. 4.1 shows the apparatus just before the student started his experiment to measure the rate of reaction.

Describe briefly the method the student should use and the measurements he should make.

.....

.....

.....

..... [3]

**(b)** The student carried out a second experiment using hydrochloric acid which had a **higher** concentration. All of the other variables which could affect the rate were kept the same as in the first experiment.

**(i)** State **one** of the other variables that the student kept constant.

.....

[1]

**(ii)** Predict and explain briefly how the results the student obtained in the second experiment would be different from the first experiment.

.....

.....

.....

[2]

**(c)** The reaction between magnesium and dilute hydrochloric acid also produces the ionic compound magnesium chloride.

In crystals of this compound, **two** chloride ions combine with **one** magnesium ion.

**(i)** State **one** difference between a magnesium atom and a magnesium ion.

.....

.....

[1]

**(ii)** State the chemical formula of magnesium chloride.

.....

[1]

**(iii)** Complete the **word** chemical equation for the reaction between magnesium and hydrochloric acid.

| | | | | | | |
|---|---|---|---|---|---|---|
| magnesium | + | hydrochloric acid | → | magnesium chloride | + | |

[1]

**5** **(a)** A bat produces a sound wave with a frequency of 212 kHz and a wavelength of 0.0

**(i)** This sound is outside the audible frequency range for humans.

State the approximate audible frequency range for humans.

..... Hz [1]

**(ii)** State the meaning of the terms *frequency* and *wavelength*, when describing a wave. You may use a diagram if it helps your explanation.

frequency

.....

.....

.....

wavelength

.....

.....

.....

[2]

**(b)** A girl shouts and waves to another girl in the school playground as shown in Fig.

**Fig. 5.1**

The sound energy and the light energy both travel from one girl to the other by wave motion.

**(i)** Explain why sound waves will **not** travel through a vacuum.

.....

..... [1]

**(ii)** If the first girl now makes another sound with a smaller amplitude, what change would the second girl notice?

..... [1]

**(iii)** The girls could have communicated with each other using their mobile phones (cell phones).

Name the type of electromagnetic wave used to communicate between mobile phones.

..... [1]

**(c)** Fig. 5.2 shows a ray of light passing through a rectangular glass block.

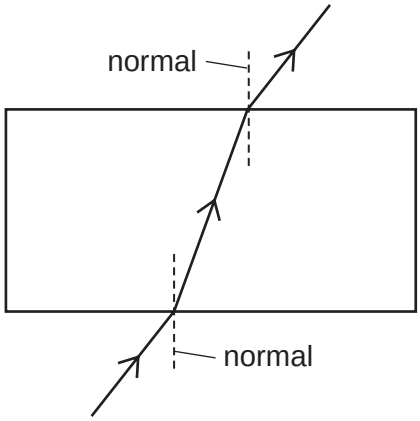


**Fig. 5.2**

**On Fig. 5.2**, label an angle of incidence, ***i***, and an angle of refraction, ***r***. [2]

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**Please turn over for Question 6.**

**6** Fig. 6.1 shows part of a section across a root from a radish plant, photographed thr microscope.

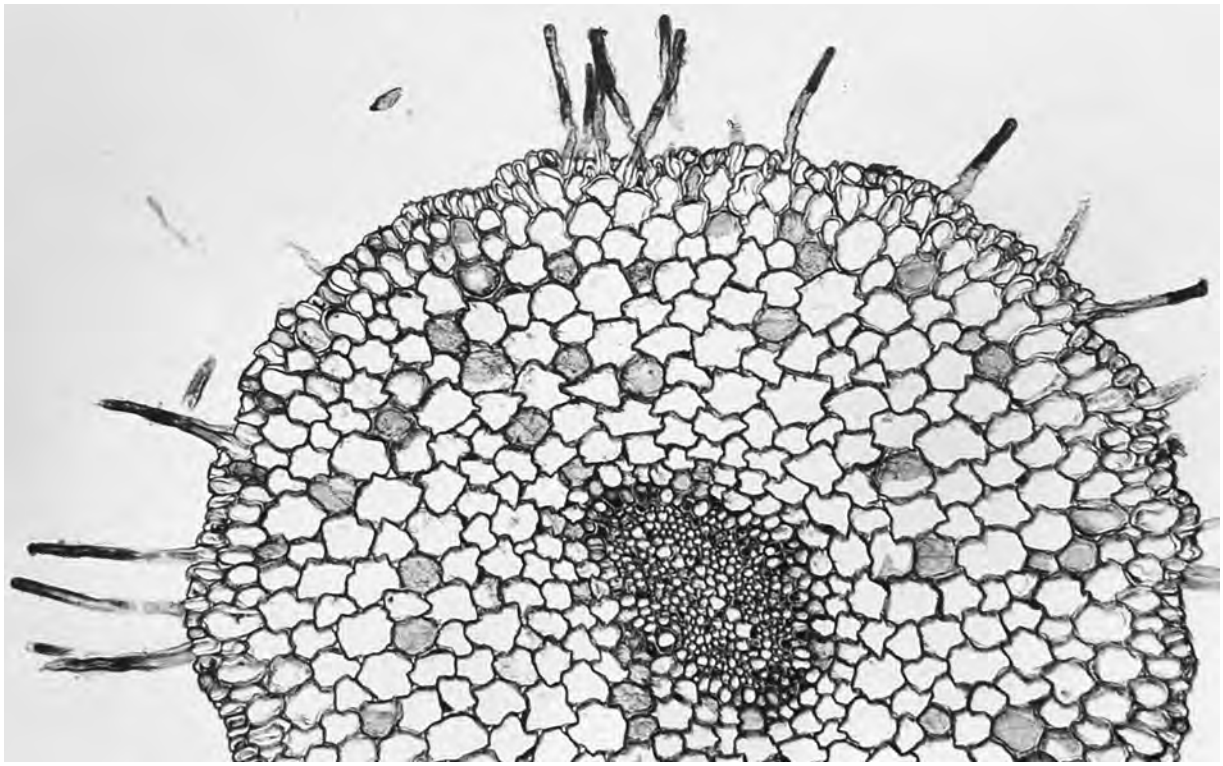


**Fig. 6.1**

**(a)** **On Fig. 6.1**, use a label line to label a root hair cell. [1]

**(b)** Root hair cells absorb substances from the soil.

Name **two** substances that root hair cells absorb from the soil.

1 .....

2 ..... [2]

**(c)** A complete radish plant was placed with the lower part of the root standing in water. A soluble red dye was added to the water. After a while, the veins in the leaves of the radish plant became red.

**(i)** Name the tissue in the radish plant through which the coloured water was transported from the roots to the leaves.

..... [1]

**(ii)** **On Fig. 6.1**, write the letter **A** to show the position of this tissue in the root. [1]

**(d) (i)** The cells in the radish root are plant cells.

Complete Table 6.1 to show which structures are present in plant cells and whic
are present in animal cells.

Use a tick ( ✓ ) to show that the structure is present. Use a cross ( ✗ ) to show that the structure is not present.

You should place either a tick or a cross in every space in the table.

**Table 6.1**

| structure | plant cells | animal cells |
|---|---|---|
| cell membrane | | |
| cell wall | | |
| nucleus | | |
| vacuole containing sap | | |

[4]

**(ii)** Would you expect the cells in the radish root to contain chloroplasts?

Explain your answer.

.....

..... [1]

7 **(a)** A student investigated how the change in potential difference across a lamp a
the current flowing through it.

She used wires to connect the components shown in Fig. 7.1 to make a suitable circuit.

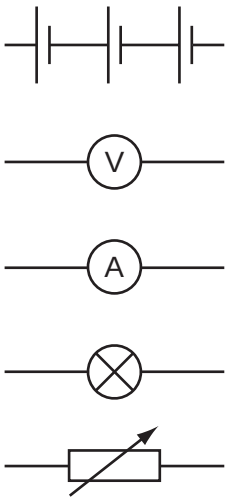



**Fig. 7.1**

**(i)** Using the correct symbols from Fig. 7.1, draw a diagram to show the circuit she made.

[3]

**(ii)** Explain why a variable resistor is used in this circuit.

.....

..... [1]

**(b)** A plastic rod is rubbed with a cloth. The rod becomes charged.

There are two types of electric charge.

**(i)** State the names of these types of charge.

1 .....

2 ..... [1]

**(ii)** Charged particles are transferred between the rod and cloth.

Name the charged particles transferred. ..... [1]

**(iii)** Plastic is an example of an electrical insulator.

Name **one** material which is an electrical conductor.

..... [1]

**8** The bar chart in Fig. 8.1 shows the approximate composition of unpolluted air.

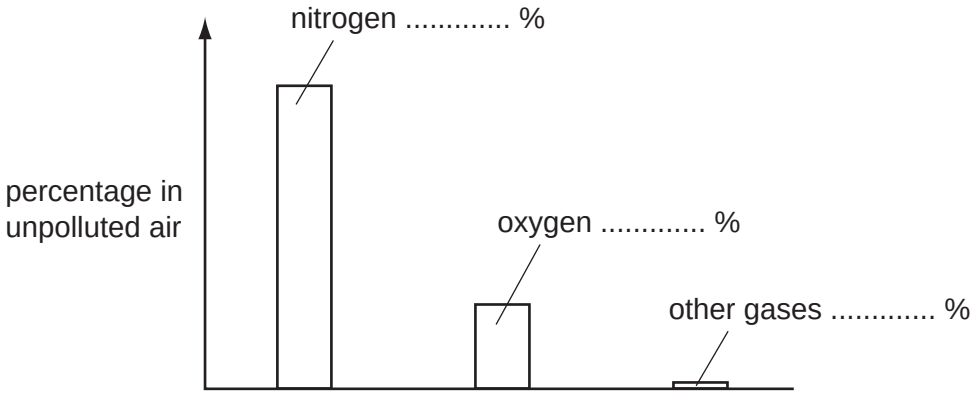



**Fig. 8.1**

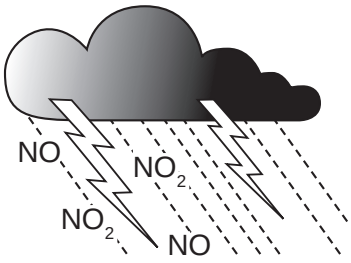
**(a) (i)** Complete the bar chart in Fig. 8.1 by labelling the percentages of nitrogen, oxygen and other gases. [2]

**(ii)** Name **one** of the **other gases** in Fig. 8.1 that exists in unpolluted air.

..... [1]

**(b)** Nitrogen and oxygen exist in the air in the form of the diatomic molecules, $N_2$ and $O_2$.

When lightning passes through the air, the gaseous compounds nitric oxide, NO, and nitrogen dioxide, $NO_2$, are formed.




**(i)** Explain why nitrogen and oxygen are described as chemical elements, but nitric oxide and nitrogen dioxide are described as compounds.

.....

.....

..... [2]

**(ii)** Suggest the type of chemical bonding in nitric oxide and nitrogen dioxide.

Explain your answer briefly.

type of bonding .....

explanation .....

..... [2]

**(iii)** Nitrogen dioxide dissolves and reacts with rainwater.

A student carried out an experiment to investigate what happened to the acidity of rainwater during a thunderstorm.

His results are shown in Table 8.1.

**Table 8.1**

| description of sample | pH |
|---|---|
| pure water obtained in a science laboratory | 7 |
| rainwater collected when no thunderstorm was occurring | 5 |
| rainwater collected during a thunderstorm | 4 |

What conclusions can the student make from these results?

.....

.....

.....

..... [2]

9 **(a)** One of the characteristics of living organisms is sensitivity. This is the ability to re to changes in the environment.

List **four** other characteristics of all living things.

1 .....

2 .....

3 .....

4 .....

[2]

**(b)** Hormones help organisms to respond to changes in their environment.

**(i)** Name the hormone that is produced when a person is frightened.

..... [1]

**(ii)** State **two** effects of this hormone.

1 .....

.....

2 .....

.....

[2]

**(c)** How are hormones transported around the body?

..... [1]

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# DATA SHEET
## The Periodic Table of the Elements

| Group | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | II | | | | | | | | | | III | IV | V | VI | VII | 0 |
| | | | | | | | 1 H Hydrogen 1 | | | | | | | | | 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 † | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | 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 |

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

Key: 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.).