CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

COMBINED SCIENCE **5129/02**

Paper 2 **May/June 2007**

2 hours 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 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 20.

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

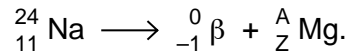This document consists of **18** printed pages and **2** blank pages.

[Turn over

1 A nucleus of $^{24}_{11}$Na emits a beta-particle to form a nucleus of magnesium, Mg.

(a) For the $^{24}_{11}$Na nucleus,

(i) state the number of protons, ………………

(ii) calculate the number of neutrons. ……………… [2]

(b) The decay of $^{24}_{11}$Na is described by the equation

$$^{24}_{11}\text{Na} \longrightarrow ^{0}_{-1}\beta + ^{A}_{Z}\text{Mg}.$$

Calculate the values of A and Z.

A = ………………………

Z = ………………………
[2]

2 Sound and light are both waves. Sound is a longitudinal wave.

Complete the following sentences.

Light waves are not longitudinal but are ……………………………… .

In a vacuum, light travels at a speed of ……………………………… m / s.

The distance between one crest of a wave and the next crest is called the

……………………………… of the wave.

The number of complete waves produced in one second is called the

……………………………… of the wave. [4]

3 Fig. 3.1 shows an experiment about the rusting of iron filings. As the iron rusts, the level of the water rises in the inverted test-tube.
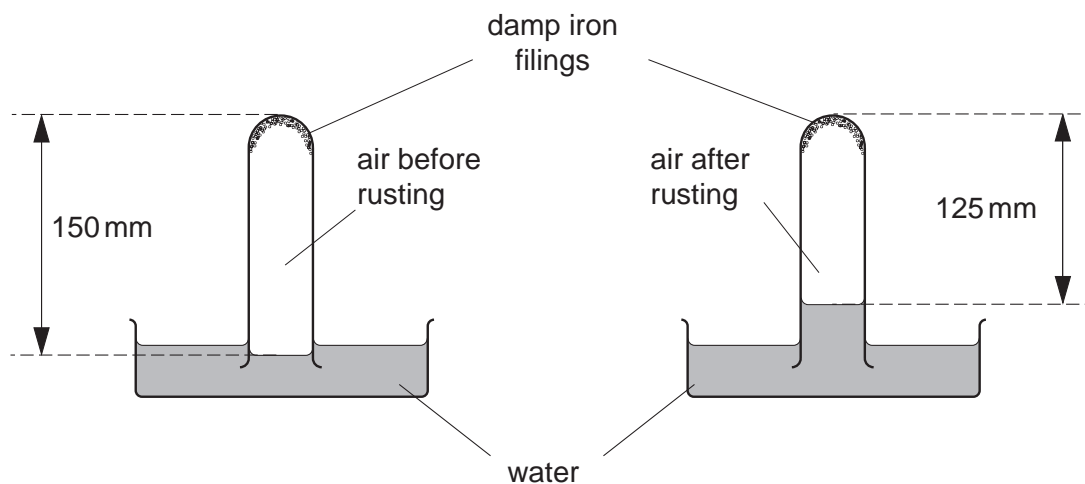
Fig. 3.1

(a) Use Fig. 3.1 to calculate how far up the test-tube the water rises.

.... [1]

(b) Which gas in the air is used up during rusting?

.... [1]

(c) In addition to this gas, what other substance is required for iron to rust?

.... [1]

(d) (i) Iron may be prevented from rusting by galvanising.
Explain the meaning of the term *galvanising*.

....

.... [2]

(ii) State **one** other way by which iron may be prevented from rusting.

.... [1]

4 Hydrogen carbonate indicator solution is used to show the amount of carbon dioxide, CO_2, passed through it. The solution changes colour as shown below.

| purple | ⟵ | orange | ⟵ | yellow |

| less CO_2 | | CO_2 in atmospheric air | | more CO_2 |
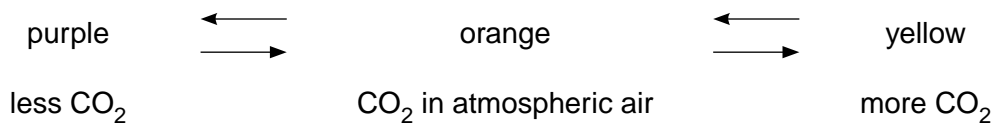
(a) Fig. 4.1 shows a bottle containing hydrogen carbonate indicator solution.

P

hydrogen carbonate indicator solution

Fig. 4.1

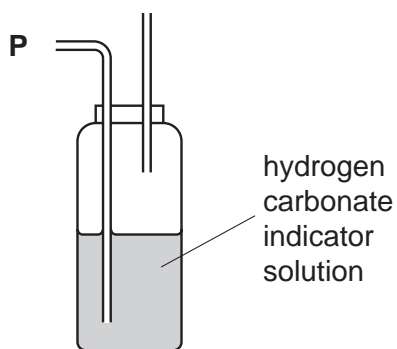A person breathes out through tube **P** five or six times.

What colour does the indicator solution become? ………………………………… [1]

(b) Fig. 4.2 shows apparatus used in an experiment.

air pump

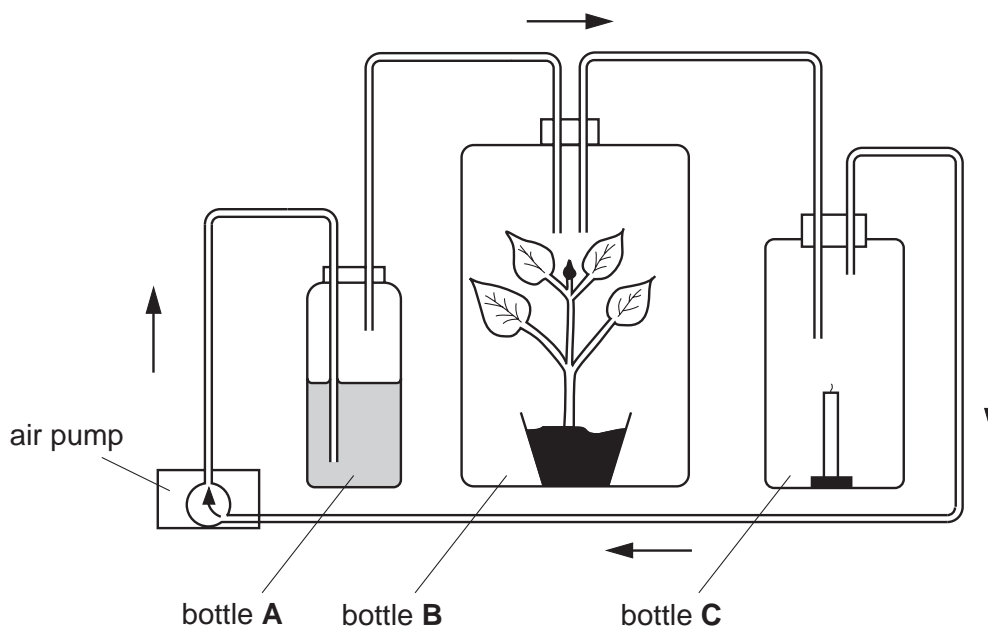bottle **A**   bottle **B**   bottle **C**

Fig. 4.2

Bottle **A** contains hydrogen carbonate indicator solution.
Bottle **B** contains a green plant.
Bottle **C** contains a candle.

The candle is lit and a black cloth is placed over bottle **B**.
The air pump moves air through all three bottles in the direction shown by the arrows.
The hydrogen carbonate indicator solution is orange at the start of the experiment.

(i) State the colour change that will occur in the indicator solution in bottle **A** during the experiment.

.... [1]

(ii) The candle in bottle **C** is extinguished and the black cloth is removed from bottle **B**. The air continues to circulate.

1. Name the process that starts when the plant is in the light.

.... [1]

2. Write a word or symbol equation for this process.

....

.... [2]

3. What colour change now occurs slowly in the indicator solution?

.... [1]

(iii) The process named in **(b)(ii)** has a waste product that may be excreted.

1. State what is meant by *excretion*.

....

.... [2]

2. Name the waste product and explain why it may **not** be excreted.

name ....

explanation ....

.... [2]

5 Fig. 5.1 shows a lighting circuit.
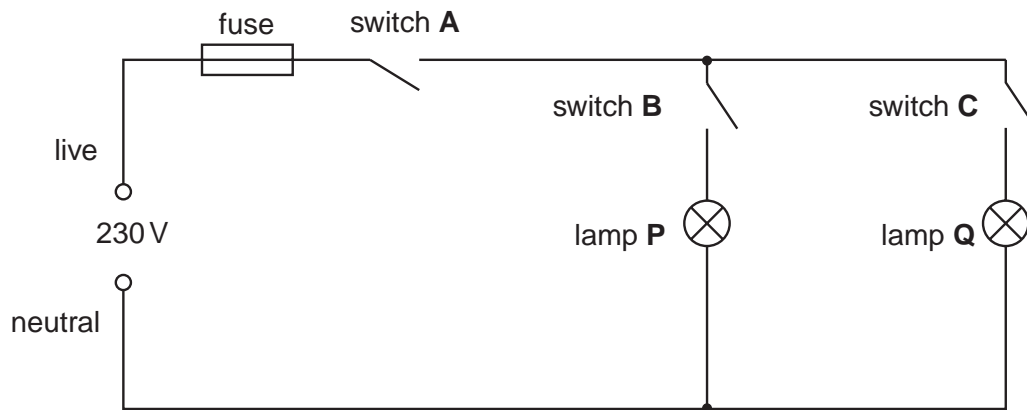
Fig. 5.1

(a) Switches **A** and **B** are closed. Switch **C** remains open.

State which lamp or lamps, if any, are lit. ……………………………… [1]

(b) When all the switches are closed, the voltage across lamp **Q** is 230 V and the current through it is 0.5 A.

(i) Calculate the resistance of lamp **Q**.

[3]

(ii) State the voltage across lamp **P**. ……………………………… [1]

(iii) Lamps **P** and **Q** are identical and are at normal brightness.
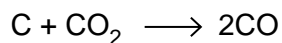Calculate the current through the fuse.

…………………………… A [1]

(c) State the energy changes taking place inside a lamp at normal brightness.

…………………………………… energy is being changed into

…………………………………… and ………………………………… [2]

6 When carbon dioxide and carbon are heated together, carbon monoxide is produced. The equation for the reaction is

$$C + CO_2 \longrightarrow 2CO$$

(a) Calculate the relative molecular mass of

   (i) carbon dioxide, …………………………………

   (ii) carbon monoxide. ………………………………… [2]

(b) Calculate the mass of carbon monoxide produced from 2.2 g of carbon dioxide.

....

.... [2]

(c) Carbon monoxide is a pollutant of the air.

   (i) Explain how carbon monoxide gets into the air.

   .... [1]

   (ii) Why is pollution of the air by carbon monoxide harmful?

   .... [1]

7 Fig. 7.1 is a diagram of a plant cell.
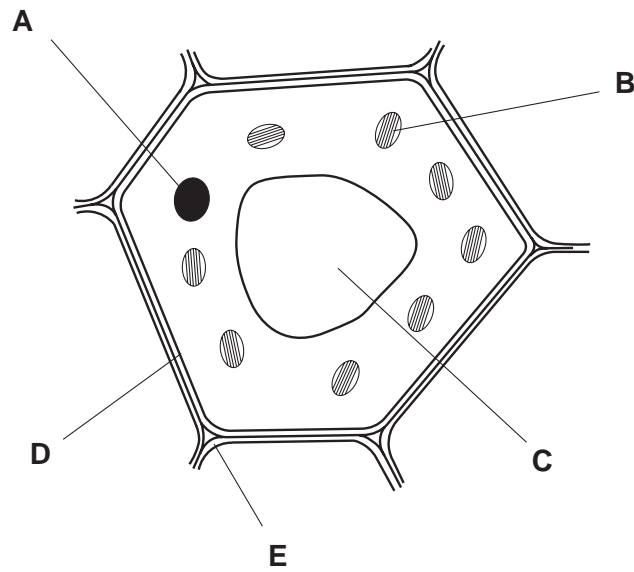
Fig. 7.1

(a) (i) State the letters of **two** parts of the cell in Fig. 7.1 that show it is a plant cell.

……………………… and ……………………… [2]

(ii) State the names of these two parts.

………………………………………… and ………………………………………… [2]

(b) State the names of three parts that are found in **both** plant cells **and** animal cells.

1. ....

2. ....

3. .... [3]

8 Fig. 8.1 shows a pin in front of a plane mirror. The position of the image of the pin is also shown.

mirror

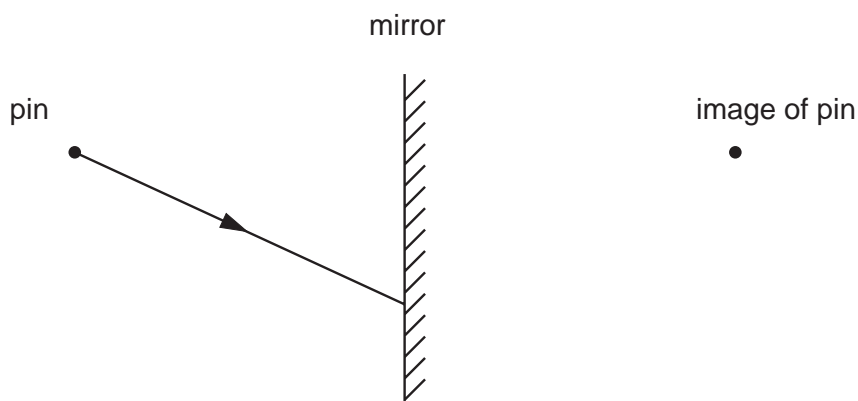pin   image of pin

Fig. 8.1

Fig. 8.1 also shows a ray of light incident on the mirror.

(a) On Fig. 8.1, draw the reflected ray. [2]

(b) Fig. 8.2 shows a ray of light entering a block of plastic.

normal
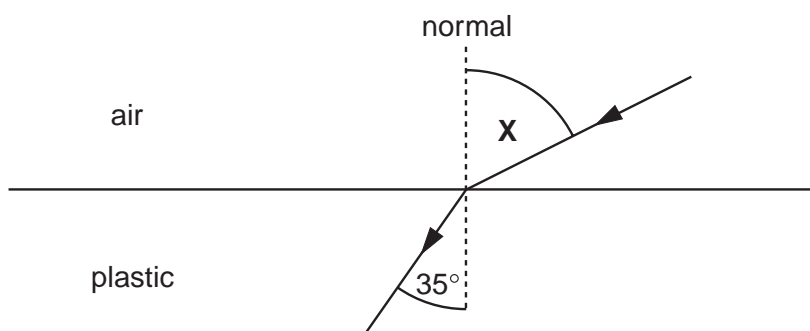
air

X

plastic

35°

Fig. 8.2

The angle of incidence is **X** and the angle of refraction is 35°.

(i) State the equation used to calculate refractive index.

[1]

(ii) The plastic has a refractive index of 1.45.
Calculate angle **X**.

angle = …………………… [2]

9 (a) In Fig. 9.1, the boxes on the left give the names of some fractions obtained from the fractional distillation of petroleum (crude oil).
The boxes on the right show the uses of these fractions.
Draw lines between the boxes to link each fraction with its correct use.

fractions   **uses**

| paraffin | | making roads |

| bitumen | | jet aircraft fuel |

| heavy oils | | fuel for cars |

| petrol | | waxes and polishes |
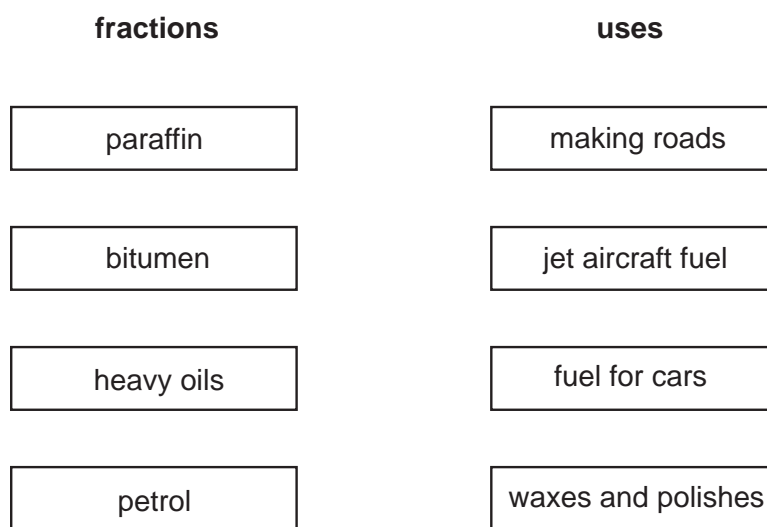
Fig. 9.1   [4]

(b) The fractions obtained from crude oil contain hydrocarbons from the homologous series called alkanes.

(i) State **one** characteristic of a homologous series.

.... [1]

(ii) Octane is an alkane with eight carbon atoms.

State the molecular formula of octane. .... [1]

10 Fig. 10.1 shows a bar magnet pushed slowly into a coil of wire. The ammeter measures a very small current in the positive direction.

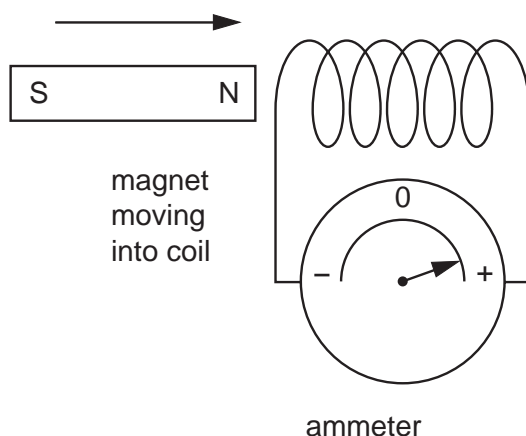**Fig. 10.1**

Use the following phrases when answering the questions below.

larger current   smaller current   no current   current in opposite direction

(a) State what happens when

(i) the North pole of the magnet is pushed **more quickly** into the coil,

....

(ii) the South pole of the magnet is pushed into the coil,

....

(iii) the magnet is inside the coil but is **not** moving.

.... [3]

(b) The number of turns of wire on the coil is decreased.
The North pole of the magnet is pushed slowly into the coil.
How is the ammeter reading different from that shown in Fig. 10.1?

.... [1]

11 Equal volumes of the same hydrochloric acid solution are placed into three separate test-tubes. Equal sized pieces of the metals, copper, iron and magnesium, are dropped into the test-tubes.

The results are shown in Fig. 11.1.
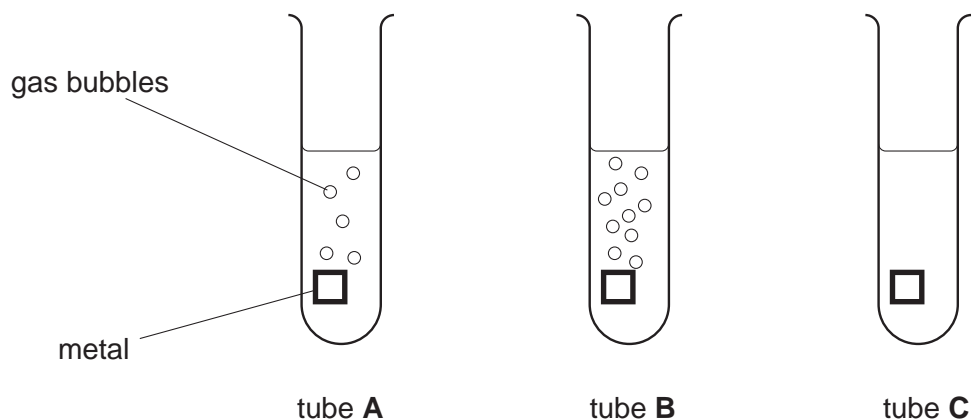
Fig. 11.1

(a) Name the gas produced in tubes **A** and **B**. .... [1]

(b) Describe a test which shows that hydrochloric acid is acidic.

test ....

result .... [2]

(c) (i) Which tube contains copper?   ………………

   (ii) Which tube contains magnesium?   ………………   [2]

12 (a) Fig. 12.1 represents blood flowing from the heart to the lungs and back to the heart.
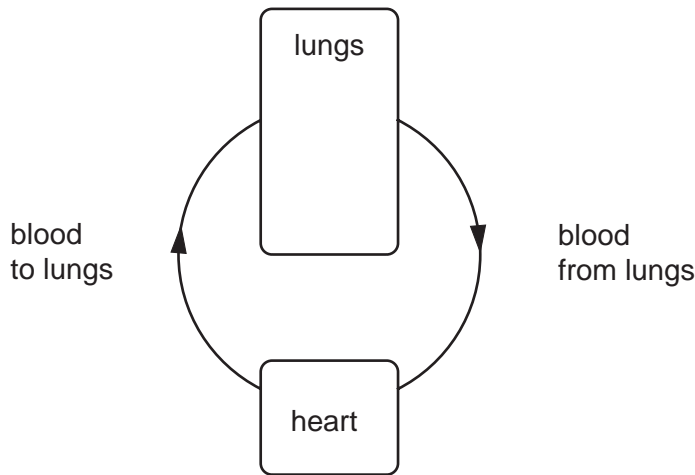
```
                    ┌─────────┐
                    │  lungs  │
                    │         │
                    └─────────┘
blood                              blood
to lungs                           from lungs
                    ┌─────────┐
                    │  heart  │
                    └─────────┘
```

Fig. 12.1

  (i) State the type of blood vessel that carries blood from the heart to the lungs.

  .... [1]

  (ii) Describe two changes that take place in the blood as it passes through the lungs.

  1. ....

  ....

  2. ....

  .... [4]

(b) A sharp stone cuts a person's foot, which then bleeds.
Explain the role of each of the following components of blood, as a result of the cut.

  platelets ....

  ....

  white blood cells ....

  .... [4]

13 Fig. 13.1 shows two bar magnets and a piece of iron. One of the bar magnets has its two poles marked.

	N S	

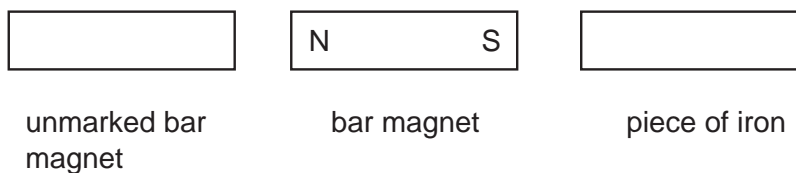unmarked bar   bar magnet   piece of iron
magnet

Fig. 13.1

(a) (i) The two bar magnets are repelling each other.
On Fig. 13.1, mark the two poles of the unmarked bar magnet.

(ii) The iron becomes magnetised and is attracted to the bar magnet next to it.
On Fig. 13.1, mark the two poles of the piece of iron. [2]

(b) Iron is a magnetic material.

Name another magnetic material. .... [1]

(c) Electromagnets are sometimes used instead of bar magnets.
State two ways in which the strength of an electromagnet may be changed.

1. ....

2. .... [2]

14 Potassium is a metal in Group I of the Periodic Table. It reacts violently with chlorine to produce potassium chloride.

(a) How many electrons are in the outer shell of a potassium atom?

.... [1]

(b) Write a balanced equation for the reaction between potassium and chlorine.

.... [2]

(c) State the type of bonding present in potassium chloride.

.... [1]

(d) Potassium reacts with carbon dioxide producing a white solid and a black solid.
Suggest the products of the reaction.

white solid   ……………………………

black solid   ……………………………   [2]

15 A student carries out an experiment using a spring to produce the load-extension graph of Fig. 15.1.
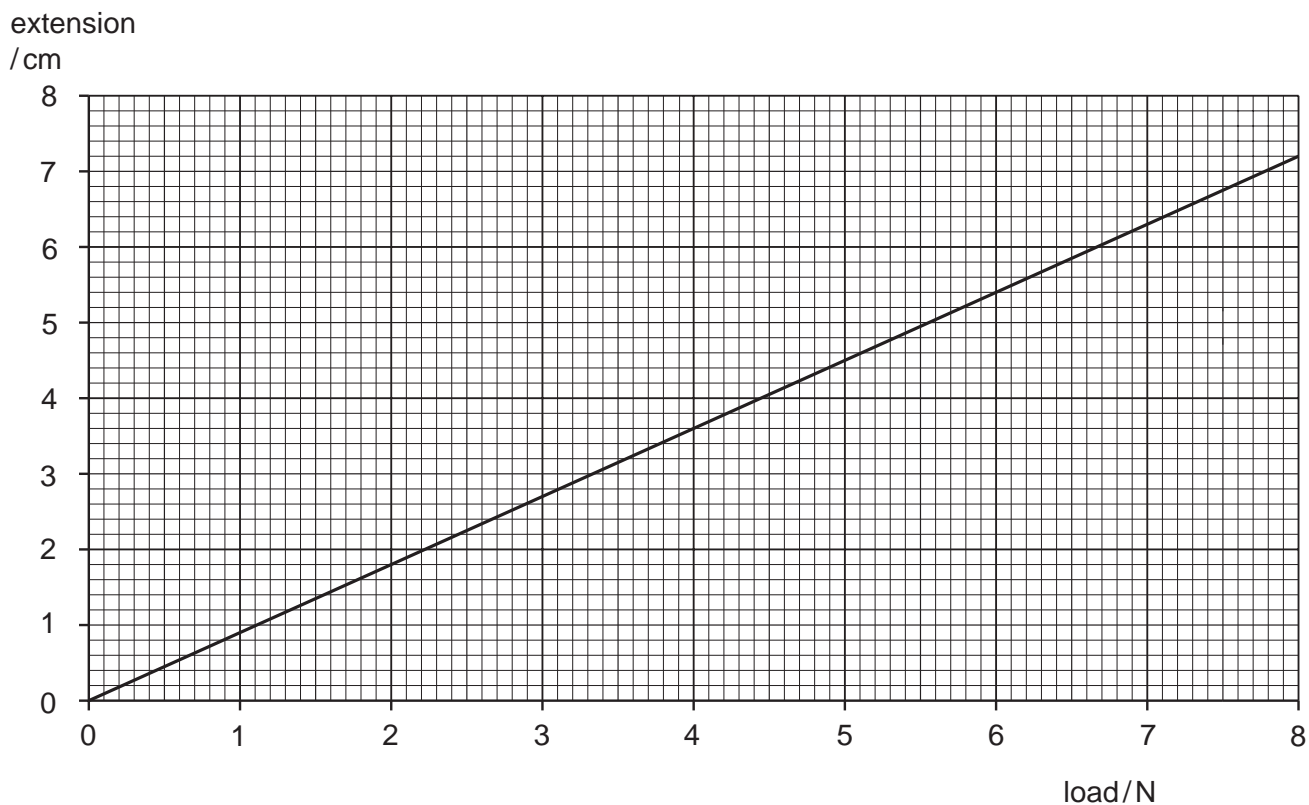
extension
/ cm

Fig. 15.1

(a) Use Fig. 15.1 to find the extension of the spring for a load of 5.0 N.

……………………… cm [1]

(b) Before the spring is stretched, its length is 10.2 cm.
Calculate the length of the spring when the load is 5.0 N.

[1]

(c) State the apparatus that may be used in the experiment to measure

    (i) the length of the spring,   ………………………

    (ii) the load on the spring.   ………………………   [2]

16 Atoms of ^{10}B and ^{11}B have different nucleon numbers.

(a) What name is given to atoms of the same element with different nucleon numbers?

.... [1]

(b) Fig. 16.1 represents the nucleus of a ^{11}B atom.
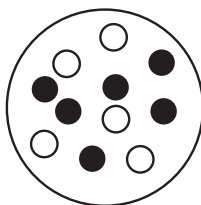
Fig. 16.1

(i) Name the particles represented by   ● …………………………

              ○ …………………………   [2]

(ii) Complete the diagram below to represent the electronic structure of boron.
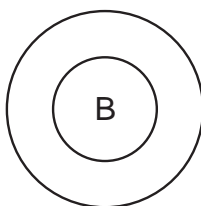
[1]

17 Fig. 17.1 shows changes in the thickness of the wall of the uterus during the human menstrual cycle.

menstrual cycle
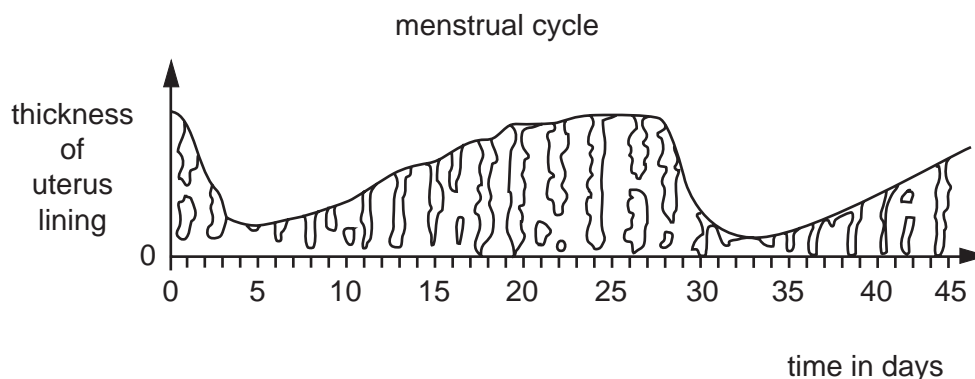

Fig. 17.1

(a) How long is the menstrual cycle in humans?

.... [1]

(b) On Fig. 17.1, write

(i) **O** at the time when ovulation is likely to occur,

(ii) **M** at the time when menstruation is likely to occur. [2]

(c) Use words from the following list to complete the sentences below.
Each word may be used once, or not at all.

abstinence   condoms   hormones   infertility

sperm   vagina   vasectomy

A natural method of contraception is ………………………………… .

A mechanical method of contraception is using ………………………………… which

prevent ………………………………… from entering the ………………………………… .

[4]

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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** Sulphur 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	**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 dm³ at room temperature and pressure (r.t.p.).

5129/02/M/J/07