



**Cambridge International Examinations**  
Cambridge International General Certificate of Secondary Education

CANDIDATE  
NAME

CENTRE  
NUMBER

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**COMBINED SCIENCE**

**0653/21**

Paper 2 (Core)

**October/November 2015**

**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 an HB pencil for any diagrams, graphs, tables or rough working.

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

**DO NOT WRITE IN ANY BARCODES.**

Answer **all** questions.

Electronic calculators may be used.

You may lose marks if you do not show your working or if you do not use appropriate units.

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.

This document consists of **23** printed pages and **1** blank page.

**2****BLANK PAGE**

3

1 Fig. 1.1 shows some cells. They are not drawn to scale.

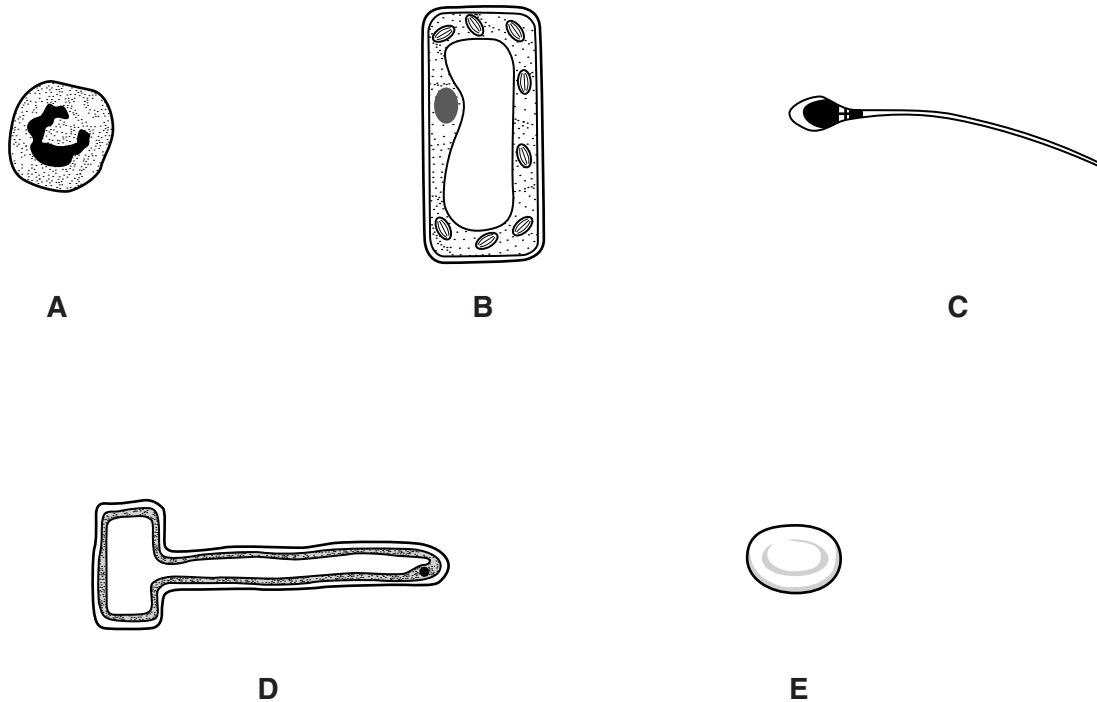


Fig. 1.1

(a) Write the letter or letters of the cell or cells

(i) that are plant cells,

.....[1]

(ii) with a haploid nucleus.

.....[1]

(b) On **one** plant cell in Fig. 1.1, use label lines and the correct names to label two parts of the cell that are present in plant cells but absent from animal cells. [2]

(c) A student uses the apparatus in Fig. 1.2 to compare the rates of transpiration of two shoots, shoot 1 and shoot 2. The shoots are taken from the same tree. The stems of the shoots each have the same diameter and the same number of leaves.

However, one shoot has leaves of shape X and the other shoot has leaves of shape Y. This is shown in Fig. 1.2.

As each shoot transpires, the meniscus moves upwards in the capillary tubing.

For each shoot the student calculates the average distance the meniscus moves in one minute.

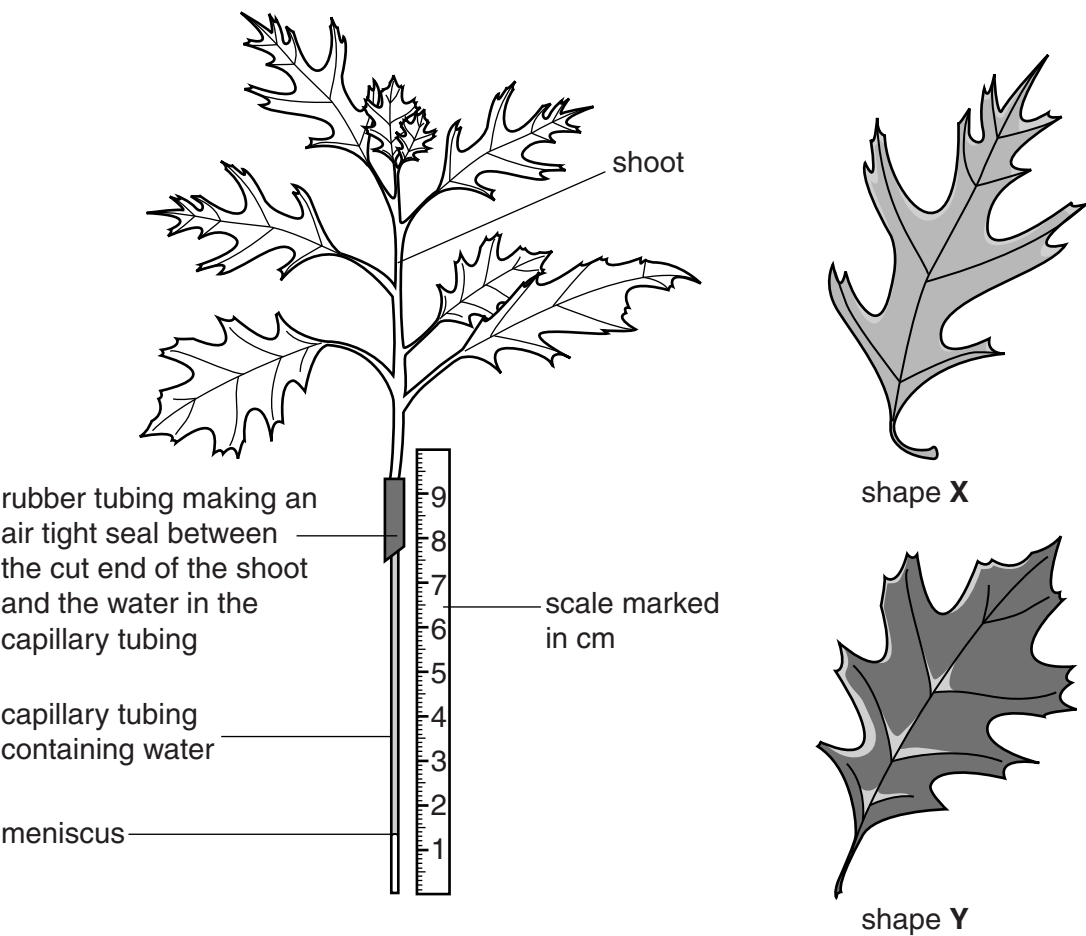


Fig. 1.2

results

Table 1.1

| shoot | average distance moved by the meniscus in one minute/cm |
|-------|---------------------------------------------------------|
| 1     | 5.8                                                     |
| 2     | 4.6                                                     |

**5**

- (i)** Use the results to state the letter of the shape of leaves on shoot **2**.

Explain your answer.

shape of leaf on shoot **2** = .....

explanation .....

.....

.....

.....[2]

- (ii)** If the same experiment is carried out under different environmental conditions the results obtained will be different from those shown in Table 1.1.

Explain why the average distance moved by the meniscus will change for both shoots when

the temperature increases,

.....

.....

.....

the humidity decreases.

.....

.....

.....

[2]

6

- 2 (a) Fig. 2.1 shows samples of some elements in Group VII of the Periodic Table at room temperature.

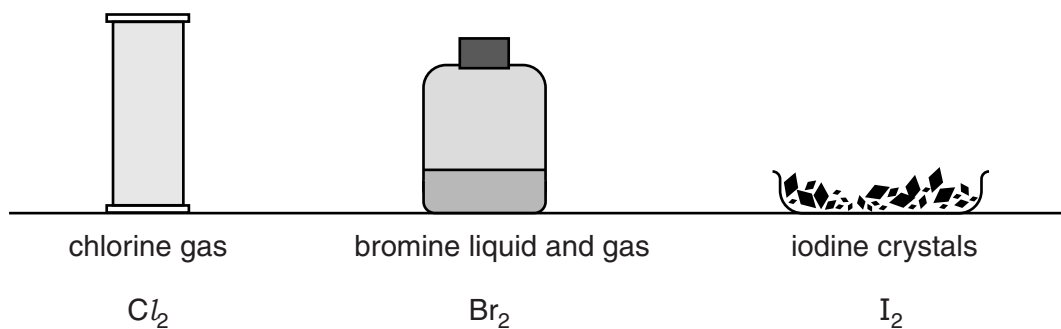


Fig. 2.1

Describe the trend in melting point down Group VII.

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

- (b) A piece of burning sodium is lowered into bromine gas.

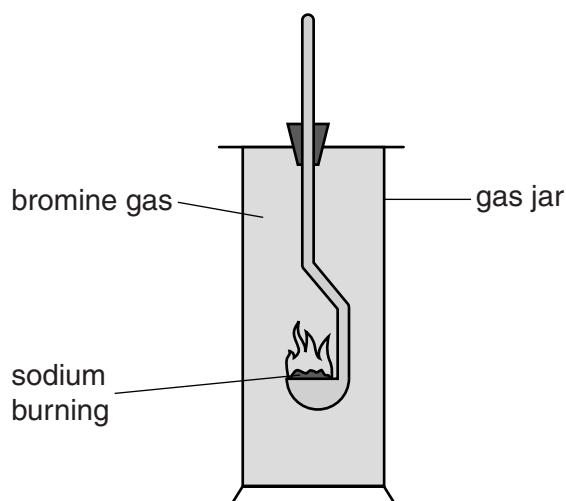
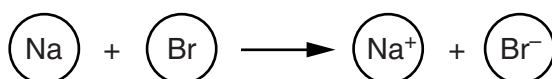


Fig. 2.2

The sodium and bromine react together to produce sodium bromide.

Sodium bromide is made of sodium ions and bromide ions.

The change from atoms to ions in this reaction can be represented as follows:



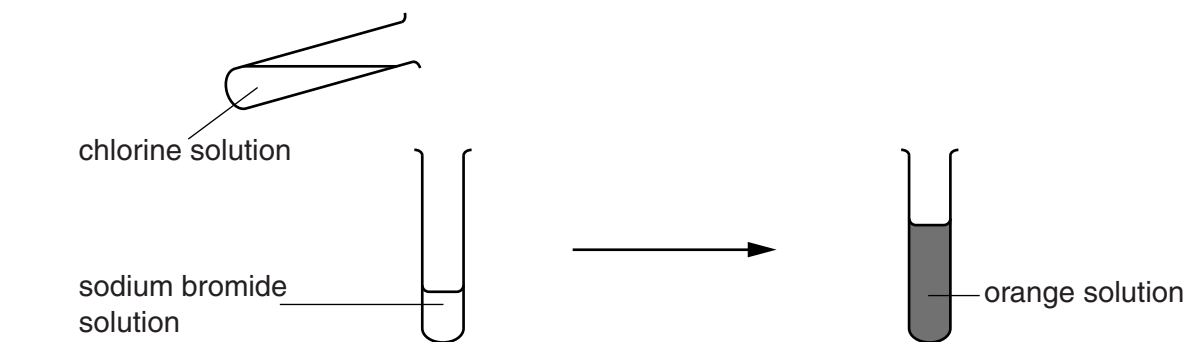
Explain how the ions are formed in terms of the movement of electrons.

.....

.....

.....[2]

- (c) Fig. 2.3 shows what happens when a student adds colourless chlorine solution to colourless sodium bromide solution.



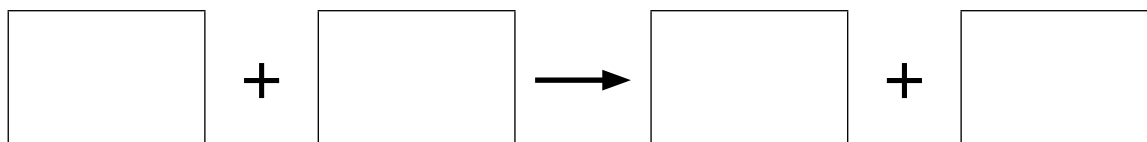
**Fig. 2.3**

The resulting mixture is orange.

- (i) State the name of the substance formed which gives the final mixture this colour.

.....[1]

- (ii) Write a word equation for the reaction that occurs.



[2]

- (iii) The reactivity of the halogens decreases down the group.

**most reactive**      chlorine

                         bromine

**least reactive**      iodine

Explain why sodium bromide reacts with chlorine but does not react with iodine.

.....

.....

.....

.....[2]

8

- 3 Fig. 3.1 shows a man bungee jumping. He is attached to a long elastic rope as he jumps off a bridge.

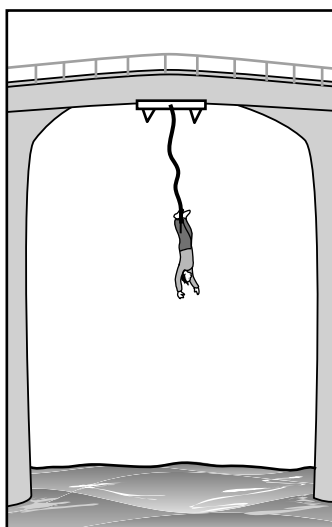
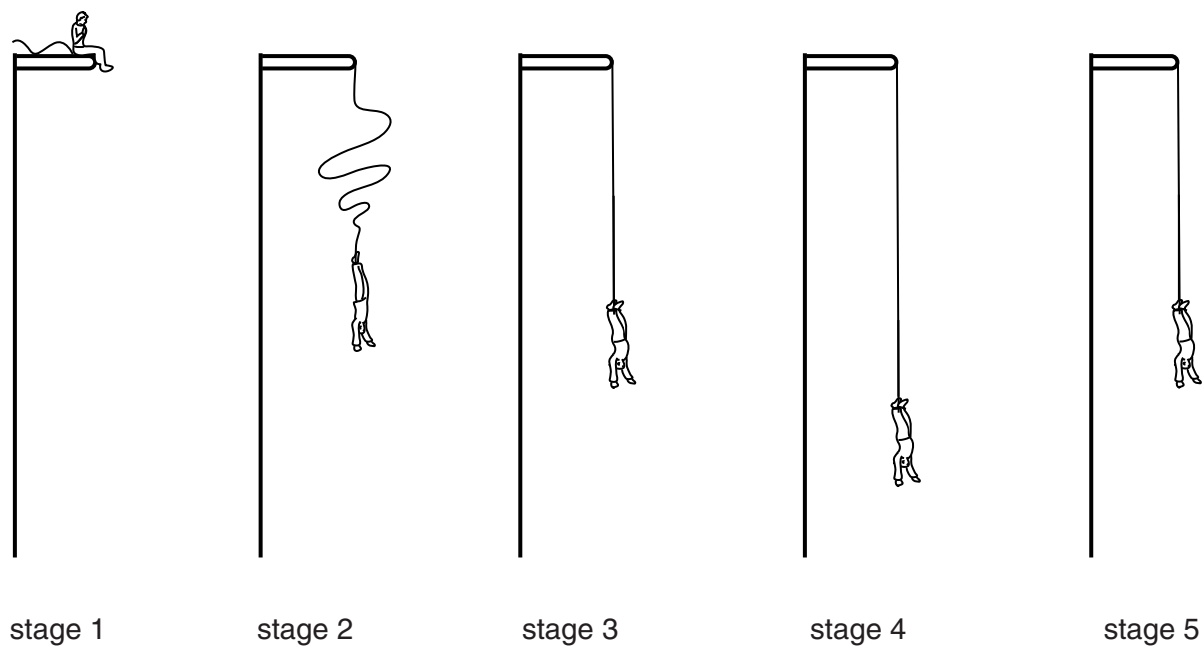
**Fig. 3.1**

Fig. 3.2 shows the jump at several stages from the time the man jumps off the bridge.

**Fig. 3.2**

- (a) State the energy transformation occurring between stage 1 and stage 2.

from ..... energy to

..... energy.

[1]

9

- (b) (i) Identify the main force acting on the man just after he jumps off the bridge.

.....[1]

- (ii) As the man falls, another force, air resistance, acts on the man to slow him down. On Fig. 3.3, draw an arrow to show the direction in which air resistance is acting on the man.



Fig. 3.3

[1]

- (iii) State the **name** of the unit in which force is measured.

..... [1]

- (c) As the man falls, the rope begins to stretch.

On the axes below, sketch a speed/time graph to show how his speed changes as the rope stretches until he reaches the lowest point.



[2]

## 10

- (d) The man then rises up again. He bounces up and down a few times before hanging from the rope at rest.

The unstretched length of the elastic rope is 25 m.

At the lowest point, the length of the rope is 40 m.

Estimate a value for the length of the rope when the man is hanging from the rope at rest.

Give a reason for your answer.

Length of rope: ..... m

Reason for your estimate: .....

.....

.....

.....[2]

- (e) Before the jump, the temperature of the rope is 20 °C. The rope is now used for several jumps by different people. At the end of all of the jumps, the temperature of the rope is 25 °C.

Suggest where the energy has come from to heat the rope.

.....

.....[1]

**Please turn over for Question 4.**

12

- 4 (a) Fig. 4.1 shows the male reproductive system.

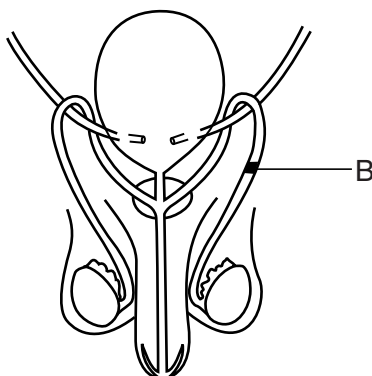


Fig. 4.1

- (i) On Fig 4.1 use lines to label and name

the urethra,

the prostate gland.

[2]

- (ii) A man's reproductive system is found to have a blockage at the point marked with a **B**.

Predict whether this man would still be able to have children.

Explain your answer.

.....

.....

.....

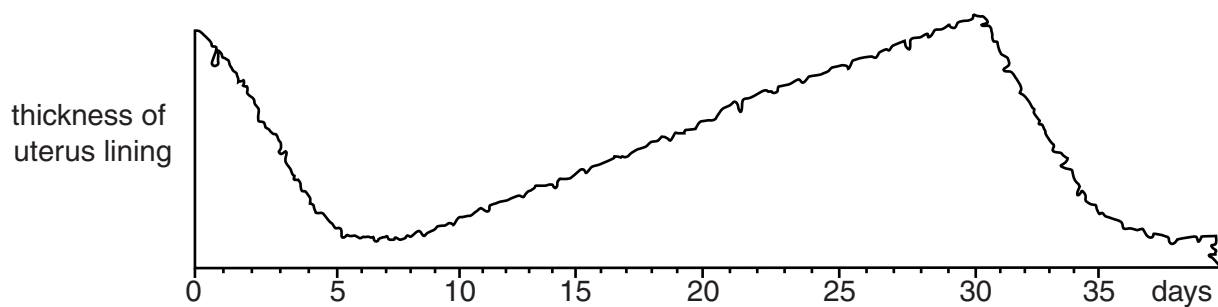
.....

.....

.....[3]

13

(b) Fig. 4.2 shows how the thickness of the lining of a woman's uterus changes with time.



**Fig. 4.2**

(i) State the days during which menstruation is taking place. Explain your answer.

days .....

explanation .....

.....

.....[2]

(ii) Suggest on which day an egg cell is most likely to be fertilised.

.....[1]

(iii) At certain times of the menstrual cycle the lining of the uterus becomes thicker.

Describe what causes this to occur.

.....

.....[1]

(iv) Explain the importance of this thickened uterus lining.

.....

.....[1]

5 Methane is a hydrocarbon which is used as a fuel to heat homes.

(a) State one source of methane.

.....

[1]

(b) Fig. 5.1 shows a demonstration of an explosion caused when methane burns.

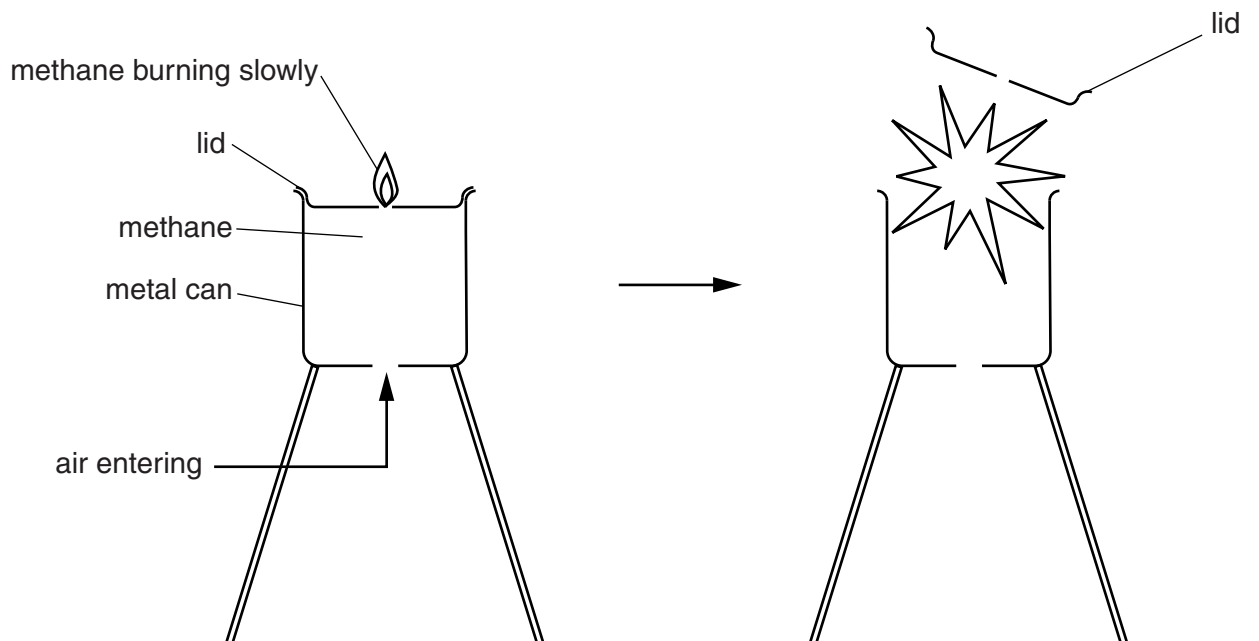


Fig. 5.1

- At first, methane escapes through the hole in the lid and burns slowly.
- As methane leaves the can, air enters through the hole in the base.
- When enough air has entered an explosion occurs.

(i) Table 5.1 compares the three main gases in the can just before and just after the explosion.

Table 5.1

| gases present <b>just before</b> the explosion |   | gases present <b>just after</b> the explosion |
|------------------------------------------------|---|-----------------------------------------------|
| methane                                        | → |                                               |
| oxygen                                         |   |                                               |
| nitrogen                                       |   |                                               |

Complete Table 5.1 showing the main gases present just before and just after the explosion. [2]

(ii) The explosion occurs when the rate of combustion of methane suddenly increases. This causes a rapid increase in temperature of the gases in the can.

State the term used to describe a chemical reaction which causes an increase in temperature.

.....

[1]

15

- (c) Gasoline (petrol) is a mixture of hydrocarbons which includes a compound called nonane.

One nonane molecule contains 20 hydrogen atoms and 9 carbon atoms.

- (i) State the chemical formula of a nonane molecule.

..... [1]

- (ii) State the type of bonding between the carbon and hydrogen atoms in a nonane molecule. Explain your answer.

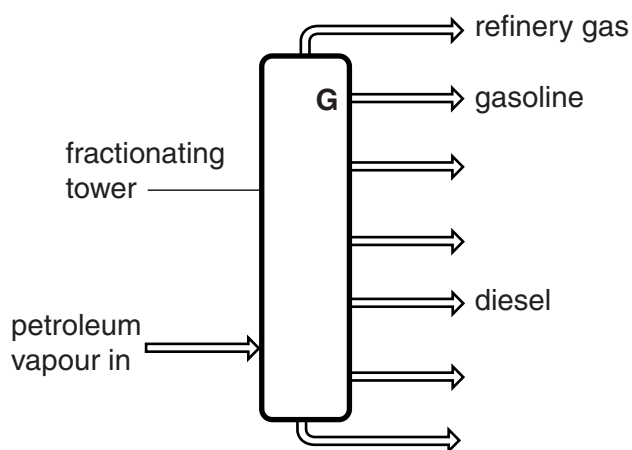
type of bonding .....

explanation .....

.....[2]

- (d) Gasoline is obtained from petroleum (crude oil) by fractional distillation.

Fig. 5.2 summarises the process.



**Fig. 5.2**

The petroleum is vaporised before it enters the fractionating tower and rises.

The gasoline fraction separates from the mixture at point **G** in the tower.

- (i) State what change happens to the gasoline vapour at point **G**.

..... [1]

- (ii) Explain why gasoline and diesel separate at different points in the tower.

.....

.....[1]

16

- 6 (a) Fig. 6.1 shows a ray of light passing through a glass block.

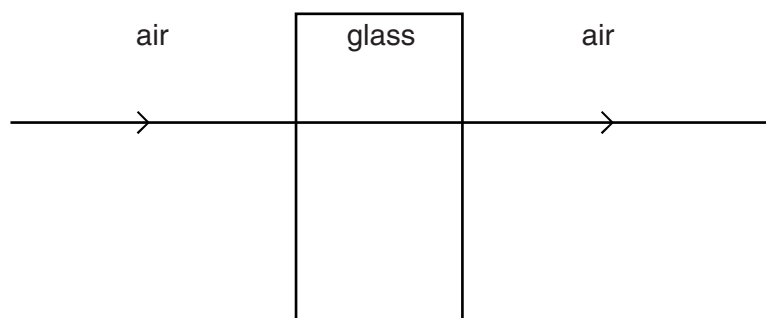


Fig. 6.1

Fig. 6.2 shows the block now turned at an angle to the ray of light.

On Fig. 6.2 draw the path of the ray of light as it enters and passes through the block, and out of the other side.

On your diagram, indicate clearly the angle of incidence  $i$  and the angle of refraction  $r$  as the ray passes into the block.

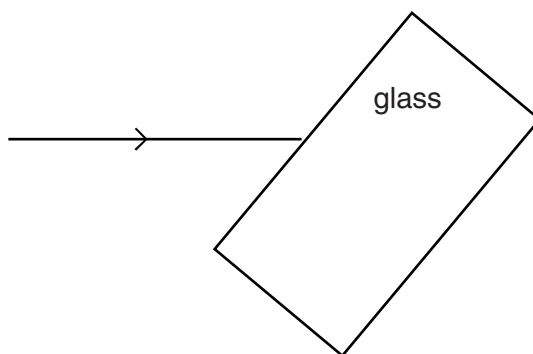


Fig. 6.2

[3]

- (b) (i) Light is a form of electromagnetic radiation. Fig. 6.3 shows the electromagnetic spectrum.

|                 |        |              |               |           |            |             |
|-----------------|--------|--------------|---------------|-----------|------------|-------------|
| gamma radiation | X-rays | ultra-violet | visible light | infra-red | microwaves | radio waves |
|-----------------|--------|--------------|---------------|-----------|------------|-------------|

Fig. 6.3

All electromagnetic radiations are refracted as they travel from one material to another.

The shorter the wavelength of an electromagnetic radiation, the more it is refracted.

From Fig. 6.3 state one form of electromagnetic radiation that is refracted more than light.

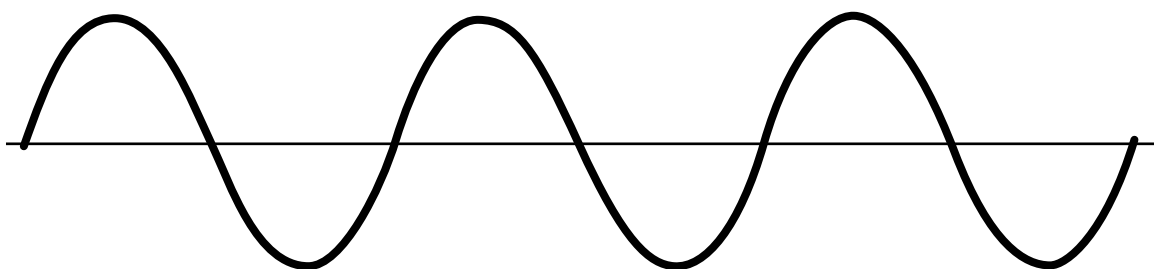
.....[1]

- (ii) Electromagnetic radiation from the Sun warms the Earth.

State the form of electromagnetic radiation mainly responsible for this energy transfer from the Sun.

.....[1]

- (c) (i) Fig. 6.4 shows a graph of a light wave. On Fig. 6.4, draw labelled arrows to indicate
1. one wavelength of this light wave,
  2. the amplitude of this light wave.



**Fig. 6.4**

[2]

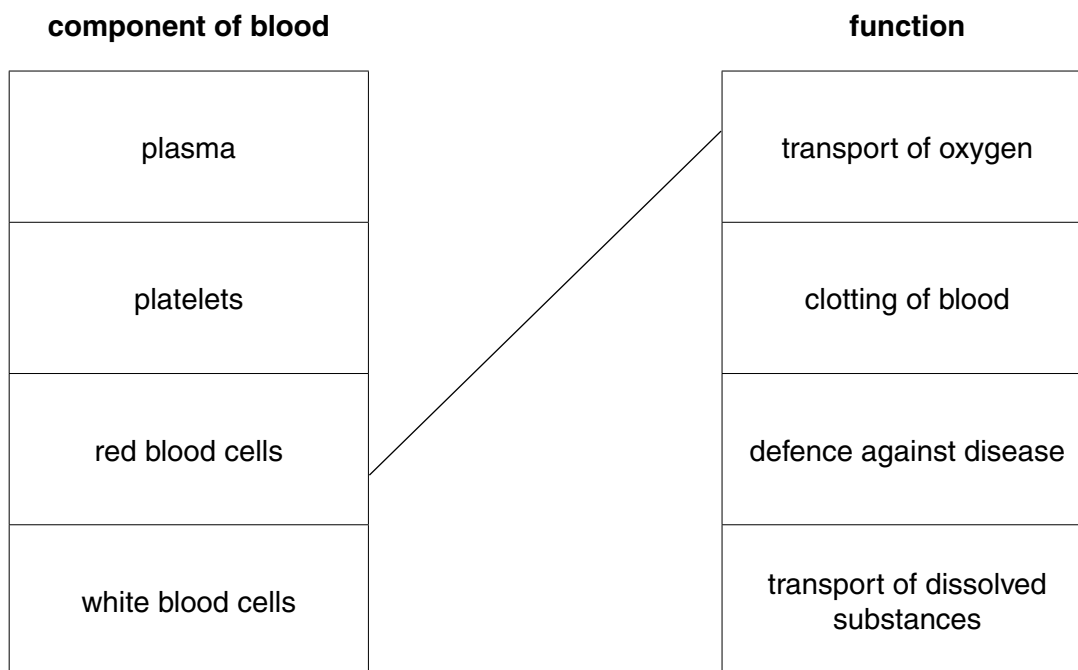
- (ii) The amplitude of a light wave determines the brightness of the light.

State the property of sound determined by the amplitude of a sound wave.

.....[1]

18

- 7 (a) Use lines to connect the boxes on the left with the correct boxes on the right. One line has been done for you.



[2]

- (b) As blood travels through an organ, substances diffuse into and out of the blood to exchange materials with the cells.

Table 7.1 shows the relative concentrations of some substances in the blood and in the cells of a part of the body called the adrenal gland.

Table 7.1

| substance      | concentration of substance |                                   |
|----------------|----------------------------|-----------------------------------|
|                | in the blood               | in the cells of the adrenal gland |
| oxygen         | higher                     | lower                             |
| carbon dioxide | lower                      | higher                            |
| glucose        | higher                     | lower                             |
| adrenaline     | lower                      | higher                            |

- (i) The oxygen diffuses from the blood into the cells of the adrenal gland.

Explain why this happens.

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

19

(ii) Describe what happens to the oxygen inside the cells.

.....

.....

.....

.....[2]

(iii) The adrenal gland releases the hormone adrenaline into the blood stream in certain situations. Describe one situation a human may be in that would cause an increase of adrenaline to be released from cells.

.....

.....[1]

(iv) State **two** effects of adrenaline on the body.

1 .....

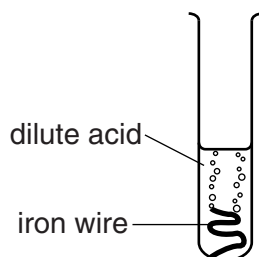
2 .....[2]

20

- 8** A student investigates the speed of reaction between metals and a dilute acid.

He knows that adding dilute acid to iron wire produces hydrogen gas.

- (a)** Fig. 8.1 shows the apparatus the student uses to carry out the reaction.



**Fig. 8.1**

The temperature of the acid is 20 °C.

- (i)** Describe the test for hydrogen gas.

test .....

result .....[2]

- (ii)** The rate of bubbling slows down and then stops. There is still some iron wire left in the test-tube.

Explain these observations.

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

- (iii)** The student thinks that the test-tube now contains a solution of iron chloride.

Describe a test and the result that shows that the solution contains chloride ions.

test .....

result .....[2]

- (b)** The student repeats the experiment using acid at a temperature of 40 °C.

Describe and explain the difference in what the student observes at this higher temperature.

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

**21**

**(c)** Describe and explain what the student notices when he uses copper wire instead of iron.

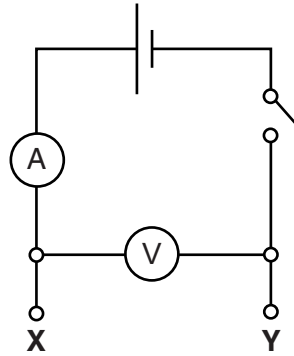
.....

.....

.....

.....[2]

- 9 Fig. 9.1 shows a circuit used to investigate the resistance of pieces of wire. The pieces of resistance wire are connected to the circuit between **X** and **Y**.



**Fig. 9.1**

A piece of resistance wire of length 100 cm is connected between **X** and **Y**.

The reading on the ammeter is 0.6 A.

The reading on the voltmeter is 1.2 V.

- (a) (i) Complete the formula.

$$\text{resistance} = \frac{\quad}{\text{current}}$$

[1]

- (ii) The piece of resistance wire is cut in half. One length of 50 cm has half the resistance of the wire of 100 cm length.

The 50 cm wire is connected between **X** and **Y**.

Explain why the reading of the ammeter increases.

.....[1]

- (iii) The second half of the resistance wire is connected in parallel with the first half between **X** and **Y**.

Predict the effect this has on the ammeter reading. Give a reason for your answer.

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

23

- (iv) 100 cm of the resistance wire has a resistance of  $2\Omega$ .

Calculate the total resistance when four lengths of 100 cm each are connected in series.

Show your working:

resistance = .....  $\Omega$  [1]

- (b) The names of some circuit components are given in the left hand column. Some circuit symbols are given in the right hand column.

Complete Table 9.1 to show the missing component name and symbols. One has been done for you.

**Table 9.1**

| circuit component     | symbol                                                                               |
|-----------------------|--------------------------------------------------------------------------------------|
| direct current source |    |
| fuse                  |                                                                                      |
|                       |  |
| fixed resistor        |                                                                                      |

[2]

- (c) Most of the stored chemical energy in the cell is changed to thermal energy in the wire. Some of this thermal energy is then transferred to the air surrounding the wire.

- (i) Name the method of thermal energy transfer by the heated air to the surroundings.

.....[1]

- (ii) Describe an experiment to show this method of thermal energy transfer. You may wish to draw a diagram.

.....

.....

.....

.....[2]

DATA SHEET  
The Periodic Table of the Elements

| Group                                                 |                             |                                                                                                                   |                             |                             |                              |                              |                              |                            |                             |                           |                            |                             |                              |                            |                             |                             |                             |                           |                             |                         |                              |                         |
|-------------------------------------------------------|-----------------------------|-------------------------------------------------------------------------------------------------------------------|-----------------------------|-----------------------------|------------------------------|------------------------------|------------------------------|----------------------------|-----------------------------|---------------------------|----------------------------|-----------------------------|------------------------------|----------------------------|-----------------------------|-----------------------------|-----------------------------|---------------------------|-----------------------------|-------------------------|------------------------------|-------------------------|
| I                                                     | II                          |                                                                                                                   |                             |                             |                              |                              |                              |                            |                             |                           |                            | III                         | IV                           | V                          | VI                          | VII                         | 0                           |                           |                             |                         |                              |                         |
|                                                       |                             | <div>1H<br/>Hydrogen<br/>1</div>                                                                                  |                             |                             |                              |                              |                              |                            |                             |                           |                            |                             |                              |                            |                             |                             |                             |                           |                             |                         |                              |                         |
| 7<br>Li<br>Lithium<br>3                               | 9<br>Be<br>Beryllium<br>4   |                                                                                                                   |                             |                             |                              |                              |                              |                            |                             |                           |                            |                             |                              |                            |                             |                             | 11<br>B<br>Boron<br>5       | 12<br>C<br>Carbon<br>6    | 14<br>N<br>Nitrogen<br>7    | 16<br>O<br>Oxygen<br>8  | 19<br>F<br>Fluorine<br>9     | 20<br>Ne<br>Neon<br>10  |
| 23<br>Na<br>Sodium<br>11                              | 24<br>Mg<br>Magnesium<br>12 |                                                                                                                   |                             |                             |                              |                              |                              |                            |                             |                           |                            |                             |                              |                            |                             |                             | 27<br>Al<br>Aluminium<br>13 | 28<br>Si<br>Silicon<br>14 | 31<br>P<br>Phosphorus<br>15 | 32<br>S<br>Sulfur<br>16 | 35.5<br>Cl<br>Chlorine<br>17 | 40<br>Ar<br>Argon<br>18 |
| 39<br>K<br>Potassium<br>19                            | 40<br>Ca<br>Calcium<br>20   | 45<br>Sc<br>Scandium<br>21                                                                                        | 48<br>Ti<br>Titanium<br>22  | 51<br>V<br>Vanadium<br>23   | 52<br>Cr<br>Chromium<br>24   | 55<br>Mn<br>Manganese<br>25  | 56<br>Fe<br>Iron<br>26       | 59<br>Co<br>Cobalt<br>27   | 59<br>Ni<br>Nickel<br>28    | 64<br>Cu<br>Copper<br>29  | 65<br>Zn<br>Zinc<br>30     | 70<br>Ga<br>Gallium<br>31   | 73<br>Ge<br>Germanium<br>32  | 75<br>As<br>Arsenic<br>33  | 79<br>Se<br>Selenium<br>34  | 80<br>Br<br>Bromine<br>35   | 84<br>Kr<br>Krypton<br>36   |                           |                             |                         |                              |                         |
| 85<br>Rb<br>Rubidium<br>37                            | 88<br>Sr<br>Strontium<br>38 | 89<br>Y<br>Yttrium<br>39                                                                                          | 91<br>Zr<br>Zirconium<br>40 | 93<br>Nb<br>Niobium<br>41   | 96<br>Mo<br>Molybdenum<br>42 | 101<br>Ru<br>Ruthenium<br>44 | 106<br>Pd<br>Palladium<br>46 | 108<br>Ag<br>Silver<br>47  | 112<br>Cd<br>Cadmium<br>48  | 115<br>In<br>Indium<br>49 | 119<br>Sn<br>Tin<br>50     | 122<br>Sb<br>Antimony<br>51 | 128<br>Te<br>Tellurium<br>52 | 127<br>I<br>Iodine<br>53   | 131<br>Xe<br>Xenon<br>54    | 222<br>Rn<br>Radon<br>86    |                             |                           |                             |                         |                              |                         |
| 133<br>Cs<br>Caesium<br>55                            | 137<br>Ba<br>Barium<br>56   | 139<br>La<br>Lanthanum<br>57                                                                                      | 178<br>Hf<br>Hafnium<br>72  | 181<br>Ta<br>Tantalum<br>73 | 184<br>W<br>Tungsten<br>74   | 186<br>Re<br>Rhenium<br>75   | 190<br>Os<br>Osmium<br>76    | 192<br>Ir<br>Iridium<br>77 | 195<br>Pt<br>Platinum<br>78 | 197<br>Au<br>Gold<br>79   | 201<br>Hg<br>Mercury<br>80 | 204<br>Tl<br>Thallium<br>81 | 207<br>Pb<br>Lead<br>82      | 209<br>Bi<br>Bismuth<br>83 | 210<br>Po<br>Polonium<br>84 | 210<br>At<br>Astatine<br>85 |                             |                           |                             |                         |                              |                         |
| 223<br>Fr<br>Francium<br>87                           | 226<br>Ra<br>Radium<br>88   | 227<br>Ac<br>Actinium<br>89                                                                                       |                             |                             |                              |                              |                              |                            |                             |                           |                            |                             |                              |                            |                             |                             |                             |                           |                             |                         |                              |                         |
| * 58–71 Lanthanoid series<br>† 90–103 Actinoid series |                             |                                                                                                                   |                             |                             |                              |                              |                              |                            |                             |                           |                            |                             |                              |                            |                             |                             |                             |                           |                             |                         |                              |                         |
| Key                                                   |                             | <div><div>aXb</div><div>a = relative atomic mass<br/>X = atomic symbol<br/>b = atomic (proton) number</div></div> |                             |                             |                              |                              |                              |                            |                             |                           |                            |                             |                              |                            |                             |                             |                             |                           |                             |                         |                              |                         |

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