Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

4255002398

COMBINED SCIENCE **5129/21**

Paper 2 **May/June 2021**

2 hours 15 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 100.
- The number of marks for each question or part question is shown in brackets [ ].
- The Periodic Table is printed in the question paper.

This document has **24** pages. Any blank pages are indicated.

[Turn over

1 Fig. 1.1 shows an animal cell.

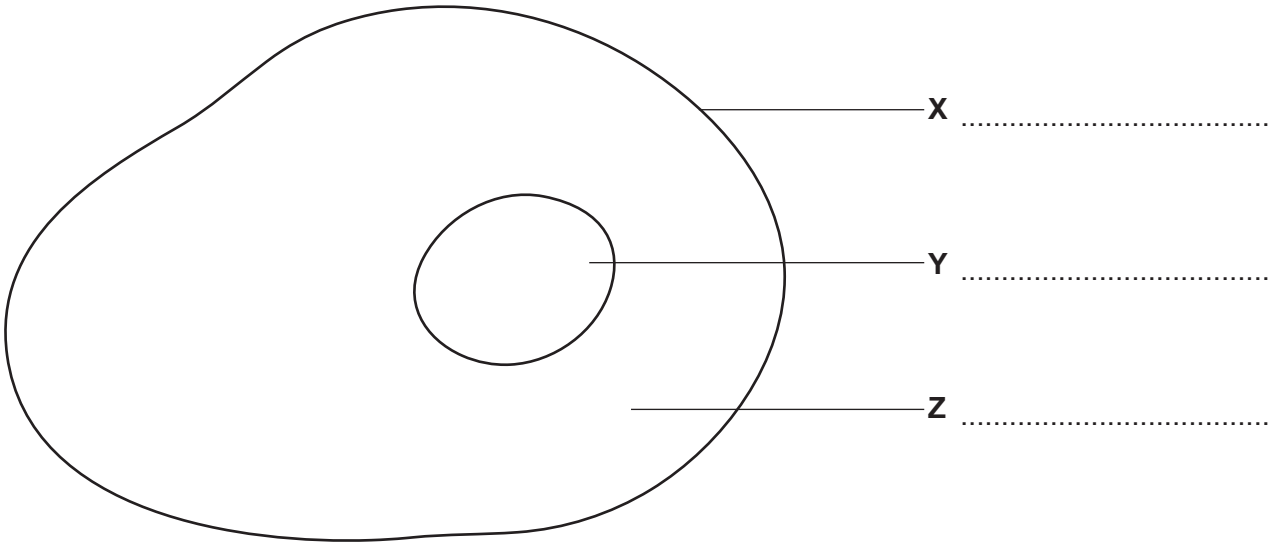

Fig. 1.1

(a) (i) On Fig. 1.1, name the structures **X**, **Y** and **Z**. [3]

(ii) State **one** function for structure **X**.

.....

..... [1]

(b) Name **two** structures that are only present in plant cells.

1 .....

2 .....

[2]

[Total: 6]

2 The following is a list of gases.

argon	**carbon dioxide**	**carbon monoxide**		**ethane**
helium	**hydrogen**	**methane**	**nitrogen**	**oxygen**

Complete the following sentences using gases from the list.

Each gas may be used once, more than once or not at all.

(a) The two gases that react together to produce ammonia are

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

(b) The gas that is used in the manufacture of margarine is

..... . [1]

(c) The gas that is the main constituent of natural gas is

..... . [1]

(d) The gas that is produced in the fermentation of glucose is

..... . [1]

(e) The noble gas that is the most abundant in clean air is

..... . [1]

[Total: 6]

[Turn over

3 A car travels at a constant speed of 8.0 m/s between time t = 0 s and time t = 10 s.

Then:

From t = 10 s to t = 13 s its speed decreases at 2 m/s^2.

From t = 13 s to t = 17 s it travels at constant speed.

From t = 17 s to t = 25 s it accelerates in a non-constant way to a speed of 12 m/s.

On Fig. 3.1 plot the speed–time graph of the journey.

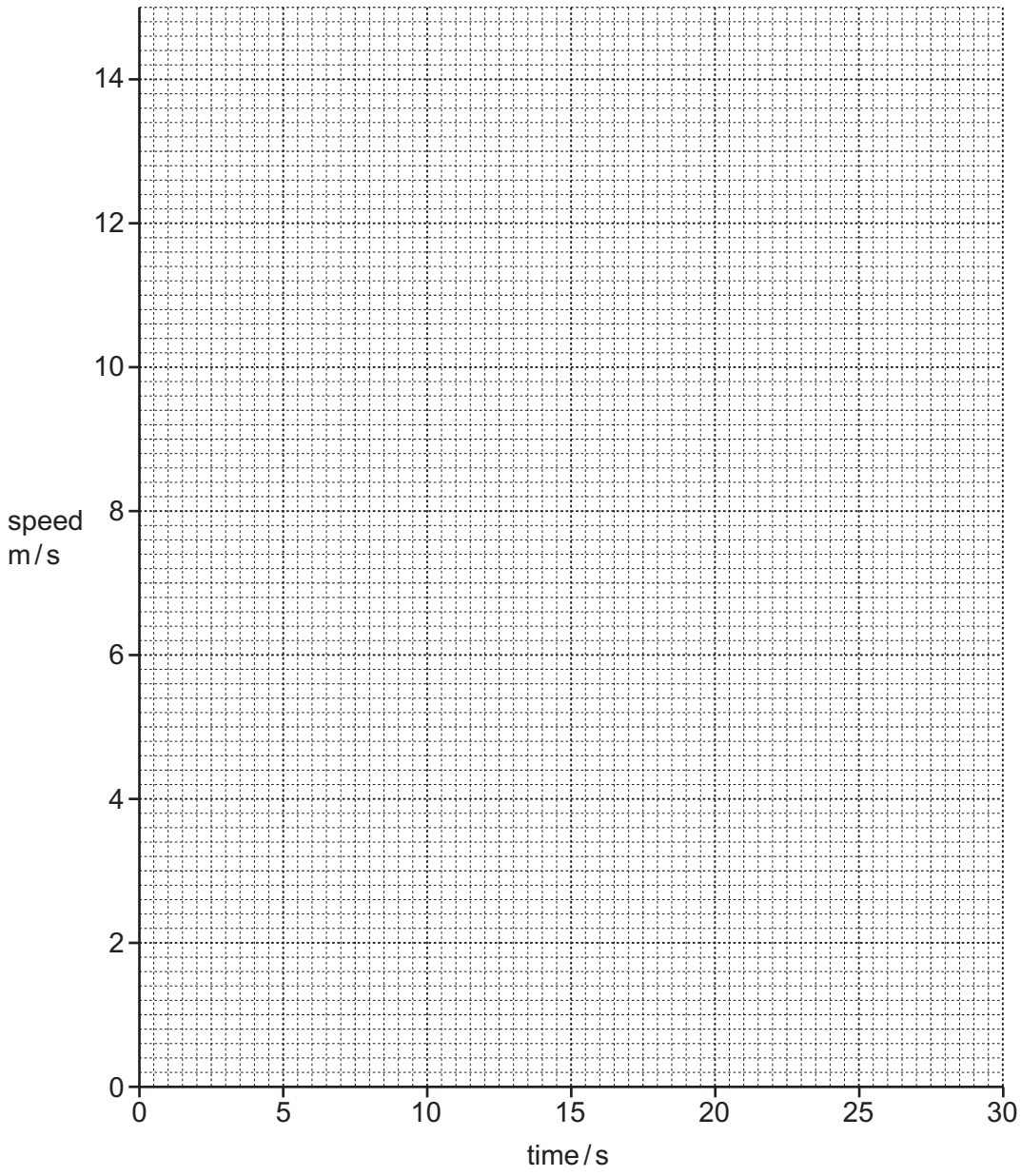

Fig. 3.1

[4]

4 Copper(II) oxide is reduced to copper by carbon.

The equation for the reaction is shown.

$$2CuO + C \longrightarrow 2Cu + CO_2$$

[A_r: Cu, 64; O, 16; C, 12]

(a) (i) Calculate the relative molecular mass M_r of carbon dioxide.

..... [1]

(ii) Complete the following sentences.

80 g of copper(II) oxide reacts with ..... g of carbon and produces ..... g of carbon dioxide.

4 g of copper(II) oxide produces ..... g of carbon dioxide. [3]

(b) Describe a test which shows copper is a metal.

.....

..... [2]

(c) State, in terms of reactivity, why copper(II) oxide is reduced by heating with carbon.

.....

..... [1]

[Total: 7]

5 The alimentary canal starts at the mouth and ends at the anus.

Fig. 5.1 names the regions of the alimentary canal, represented by boxes.

(a) Complete Fig. 5.1 by drawing lines with arrows between the boxes to show the route that food takes between the mouth and the anus.

Two arrows have been drawn for you.

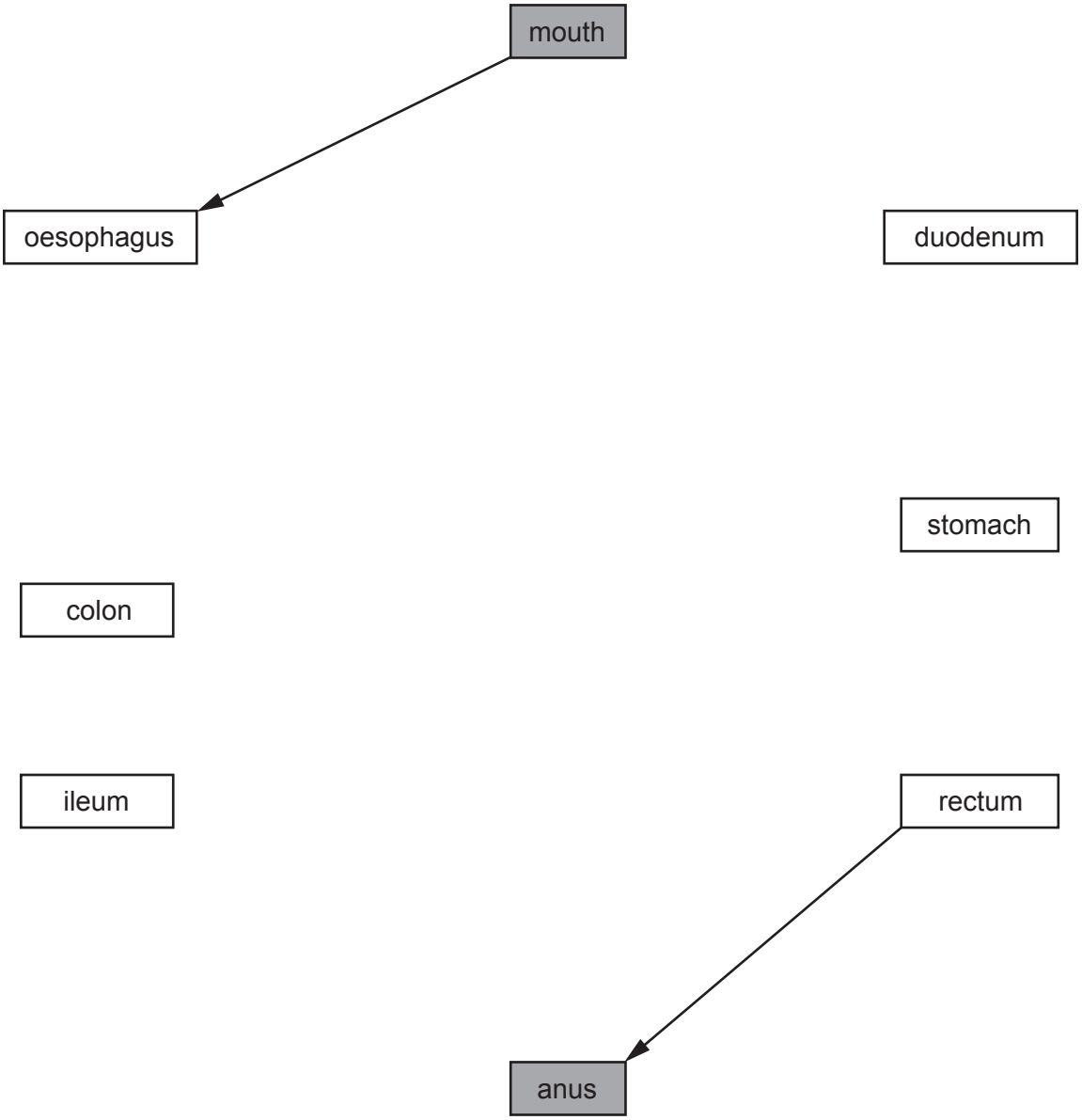

Fig. 5.1

[3]

(b) The liver is an organ associated with the alimentary canal.

State **three** functions of the liver.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

[Total: 6]

6 Fig. 6.1 shows a spring attached to a wooden block at rest on a surface.

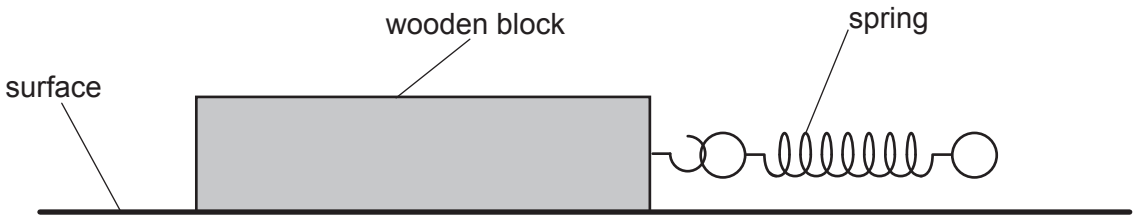

Fig. 6.1

The spring is pulled until the block begins to move.

(a) Describe how the apparatus in Fig. 6.1 can be used to show that the amount of friction depends on the roughness of the surface.

.....

.....

.....

..... [3]

(b) The dimensions of the block are shown in Fig. 6.2.

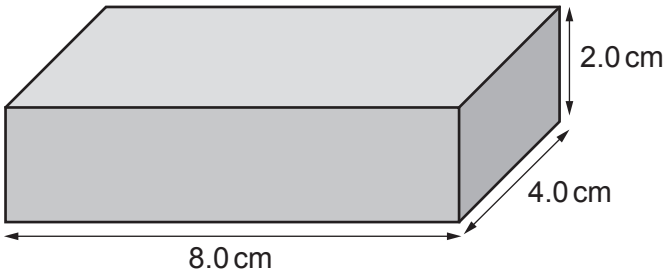

Fig. 6.2

The density of the wood is 0.50 g / cm^3.

Calculate:

(i) the volume of the block,

volume = ... cm^3 [1]

(ii) the mass of the block.

mass = ... g [2]

[Total: 6]

7 **(a)** Complete the sentences about photosynthesis.

During photosynthesis carbon dioxide and ..... are taken into a plant.

These chemicals are combined to produce ..... and oxygen.

Energy is needed for this process.

Leaves contain ..... which traps light energy and converts it into ..... energy.

[4]

(b) Fig. 7.1 shows how the rate of photosynthesis in a plant changes with temperature.

The rate of photosynthesis depends on enzyme activity.

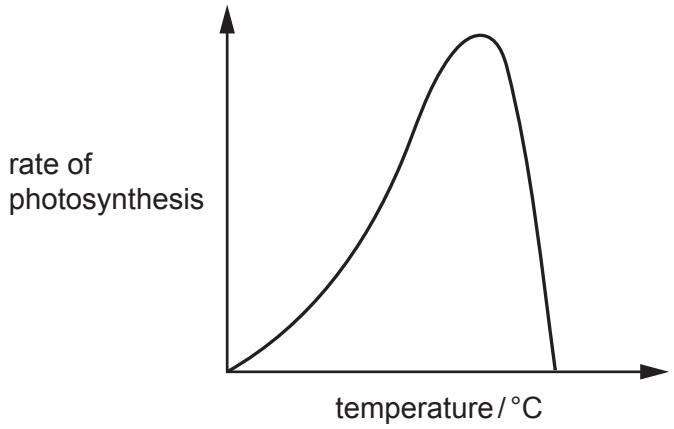

Fig. 7.1

Explain why the rate of photosynthesis changes as the temperature increases.

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 7]

8 Some reactions of ethanol are shown in Fig. 8.1.

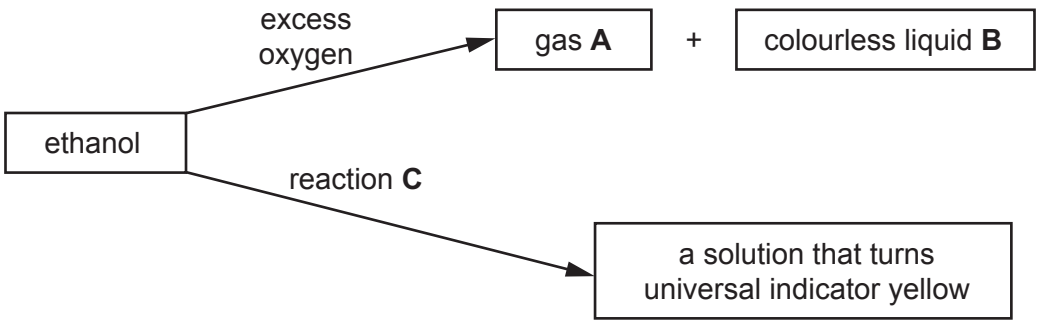

Fig. 8.1

(a) **(i)** Identify:

gas **A** .....

colourless liquid **B** .....

[2]

(ii) Name the type of reaction **C**.

..... [1]

(iii) Suggest the pH of the solution that turns the universal indicator yellow.

pH = ... [1]

(b) Draw the structure of ethanol.

[1]

(c) In the manufacture of perfumes, solid substances are dissolved in ethanol.

State the name given to a liquid that dissolves substances.

..... [1]

[Total: 6]

9 **(a)** Some sources of energy are:

chemical **geothermal** **hydroelectric** **nuclear** **solar**

Use words from the list to identify the source of energy in which:

(i) atoms regroup ..... [1]

(ii) the nuclei of atoms are rearranged ..... [1]

(iii) the energy passes through a vacuum. ..... [1]

(b) Describe how energy is converted from one form to another in a wind turbine.

.....

.....

..... [2]

[Total: 5]

10 Table 10.1 contains six statements.

Tick (✓) the three correct statements about the heart.

Table 10.1

statement	✓
1 Blood is pumped from the heart to the lungs along veins.	
2 The heart contains valves.	
3 The heart does not carry our respiration.	
4 The heart is composed of muscle.	
5 The right hand side of the heart pumps blood around the body.	
6 There are four chambers in the heart.	

[3]

11 The electronic structure of a magnesium atom is shown in Fig. 11.1.

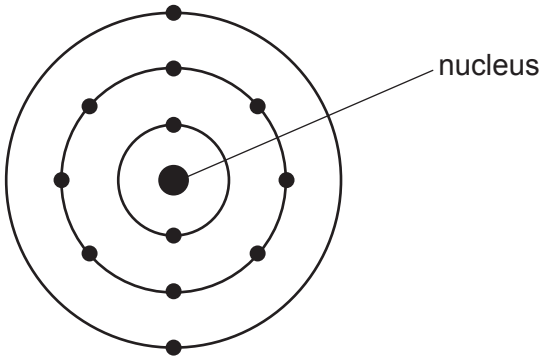

Fig. 11.1

(a) (i) State the number of protons in the nucleus of a magnesium atom.

..... [1]

(ii) Describe and explain why magnesium forms a stable Mg^{2+} ion.

.....

.....

..... [2]

(b) Some reactions of magnesium and magnesium oxide are shown in Fig. 11.2.

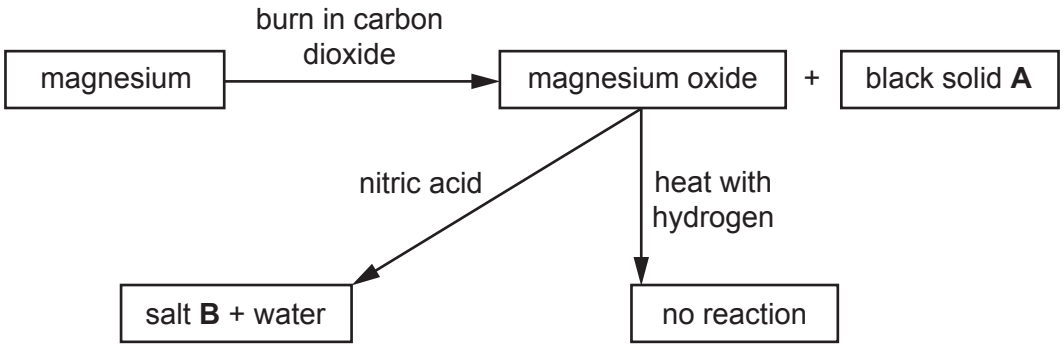

Fig. 11.2

(i) Identify the:

black solid **A** .....

salt **B**. ..... [2]

(ii) State the type of reaction that occurs when magnesium oxide reacts with nitric acid.

..... [1]

(c) Explain why magnesium oxide does **not** react with hydrogen.

..... [1]

[Total: 7]

12 (a) Gamma-rays and radio waves are examples of electromagnetic waves.

Describe three properties of gamma-rays that are the same as the properties of radio waves.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

(b) Infrared radiation has a wavelength of 6×10^{-4} m.

The speed of infrared radiation is 3×10^{8} m/s.

Calculate the frequency of this radiation and state the unit.

frequency = ... unit .....

[3]

[Total: 6]

13 Fig. 13.1 shows the male reproductive system.

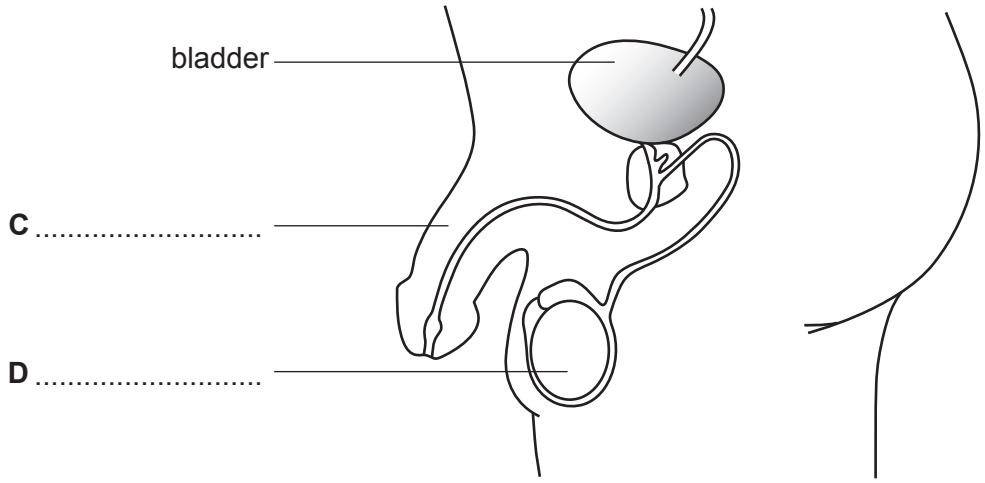

Fig. 13.1

(a) On Fig. 13.1, name the structures **C** and **D**.

Write your answers on Fig. 13.1. [2]

(b) State a function for each of the following structures in the male reproductive system.

testis .....

.....

sperm duct .....

.....

prostate gland .....

.....

urethra .....

.....

[4]

[Total: 6]

14 The apparatus used to analyse a green substance using chromatography is shown in Fig. 14.1. The solvent used in the experiment is water.

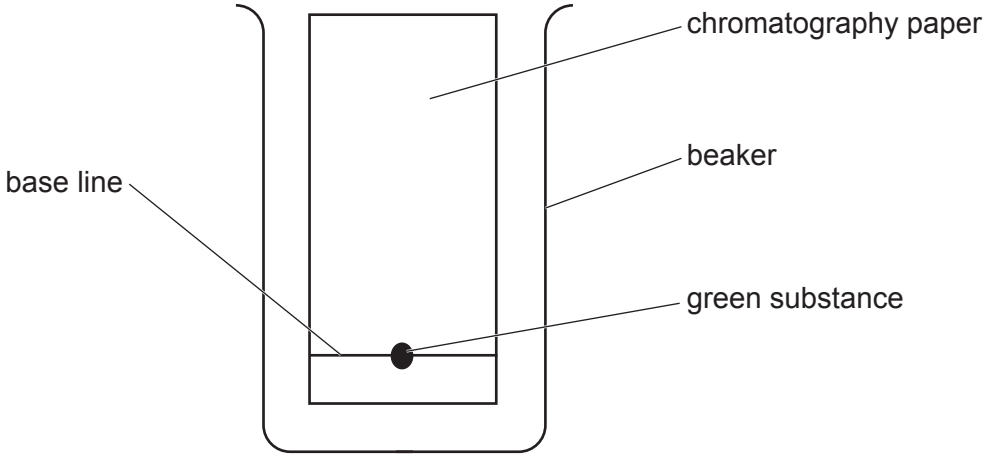

Fig. 14.1

(a) On Fig. 14.1, draw a line to show the level of the water at the start of the chromatography experiment. [1]

(b) Explain why the base line is drawn in pencil rather than ink.

.....

..... [1]

(c) The chromatogram obtained in the experiment is shown in Fig. 14.2.

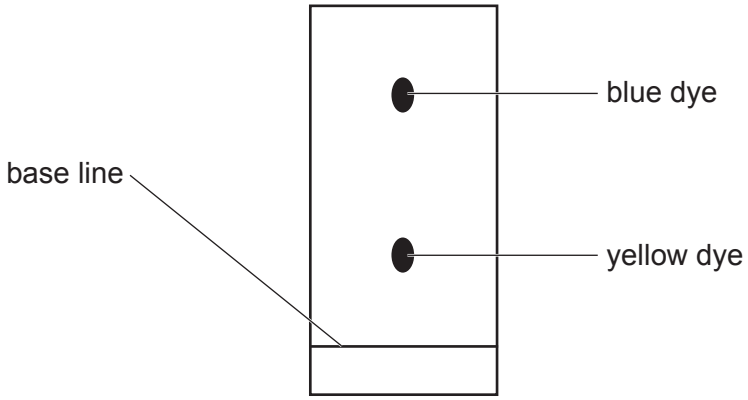

Fig. 14.2

State which dye in Fig. 14.2 is the most soluble in water.
Give a reason for your choice.

dye .....

reason .....

.....
[1]

[Total: 3]

15 Fig. 15.1 shows a positively charged plastic sphere suspended from a horizontal support by an insulating thread.

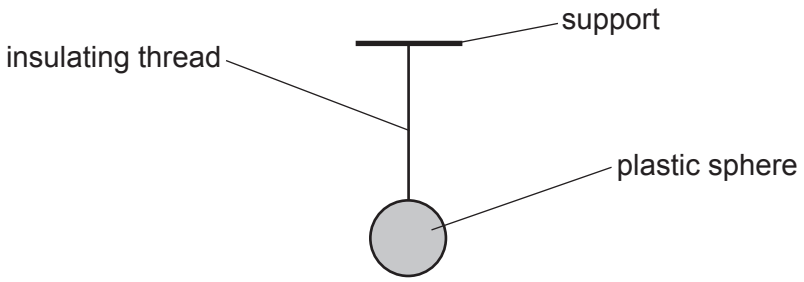

Fig. 15.1

(a) Explain why the charge remains on the sphere.

..... [1]

(b) A charged plastic rod is moved towards the sphere, as shown in Fig. 15.2.

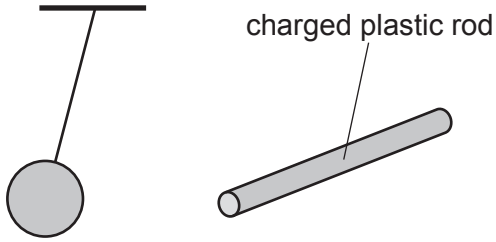

Fig. 15.2

Explain why the sphere moves away from the rod.

.....

..... [2]

[Total: 3]

16 Fig. 16.1 shows part of a food web.

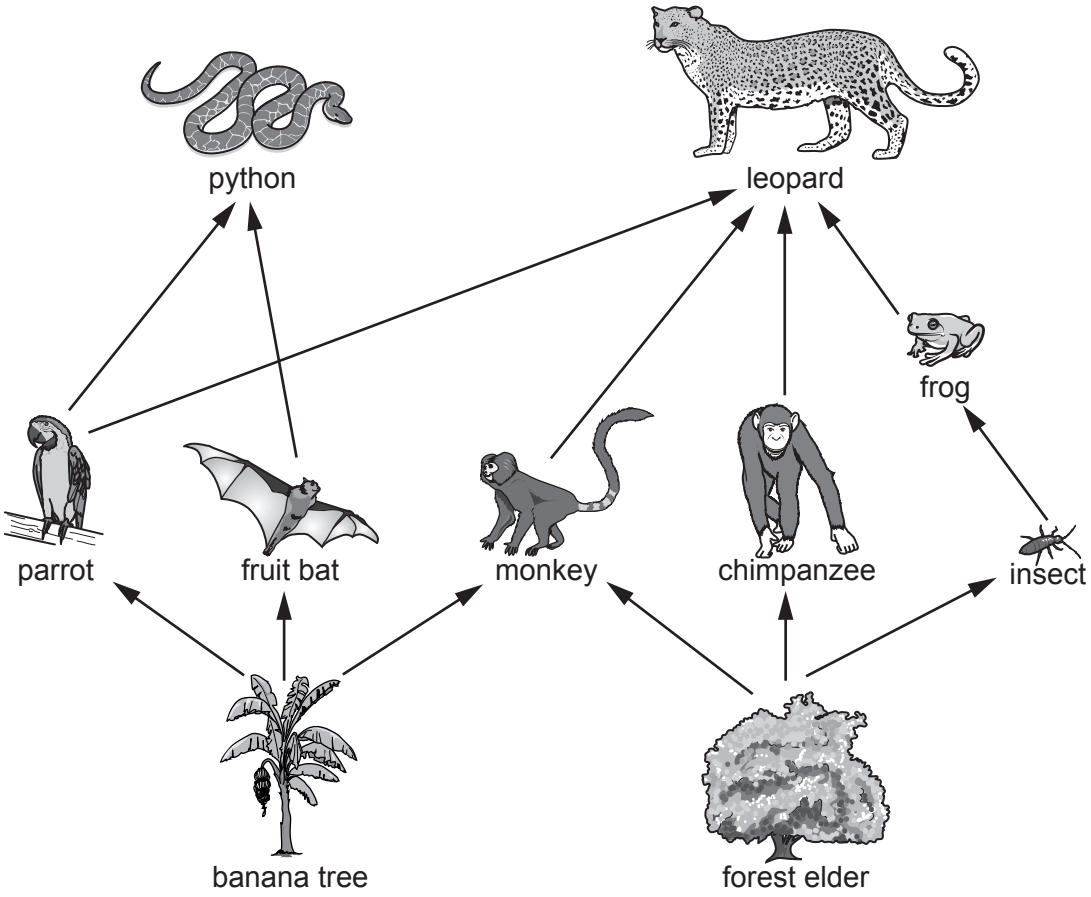

Fig. 16.1

(a) State the number of herbivores in this food web.

..... [1]

(b) Complete Fig. 16.2 to show the food chain from Fig. 16.1 that contains four organisms.

Fig. 16.2

[2]

(c) Explain how energy is lost between one trophic level and the next trophic level in a food chain.

.....

.....

.....

.....

..... [2]

[Total: 5]

17 Fig. 17.1 shows a circuit containing a resistor.

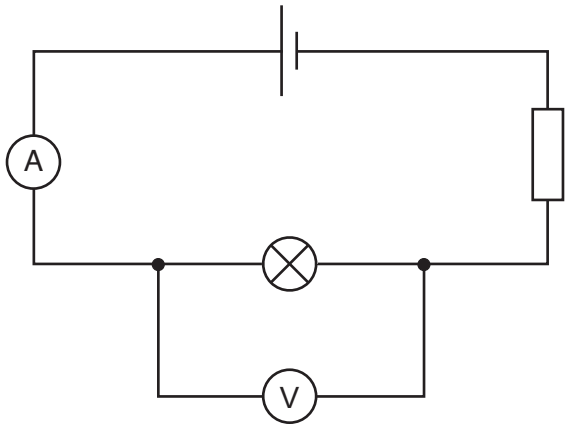

Fig. 17.1

The circuit is used to investigate two different cells **Y** and **Z**.

The results are shown in Table 17.1.

Table 17.1

cell	potential difference across lamp / V	current through lamp / A
Y	1.88	0.21
Z	2.63	0.29

(a) Show that the lamp has a resistance of approximately 9 Ω.

[2]

(b) The e.m.f. of cell **Z** is 3.5 Volts.

(i) Determine the potential difference across the resistor shown in the circuit.

potential difference = …….. V [1]

(ii) Use your answer to **(b)(i)** to calculate the resistance of the resistor shown in the circuit.

resistance = …….. Ω [1]

(iii) Calculate the e.m.f. of cell **Y**.

e.m.f. = …….. V [2]

[Total: 6]

18 Petroleum is a source of fuels.

Fuels produce energy during combustion.

(a) State the name given to reactions that release energy.

..... [1]

(b) Petroleum is separated into fractions by fractional distillation.

Some uses of the fractions are shown in Table 18.1.

Complete Table 18.1 by naming the fraction that matches its use.

Table 18.1

use	name of fraction
fuel for oil stoves	
road making	
making waxes and polishes	

[3]

[Total: 4]

19 Technetium-99 is produced when molybdenum-99 emits beta radiation.

(a) Complete the nuclear equation for the decay of molybdenum-99.

$$^{99}_{.....}\text{Mo} \longrightarrow {}^{99}_{43}\text{Tc} + {}^{.....}_{.....}\text{e}$$

[2]

(b) Molybdenum-99 has a half-life of 66 hours.

Show that approximately 3% of a sample of molybdenum-99 will remain after 14 days.

[2]

[Total: 4]

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The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	VIII
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key

atomic number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

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