



Cambridge O Level

CANDIDATE
NAME

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

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.



1 Fig. 1.1 shows an animal cell.

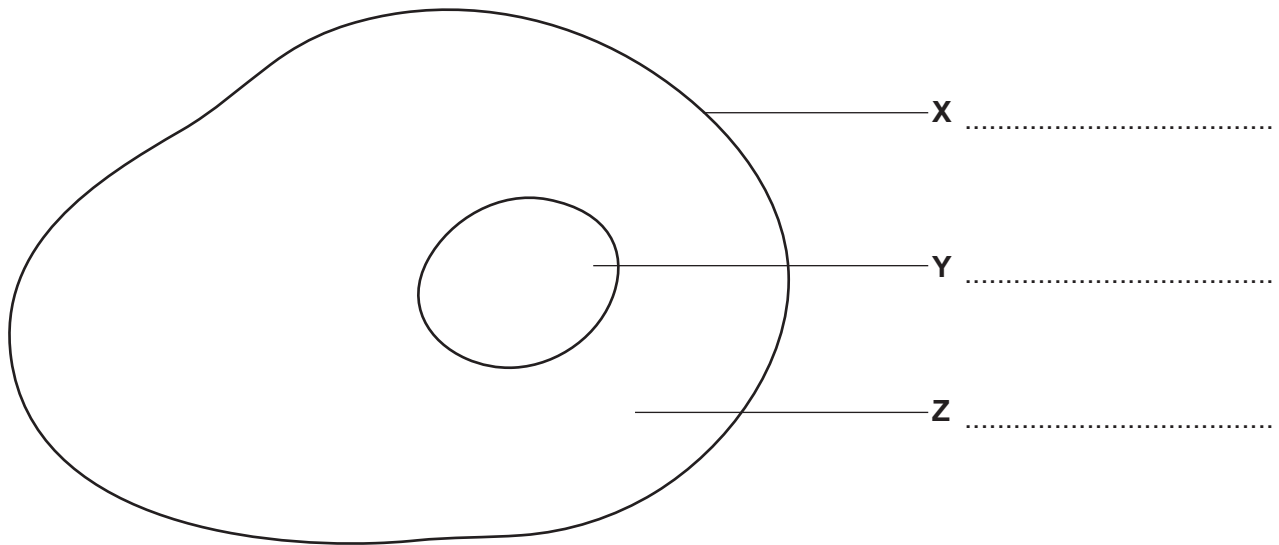


Fig. 1.1

(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]

- 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.

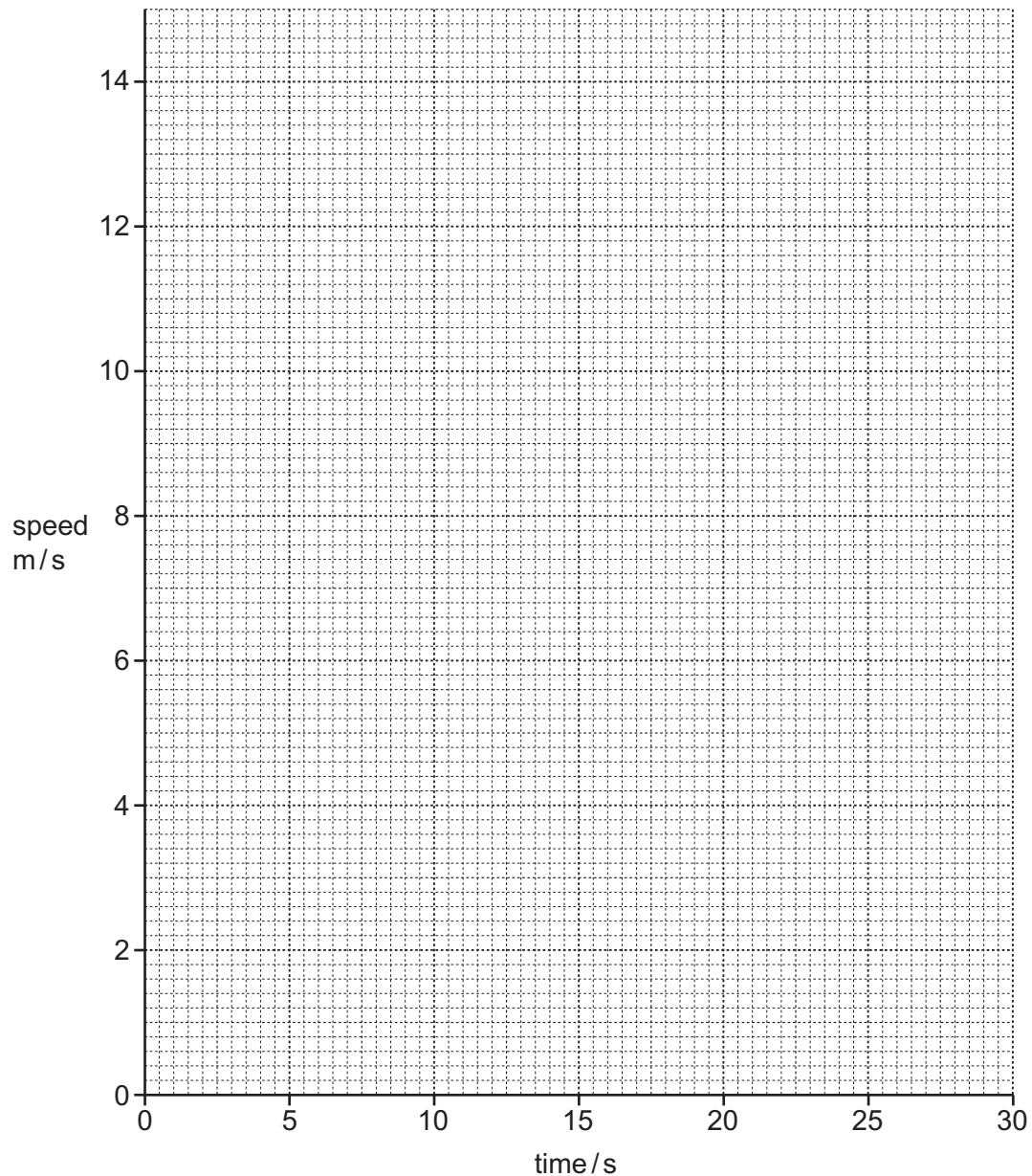


Fig. 3.1

[4]

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

The equation for the reaction is shown.



[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.

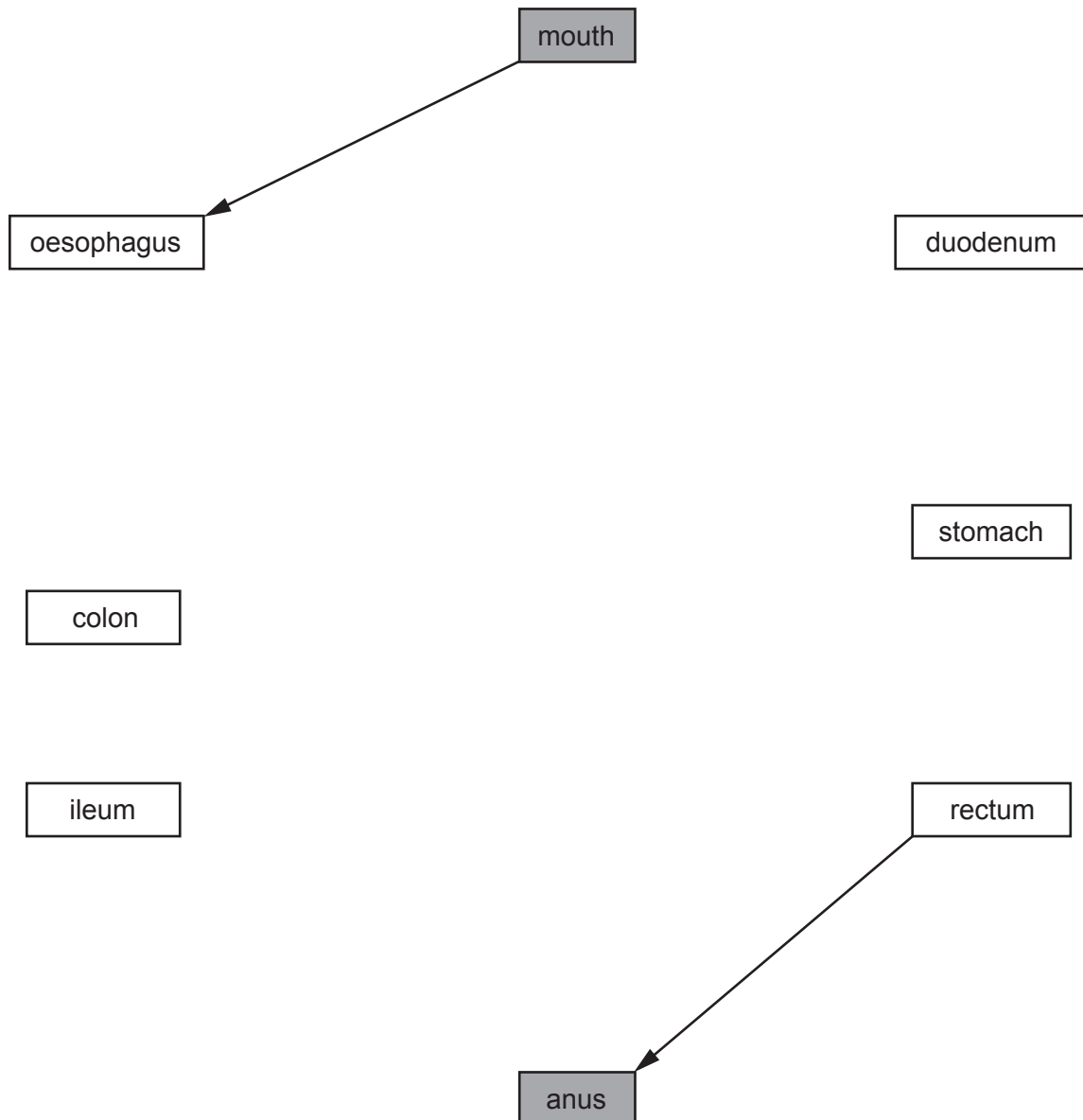


Fig. 5.1

[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.

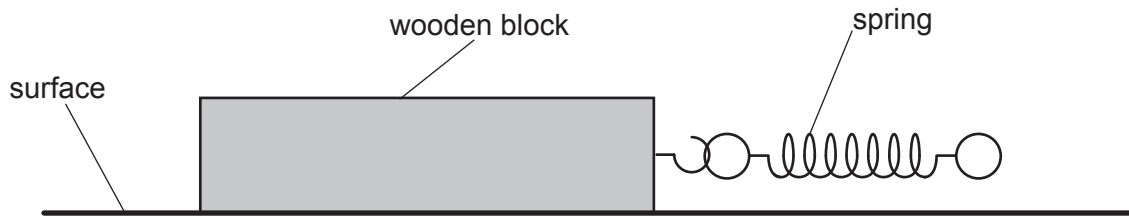


Fig. 6.1

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.

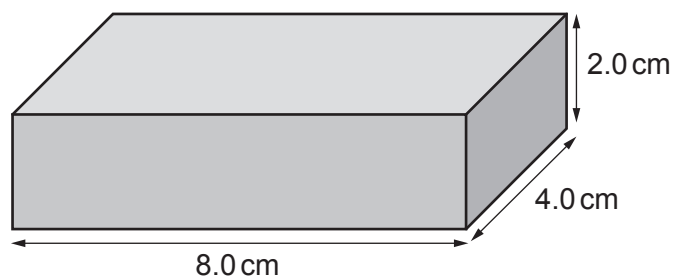


Fig. 6.2

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.

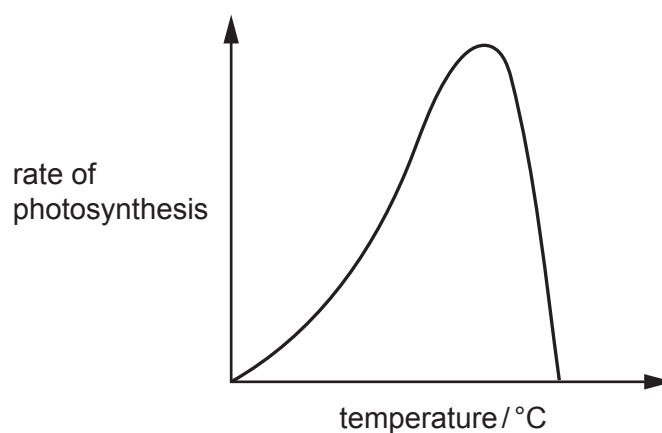


Fig. 7.1

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.

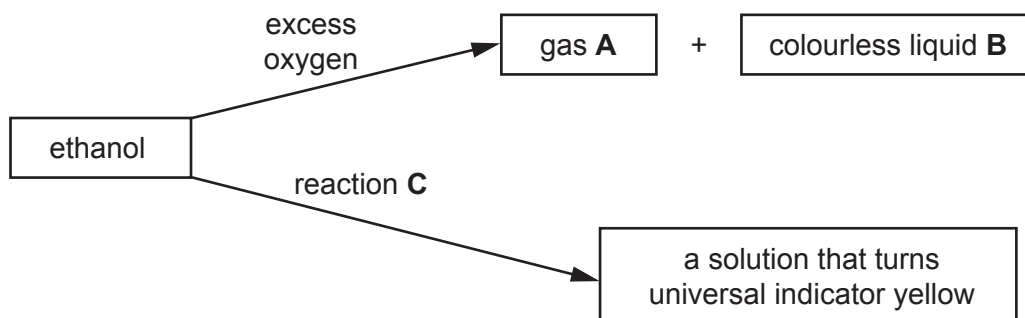


Fig. 8.1

(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.

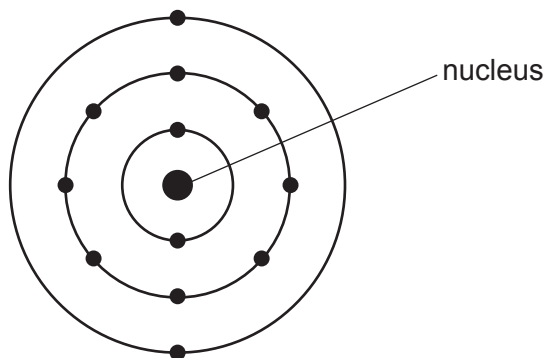


Fig. 11.1

- (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.

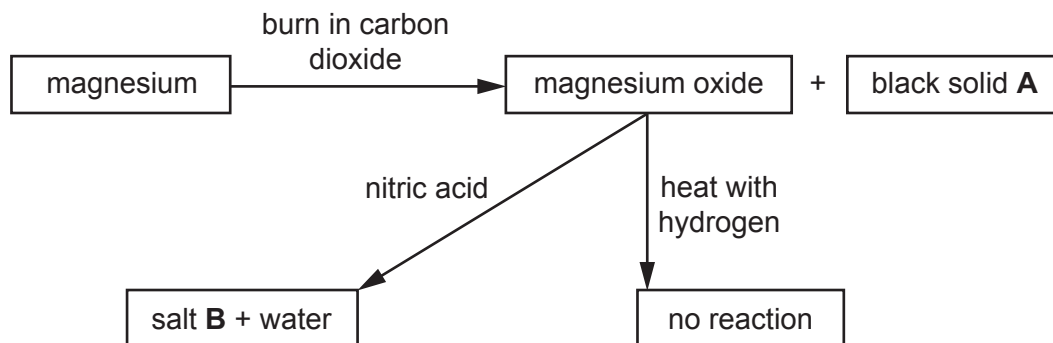


Fig. 11.2

- (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.

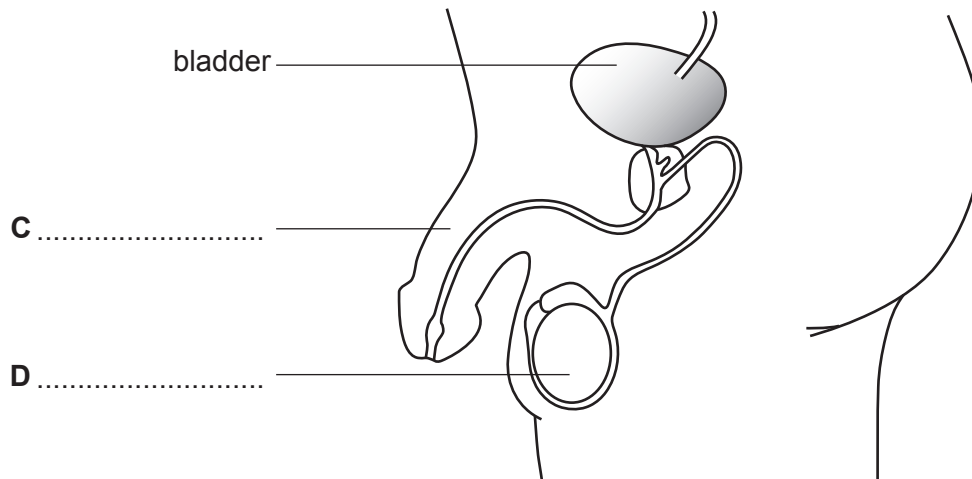


Fig. 13.1

(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.

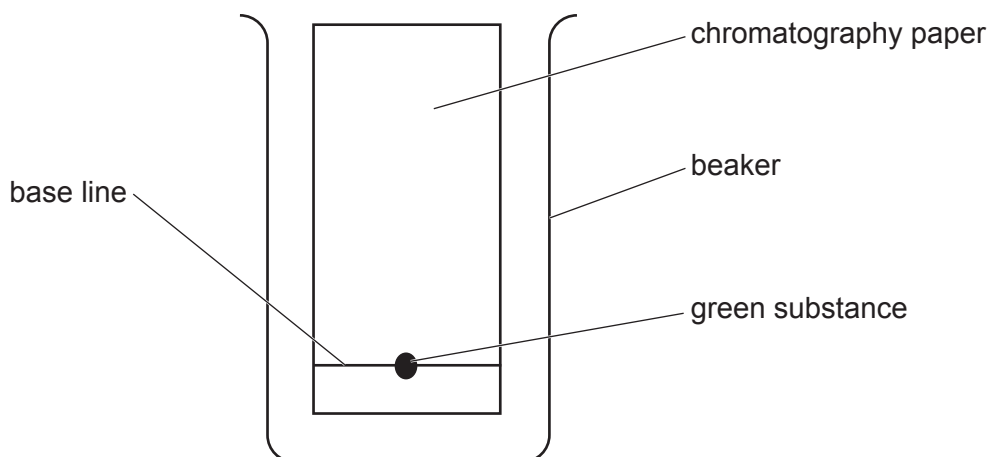


Fig. 14.1

- (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.

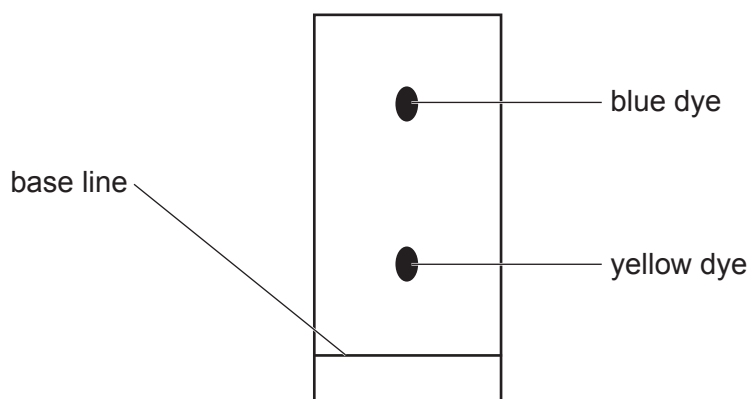


Fig. 14.2

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.

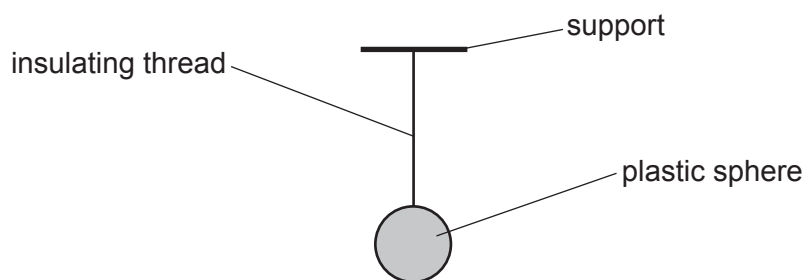


Fig. 15.1

- (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.

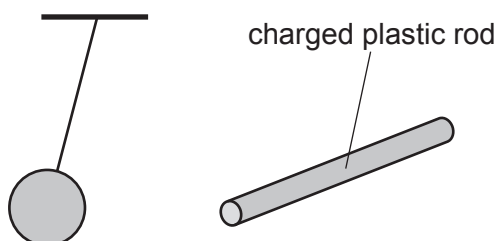


Fig. 15.2

Explain why the sphere moves away from the rod.

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

[Total: 3]

16 Fig. 16.1 shows part of a food web.

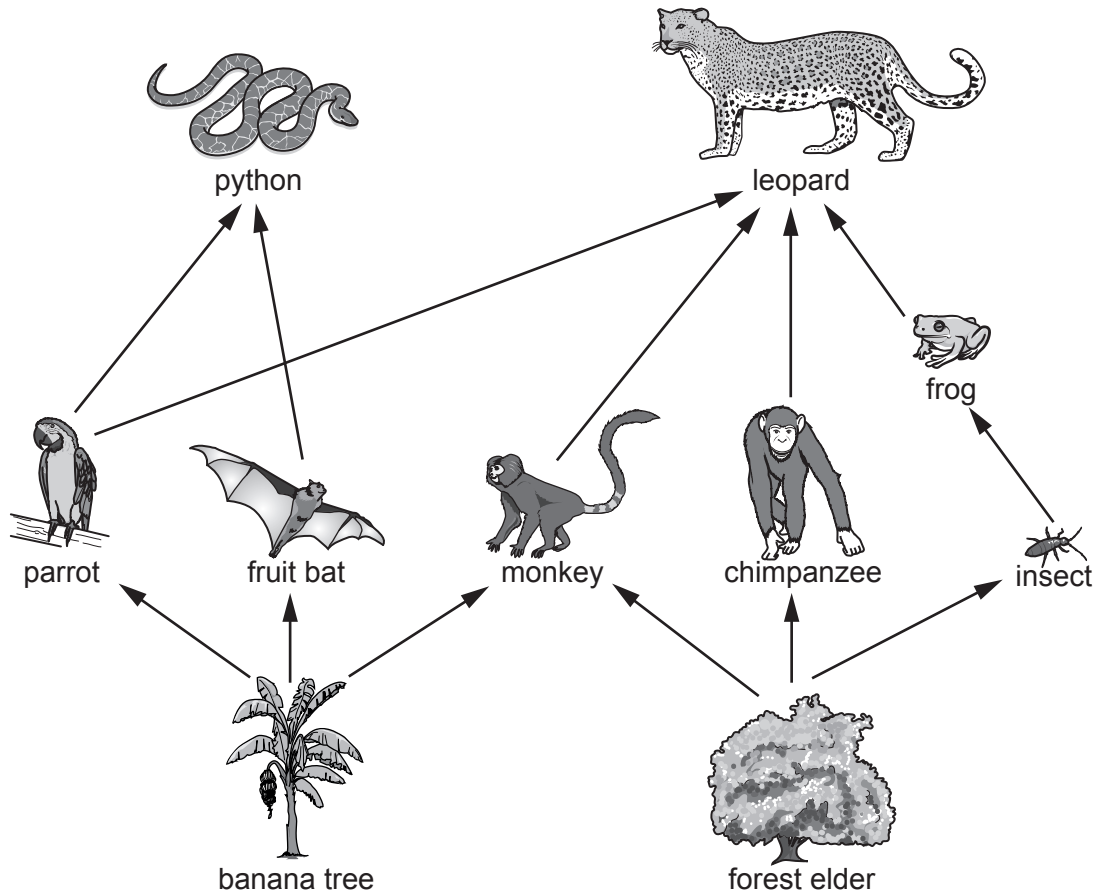


Fig. 16.1

(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.

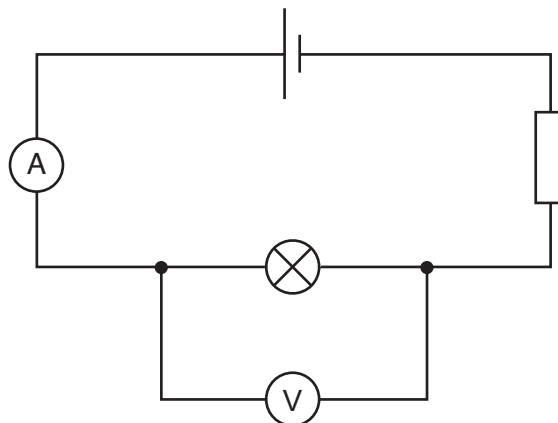


Fig. 17.1

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 9Ω .

[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

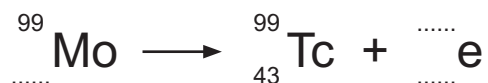
use	name of fraction
fuel for oil stoves	
road making	
making waxes and polishes	

[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.



[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]

BLANK PAGE

BLANK PAGE

BLANK PAGE

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

Cambridge Assessment International Education is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which itself is a department of the University of Cambridge.

The Periodic Table of Elements

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	euporium	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	yterbium	173	71	Lu	lutetium	175
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	merendelevium	—	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.).