Cambridge Assessment
International Education

Cambridge O Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

COMBINED SCIENCE **5129/22**

Paper 2 Theory **May/June 2025**

1 hour 45 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 80.
- 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 **20** pages. Any blank pages are indicated.
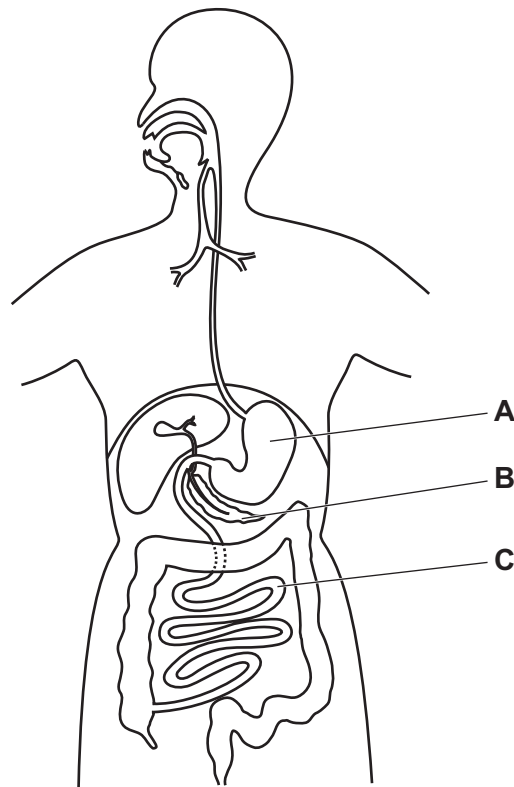
1 Fig. 1.1 shows the human digestive system.

Fig. 1.1

(a) (i) Draw an **X** on **two** structures in Fig. 1.1 to show where physical digestion takes place.
[2]

(ii) State the names of the parts of the digestive system labelled **A**, **B** and **C** on Fig. 1.1.

A ....

B ....

C ....
[3]

(b) Complete the sentences about digestion by using words or phrases from the list.

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

amino acids	amylase	fatty acids
lipase	maltase	protease

The enzyme .... breaks down starch to maltose.

Maltose is then broken down to glucose by ....

Fats are broken down into glycerol and .... by the

enzyme ....
[4]

[Total: 9]

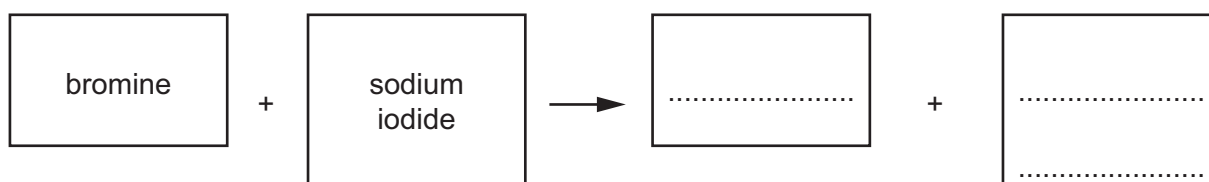**2 (a)** Table 2.1 lists the densities of some Group VII elements going down the group.

Table 2.1

element	$\dfrac{density}{g/cm^3}$
fluorine	
chlorine	0.003
bromine	3.103
iodine	4.933

Suggest a value for the density of fluorine.

density of fluorine = ...g/cm^3 [1]

(b) Bromine reacts with sodium iodide.

Complete the word equation for the reaction.

| bromine | + | sodium iodide | → | .... | + | .... |

[2]

(c) Explain why bromine does **not** react with sodium chloride.

....

.... [1]

[Total: 4]

3 A swimming team competes in a race.

Each swimmer in the team swims one 25 m length of a swimming pool before the next swimmer starts the next length. The fourth swimmer finishes the race.

Table 3.1 shows the time taken by each member of the team to swim one length.

Table 3.1

swimmer number	time / s
1	21
2	20
3	19
4	18

(a) State which swimmer swims the fastest.

swimmer number .... [1]

(b) (i) Calculate the total distance the team swims.

total distance = ...m [1]

(ii) Use your answer from **(b)(i)** to determine the average speed of the swimming team.

Give your answer to 2 significant figures.

average speed = ... m / s [3]

[Total: 5]

5

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5129/22/M/J/25

[Turn over

4 (a) (i) State the name of the component of cigarette smoke that increases the risk of a person developing lung cancer.

.... [1]

(ii) State **one** other harmful condition which can result from smoking cigarettes.

.... [1]

(b) Fig. 4.1 shows information about the effect of continued smoking of cigarettes on the risk of dying from lung cancer.
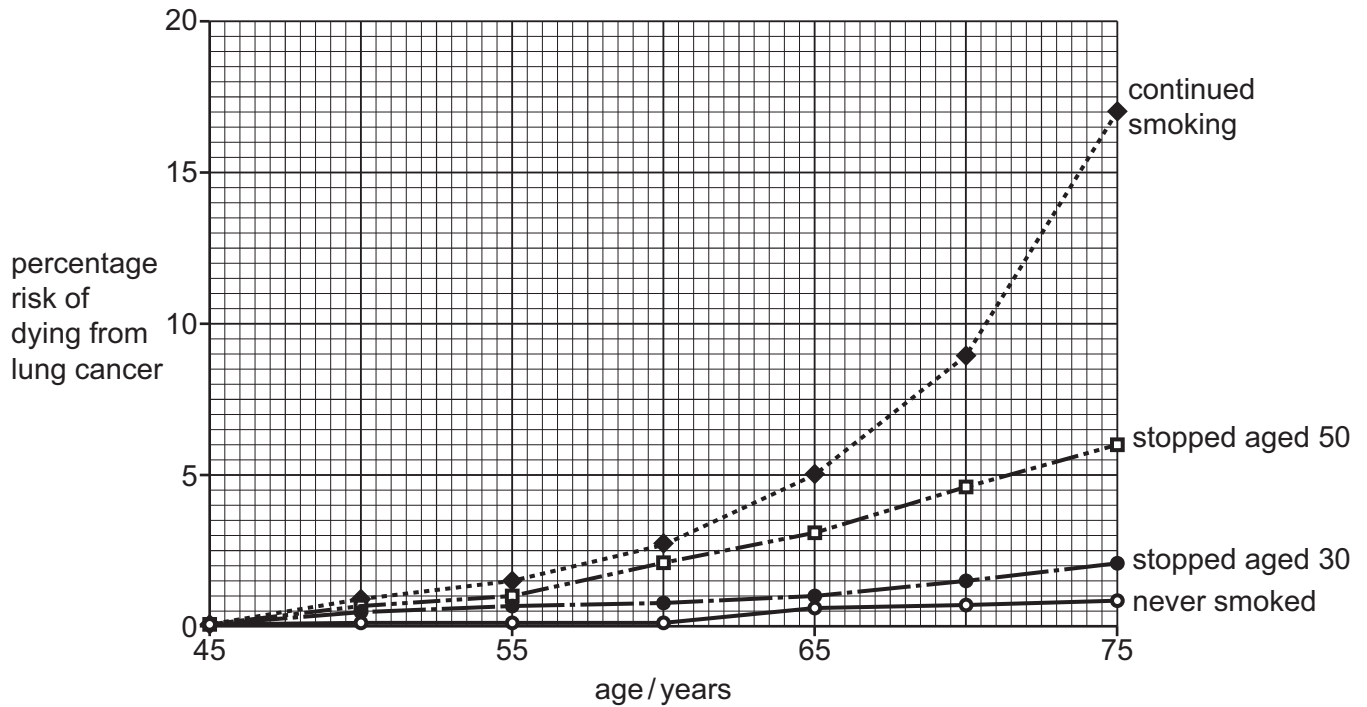

Fig. 4.1

Determine the percentage risk of a 75-year-old person dying from lung cancer if the person stopped smoking at 50 years old.

percentage risk = ... [1]

(c) A student makes conclusions from the information in the graph in Fig. 4.1.

Tick (✓) **three** sentences in Table 4.1 that are correct conclusions for the information in the graph in Fig. 4.1.

Table 4.1

conclusion made by student	tick if correct
People who have never smoked cigarettes do not die from lung cancer.	
Smoking cigarettes increase a person's percentage risk of dying from lung cancer.	
If a person stops smoking cigarettes, the percentage risk of that person developing lung cancer is reduced.	
Lung cancer is always fatal.	
The risk of dying from lung cancer increases with age.	
A 65-year-old smoker has a smaller percentage risk of dying from lung cancer than a 75-year-old person who has never smoked.	

[3]

[Total: 6]

5 An aqueous solution of sodium sulfate contains sulfate ions.

(a) (i) Give the state symbol for an aqueous solution.

.... [1]

(ii) State the names of **two** chemicals used in the test for sulfate ions.

chemical 1 ....

chemical 2 ....

[2]

(b) Calculate the relative formula mass M_r of sodium sulfate, Na_2SO_4.

The relative atomic masses, A_r, of oxygen, sodium and sulfur are shown.

[A_r: O, 16; Na, 23; S, 32]

M_r = ... [1]

(c) State the name of an acid that contains sulfate ions.

.... [1]

[Total: 5]

6 Fig. 6.1 shows a Mars Rover. It landed on the planet Mars in August 2012.
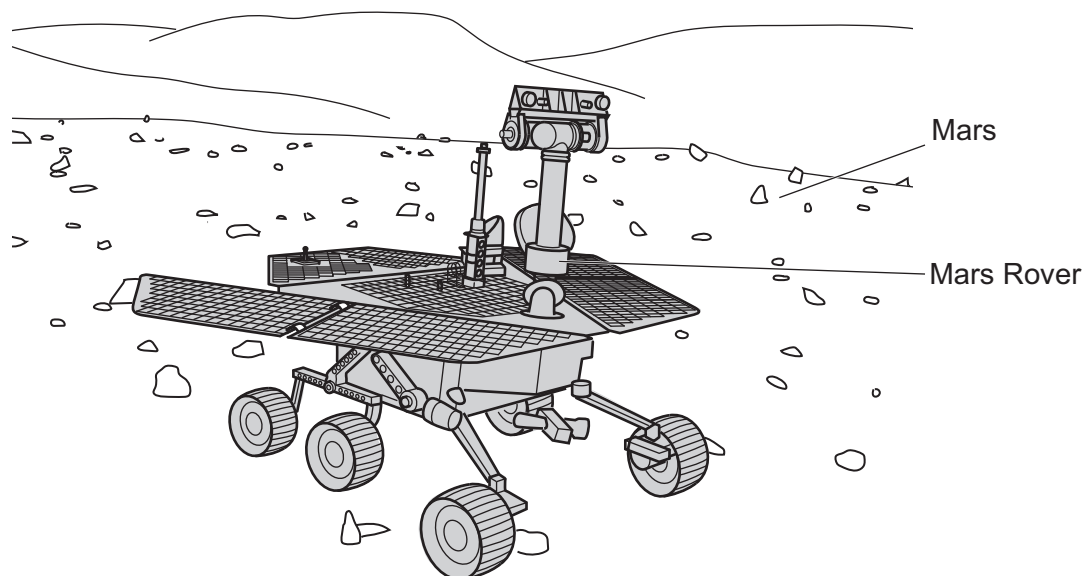

Fig. 6.1

The mass of the Rover on Earth is 899 kg.

(a) Calculate the weight of the Rover on Earth.

Gravitational field strength *g* = 10 N / kg.

weight = ... N [1]

(b) (i) The weight of the Rover on Mars is 3326 N.

Calculate the gravitational field strength on Mars.

gravitational field strength on Mars = ...N / kg [1]

(ii) Define gravitational field strength.

.... [1]

[Total: 3]

7 Draw **three** straight lines from the box on the left in Fig. 7.1 to three boxes on the right to make three correct sentences about aerobic respiration.

… takes place in animal cells only.

… releases energy from food.

Aerobic respiration …

… takes place in the mitochondria of cells.

… results in carbon dioxide production.

… releases less energy than anaerobic respiration.

… results in an oxygen debt.

Fig. 7.1

[3]

8 Complete the sentences about petroleum.

Petroleum is a .... of hydrocarbons.

The bitumen fraction is used in making ....

The viscosity of the kerosene fraction is .... the viscosity of the bitumen fraction.

The incomplete combustion of kerosene produces .... which increase the risk of cancer.

[4]

9 Fig. 9.1 shows a person using an electric drill to make a hole in a block of wood.

electric drill ——————

—————— battery

—————— drill bit

block of wood ——————
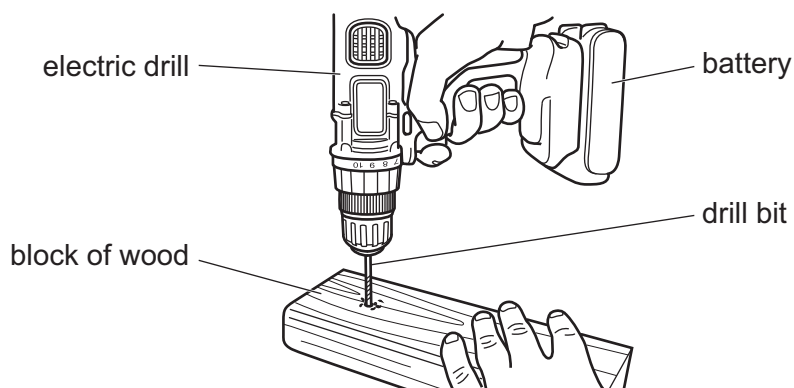
Fig. 9.1

The power supply of the drill is a battery.

(a) State why the drill bit gets hot when it makes the hole in the wood.

.... [1]

(b) As the hole is made, 1.2 kJ of energy is transferred between energy stores in a time of 28 s.

  (i) State the name of the energy store that decreases as the hole is made.

.... [1]

  (ii) State the name of the energy store that increases as the hole is made.

.... [1]

  (iii) The battery supplies a voltage of 20 V.

Calculate the current in the drill.

current = ...A [3]

[Total: 6]

10 The word equation for photosynthesis is:

carbon dioxide + water → glucose + oxygen

(a) Explain how a plant cell obtains the carbon dioxide it needs for photosynthesis.

....

....

....

.... [2]

(b) State the name of the process that moves water up the stem of a plant.

.... [1]

(c) Explain the function of chlorophyll in photosynthesis.

....

....

....

.... [2]

[Total: 5]

11 (a) State the electronic configuration of an atom of the element found in Group III and Period 3 of the Periodic Table.

.... [2]

(b) The electronic configuration of an atom of nitrogen is 2,5.

When nitrogen reacts with magnesium it forms an ion with a charge of –3.

Describe how the electronic configuration changes when an atom of nitrogen forms an ion with a charge of –3.

....

.... [2]

(c) State the word used for a negative ion.

.... [1]

[Total: 5]

12 (a) Some road signs are designed to reflect the light from a car's headlamps back towards the car.

Fig. 12.1 shows one of many glass beads on the surface of a road sign.

The arrows show the path of a ray from the headlamp of a car passing into the glass bead and incident on its reflecting surface.
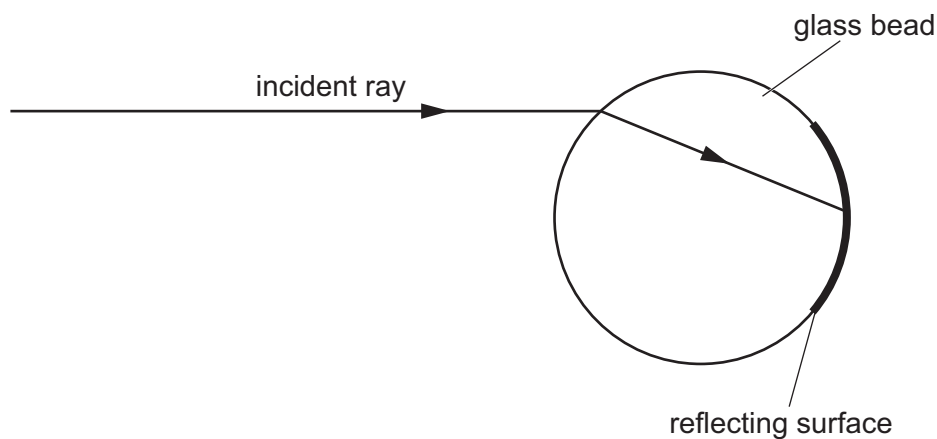

Fig. 12.1

Complete Fig. 12.1 by drawing the path of the ray reflected from the reflecting surface and passing back out of the glass bead. [2]

(b) Light is a transverse wave.

Complete the sentence to describe what is meant by a transverse wave.

The direction of .... is perpendicular to the

transfer of ....

[2]

(c) State **one** use of visible light.

.... [1]

[Total: 5]

13 The boxes on the left in Fig. 13.1 contain the names of structures involved in human reproduction.

The boxes on the right each contain a function needed for human reproduction.

Draw **one** straight line from each box on the left to a box on the right to link the structure to its function.
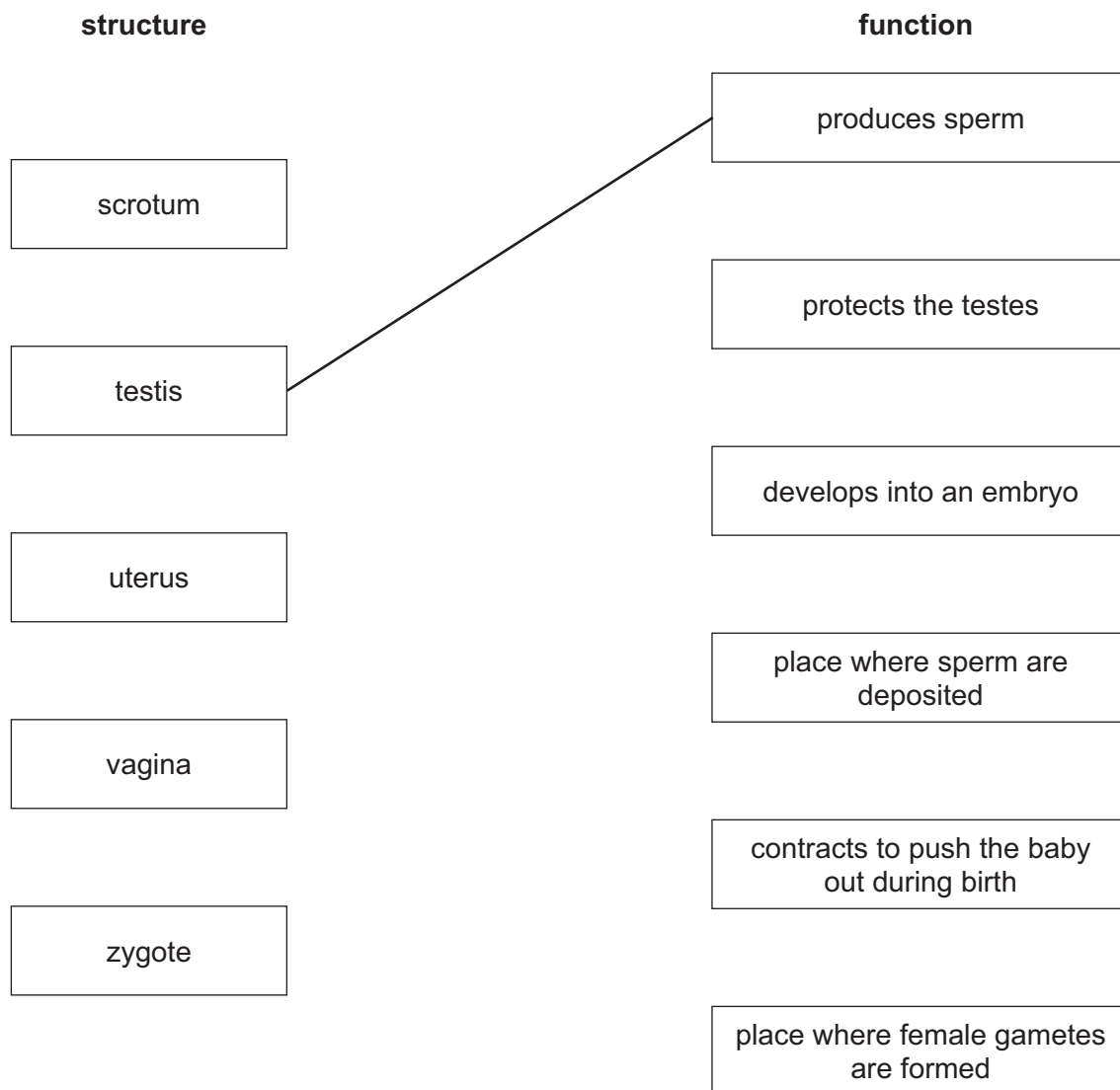
An example has been done for you.

structure	**function**

scrotum

testis

uterus

vagina

zygote

produces sperm

protects the testes

develops into an embryo

place where sperm are deposited

contracts to push the baby out during birth

place where female gametes are formed

Fig. 13.1

[4]

14 Ammonium nitrate dissolves in water to form a solution.

An endothermic change takes place.

(a) (i) State the name of the solute.

.... [1]

(ii) Describe the change in temperature when ammonium nitrate dissolves in water.

.... [1]

(iii) A student dissolves 1.5 g of solid ammonium nitrate in 100 cm³ of distilled water to form a solution.

Calculate the concentration of the solution.

$[1\,dm^3 = 1000\,cm^3]$

concentration = ...g/dm³ [1]

(iv) Universal indicator turns yellow when added to the solution.

Suggest the pH of the solution.

.... [1]

(b) Ammonia is formed from the solution of ammonium nitrate.

(i) Give the molecular formula of ammonia.

.... [1]

(ii) Explain why ammonia has a low boiling point.

....

.... [1]

[Total: 6]

15 Fig. 15.1 shows a method used to generate electrical power.

Water flowing through the tunnel in the dam causes machine **X** to rotate. Machine **X** is connected to machine **Y**, which also rotates.
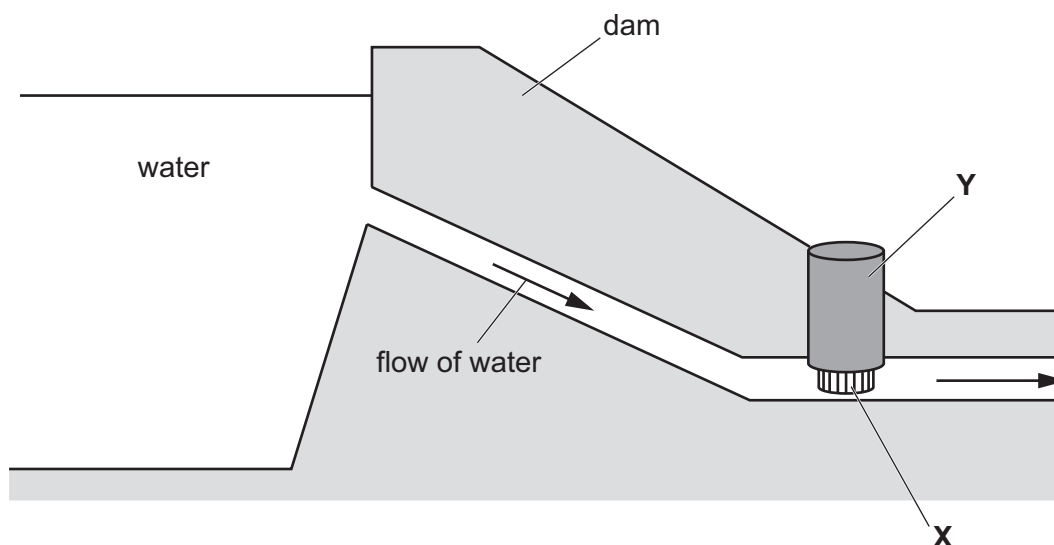

Fig. 15.1

State the name of:

• this energy source ....

• machine **X** ....

• machine **Y**. ....

[3]

16 Fig. 16.1 shows the results of an experiment to investigate the purity of five substances **A**, **B**, **C**, **D** and **E**.
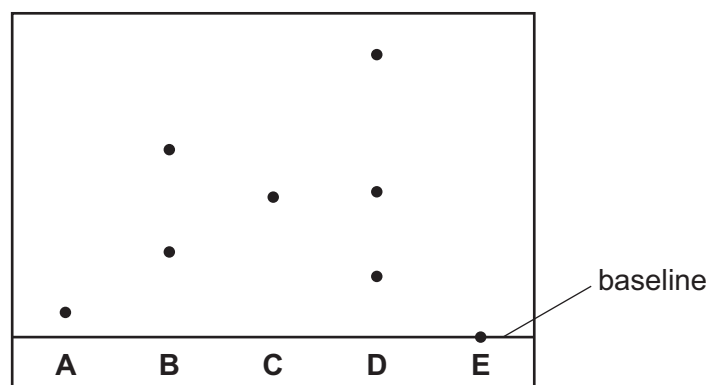

Fig. 16.1

(a) State the name of the technique used to produce the results shown in Fig. 16.1.

.... [1]

(b) Use Fig. 16.1 to deduce which of the substances **A**, **B**, **C** or **D** are pure.

substances .... and .... [1]

(c) Substance **E** does not move away from the baseline.

State why substance **E** does not move away from the baseline.

....

.... [1]

[Total: 3]

17 A student measures the count rate of a radioactive isotope each day for five days.

Table 17.1 shows the results.

Table 17.1

day	count rate counts / minute
1	80
2	55
3	39
4	20
5	14

(a) State the name of the instrument used to detect and measure nuclear radiation.

.... [1]

(b) Describe and explain the trend in the count rate shown in Table 17.1.

Use the data in Table 17.1 and ideas about changes in the nucleus in your answer.

....

....

....

.... [3]

[Total: 4]

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The Periodic Table of Elements

Key

| atomic number |
| atomic symbol |
| name |
| relative atomic mass |

Group																	
I	**II**											**III**	**IV**	**V**	**VI**	**VII**	**VIII**
																	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 –	113 Nh nihonium –	114 Fl flerovium –	115 Mc moscovium –	116 Lv livermorium –	117 Ts tennessine –	118 Og oganesson –

1 H hydrogen 1

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.).