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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.

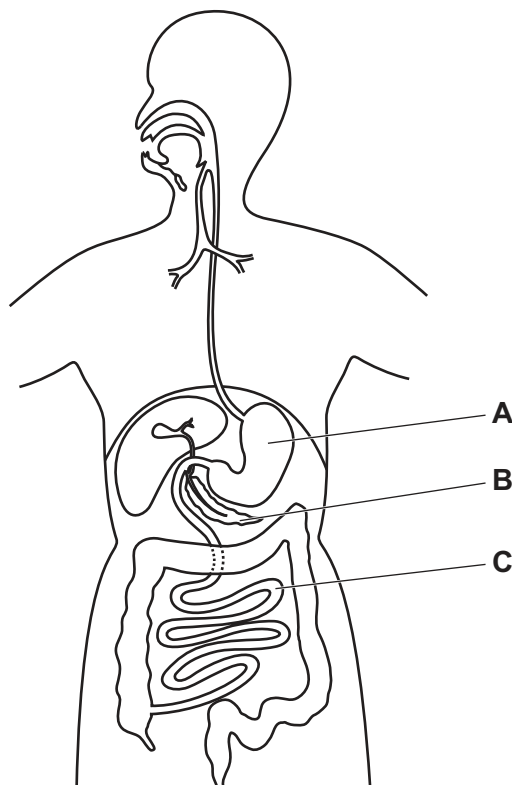


Fig. 1.1

(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

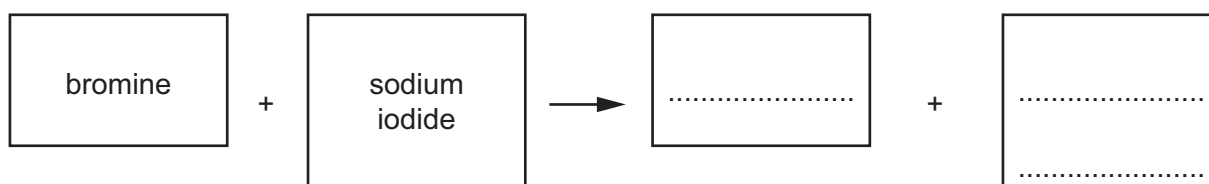
element	$\frac{\text{density}}{\text{g/cm}^3}$
fluorine	
chlorine	0.003
bromine	3.103
iodine	4.933

Suggest a value for the density of fluorine.

density of fluorine =g/cm³ [1]

- (b) Bromine reacts with sodium iodide.

Complete the word equation for the reaction.



[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 25m 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]





- 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.

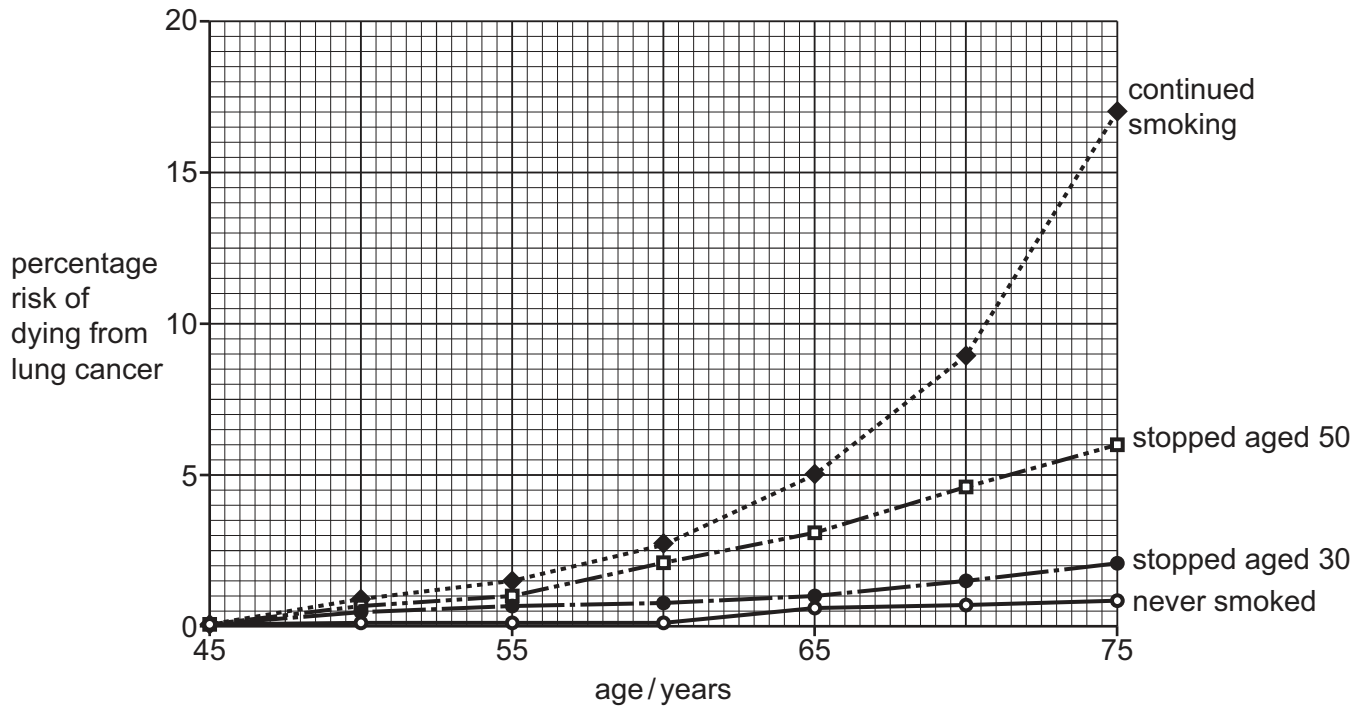


Fig. 4.1

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.

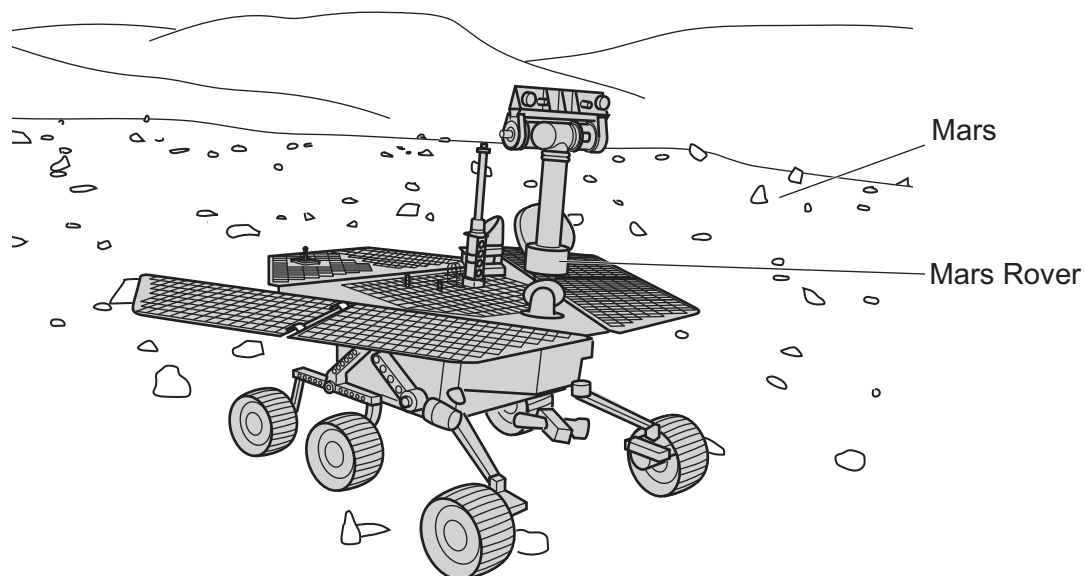


Fig. 6.1

The mass of the Rover on Earth is 899 kg.

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

Gravitational field strength $g = 10 \text{ N/kg}$.

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.

Aerobic respiration ...

- ... takes place in animal cells only.
- ... releases energy from food.
- ... 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.

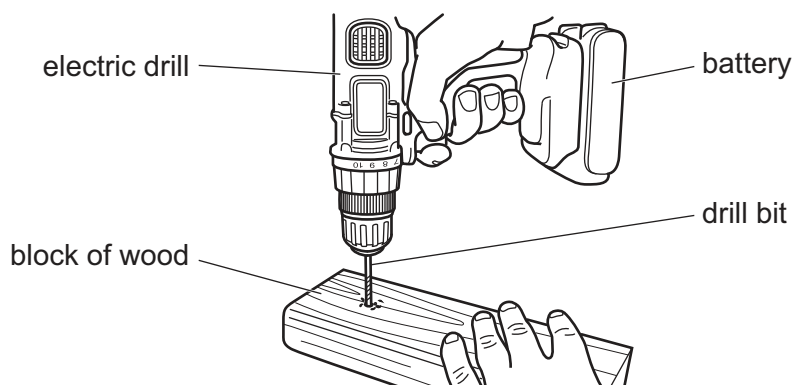


Fig. 9.1

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:



(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.

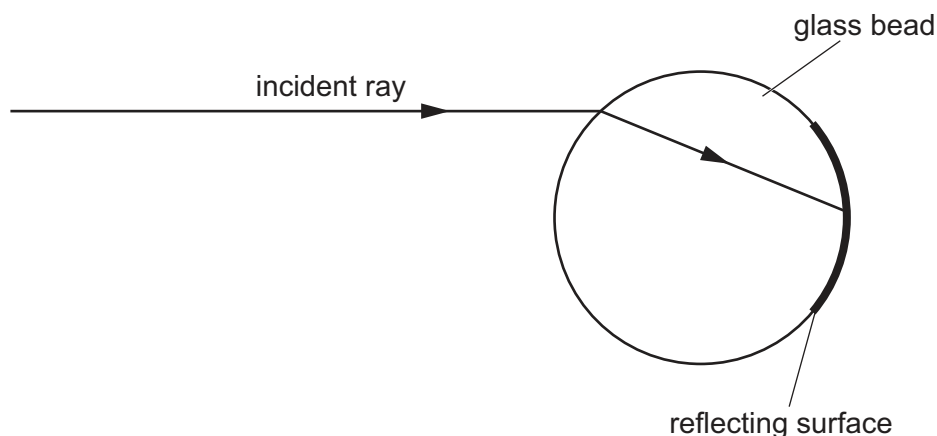


Fig. 12.1

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.

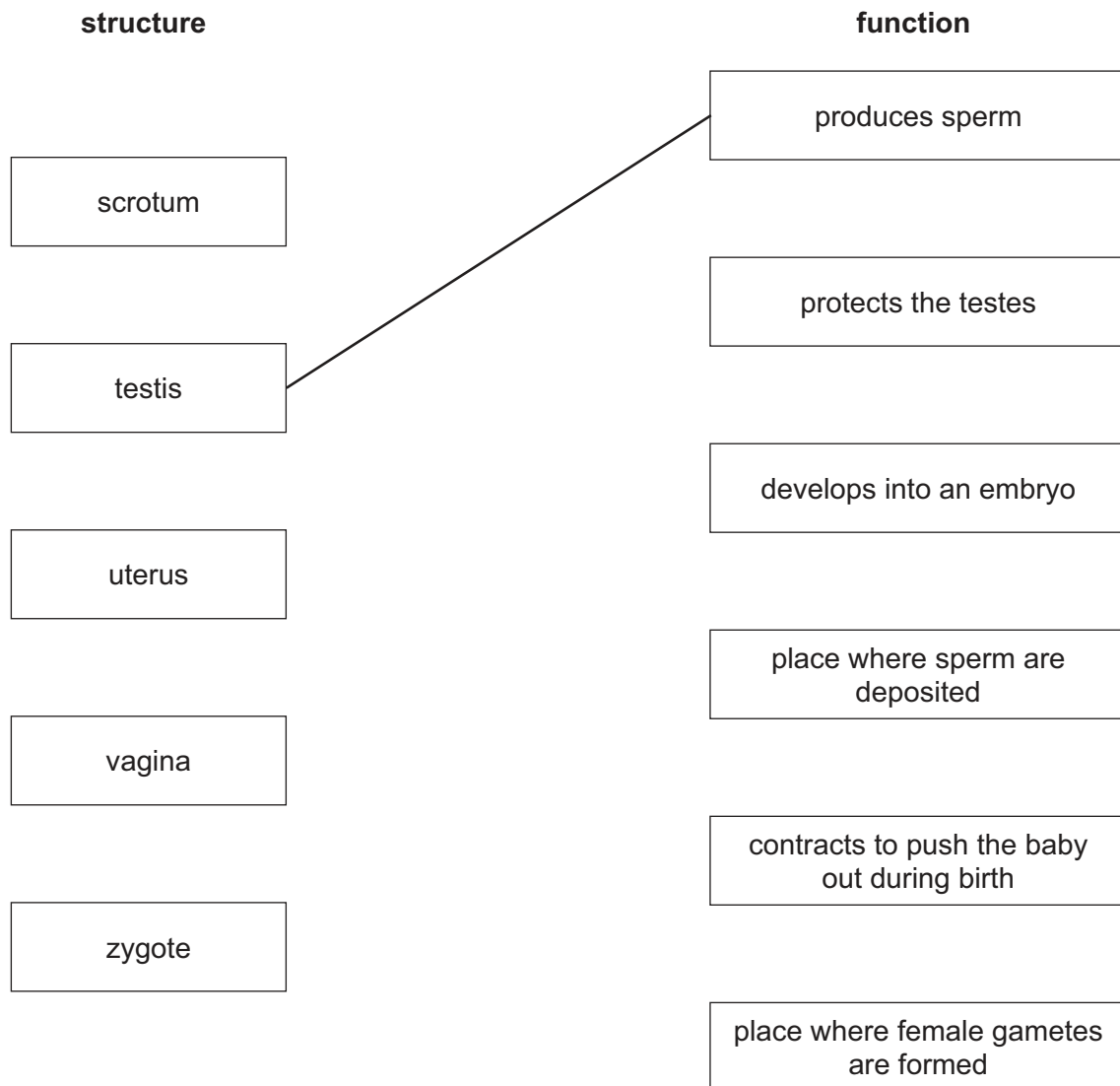


Fig. 13.1

[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.

$$[1 \text{ dm}^3 = 1000 \text{ cm}^3]$$

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.

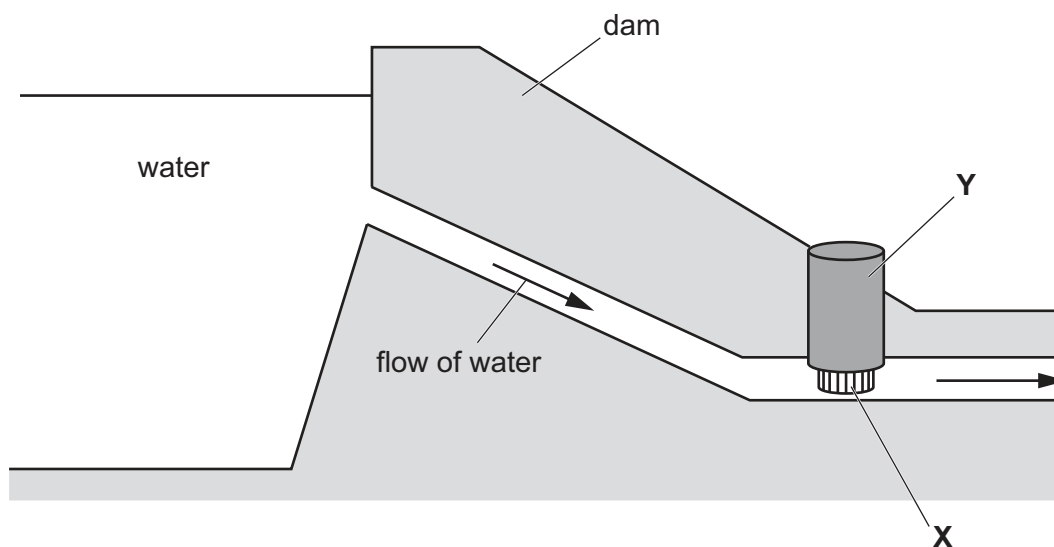


Fig. 15.1

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**.

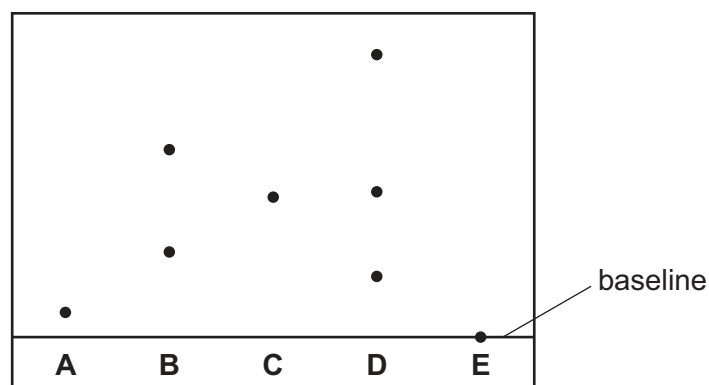


Fig. 16.1

- (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	$\frac{\text{count rate}}{\text{counts/minute}}$
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

Group																			
I	II											III	IV	V	VI	VII	VIII		
		1Hhydrogen1																	
		Key atomic number atomic symbol name relative atomic mass																	
3Li lithium 7	4Be beryllium 9													5B boron 11	6C carbon 12	7N nitrogen 14	8O oxygen 16	9F fluorine 19	10Ne neon 20
11Na sodium 23	12Mg magnesium 24													13Al aluminium 27	14Si silicon 28	15P phosphorus 31	16S sulfur 32	17Cl chlorine 35.5	18Ar argon 40
19K potassium 39	20Ca calcium 40	21Sc scandium 45	22Ti titanium 48	23V vanadium 51	24Cr chromium 52	25Mn manganese 55	26Fe iron 56	27Co cobalt 59	28Ni nickel 59	29Cu copper 64	30Zn zinc 65	31Ga gallium 70	32Ge germanium 73	33As arsenic 75	34Se selenium 79	35Br bromine 80	36Kr krypton 84		
37Rb rubidium 85	38Sr strontium 88	39Y yttrium 89	40Zr zirconium 91	41Nb niobium 93	42Mo molybdenum 96	43Tc technetium —	44Ru ruthenium 101	45Rh rhodium 103	46Pd palladium 106	47Ag silver 108	48Cd cadmium 112	49In indium 115	50Sn tin 119	51Sb antimony 122	52Te tellurium 128	53I iodine 127	54Xe xenon 131		
55Cs caesium 133	56Ba barium 137	57–71 lanthanoids		72Hf hafnium 178	73Ta tantalum 181	74W tungsten 184	75Re rhenium 186	76Os osmium 190	77Ir iridium 192	78Pt platinum 195	79Au gold 197	80Hg mercury 201	81Tl thallium 204	82Pb lead 207	83Bi bismuth 209	84Po polonium —	85At astatine —	86Rn radon —	
87Fr francium —	88Ra radium —	89–103 actinoids		104Rf rutherfordium —	105Db dubnium —	106Sg seaborgium —	107Bh bohrium —	108Hs hassium —	109Mt meitnerium —	110Ds darmstadtium —	111Rg roentgenium —	112Cn copernicium —	113Nh nihonium —	114Fl flerovium —	115Mc moscovium —	116Lv livermorium —	117Ts tennessine —	118Og oganesson —	

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