



Cambridge O Level

CANDIDATE
NAME

CENTRE
NUMBER

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CANDIDATE
NUMBER

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COMBINED SCIENCE

5129/22

Paper 2

May/June 2022

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.

1 Fig. 1.1 shows a magnified section through part of a leaf.

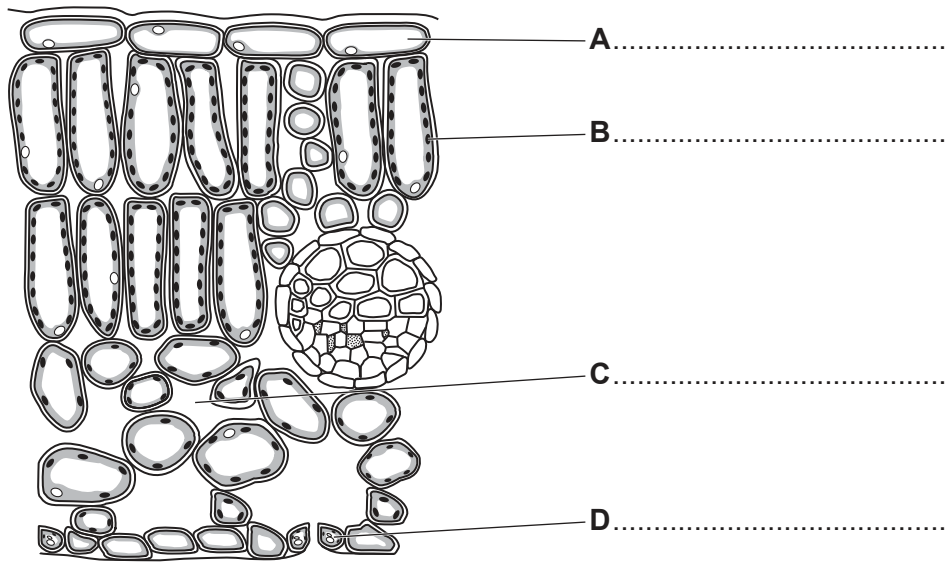


Fig. 1.1

(a) Complete Fig. 1.1 by labelling the structures A, B, C and D.

Write your answers on the lines provided.

Choose your labels from the list.

- | | | | |
|------------|----------------|---------|----------------|
| air space | chloroplast | cuticle | epidermal cell |
| guard cell | mesophyll cell | nucleus | stoma |

[4]

The vascular bundle contains xylem and phloem.

(b) State the function of xylem and of phloem.

xylem

.....

phloem

.....

[2]

(c) State the names of **two** gases which are produced by green leaves when there is no light.

1

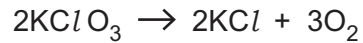
2

[2]

[Total: 8]

- 2 When potassium chlorate is heated, it decomposes to form potassium chloride and oxygen.

The equation for the reaction is:



The relative molecular mass of potassium chlorate is 122.5.

[A_r: Cl, 35.5; K, 39; O, 16]

- (a) (i) Calculate the relative molecular mass of potassium chloride.

..... [1]

- (ii) Complete the following sentences.

49g of potassium chlorate produces g of potassium chloride and g of oxygen.

14.9g of potassium chloride is produced from g of potassium chlorate.

[3]

- (b) State a test and the result of the test to show that oxygen is produced.

test

result

[2]

[Total: 6]

3 A micrometer is used to measure the diameter d of a piece of wire as shown in Fig. 3.1.

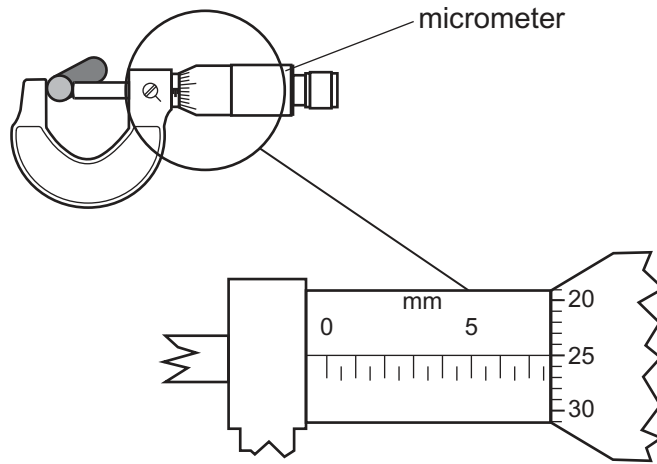


Fig. 3.1

(a) Determine the reading shown on the micrometer scale in Fig. 3.1.

$d = \dots\dots\dots$ mm [1]

(b) The length l of the piece of wire is 850 mm.

(i) Calculate the volume V of the wire using the equation:

$$V = 0.25 \pi l d^2$$

where $\pi = 3.14$ and d is your answer to (a).

$V = \dots\dots\dots$ mm³ [2]

(ii) Name a piece of apparatus suitable for measuring the length of the piece of wire.

Describe **one** feature of this piece of apparatus that enables the length to be measured accurately.

apparatus

feature

.....

[2]

[Total: 5]

4 Fig. 4.1 shows a plant cell.

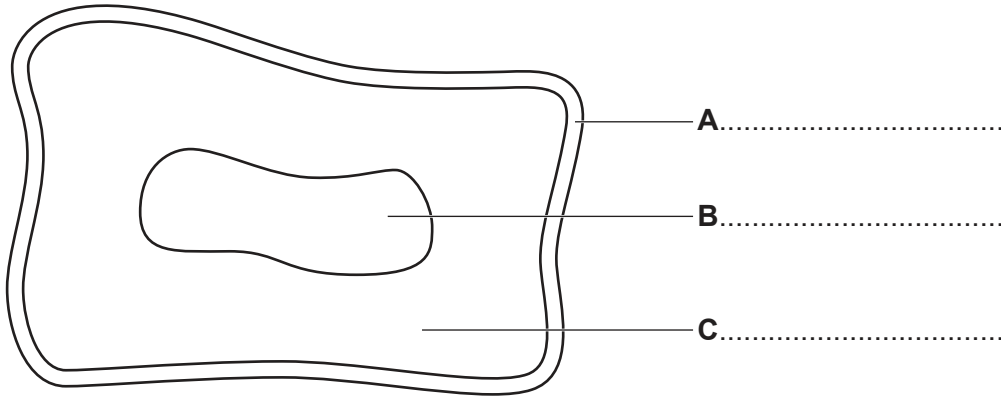


Fig. 4.1

(a) Complete Fig. 4.1 by labelling the structures **A**, **B** and **C**.

Write your answers on the lines provided. [3]

(b) Draw the nucleus in the cell on Fig. 4.1. [1]

(c) When a plant cell is placed in distilled water for 15 minutes, it increases in size.

State the name of the process that makes the cell increase in size.

..... [1]

(d) When an animal cell is placed in distilled water for fifteen minutes, it bursts. A plant cell placed in distilled water for fifteen minutes does **not** burst.

Suggest why a plant cell does **not** burst.

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

[Total: 6]

5 The alkali metals are a group of elements in the Periodic Table.

Table 5.1 shows the melting points of some alkali metals.

Table 5.1

element	proton number	melting point /°C
lithium	3	180
sodium	11	98
potassium	19
rubidium	37	39

(a) Use the information in Table 5.1 to predict the melting point of potassium.

Complete the table by writing your answer in the box.

[1]

(b) Use the words in the list to complete the sentences about alkali metals.

decreases hard hydrogen increases
one oxygen seven soft unreactive

The words can be used once, more than once or not at all.

The number of electrons in the outer shell of an alkali metal atom

is

Alkali metals are relatively metals.

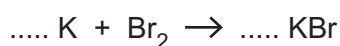
The reactivity of the alkali metals down the group.

Alkali metals and water produce when they react.

[4]

(c) Potassium reacts with bromine to form potassium bromide.

Balance the equation for the reaction.



[1]

[Total: 6]

6 Two forces act on a beam attached to a pivot, as shown in Fig. 6.1.

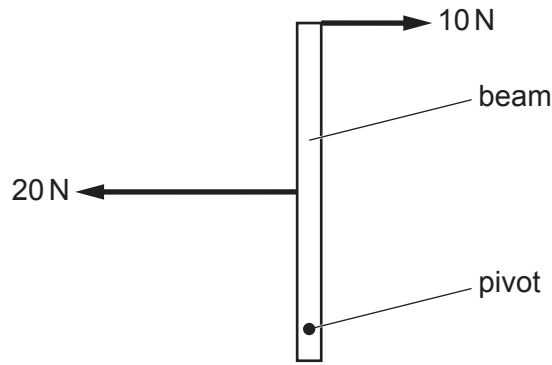


Fig. 6.1

(a) The beam is free to rotate about the pivot.

The two forces shown in Fig. 6.1 have different magnitudes.

Explain why the two forces do **not** cause the beam to rotate.

.....

 [2]

(b) The beam is removed from the pivot and lifted by a machine.

The beam has a weight of 8 N.

The machine develops a power of 4 W as it lifts the beam.

Calculate the time taken to lift the beam through a height of 0.2 m.

time = s [4]

[Total: 6]

7 (a) State the **three** environmental conditions that seeds need to germinate.

1

2

3

[3]

(b) Fig. 7.1 shows how the percentage germination of one type of seed is affected by the pH of the soil in which it is planted.

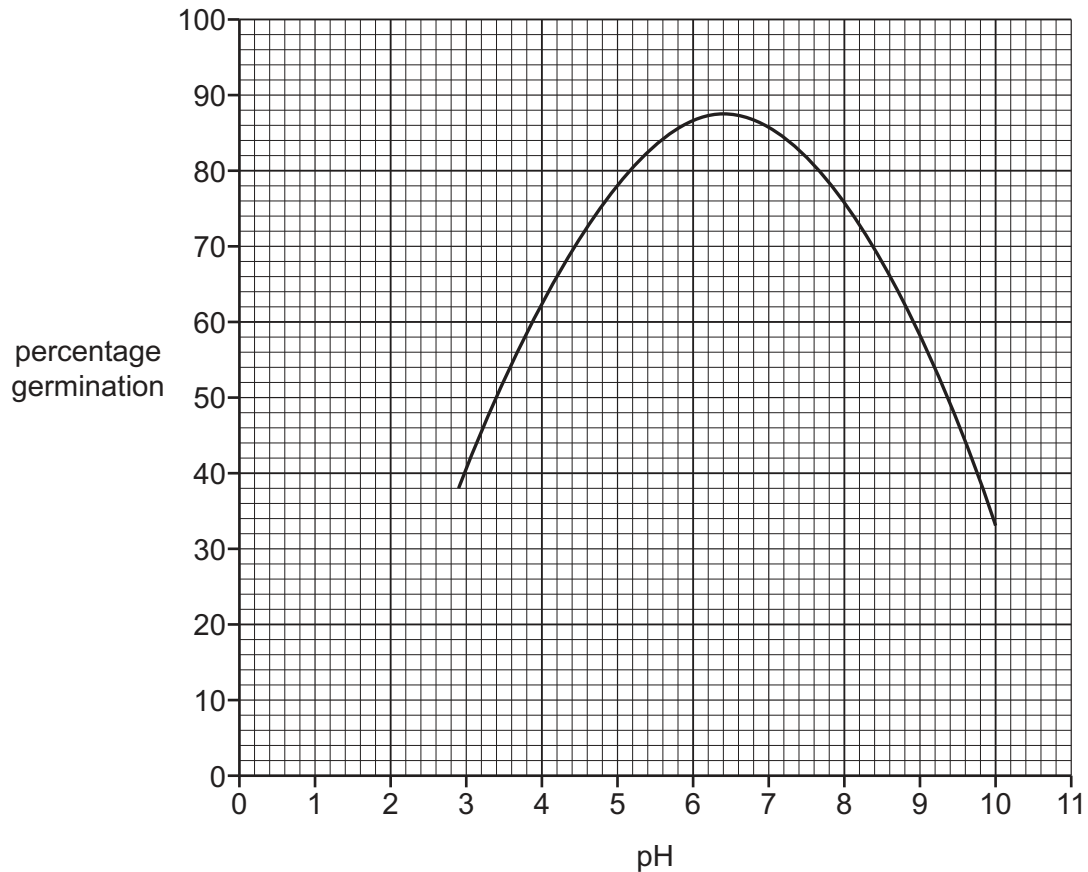


Fig. 7.1

8 Fig. 8.1 shows a beaker of water being heated.

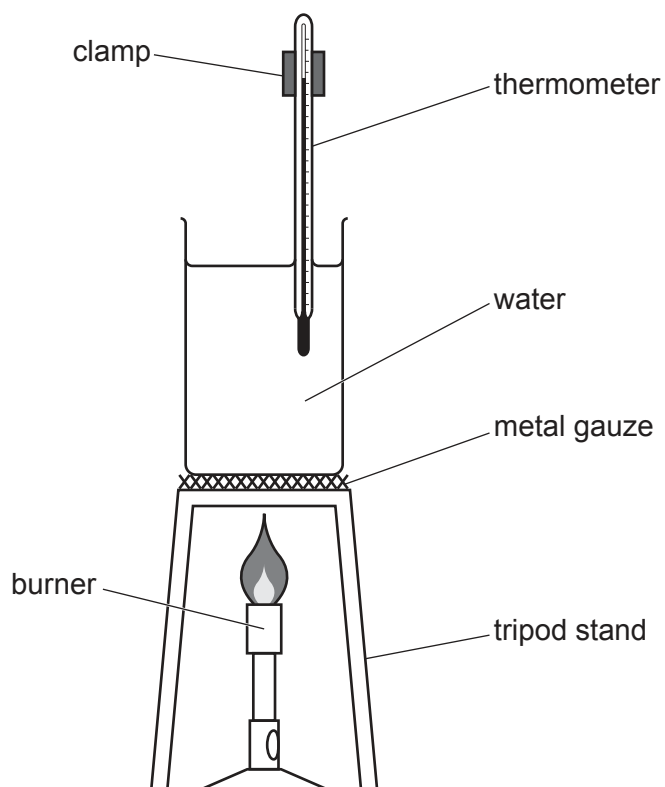


Fig. 8.1

(a) Name the main process by which thermal energy is transferred through:

- the metal gauze

.....

- the water.

.....

[2]

(b) The burner heats the water at the bottom of the beaker. Describe the process by which the water at the top of the beaker becomes hotter.

.....

.....

.....

..... [2]

(c) Fig. 8.2 shows the liquid inside a thermometer.

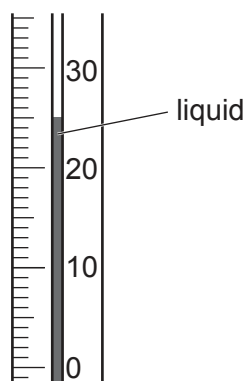


Fig. 8.2

Use ideas about particles to explain how thermal energy causes the liquid to expand up the thermometer.

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

[Total: 6]

9 Fig. 9.1 shows the alimentary canal and associated organs.

Four structures are labelled, **A**, **B**, **C** and **D**.

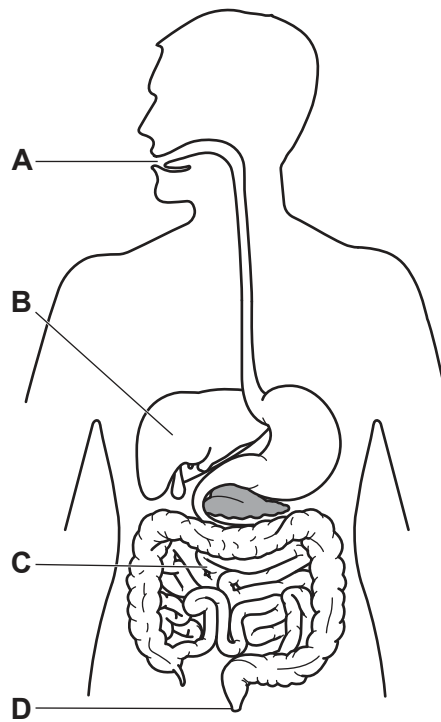


Fig. 9.1

(a) Complete Fig. 9.2 by drawing **one** straight line from **each** label to the name of the structure.

label	structure
A	anus
B	ileum
C	liver
D	mouth

Fig. 9.2

[3]

- (b) Complete Fig. 9.3 by drawing **one** straight line from **each** structure to the process it carries out.



Fig. 9.3

[3]

[Total: 6]

10 Different gases have different properties.

On Fig. 10.1, draw **one** straight line from **each** property to a gas with that property.

property	gas
the gas used in the purification of water supplies	ammonia
the gas that reacts with acids to make fertilisers	argon
the gas that is 21% of the atmosphere	chlorine
a noble gas	ethane
the main compound in natural gas	methane
	nitrogen
	oxygen

Fig. 10.1

[5]

11 Ethene C_2H_4 is a covalent molecule.

(a) Draw the structure of ethene.

[1]

(b) Study the reaction scheme shown in Fig. 11.1.

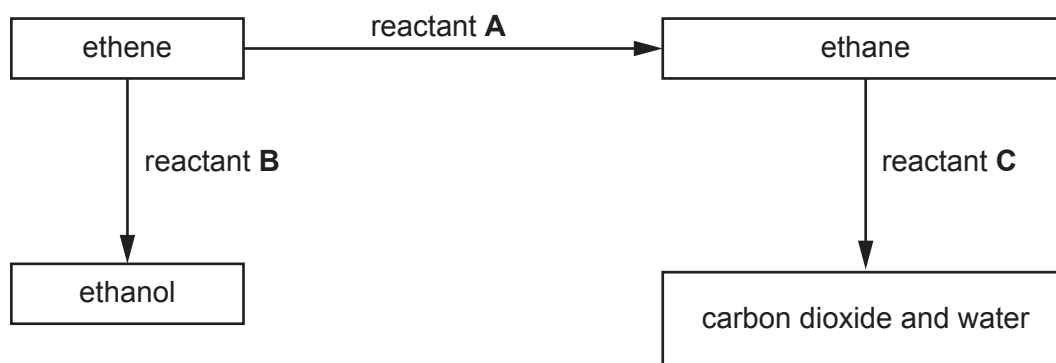


Fig. 11.1

Identify the reactants **A**, **B** and **C**.

reactant **A**

reactant **B**

reactant **C**

[3]

(c) Define reduction in terms of what happens to the hydrogen in a reaction.

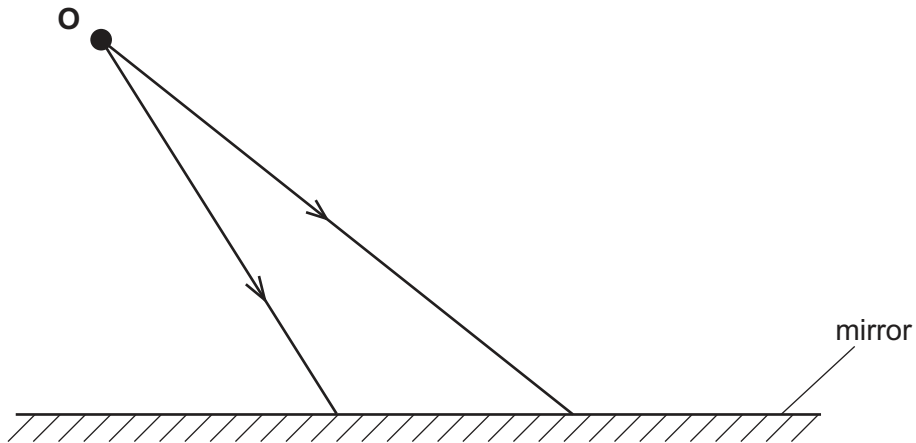
.....

..... [1]

[Total: 5]

12 Two rays of light from an object at **O** are incident on a plane mirror as shown in Fig. 12.1.

The image of the object is formed at **I**.



I

Fig. 12.1

(a) Describe how to determine the angle of incidence for **one** of these rays. [2]

You may draw on Fig. 12.1 if you wish.

.....

.....

..... [2]

(b) Complete Fig. 12.1 to show how the image is formed. [2]

[Total: 4]

13 Complete the sentences about excretion by inserting words or phrases from the list.

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

carbon dioxide fibrous kidney liver
lungs nitrogen pancreas toxic

Excretion is defined as the removal of materials and the waste products of metabolism from an organism.

The lungs excrete

Urea is produced in the and then excreted by the
.....

[4]

14 Chemical substances can be described as elements, compounds or mixtures.

(a) The following is a list of substances.

air brass calcium chloride
petroleum poly(ethene) sulfur

Complete Table 14.1 by writing each substance in the correct column.

The first one has been done for you.

Table 14.1

compound	element	mixture
		air

[3]

(b) (i) A mixture of sodium chloride and sand is added to water.

Describe how you could obtain a sample of pure sodium chloride from the mixture.

.....

 [2]

(ii) State how to show that the sample of sodium chloride is pure.

.....
 [1]

[Total: 6]

15 Fig. 15.1 shows a simple circuit.

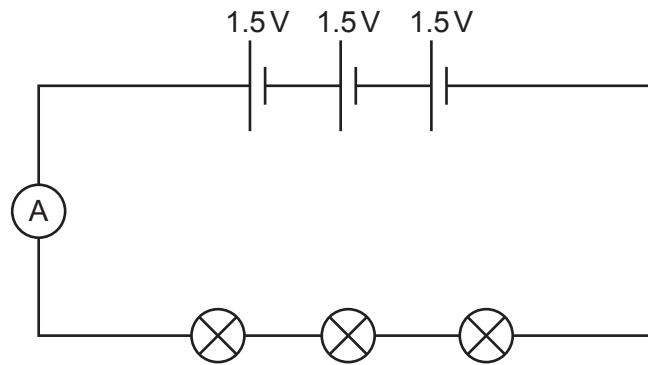


Fig. 15.1

(a) (i) The resistance of each lamp is $9.0\ \Omega$.

Calculate the total resistance of the lamps.

resistance = Ω [1]

(ii) Determine the total voltage of the battery.

voltage = V [1]

(b) Calculate the current in the circuit.

Give your answer to 2 significant figures.

current = A [2]

[Total: 4]

16 A student makes some observations of the scene shown in Fig. 16.1.



Fig. 16.1

The student's observations are shown in Fig. 16.2.

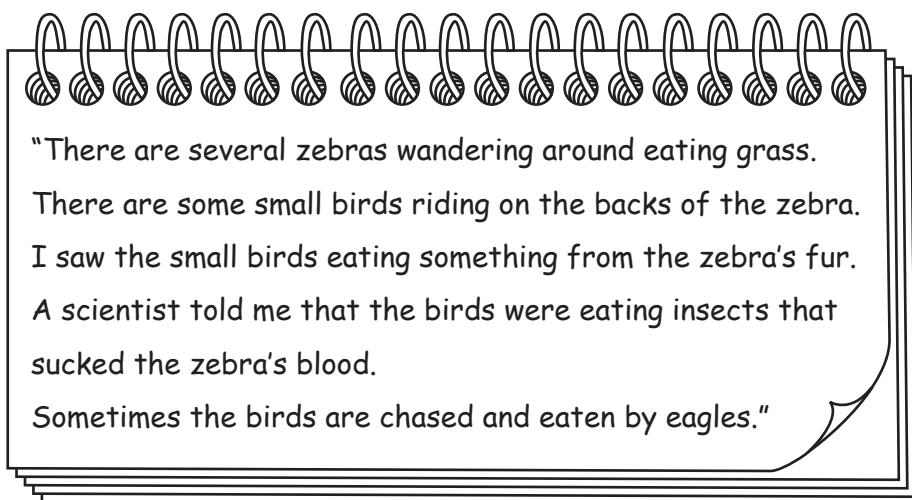


Fig. 16.2

Use the information in Fig. 16.1 and Fig. 16.2 to construct a food chain.

17 (a) Lead is in Group IV of the Periodic Table.

State the number of electrons in the outer shell of an atom of lead.

..... [1]

(b) Lead nitrate is an ionic substance.

It contains lead ions, Pb^{2+} , and nitrate ions, NO_3^- .

Deduce the formula of lead nitrate.

..... [1]

(c) State **two** ways in which lead nitrate can be made to conduct electricity.

1

2 [2]

(d) When a solution of lead nitrate is mixed with dilute sulfuric acid, it forms insoluble lead sulfate, PbSO_4 .

Deduce the ionic charge on the sulfate ion. [1]

[Total: 5]

18 (a) An iron bar is used as the core of a simple electromagnet.

On Fig. 18.1, draw a circuit to show how the bar is made into an electromagnet.

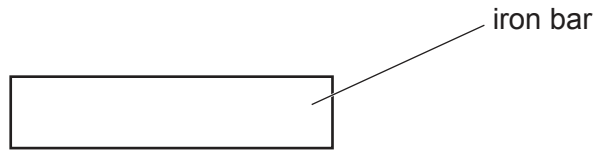


Fig. 18.1

[2]

(b) Explain why iron is a suitable material for the core of an electromagnet.

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

(c) State **one** difference between a permanent magnet and an induced magnet.

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

[Total: 5]

19 Uranium-238 is radioactive.

The nucleus of uranium-238 decays to an isotope of thorium with the emission of radiation.

The graph in Fig. 19.1 shows the changes in the nucleus as a result of this emission.

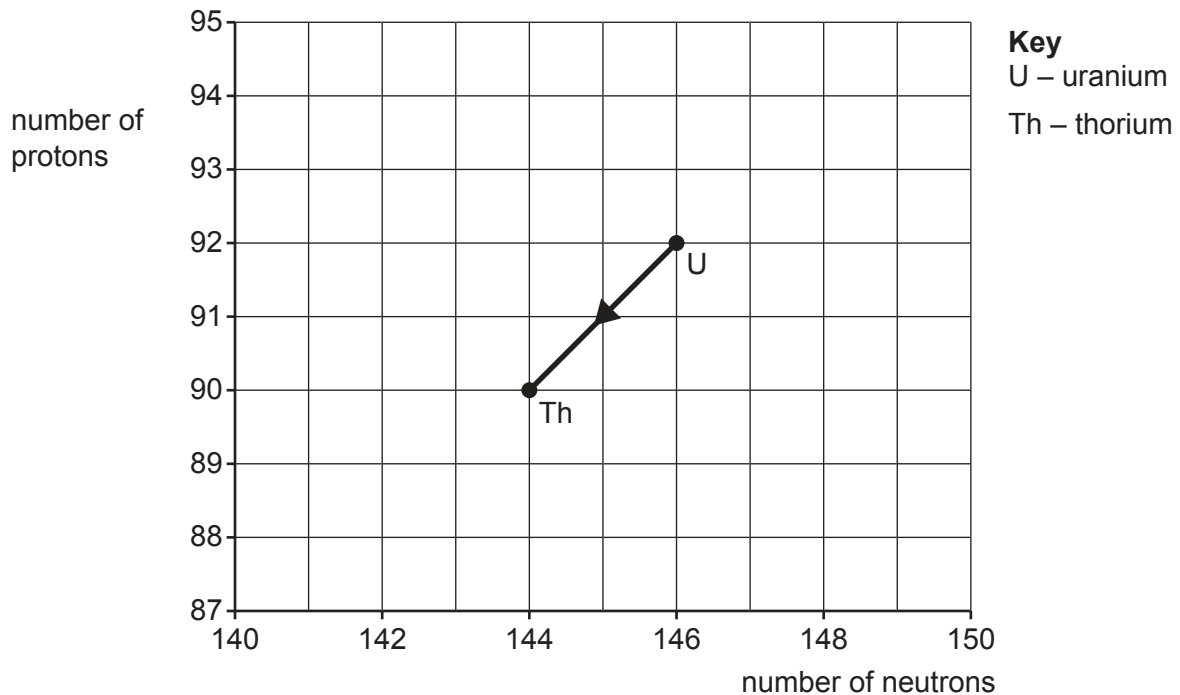


Fig. 19.1

- (a) Determine the nucleon number and proton number of the particle emitted from the uranium nucleus.

nucleon number of emitted particle

proton number of emitted particle

[2]

- (b) Thorium is also radioactive. It decays to an isotope of protactinium by the emission of a beta-particle.

On Fig. 19.1 plot the position of this protactinium isotope. Label this point Pa.

[1]

[Total: 3]

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The Periodic Table of Elements

		Group															
I	II	III	IV	V	VI	VII	VIII					VIII					
		1 H hydrogen 1										2 He helium 4					
3 Li lithium 7	4 Be beryllium 9	Key atomic number atomic symbol name relative atomic mass										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 —				

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