Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

2526510071

COMBINED SCIENCE **5129/22**

Paper 2 **October/November 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.

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[Turn over

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1 The speed of a motorcycle is measured at different checkpoints in a race.

At 22 s, the motorcycle passes checkpoint **A** at a speed of 32 m / s.

Point **A** in Fig. 1.1 shows the speed of the motorcycle and the time when it passes checkpoint **A**.

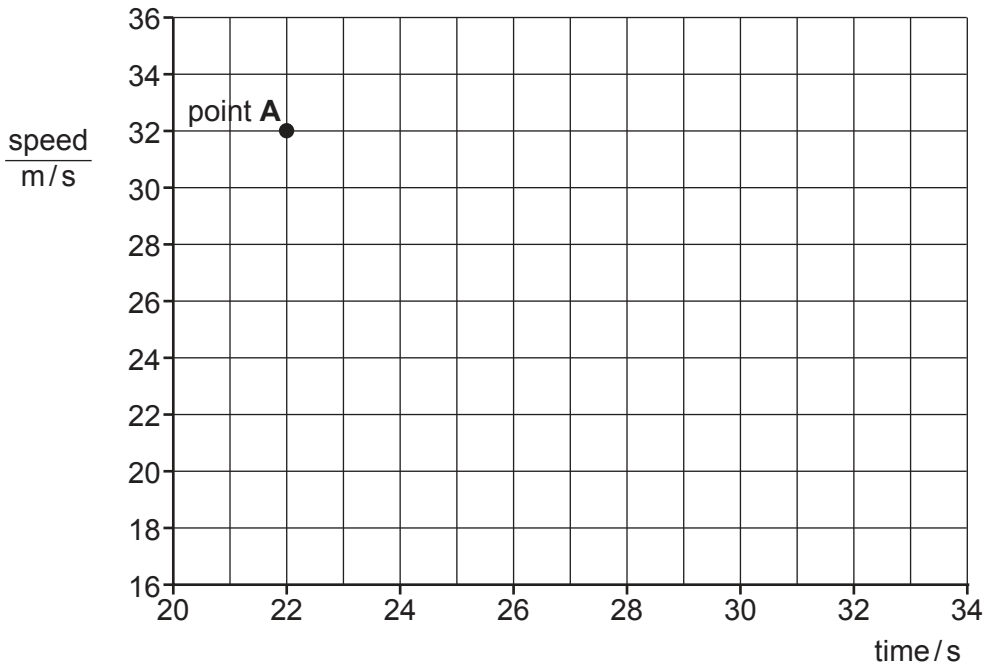

Fig. 1.1

(a) After passing checkpoint **A**, the motorcycle decelerates uniformly.

It passes checkpoint **B** at a speed of 18 m / s, 9 seconds after passing checkpoint **A**.

(i) On Fig. 1.1, mark and label point **B** to show the speed of the motorcycle and the time when it passes checkpoint **B**. [1]

(ii) On Fig. 1.1, draw a straight line between point **A** and point **B** to show how the speed of the motorcycle changes between checkpoint **A** and checkpoint **B**. [1]

(iii) Calculate the deceleration of the motorcycle between checkpoint **A** and checkpoint **B**.

Use the equation:

$$\text{deceleration} = \frac{\text{change in speed}}{\text{time taken}}.$$

Give your answer to **three** significant figures.

deceleration = ... m / s^2 [2]

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(b) A force of 420 N is applied at the brakes to decelerate the motorcycle.

Using your answer to **(a)(iii)**, calculate the mass of the motorcycle.

mass = ... kg [2]

[Total: 6]

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2 Fig. 2.1 shows part of a food web in a lake.

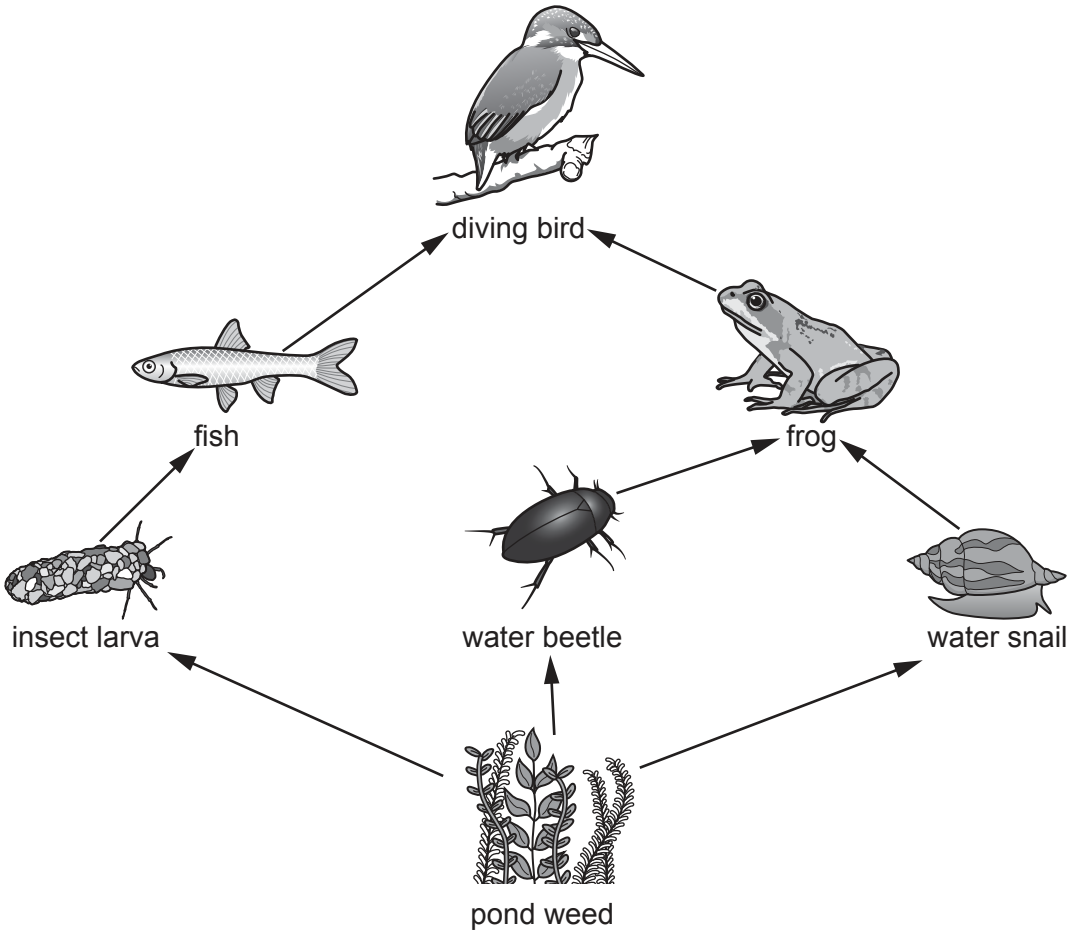

Fig. 2.1

(a) Determine the number of each type of organism in Fig. 2.1.

Write your answers in Table 2.1.

Table 2.1

type of organism	number
producers	.....
herbivores	.....
carnivores	.....
consumers	.....

[4]

(b) Determine the number of food chains in the food web in Fig. 2.1.

number of food chains = ... [1]

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(c) A snake also lives in the lake.

It eats diving birds and frogs.

Add this information to the food web in Fig. 2.1.

(Do **not** draw a diagram of the snake.) [2]

[Total: 7]

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3 Table 3.1 shows some information about the reactions of four different metals **A**, **B**, **C** and **D**.

The letters **A**, **B**, **C** and **D** are **not** the chemical symbols of the elements.

Table 3.1

metal	reacts with dilute hydrochloric acid	reacts with cold water	reacts with steam
A	yes	no	yes
B	yes	yes	yes
C	no	no	no
D	yes	no	no

(a) **(i)** Deduce the order of reactivity of the four metals.

most reactive .....

.....

.....

least reactive .....

[2]

(ii) Suggest the name of metal **C**.

..... [1]

(b) State the name of the gas produced by the reaction of a metal with hydrochloric acid.

..... [1]

(c) Aluminium is above zinc in the reactivity series but reacts more slowly with hydrochloric acid.

Explain the apparent unreactivity of aluminium.

.....

..... [1]

(d) State **one** general physical property of metals.

..... [1]

(e) Suggest why copper and zinc are sometimes mixed together to form the alloy brass rather than either being used as the pure metal.

..... [1]

[Total: 7]

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4 A block of weight 9.0 N is placed at one end of a beam resting on a pivot as shown in Fig. 4.1.

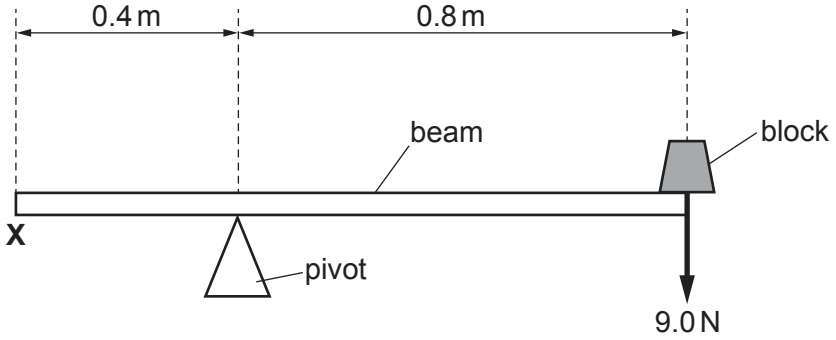

Fig. 4.1

(a) Calculate the moment of the block about the pivot.

moment = ... N m [2]

(b) The volume of the block is 0.00018 m^3.

Calculate the density of the block. Give your answer in kg / m^3.

Gravitational field strength = 10 N / kg

density of the block = ... kg / m^3 [3]

(c) A weight of 18.0 N placed at point **X** in Fig. 4.1 will **not** balance the beam.

Explain why.

.....

..... [1]

[Total: 6]

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5 Fig. 5.1 shows a section through a human heart.

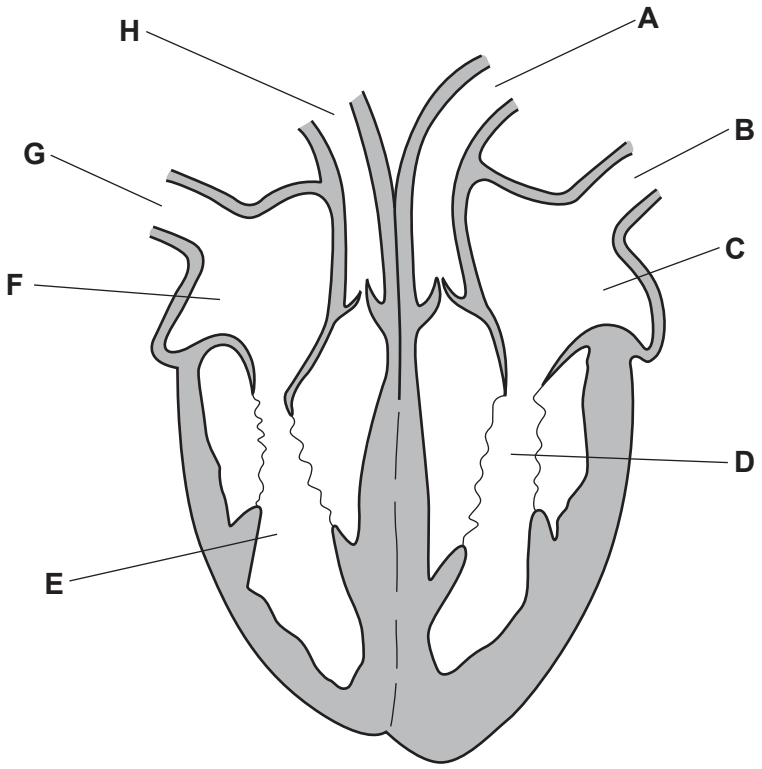

Fig. 5.1

(a) Complete Table 5.1 by inserting the letters from Fig. 5.1 that match each of the descriptions.

Table 5.1

description	letters
two structures that contain oxygenated blood	..... and .....
the blood vessel carrying blood to the lungs	.....
the right ventricle	.....
an artery	.....

[4]

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(b) The heart pumps blood round the body.

Blood consists of plasma and blood cells.

(i) State **three** substances present in plasma.

1 .....

2 .....

3 .....
[3]

(ii) State the names of **two** types of cell found in blood.

1 .....

2 .....
[2]

[Total: 9]

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6 Fig. 6.1 shows some reactions involving ammonia.

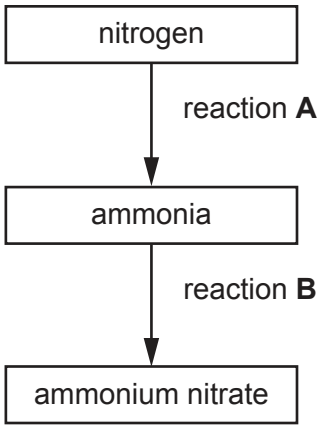

Fig. 6.1

(a) Reaction **A** takes place in the Haber process.

(i) Name the gas that reacts with nitrogen in the Haber process.

..... [1]

(ii) Describe **two** conditions needed for the Haber process.

1 .....

2 .....

[2]

(b) Name the acid that is used in reaction **B**.

..... [1]

(c) State **one** use of ammonium nitrate.

..... [1]

[Total: 5]

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7 A student investigates how different loads cause the length of a spring to increase.

The results of the investigation are shown in Fig. 7.1.

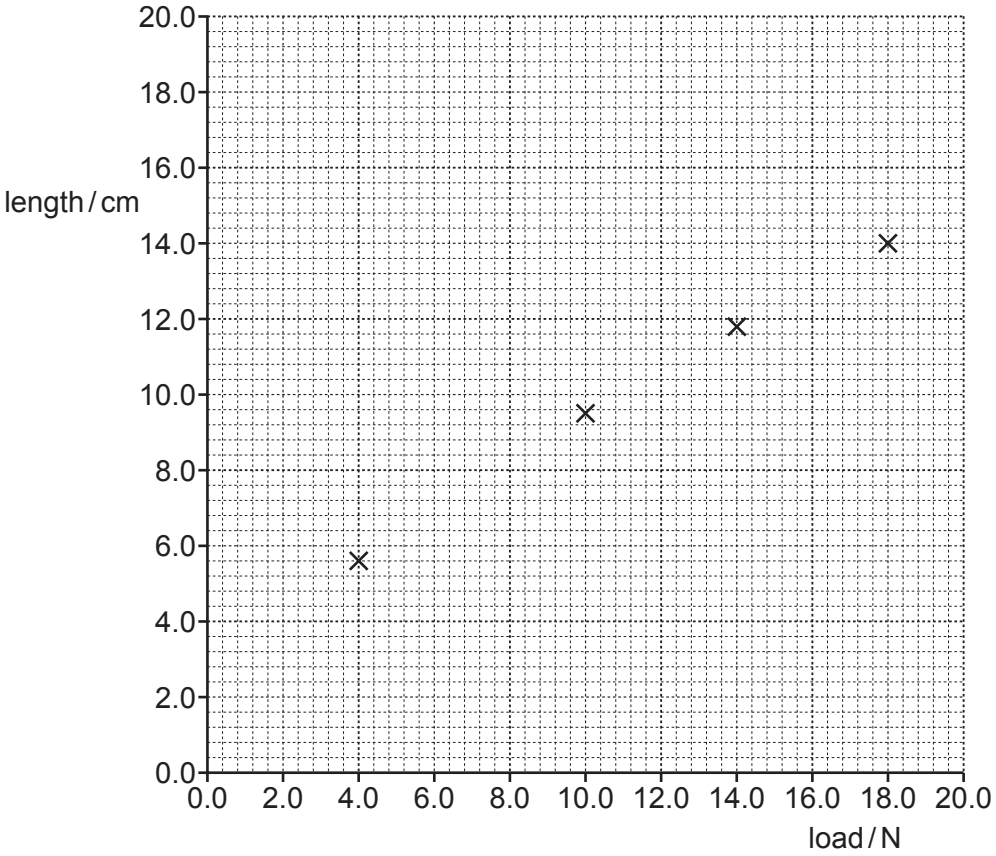

Fig. 7.1

(a) Describe how the student obtains these results.

.....

.....

..... [2]

(b) Use the results shown in Fig. 7.1 to determine the **initial** length of the spring (when it is not carrying any load).

Show any working on the graph.

initial length = ... cm [2]

(c) Determine the **extension** of the spring at 16.0 N.

extension = ... cm [1]

[Total: 5]

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8 Methane, CH_4, and ethane, C_2H_6, are both members of the same homologous series.

(a) (i) Complete Fig. 8.1 to show the outer electrons in a molecule of methane.

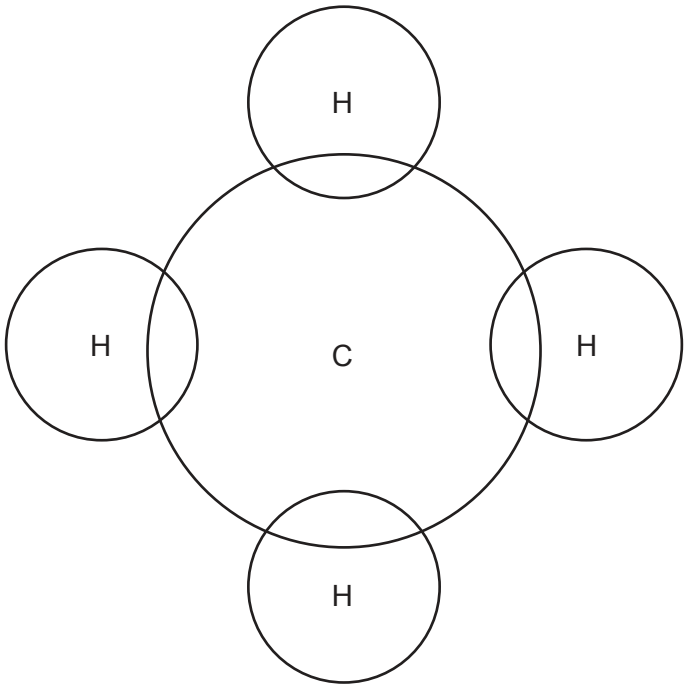

Fig. 8.1

[1]

(ii) State the name of the homologous series that contains methane and ethane.

..... [1]

(iii) State **two** reasons why methane and ethane are members of the same homologous series.

1 .....

2 .....

[2]

(b) State the colour of the mixture obtained when ethane is bubbled through aqueous bromine.

..... [1]

[Total: 5]

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9 A list of words and phrases about photosynthesis is shown.

amino acids **chemical** **cuticle** **glucose**

nitrogen **oxygen** **phloem** **root hair**

stomata **thermal** **xylem**

Complete the sentences using words or phrases from the list.

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

(a) The process of photosynthesis combines carbon dioxide and water to produce ..... and ..... . [2]

(b) Carbon dioxide enters the leaves of green plants by diffusing in through the ..... . [1]

(c) Water is absorbed from the soil by the ..... cells and then travels to the leaves in the ..... tissue. [2]

(d) The function of the chlorophyll is to convert light energy into ..... energy. [1]

[Total: 6]

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10 A night vision camera is used to detect animals at night or when there is no natural light.

Infrared radiation emitted by the warm animal is detected by the camera. This causes a charge to move in a circuit, which results in a visible image on a display screen.

(a) (i) Identify the energy in the animal which is transferred, during respiration, to thermal energy.

Tick (✓) **one** box.

chemical ☐

elastic ☐

electrical ☐

kinetic ☐

light ☐

[1]

(ii) State how energy is transferred from the battery in the night vision camera to the screen.

..... [1]

(iii) Identify the main way that energy is transferred from the display screen.

Tick (✓) **one** box.

chemical ☐

electrical ☐

kinetic ☐

light ☐

thermal ☐

[1]

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(b) The camera contains a battery with a potential difference of 3.8 V.

In normal use, the battery produces 2.7×10^{-3} W of electrical power.

(i) Calculate the current in the circuit.

current in circuit = ... A [2]

(ii) Show that approximately 2.6 C of charge is transferred in the circuit in one hour.

[3]

[Total: 8]

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11 Two groups of students, group **X** and group **Z**, measure their heart rates during different activities.

The results are averaged and plotted on a graph.

Fig. 11.1 shows the results for each group after averaging.

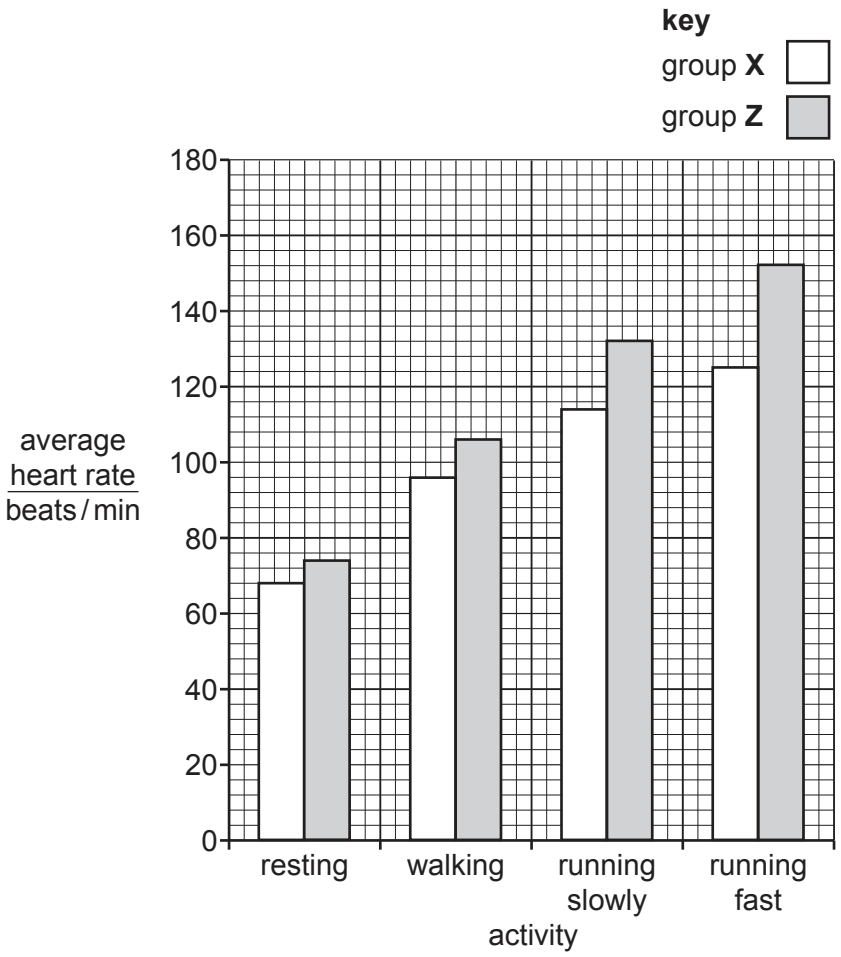

Fig. 11.1

(a) (i) State the activity which produces an average heart rate in group **X** of 114 beats / min.

..... [1]

(ii) State the average heart rate for group **Z** when the activity is 'running fast'.

..... beats / min [1]

(iii) Using the data shown in Fig. 11.1, determine **one** conclusion that can be made by comparing the heart rate of different activities.

.....

..... [1]

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(b) (i) Energy for these activities is supplied by respiration.

Complete the word equation for aerobic respiration.

..... + ... ⟶ ..... + ...

[2]

(ii) State **one** difference between aerobic and anaerobic respiration.

.....

..... [1]

[Total: 6]

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12 An iron nail reacts with a mixture of water and air.

The mass of the nail is measured every 100 days.

The results are shown in Table 12.1.

Table 12.1

day	mass of nail /g
0	9.55
100	9.62
200	9.68
300	9.71

(a) (i) Name the piece of apparatus used to measure the mass of the nail.

..... [1]

(ii) Calculate the increase in the mass of the nail over 300 days.

..... g [1]

(iii) Name the type of reaction that iron undergoes when it reacts with water and air.

..... [1]

(b) State **two** methods that could be used to prevent the iron nail from reacting with the water and air.

1 .....

2 .....

[2]

[Total: 5]

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13 A light-weight metal sphere is at rest on a smooth surface.

The sphere has positive and negative charges.

Fig. 13.1 shows the distribution of charges on the sphere when it is neutral.

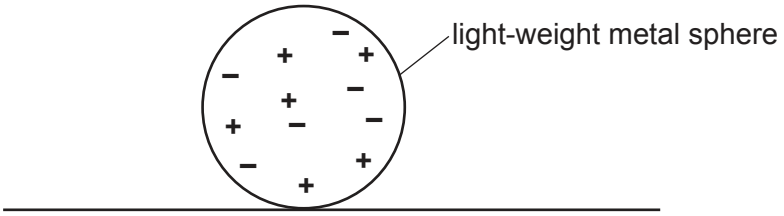

Fig. 13.1

(a) Explain why the sphere is neutral.

.....

..... [1]

(b) A positively charged object is placed near to the sphere as shown in Fig. 13.2.

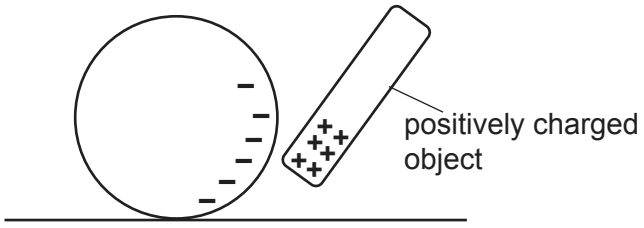

Fig. 13.2

(i) Explain why the negative charges on the sphere are now distributed as shown in Fig. 13.2.

.....

.....

..... [2]

(ii) Suggest what now happens to the sphere.

.....

..... [1]

[Total: 4]

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14 A volume of aqueous sodium hydroxide is neutralised with dilute hydrochloric acid using the following method:

Step 1 25.0 cm^3 of aqueous sodium hydroxide is added to a conical flask.

Step 2 Dilute hydrochloric acid is titrated into the conical flask until the solution is neutral.

A solution of sodium chloride is produced.

(a) (i) Suggest a suitable piece of apparatus to measure the volume of aqueous sodium hydroxide.

..... [1]

(ii) Describe the change to the pH value of the mixture in the conical flask.

..... [1]

(iii) State the colour of universal indicator paper in a neutral solution.

..... [1]

(b) State the ionic equation for a neutralisation reaction.

..... [1]

(c) Describe how sodium chloride solid is obtained from the neutralised solution.

..... [1]

[Total: 5]

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15 The boxes on the left in Fig. 15.1 contain names of animal and plant structures.

The boxes on the right in Fig. 15.1 contain names of different functions.

Draw one straight line from each structure to its function.

structure	function
alveolus	urea formation
anther	pollen production
liver	oxygen absorption
testes	sperm production
pancreas	transport
vascular bundle	amylase formation

Fig. 15.1

[5]

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16 During radioactive decay, changes in the nucleus of an atom cause emissions of radiation.

(a) Alpha-particles are one type of emission.

Suggest **one** feature of alpha-particles that explains why they are the **most** ionising type of radiation.

feature .....

explanation .....

.....

[2]

(b) State **one** other type of radioactive emission.

..... [1]

(c) Explain why some types of emission lead to the formation of new elements.

.....

..... [1]

(d) Explain why waste radioactive materials are encased in concrete and stored deep underground for many years.

.....

..... [1]

[Total: 5]

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17 (a) The following is a list of words used when describing reactions.

acidic amphoteric basic

hydrogen hydroxide ionic metallic

Use the words in the list to complete the following sentences.

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

(i) Non-metallic elements form ..... bonds with metallic elements. [1]

(ii) Non-metallic elements react with oxygen to form ..... oxides. [1]

(iii) An alkali forms ..... ions in aqueous solution. [1]

(iv) ..... oxides react with acids and bases. [1]

(b) State an atmospheric pollutant that is responsible for acid rain.

..... [1]

(c) Explain why farmers add calcium carbonate to soil.

.....

..... [1]

[Total: 6]

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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.).