



## Cambridge O Level

CANDIDATE  
NAME

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CENTRE  
NUMBER

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**COMBINED SCIENCE**

**5129/21**

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. Any blank pages are indicated.



1 Many cells are specialised for particular functions.

Draw **one** straight line from each specialised cell shown on Fig. 1.1 to link it to its function.

<b>specialised cell</b>	<b>function</b>
liver cell	enzyme production
mesophyll cell	alcohol breakdown
cell of pancreas	glucose production
red blood cell	antibody formation
root hair cell	oxygen transport
white blood cell	water absorption

**Fig. 1.1**

[5]

2 Fig. 2.1 shows the apparatus used to separate a mixture of water and ethanol.

Ethanol has a boiling point of  $78^{\circ}\text{C}$ .

Water has a boiling point of  $100^{\circ}\text{C}$ .

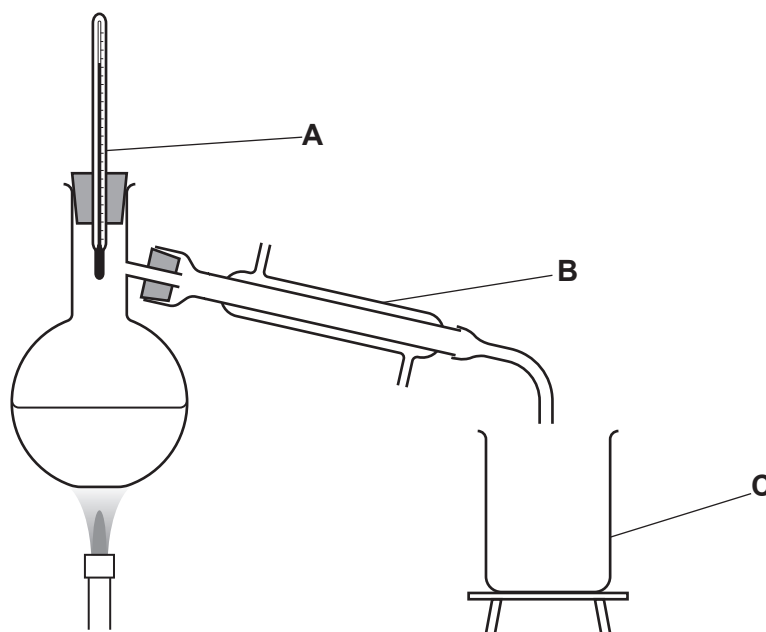


Fig. 2.1

(a) (i) State the name of the separation process shown in Fig. 2.1.

..... [1]

(ii) State the names of the pieces of apparatus **A** and **B**.

**A** .....

**B** .....

[2]

(iii) State the name of the first liquid that is collected in **C**.

..... [1]

(b) State an industrial use of water.

..... [1]

(c) Describe the movement and bunching of the particles in ice (solid water).

movement .....

bunching .....

[2]

[Total: 7]

- 3 Fig. 3.1 shows how the speed of a racing car increases with uniform acceleration.

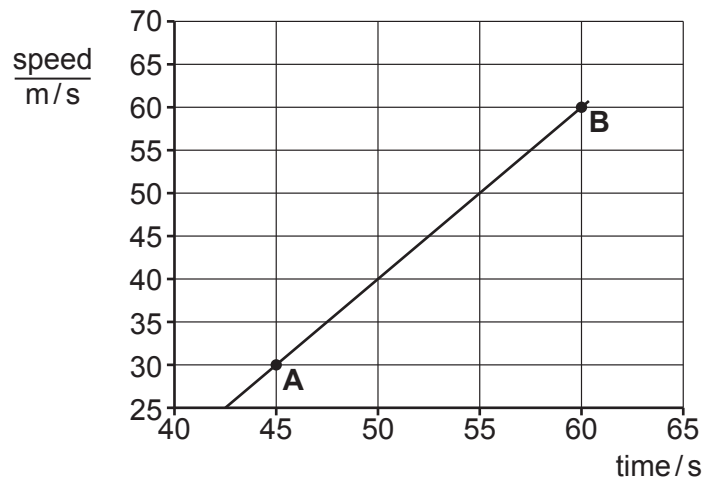


Fig. 3.1

- (a) (i) Calculate the change in the speed of the car as it moves from point **A** to point **B**.

..... m/s [1]

- (ii) Calculate the time taken by the car to move from point **A** to point **B**.

..... s [1]

- (iii) Use your answers in (a)(i) and (a)(ii) to calculate the acceleration of the car.

Use the equation:

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

acceleration = ..... m/s<sup>2</sup> [1]

(b) The car has a mass of 725 kg.

Use your answer to (a)(iii) to calculate the force accelerating the car.

force = ..... N [2]

(c) One force acting on the car is from the engine.

State **one** other force acting on the car.

..... [1]

[Total: 6]

- 4 (a) The sentences in the box in Fig. 4.1 describe the feeding relationships between four organisms.

Eagles obtain their energy from sparrows.  
An oak tree carries out photosynthesis.  
Sparrows are carnivores.  
Caterpillars are herbivores.

Fig. 4.1

Use the information in the box to draw a food chain containing these four organisms.

(Do **not** draw pictures of the organisms.)

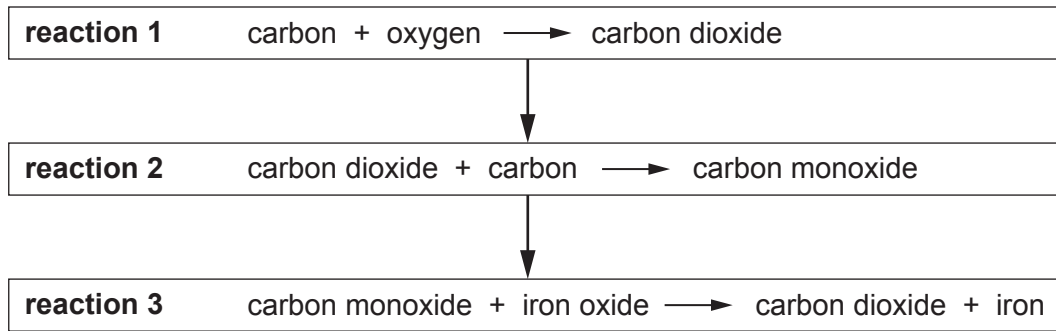
[3]

- (b) Explain why both animals and plants are dependent on photosynthesis.

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

[Total: 5]

5 Fig. 5.1 shows the reactions that take place in a blast furnace during the extraction of iron.



**Fig. 5.1**

(a) (i) State the name of a substance in Fig. 5.1 that is oxidised.

..... [1]

(ii) **Reaction 1** is an exothermic reaction.

State the meaning of 'exothermic'.

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

(iii) Construct a balanced symbol equation for **reaction 2**.

..... [2]

(b) State the name of an ore that contains iron oxide.

..... [1]

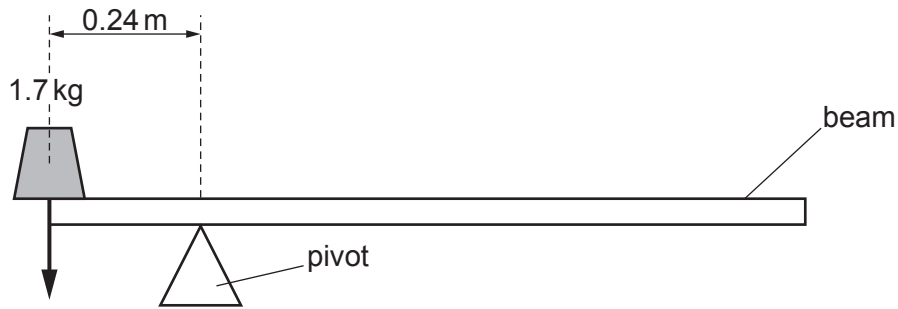
(c) The iron produced in **reaction 3** is brittle and not very strong.

Describe **one** way that the properties of the iron can be changed.

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

[Total: 6]

- 6 A 1.7 kg mass is placed at one end of a beam resting on a pivot, as shown in Fig. 6.1.



**Fig. 6.1**

- (a) Calculate the moment of the 1.7 kg mass about the pivot.  
Give your answer in Nm.

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

moment = ..... Nm [3]

- (b) The 1.7 kg mass has a density of  $6800 \text{ kg/m}^3$ .

Calculate the volume of the 1.7 kg mass.

volume = .....  $\text{m}^3$  [2]

- (c) The beam shown in Fig. 6.1 is balanced.

Explain why it is balanced, in terms of moments.

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

[Total: 6]



7 A list of words and phrases about blood vessels is shown.

**away from      carbon dioxide      higher      lower**  
**oxygen      thicker      thinner      towards**

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 wall of a vein is ..... than the wall of an artery. [1]
- (b) Veins carry blood ..... the heart. [1]
- (c) The blood in most veins contains more ..... than the blood in arteries. [1]
- (d) The blood in an artery is at a ..... pressure than blood in a vein. [1]

[Total: 4]

8 The following is a list of substances.

**argon      ethane      ethene      helium      magnesium**  
**mild steel      nitrogen      oxygen      stainless steel      zinc**

Use the list to complete the following sentences.

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

- (a) The substance that is used to make plastic for plastic bags is  
 ..... [1]
- (b) The substance that is used to make cutlery is  
 ..... [1]
- (c) The inert substance that is used to fill balloons is  
 ..... [1]
- (d) The substance that is used to make brass is  
 ..... [1]
- (e) The substance that makes up 78% of the atmosphere is  
 ..... [1]

[Total: 5]

- 9 In an investigation, three female students and three male students measure their heart rate first when they are resting and again immediately after exercise.

Their results are shown in Fig. 9.1.

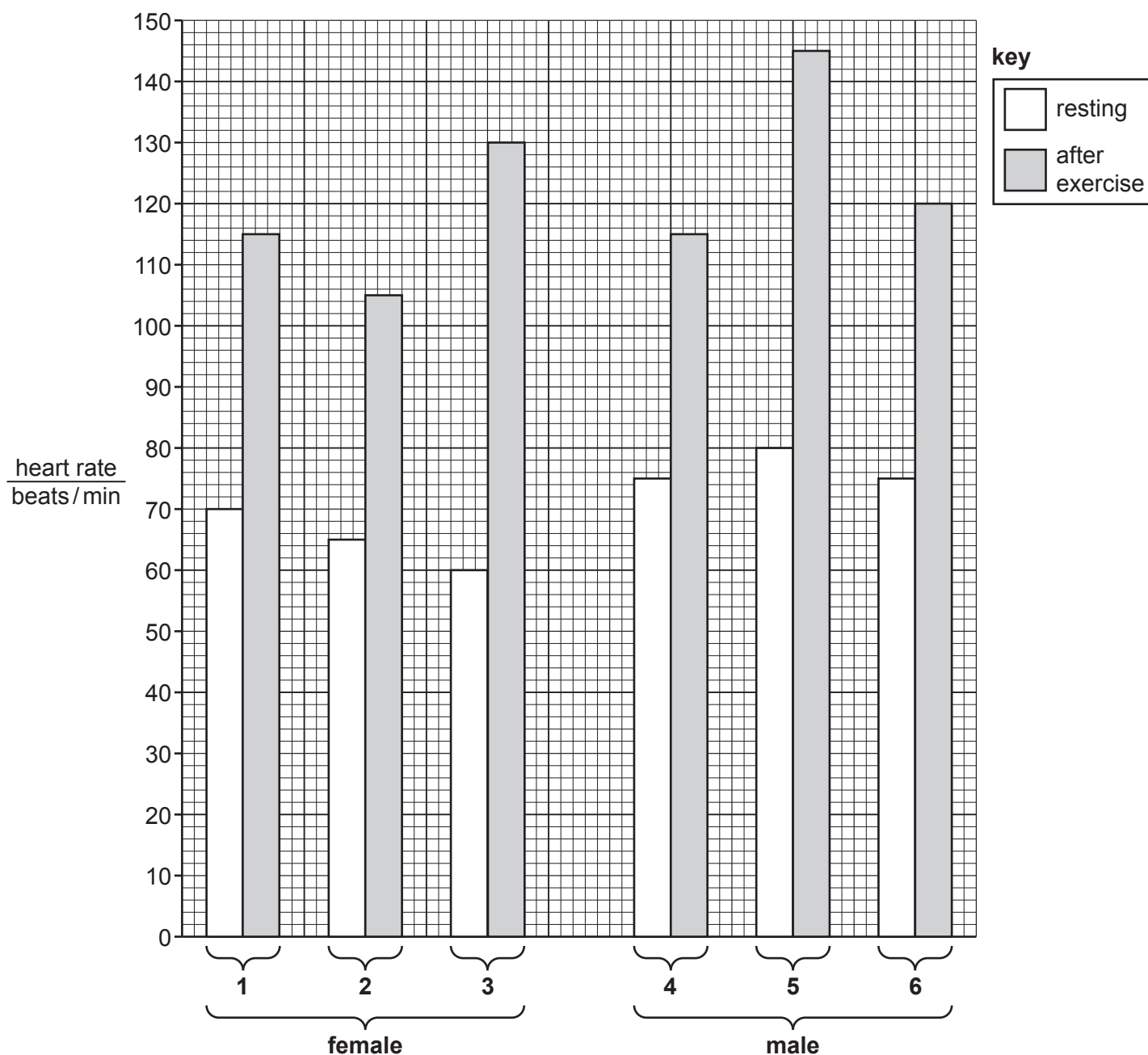


Fig. 9.1

- (a) (i) State the heart rate of student **female 2** when resting.

..... beats/min [1]

- (ii) State which student has the largest increase in heart rate during this investigation.

student ..... [1]

(b) Suggest **one** way in which this investigation can be changed to make the results more reliable.

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

(c) Suggest why the heart rate increases during exercise.

.....  
.....  
.....  
.....  
.....  
..... [3]

[Total: 6]

10 A student investigates the extension of a spring.

(a) She adds a load of 9.0N to the spring and she calculates an extension of 7.0cm.

Mark a cross (x) on Fig. 10.1 to plot this point and draw a straight line from the origin (0, 0) to the plotted point.

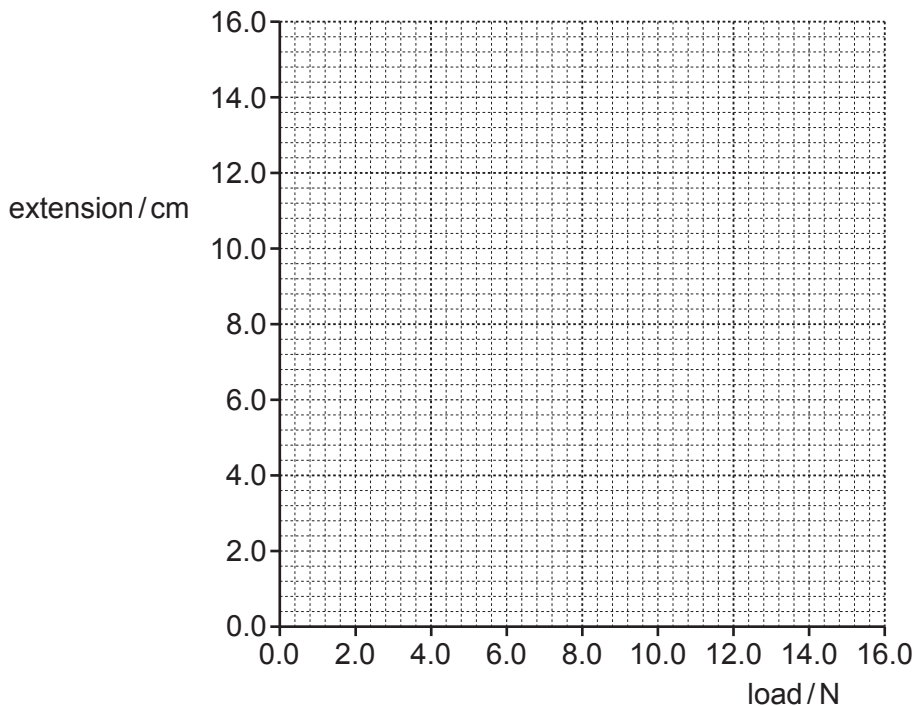


Fig. 10.1

[2]

(b) The load is removed and the spring returns to its original length.

The student then adds a load of 12.0N to the spring.

Determine the extension of the spring with a load of 12.0N.

extension = ..... cm [1]

(c) Suggest **one** assumption that you made when determining your answer to (b).

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

[Total: 4]

11 Fig. 11.1 shows the structure of ethanol.

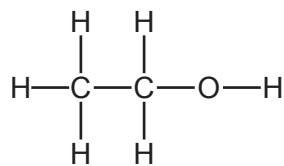


Fig. 11.1

(a) Deduce the formula of ethanol.

..... [1]

(b) Ethanol is used as a fuel.

State **one** other use of ethanol.

..... [1]

(c) Fig. 11.2 shows one process and two reactions involving ethanol.

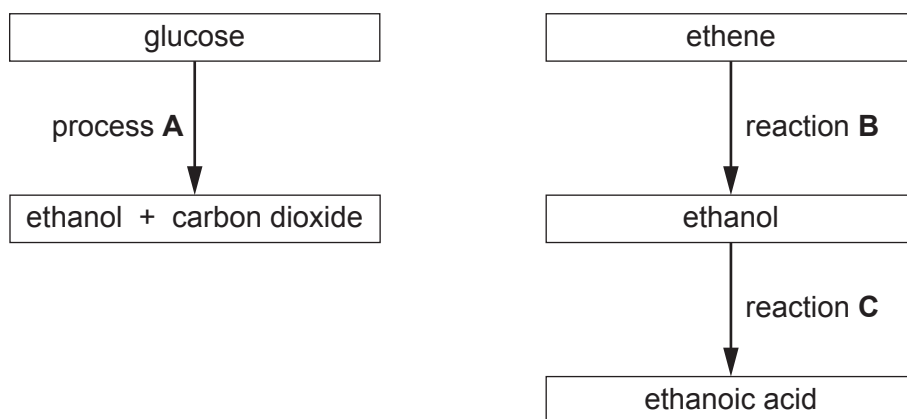


Fig. 11.2

(i) State the names of process **A** and reaction **B**.

process **A** .....

reaction **B** .....

[2]

(ii) Describe a test and the result of the test that shows an acid is produced in reaction **C**.

test .....

result .....

[2]

[Total 6]

12 A smoke detector contains an electric circuit and a radioactive source.

The circuit is shown in Fig. 12.1.

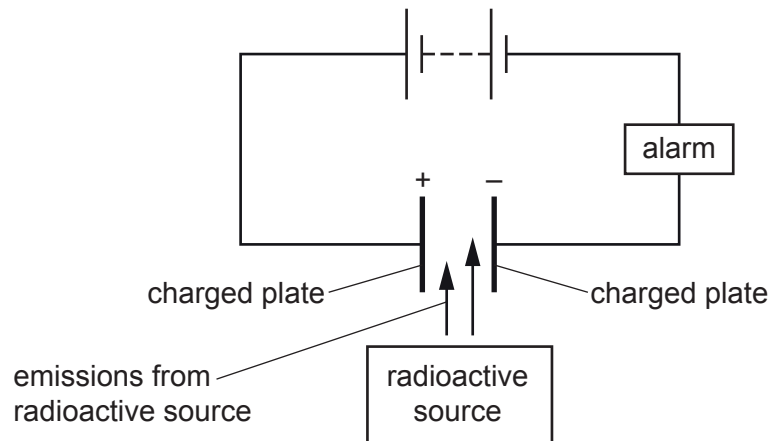


Fig. 12.1

Emissions from the radioactive source give a charge to the air particles between the charged plates.

The charged air particles then move towards the charged plates.

Electric charge is transferred between the plates and through the wires in the circuit.

(a) (i) Identify the energy store in the radioactive source. Tick (✓) one box.

- |            |                          |
|------------|--------------------------|
| chemical   | <input type="checkbox"/> |
| electrical | <input type="checkbox"/> |
| kinetic    | <input type="checkbox"/> |
| nuclear    | <input type="checkbox"/> |
| sound      | <input type="checkbox"/> |

[1]

(ii) Identify the energy gained by the air particles. Tick (✓) one box.

chemical

electrical

kinetic

nuclear

sound

[1]

(iii) Identify the type of energy store in the battery in the circuit. Tick (✓) one box.

chemical

electrical

kinetic

nuclear

sound

[1]

(b) The smoke detector contains a battery with an e.m.f. of 9.0V.

In normal use, a charge of 4.1 C moves through the circuit in one hour.

(i) Calculate the current in the circuit.

current = ..... A [3]

(ii) Show that the battery produces approximately  $1.0 \times 10^{-2} \text{ W}$  of electrical power.

[2]

[Total:8]

13 (a) Asexual reproduction produces offspring from one parent.

Sexual reproduction produces offspring from two parents.

State **one** other difference between asexual and sexual reproduction.

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

(b) Fig. 13.1 shows the female reproductive system as seen from the front.

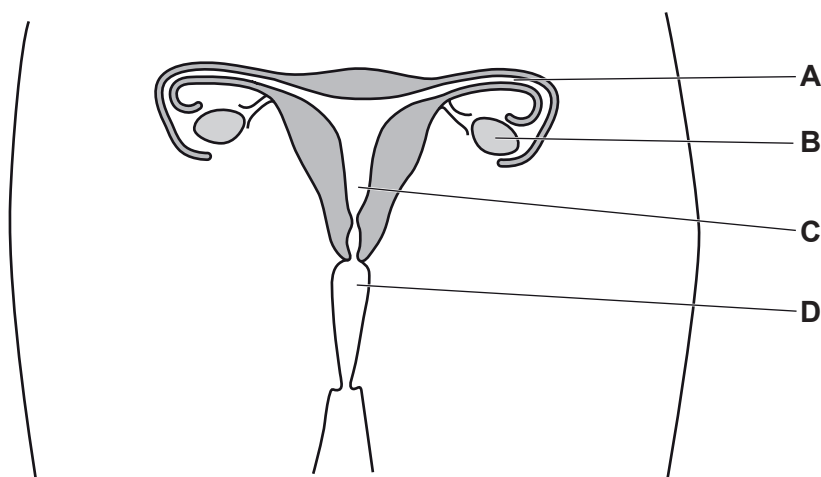


Fig. 13.1

Complete Table 13.1 by inserting the name and **one** function for each of the structures **A**, **B**, **C** and **D** indicated on Fig. 13.1.

One structure and one function have been done for you.

Table 13.1

	name of structure	<b>one</b> function of structure
<b>A</b>	oviduct	.....
<b>B</b>	.....	.....
<b>C</b>	.....	.....
<b>D</b>	.....	allows the baby to pass out of the body

[6]



(c) State the name of **one** mechanical and **one** surgical method of birth control used by a man.

mechanical method .....

.....

surgical method .....

.....

[2]

[Total: 9]

14 Fig. 14.1 shows the electronic structure of an element in the Periodic Table.

(a) (i) Deduce the group number and period number for this element.

group number .....

period number .....

[2]

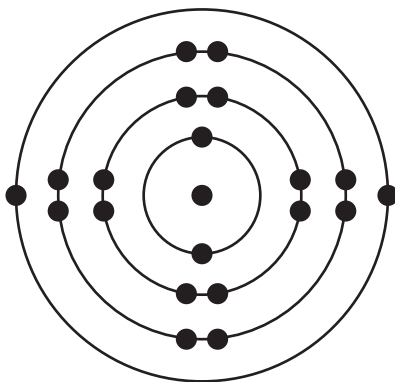


Fig. 14.1

(ii) State the charge on the ion formed by this element.

..... [1]

(b) Define the meaning of the term 'isotopes'.

.....

..... [2]

[Total: 5]

15 Two charged insulating spheres, **A** and **B**, are at rest on a smooth insulating surface.

(a) Complete Fig. 15.1 to show the equal and opposite charge on sphere **B**.

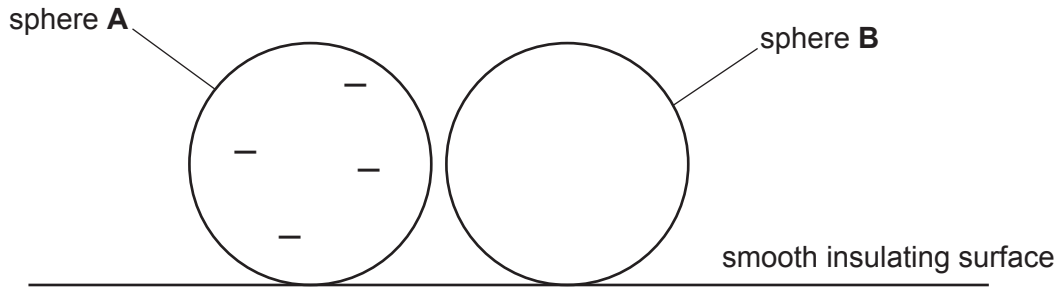


Fig. 15.1

[1]

(b) Sphere **A** and sphere **B** are still charged. A charged object **C** is placed near to sphere **A**.

This causes sphere **A** to move to the left and sphere **B** to move to the right as shown in Fig. 15.2.

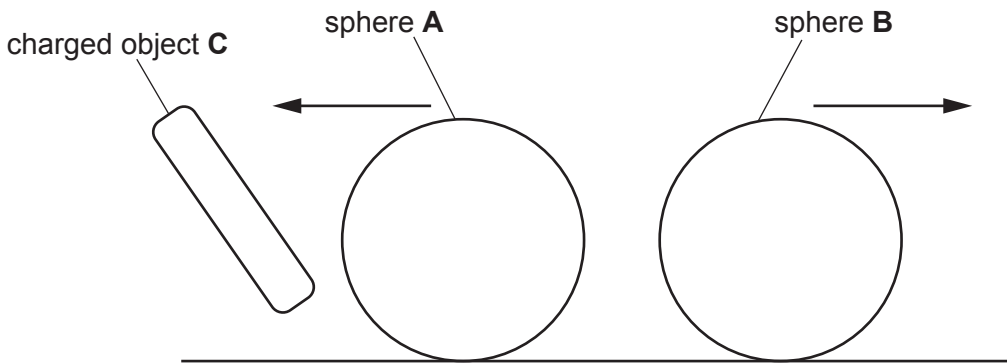


Fig. 15.2

Deduce the type of charge on object **C** and explain why the spheres move apart.

.....

.....

.....

.....

..... [3]

[Total: 4]

16 (a) Draw **three** straight lines on Fig. 16.1, from the box on the left to different boxes on the right, to make **three** correct statements about the alimentary canal.

In the alimentary canal, ...

... amylase digests fat.

... peristalsis occurs.

... fibre is digested in the colon.

... digestion is extra-cellular.

... digested food is absorbed by osmosis.

... teeth chew food.

Fig. 16.1

[3]

(b) The stomach contains hydrochloric acid.

State the effect of hydrochloric acid on amylase.

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

[Total: 4]

- 17 Respiration and complete combustion of methane are two sources of carbon dioxide in the atmosphere.

The symbol equations for the reactions in these two processes are shown.



- (a) (i) State the test and the result of the test that shows carbon dioxide is produced in each of these reactions.

test .....

result .....

[2]

- (ii) Describe **two** other similarities between respiration and complete combustion of methane.

similarity 1 .....

.....

similarity 2 .....

.....

[2]

- (b) Incomplete combustion of methane produces carbon monoxide.

State an adverse effect of carbon monoxide.

..... [1]

[Total: 5]

18 Fig. 18.1 shows the apparatus used to induce and measure an e.m.f. (electromotive force) across a wire.

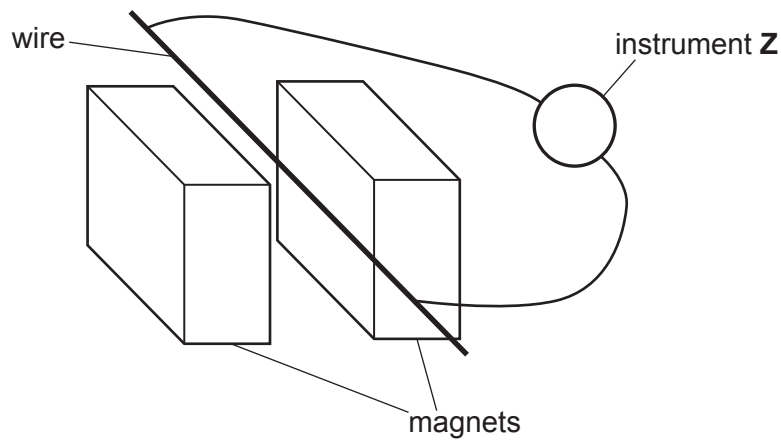


Fig. 18.1

(a) (i) Instrument Z measures the induced e.m.f.

State the name of instrument Z.

..... [1]

(ii) Describe how the apparatus in Fig. 18.1 is used to induce the e.m.f. across the wire.

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

(iii) Describe how the poles of the magnets in Fig. 18.1 must be arranged so that an e.m.f. can be induced across the wire.

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

(b) State **two** factors that affect the size of the induced e.m.f.

1 .....

2 .....

[2]

[Total: 5]

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## The Periodic Table of Elements

		Group															
I	II											III	IV	V	VI	VII	VIII
3 <b>Li</b> lithium 7	4 <b>Be</b> beryllium 9	<b>Key</b> atomic number atomic symbol name relative atomic mass										5 <b>B</b> boron 11	6 <b>C</b> carbon 12	7 <b>N</b> nitrogen 14	8 <b>O</b> oxygen 16	9 <b>F</b> fluorine 19	10 <b>Ne</b> neon 20
11 <b>Na</b> sodium 23	12 <b>Mg</b> magnesium 24											1 <b>H</b> hydrogen 1	13 <b>Al</b> aluminium 27	14 <b>Si</b> silicon 28	15 <b>P</b> phosphorus 31	16 <b>S</b> sulfur 32	17 <b>Cl</b> chlorine 35.5
19 <b>K</b> potassium 39	20 <b>Ca</b> calcium 40	21 <b>Sc</b> scandium 45	22 <b>Ti</b> titanium 48	23 <b>V</b> vanadium 51	24 <b>Cr</b> chromium 52	25 <b>Mn</b> manganese 55	26 <b>Fe</b> iron 56	27 <b>Co</b> cobalt 59	28 <b>Ni</b> nickel 59	29 <b>Cu</b> copper 64	30 <b>Zn</b> zinc 65	31 <b>Ga</b> gallium 70	32 <b>Ge</b> germanium 73	33 <b>As</b> arsenic 75	34 <b>Se</b> selenium 79	35 <b>Br</b> bromine 80	36 <b>Kr</b> krypton 84
37 <b>Rb</b> rubidium 85	38 <b>Sr</b> strontium 88	39 <b>Y</b> yttrium 89	40 <b>Zr</b> zirconium 91	41 <b>Nb</b> niobium 93	42 <b>Mo</b> molybdenum 96	43 <b>Tc</b> technetium —	44 <b>Ru</b> ruthenium 101	45 <b>Rh</b> rhodium 103	46 <b>Pd</b> palladium 106	47 <b>Ag</b> silver 108	48 <b>Cd</b> cadmium 112	49 <b>In</b> indium 115	50 <b>Sn</b> tin 119	51 <b>Sb</b> antimony 122	52 <b>Te</b> tellurium 128	53 <b>I</b> iodine 127	54 <b>Xe</b> xenon 131
55 <b>Cs</b> caesium 133	56 <b>Ba</b> barium 137	57–71 lanthanoids	72 <b>Hf</b> hafnium 178	73 <b>Ta</b> tantalum 181	74 <b>W</b> tungsten 184	75 <b>Re</b> rhenium 186	76 <b>Os</b> osmium 190	77 <b>Ir</b> iridium 192	78 <b>Pt</b> platinum 195	79 <b>Au</b> gold 197	80 <b>Hg</b> mercury 201	81 <b>Tl</b> thallium 204	82 <b>Pb</b> lead 207	83 <b>Bi</b> bismuth 209	84 <b>Po</b> polonium —	85 <b>At</b> astatine —	86 <b>Rn</b> radon —
87 <b>Fr</b> francium —	88 <b>Ra</b> radium —	89–103 actinoids	104 <b>Rf</b> rutherfordium —	105 <b>Db</b> dubnium —	106 <b>Sg</b> seaborgium —	107 <b>Bh</b> bohrium —	108 <b>Hs</b> hassium —	109 <b>Mt</b> meitnerium —	110 <b>Ds</b> darmstadtium —	111 <b>Rg</b> roentgenium —	112 <b>Cn</b> copernicium —	114 <b>Fl</b> flerovium —	116 <b>Lv</b> livermorium —	—	—	—	—
												67 <b>Ho</b> holmium 165	68 <b>Er</b> erbium 167	69 <b>Tm</b> thulium 169	70 <b>Yb</b> ytterbium 173	71 <b>Lu</b> lutetium 175	
<b>lanthanoids</b>												99 <b>Es</b> einsteinium —	100 <b>Fm</b> fermium —	101 <b>Md</b> mendelevium —	102 <b>No</b> nobelium —	103 <b>Lr</b> lawrencium —	
<b>actinoids</b>												98 <b>Cf</b> californium —	99 <b>Bk</b> berkelium —	100 <b>Cm</b> curium —	101 <b>Np</b> neptunium —	102 <b>Pu</b> plutonium —	

The volume of one mole of any gas is 24 dm<sup>3</sup> at room temperature and pressure (r.t.p.).