Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

7714188139

CO-ORDINATED SCIENCES **0654/33**

Paper 3 Theory (Core) **May/June 2021**

2 hours

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 120.
- 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 **28** pages. Any blank pages are indicated.

DC (CE/SG) 213460

1 **(a)** Fig. 1.1 is a diagram of the female reproductive system.

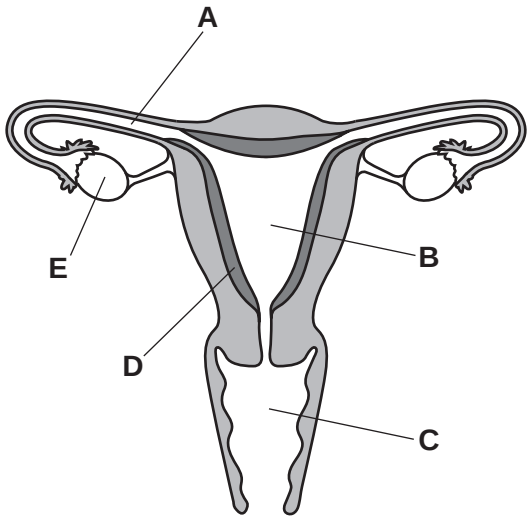


Fig. 1.1

(i) State the letter from Fig. 1.1 that shows the part where:

fertilisation occurs .....

gametes are produced. .....

[2]

(ii) Identify the part labelled **B** in Fig. 1.1.

..... [1]

(b) Fig. 1.2 shows a student's description of fertilisation in humans.

The description of fertilisation in humans is incorrect.

Circle the **two** incorrect words in the description in Fig. 1.2.

Fertilisation is the separation of the nuclei from a sperm cell and an ovary cell.

Fig. 1.2

[2]

(c) Fig. 1.3 shows how the thickness of the uterus lining changes during the menstrual cycle.

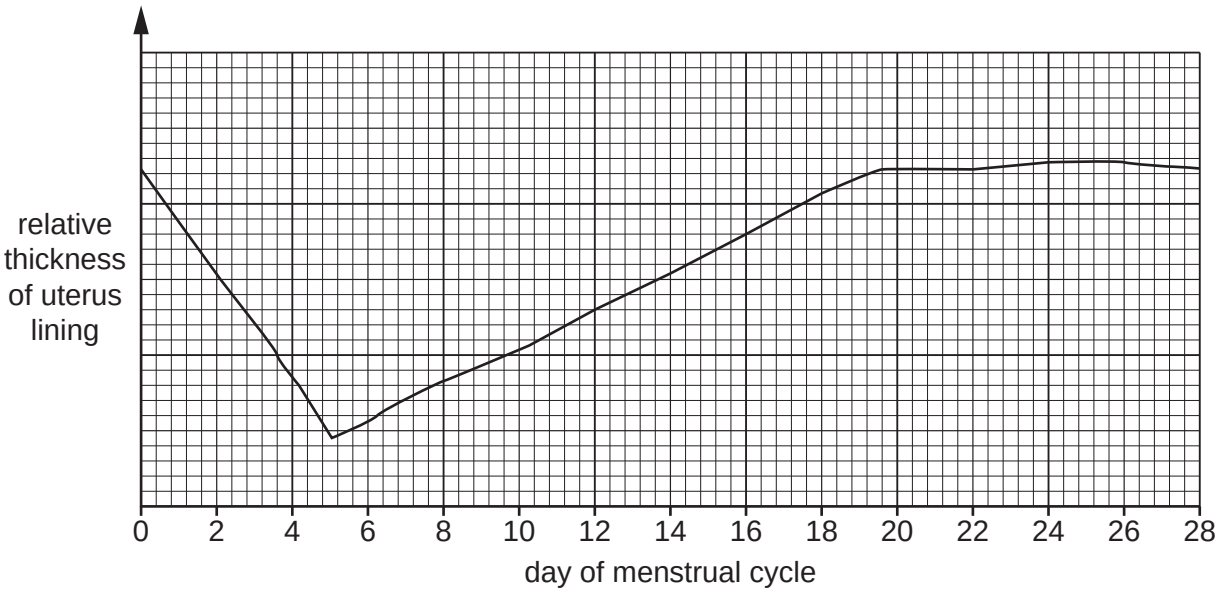


Fig. 1.3

Table 1.1 represents the days during an average menstrual cycle.

Table 1.1

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
15	16	17	18	19	20	21	22	23	24	25	26	27	28	

Use Fig. 1.3 and your own knowledge to:

(i) place ticks (✓) in Table 1.1 to show the days when the uterus lining is shed [1]

(ii) place crosses (✗) in Table 1.1 to show the days when the uterus lining is at its thickest. [1]

(d) Complete the sentence to define the term reproduction.

Reproduction is the processes that make ..... of the same

..... of organism. [2]

[Total: 9]

2 **(a)** Magnesium is in Period 3 of the Periodic Table.

(i) Use the Periodic Table to name the noble gas in Period 3 of the Periodic Table.

..... [1]

(ii) Describe the change in metallic character across Period 3.

.....

..... [1]

(b) Magnesium reacts with carbon dioxide.

Magnesium oxide and carbon are made.

(i) Write the word equation for this reaction.

..... + ... → ..... + ... [1]

(ii) The reaction between magnesium and carbon dioxide is exothermic.

Explain what is meant by an *exothermic* reaction.

.....

..... [1]

(c) An atom of magnesium has a proton number (atomic number) of 12 and a nucleon number (mass number) of 24.

Complete Table 2.1 to show the names and numbers of the two particles contained in the nucleus of this magnesium atom.

Table 2.1

name of particle	number of particles

[2]

(d) Magnesium carbonate reacts with dilute hydrochloric acid to make aqueous magnesium chloride.

(i) Magnesium carbonate is insoluble in water.

State the separation technique used to remove magnesium carbonate from a mixture of magnesium carbonate and water.

..... [1]

(ii) Magnesium chloride dissolves in water.

State the separation technique used to obtain solid magnesium chloride from a solution of magnesium chloride.

..... [1]

(iii) Magnesium carbonate reacts with dilute hydrochloric acid.

Complete the balanced symbol equation for this reaction.

$$MgCO_3 + ...HCl \rightarrow MgCl_2 + CO_2 + H_2O$$ [1]

(iv) Dilute hydrochloric acid contains aqueous chloride ions.

State the test for aqueous chloride ions and give the observation for a positive result.

test .....

observation .....
[2]

(e) Table 2.2 shows the composition of a magnesium alloy.

Table 2.2

element	% by mass
magnesium	94
neodymium	2
yttrium	4

(i) Calculate the mass of magnesium in 500 kg of the alloy.

..... kg [1]

(ii) The alloy is used in aircraft bodies.

Suggest why the alloy of magnesium is used rather than pure magnesium for aircraft bodies.

.....

..... [1]

[Total: 13]

3 **(a)** A torch (flashlight) contains four cells, a lamp and a switch connected in series.

(i) Draw a circuit diagram for the torch using standard electrical symbols.

[3]

(ii) The potential difference (p.d.) across the lamp is 6.0 V when the switch is closed.

The resistance of the lamp is 5.0 Ω when lit.

Calculate the current in the lamp.

current = ...A [2]

(iii) Two lamps each of resistance 5.0 Ω are connected together in a series circuit.

Calculate the combined resistance of the two lamps in series.

resistance = ... Ω [1]

(b) Choose words from the list to complete the sentences to describe the energy transfers that occur when the torch is switched on.

You may use each word once, more than once or not at all.

chemical **elastic** **electrical** **gravitational**

light **nuclear** **sound** **thermal**

The energy stored in the cells is ..... potential energy.

This energy is transferred into ..... energy which passes through the lamp.

The useful energy from the lamp is ..... energy.

Some energy is wasted as ..... energy.

[3]

(c) Solar energy is sometimes used to power torches. Solar energy is a renewable energy resource.

State two other renewable energy resources.

1 .....

2 .....

[2]

(d) Fig. 3.1 shows a ray of light from a torch shining on a mirror.

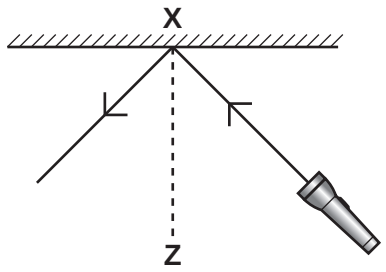


Fig. 3.1

(i) State the name of line **XZ**.

..... [1]

(ii) State what happens to the ray of light at point **X** on Fig. 3.1.

..... [1]

[Total: 13]

4 **(a)** Fig. 4.1 is a diagram of the heart.

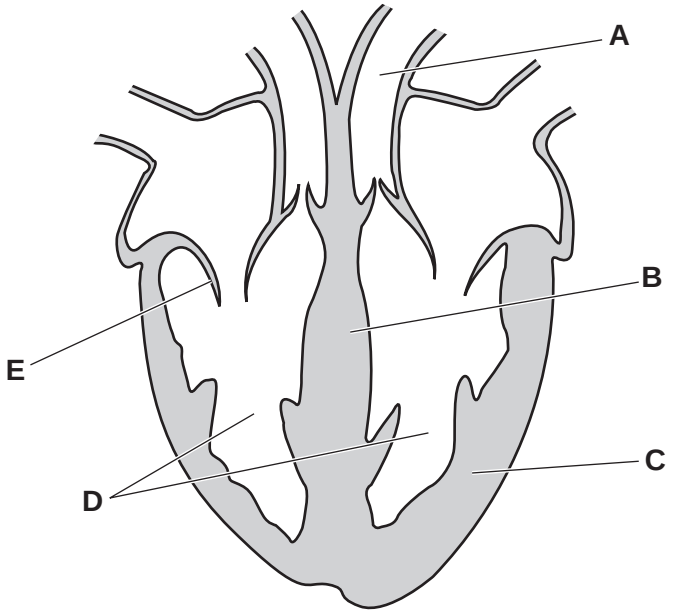


Fig. 4.1

(i) Identify the parts labelled **B**, **C** and **D** in Fig. 4.1.

B .....

C .....

D .....
[3]

(ii) Describe the function of the structure labelled **E**.

.....

..... [1]

(iii) The blood vessel labelled **A** is an artery.

Describe the role of arteries in the circulatory system.

.....

..... [1]

(b) Name two of the main components of blood.

1 .....

2 .....
[2]

(c) A student measures their heart rate over a 24-hour period.

Fig. 4.2 shows a graph of the results.

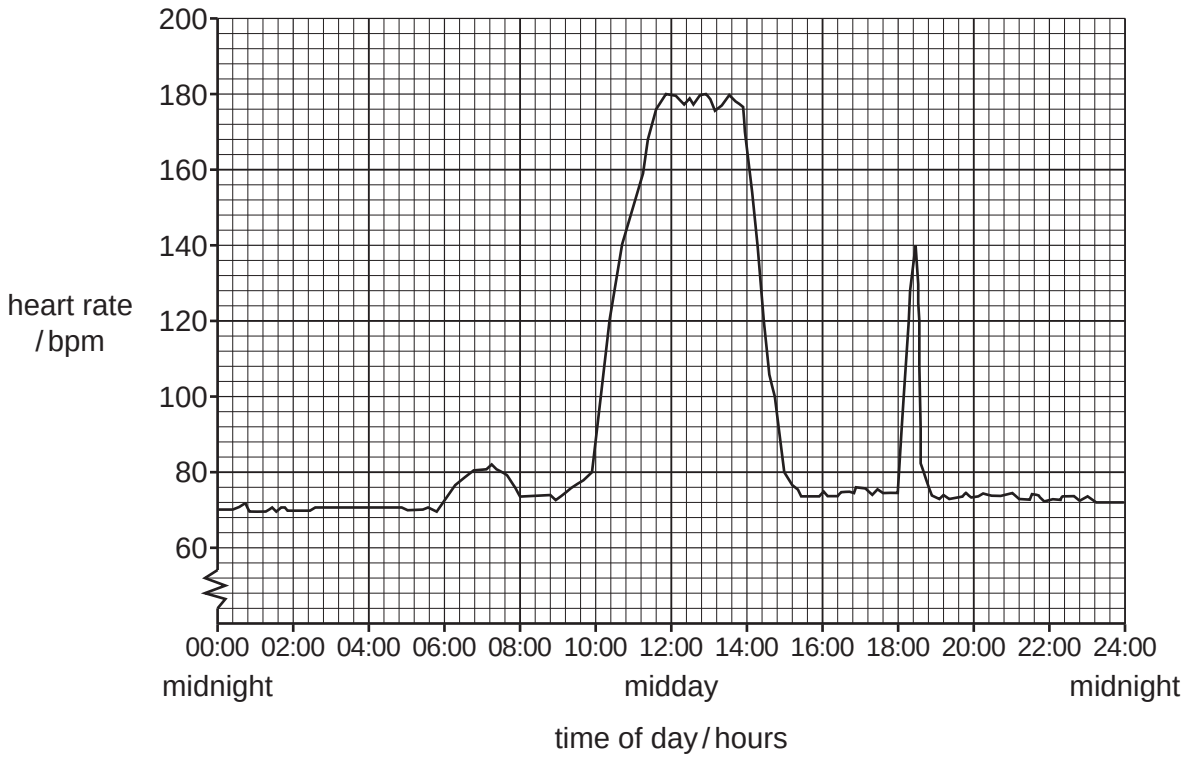


Fig. 4.2

(i) Calculate the difference in heart rate between the minimum and maximum heart rate seen in Fig. 4.2.

.....bpm [1]

(ii) At 10:00 hours the student attends a fitness class.

Estimate the length of time of the fitness class.

.....hours [1]

(iii) At 18:00 hours the student was scared by a snake.

Describe **and** explain the result seen at 18:00 hours in Fig. 4.2.

Use ideas about hormones in your answer.

.....

.....

.....

..... [2]

[Total: 11]

5 **(a)** Potassium is a very reactive metal.

Potassium is stored under oil as shown in Fig. 5.1.

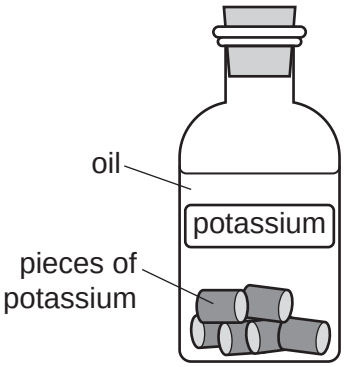


Fig. 5.1

Suggest two reasons why potassium is stored under oil.

1 .....

2 .....

[2]

(b) Potassium has a proton number of 19.

Complete Fig. 5.2 to show the electronic structure of a potassium atom.

The inner shell electrons have been drawn for you.

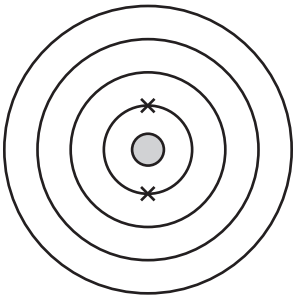


Fig. 5.2 [2]

(c) Solid potassium reacts with chlorine gas to make solid potassium chloride.

(i) Describe the differences between the structures of a solid and a gas in terms of particle separation and particle arrangement.

particle separation .....

.....

particle arrangement .....

.....

[2]

(ii) When potassium reacts with chlorine, potassium atoms become potassium ions.

Describe what happens to a potassium atom when it becomes a potassium ion.

..... [1]

(iii) Potassium and chlorine are elements. Potassium chloride is a compound.

Describe the difference between an element and a compound.

.....

.....

..... [2]

(d) The maximum mass of potassium chloride that dissolves in 100 cm^3 of water is called the solubility of potassium chloride.

Fig. 5.3 shows the solubility of potassium chloride in water at different temperatures.

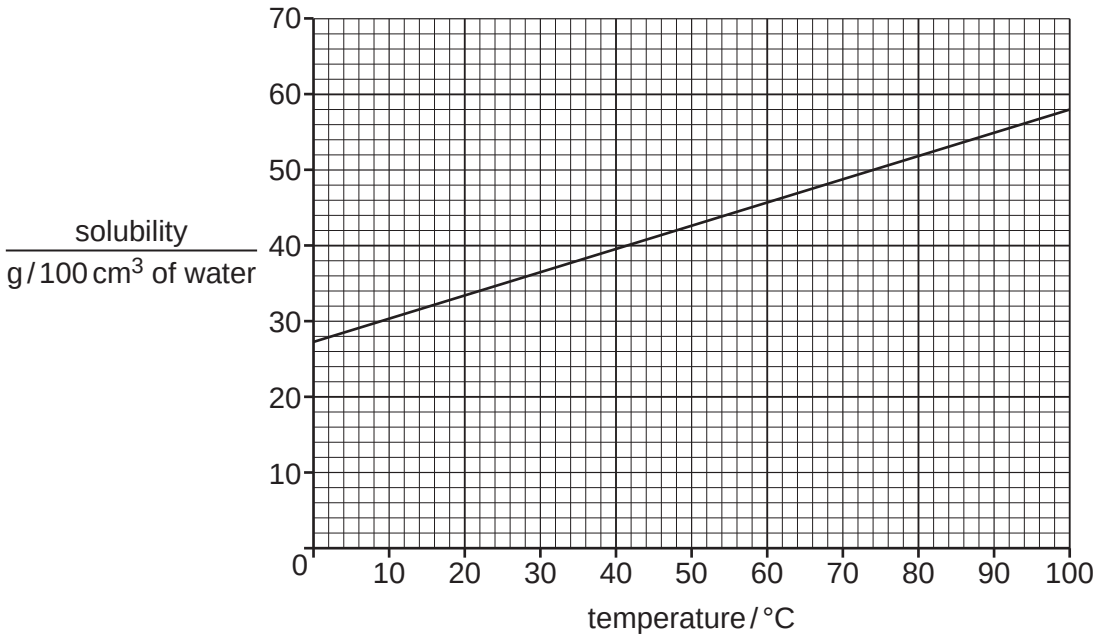


Fig. 5.3

(i) Describe the trend in solubility shown in Fig. 5.3.

..... [1]

(ii) State the mass of potassium chloride that dissolves in 100 cm^3 of water at 45 °C.

..... g [1]

[Total: 11]

6 **(a)** Fig. 6.1 shows the speed-time graph for the journey of a train travelling between two stations.

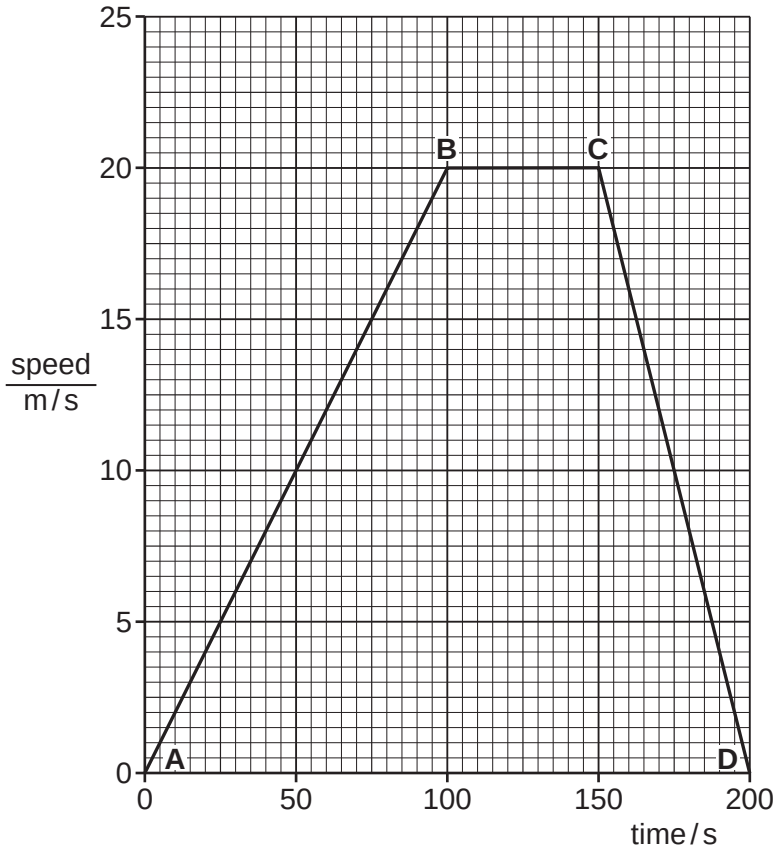


Fig. 6.1

(i) Use letters from the graph in Fig. 6.1 to identify the two stations on the train's journey.

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

(ii) On Fig. 6.1, label with a cross **(X)** a part of the journey when the train is accelerating. [1]

(iii) Use Fig. 6.1 to calculate the total distance travelled by the train on this journey.

distance = ... m [3]

(b) Fig. 6.2 shows the forces acting on the train when it travels at a constant speed.

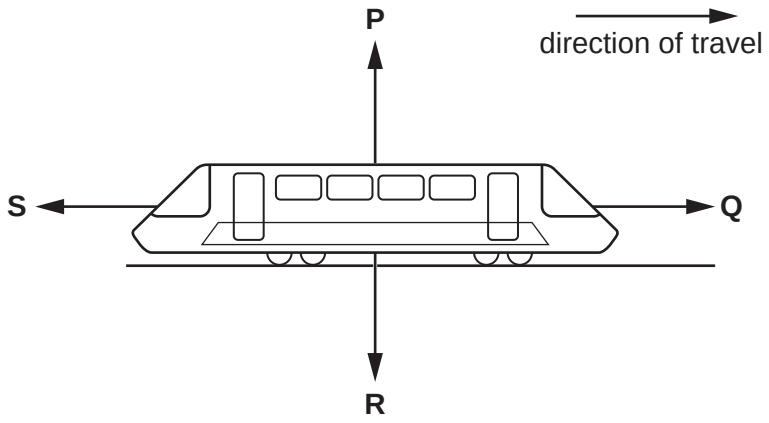


Fig. 6.2

(i) State which force, **P**, **Q**, **R** or **S**, is the weight of the train.

..... [1]

(ii) Compare the magnitude and the direction of forces **Q** and **S** when the train is travelling at a constant speed.

.....

..... [2]

[Total: 8]

[Turn over

7 **(a)** A scientist investigates the effect of immersion of plant cells in different concentrations of sugar solution.

Fig. 7.1 shows the appearance of the plant cells before immersion.

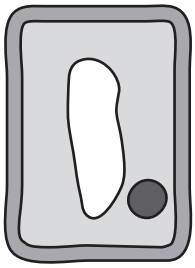


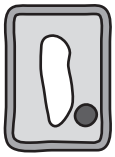
Fig. 7.1

Beakers **A**–**D** contain different concentrations of sugar solution.

Some plant cells are placed in each solution and left for an hour.

Table 7.1 shows the results.

Table 7.1

beaker	appearance of plant cells after immersion
A	
B	
C	
D	

(i) Describe the change seen to the plant cells placed in beaker **A** in Table 7.1.

.....

..... [1]

(ii) Suggest which beaker contains the solution with the same concentration as the plant cells.

Give a reason for your answer.

beaker .....

reason .....
[2]

(b) Water enters the plant through the root hair cells.

Complete the flow chart to show the pathway of water through the cells of a plant.

root hair cell → ..... → xylem → ..... [2]

(c) Xylem transports water through the plant stem.

Name the tissue that transports sugars through the plant stem.

..... [1]

(d) Water and carbon dioxide are raw materials required for photosynthesis.

Name two other requirements for photosynthesis.

1 .....

2 .....
[2]

(e) Protecting land from deforestation helps stop the loss of soil.

This is because tree roots hold the soil together, stopping it being washed away.

Suggest two other benefits of protecting land from deforestation.

1 .....

.....

2 .....

.....
[2]

[Total: 10]

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8 **(a)** Fig. 8.1 shows the electrolysis of molten lead(II) bromide.

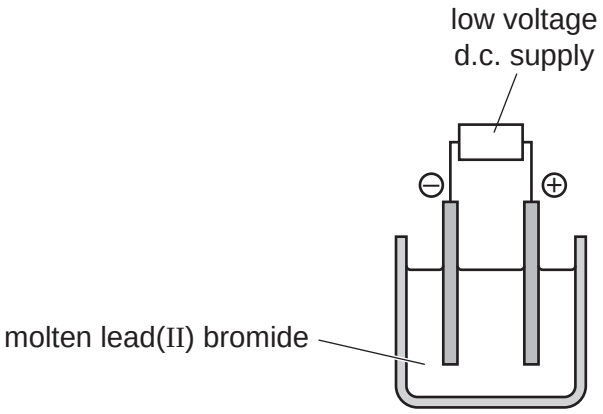


Fig. 8.1

(i) State the name of the electrode where lead is made.

..... [1]

(ii) Explain why an orange gas is seen above the molten lead(II) bromide.

..... [1]

(b) Lead is extracted from lead oxide by reaction with carbon.

The equation for the reaction is shown.

$$\text{lead oxide} + \text{carbon} \rightarrow \text{lead} + \text{carbon dioxide}$$

Name the substance that is oxidised and the substance that is reduced in this reaction.

substance oxidised .....

substance reduced .....
[1]

(c) Lead is a metal.

Suggest one test to show that lead is a metal.

.....

..... [1]

(d) Lead reacts very slowly with dilute sulfuric acid.

State two ways of increasing the rate of reaction between lead and dilute sulfuric acid.

1 .....

2 .....
[2]

[Total: 6]

9 Fig. 9.1 shows a tumble dryer.

Fig. 9.1

In a tumble dryer, wet clothes are warmed and dried. Water on the clothes evaporates.

(a) (i) Describe the process of evaporation.

Use ideas about molecules in your answer.

.....

.....

.....

..... [2]

(ii) During evaporation the water does not boil.

State the boiling point of water.

.....°C [1]

(iii) Inside the tumble dryer, water vapour changes into liquid water.

State the term used to describe a gas changing into a liquid.

..... [1]

(iv) Thermal energy passes through the metal casing of the tumble dryer.

State the method of thermal energy transfer through metals.

..... [1]

(b) (i) The tumble dryer is noisy and emits loud sound waves with a low pitch.

Describe the sound waves in terms of their amplitude and frequency.

amplitude .....

frequency .....
[2]

(ii) State the lowest audible frequency for a healthy human ear.

State the unit of your answer.

frequency = ... unit ..... [2]

(iii) The speed of sound in air is 340 m / s.

Calculate the time taken for a sound wave to travel 85 m.

time = ... s [2]

[Total: 11]

10 **(a)** Fig. 10.1 is a diagram of the human alimentary canal and associated organs.

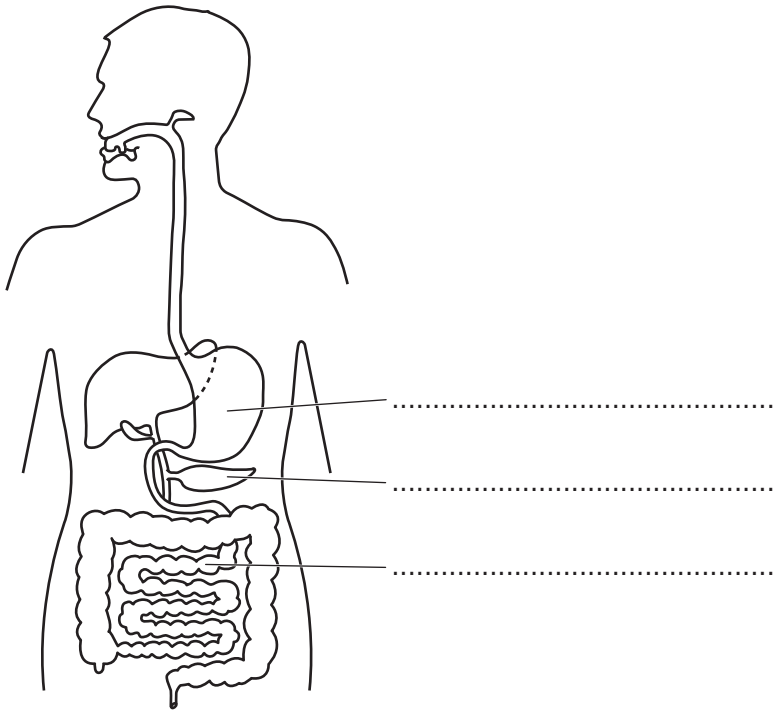


Fig. 10.1

(i) Label Fig. 10.1 on the answer lines provided.

Choose words from the list.

- anus
- large intestine
- mouth
- pancreas
- small intestine
- stomach

[3]

(ii) Different processes occur in the alimentary canal.

Complete Table 10.1 using words from the list in **(a)(i)**.

Table 10.1

process	one part of the alimentary canal where process occurs
ingestion	
egestion	
mechanical digestion	

[3]

(b) Describe the role of chemical digestion in the alimentary canal.

.....

.....

.....

..... [2]

(c) The boxes contain the beginnings and the endings of some sentences.

Join **one** sentence beginning to **one** sentence ending to define the term assimilation.

beginning	**ending**
Assimilation is the movement of digested food molecules into the cells of the body	where they are excreted, becoming part of the faeces.
Assimilation is the movement of digested food molecules into the lungs of the body	where they are excreted, becoming part of the cells.
Assimilation is the movement of undigested food molecules into the lungs of the body	where they are used, becoming part of the faeces.
Assimilation is the movement of undigested food molecules into the cells of the body	where they are used, becoming part of the cells.

[2]

[Total: 10]

11 Fig. 11.1 shows the structures of five compounds **A**, **B**, **C**, **D** and **E**.

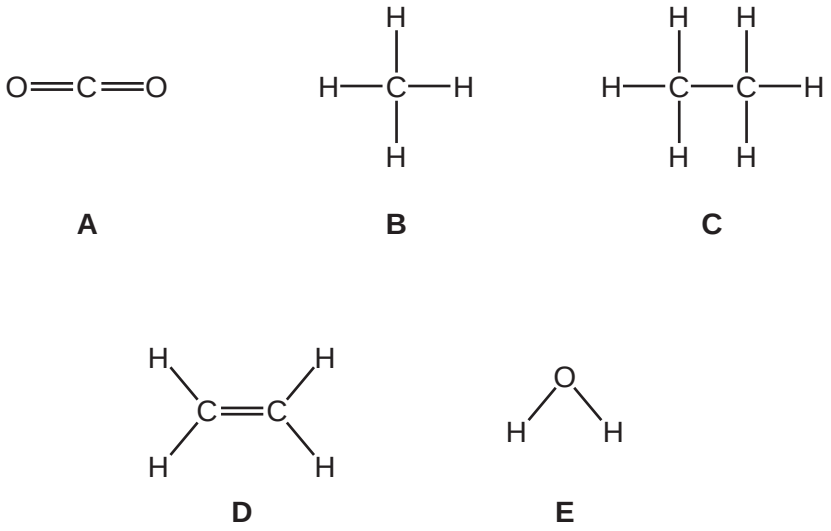


Fig. 11.1

(a) Use the letters **A**–**E** to identify all the hydrocarbon molecules.

..... [1]

(b) Use the letters **A**–**E** to identify the **two** products of the complete combustion of a hydrocarbon.

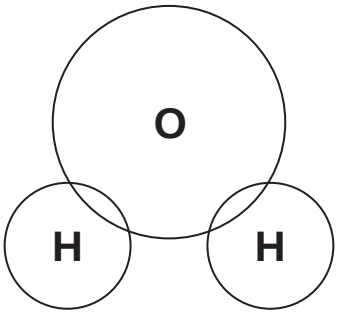
..... and ..... [1]

(c) Use Fig. 11.1 to **name** one greenhouse gas.

..... [1]

(d) Draw a dot-and-cross diagram to show the bonding in molecule **E**.

Only show the outer shell electrons.



[3]

(e) Compound **D** is an unsaturated compound.

(i) State what is meant by the term *unsaturated* compound.

.....

..... [1]

(ii) Name the process that produces smaller unsaturated hydrocarbon molecules from large saturated hydrocarbon molecules.

..... [1]

(iii) State the chemical test for an unsaturated hydrocarbon and give the observation for a positive result.

test .....

observation .....
[2]

[Total: 10]

12 **(a)** Electricity is generated in a nuclear power station by the nuclear fission of plutonium-239.

Describe what happens to a nucleus of plutonium-239 during nuclear fission.

..... [1]

(b) Plutonium-239 is an isotope of plutonium.

(i) State the meaning of *isotope*.

.....

..... [1]

(ii) Plutonium-239 emits β-radiation.

Suggest how a small sample of plutonium-239 can be stored safely.

..... [1]

(iii) Plutonium-239 has a half-life of 24 000 years.

A sample of plutonium-239 has a mass of 800 g.

Calculate the mass of plutonium-239 remaining after 48 000 years.

mass = ... g [2]

(iv) State two differences between β-radiation and γ-radiation.

1 .....

.....

2 .....

.....

[2]

(v) Fig. 12.1 shows an incomplete electromagnetic spectrum.

Place γ-radiation in its correct place in Fig. 12.1.

		ultraviolet	**visible light**		**microwaves**	

Fig. 12.1

[1]

[Total: 8]

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The Periodic Table of Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 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.).