Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

CO-ORDINATED SCIENCES **0654/33**

Paper 3 Theory (Core) **October/November 2024**

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.

[Turn over

1 **(a)** Fig. 1.1 is a diagram of the male reproductive system in humans.

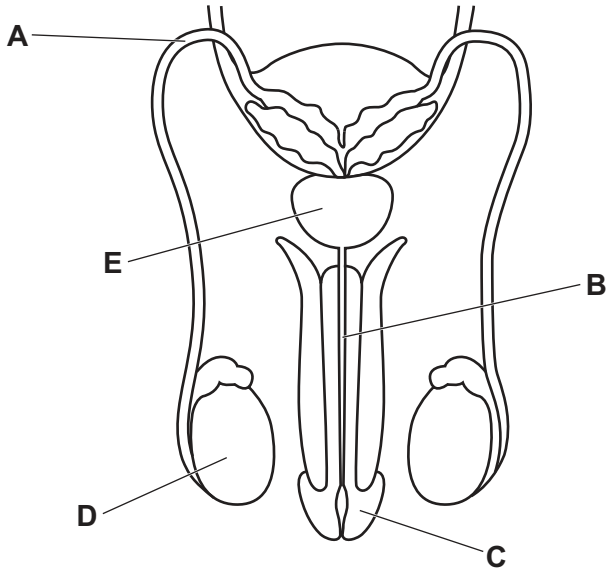


Fig. 1.1

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

carries urine and semen .....

produces sperm .....

transfers sperm to the urethra. .....

[3]

(ii) Draw an **X** on Fig. 1.1 to identify the position of the prostate gland. [1]

(b) Sperm cells are the male gametes in humans.

Sperm cells are 0.05 mm in length.

Female gametes are 0.1 mm in length.

(i) State the name of the female gametes in humans.

..... [1]

(ii) Calculate how many times longer female gametes are than male gametes.

..... [1]

(c) Sperm cells have a high rate of respiration.

(i) State the word equation for aerobic respiration.

..... [2]

(ii) Complete the sentence about respiration.

Respiration releases the ..... needed for cell division and movement. [1]

(d) Sperm cells are involved in fertilisation.

Describe the process of fertilisation in humans.

Include the site of fertilisation in your answer.

.....

.....

.....

.....

..... [3]

[Total: 12]

2 **(a)** Choose from the following substances to answer the questions.

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

aluminium
chlorine
copper(II) sulfate
ethanol
limestone
sulfur

(i) Used as a chemical test for water.

..... [1]

(ii) Used as a solvent.

..... [1]

(iii) Used in aircraft parts.

..... [1]

(iv) Used in the manufacture of sulfuric acid.

..... [1]

(v) Used in the treatment of the water supply.

..... [1]

(vi) Used in the treatment of acidic soil.

..... [1]

(b) Sulfuric acid has the formula H_2SO_4.

(i) State the total number of atoms in one molecule of sulfuric acid.

..... [1]

(ii) State the total number of different elements found in one molecule of sulfuric acid.

..... [1]

(c) A student reacts magnesium with dilute sulfuric acid.

The equation for the reaction is shown.

$$Mg(s) + H_2SO_4(aq) \rightarrow MgSO_4(aq) + H_2(g)$$

(i) State the names of the two products of the reaction.

1 .....

2 .....
[2]

(ii) State the separation technique used by the student to remove any unreacted solid magnesium from the reaction mixture.

..... [1]

[Total: 11]

3 A person climbs a mountain.

(a) The person is exposed to infrared and ultraviolet radiation from the Sun.

Infrared and ultraviolet radiation are part of the electromagnetic spectrum.

(i) Fig. 3.1 shows an incomplete electromagnetic spectrum.

On Fig. 3.1, write **infrared** and **ultraviolet** in their correct places.

increasing frequency ⟶

radio waves			visible light			γ-rays

Fig. 3.1

[2]

(ii) Ultraviolet waves travel at 300 000 000 m / s in a vacuum.

State the speed of infrared waves in a vacuum.

speed = ... m / s [1]

(b) The person makes a loud sound and then hears an echo.

State what is meant by an echo.

.....

..... [1]

(c) The person takes a photograph with a camera.

The camera contains a thin converging lens.

Fig. 3.2 shows an incomplete ray diagram for a thin converging lens forming an image.

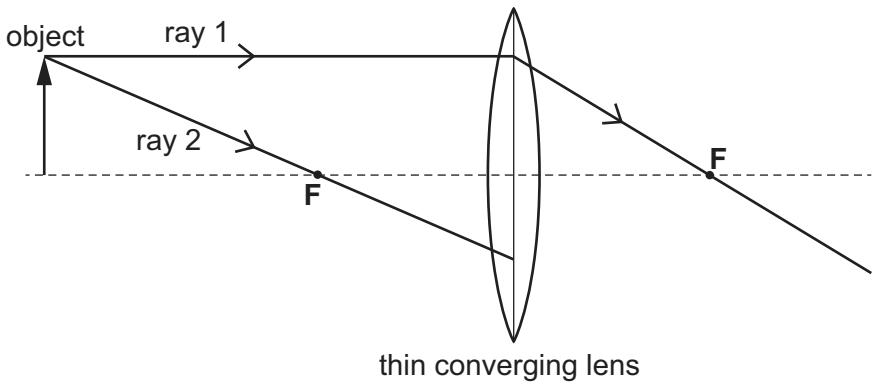


Fig. 3.2

(i) State the name of the points labelled **F** on Fig. 3.2.

..... [1]

(ii) On Fig. 3.2:
- draw a line to complete the path of ray 2
- draw the image formed
- label the image.

[2]

(d) The person drops the camera from the top of the mountain. The camera falls down the mountain.

Fig. 3.3 shows the distance–time graph for the motion of the camera over the first 6.0 s.

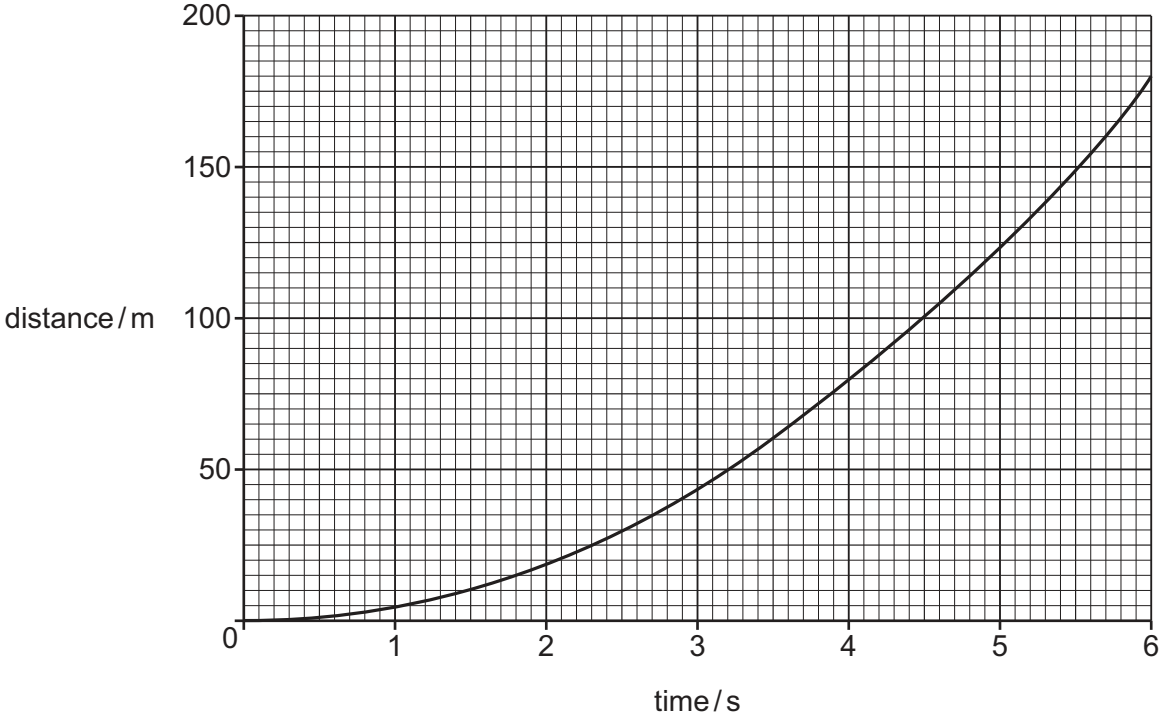


Fig. 3.3

Use Fig. 3.3 to determine the average speed of the camera over 6.0 s.

speed = ... m / s [3]

[Total: 10]

4 **(a)** Fig. 4.1 is a photomicrograph of a cross-section through a root.

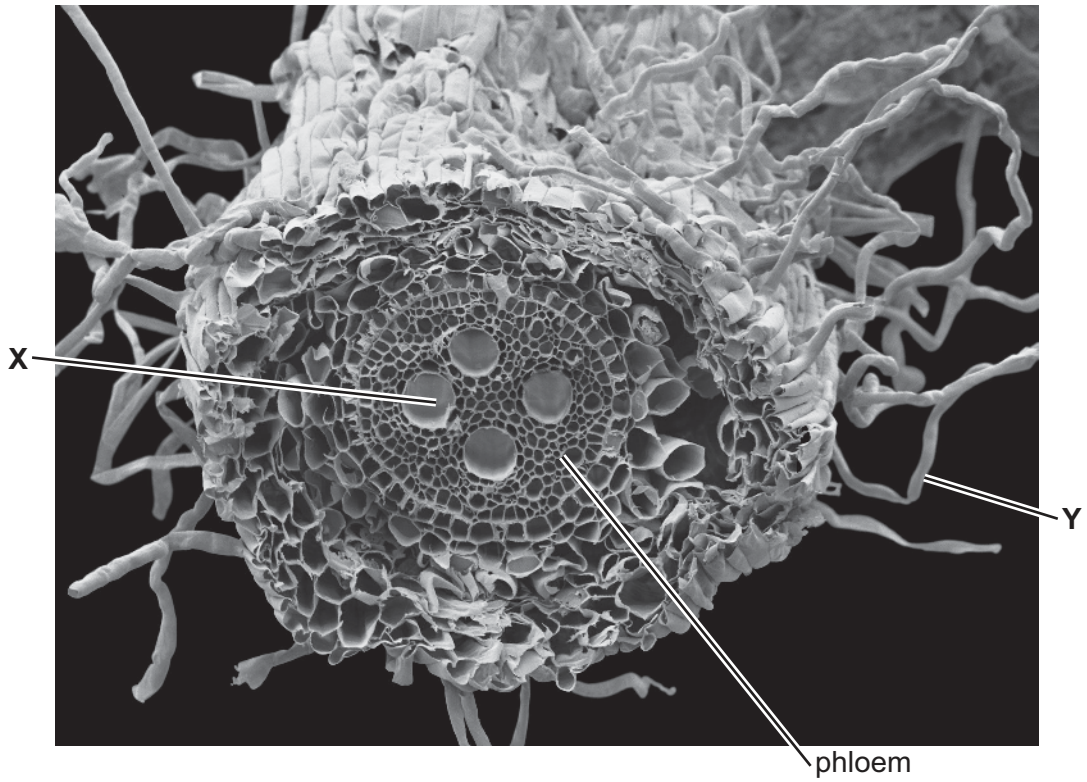


Fig. 4.1

The boxes on the left show the letters of the parts labelled **X** and **Y** in Fig. 4.1.

The boxes on the right show some functions.

Draw lines to link each part with its main function(s).

Draw **three** lines.

	absorption of water from soil
	photosynthesis
X	
	maintain a constant internal temperature
	transport of mineral ions
Y	
	transport of water
	transfers electrical impulses

[3]

(b) State the function of phloem.

.....

..... [1]

(c) Mineral ions are necessary for plant health.

(i) Explain why nitrate ions are required for growth.

.....

.....

.....

..... [2]

(ii) Magnesium ions are used to make a substance required for photosynthesis.

State the name of this substance.

..... [1]

(d) Table 4.1 shows some of the requirements for the processes of germination and photosynthesis.

Place ticks (✓) in the boxes to show the requirements for each process.

Table 4.1

	light	oxygen	carbon dioxide
photosynthesis			
germination			

[2]

[Total: 9]

5 **(a)** Chlorine reacts with hydrogen to make hydrogen chloride.

(i) Construct the word equation for this reaction.

..... + ... → .....

[1]

(ii) Hydrogen chloride gas is a covalent compound.

Explain why hydrogen chloride gas is a covalent compound and **not** an ionic compound.

.....

..... [1]

(iii) Fig. 5.1 shows the electronic structure in atoms of hydrogen and chlorine.

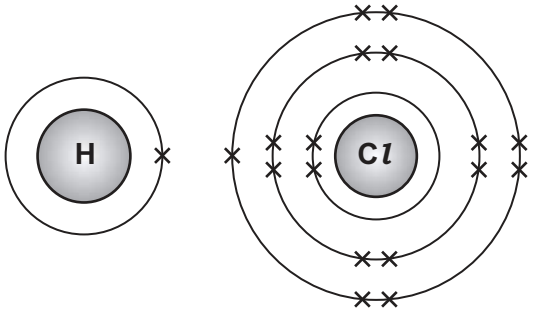


Fig. 5.1

Draw a dot-and-cross diagram to show the arrangement of outer-shell electrons in a molecule of hydrogen chloride gas.

[2]

(iv) Hydrogen chloride dissolves in water to make dilute hydrochloric acid.

The pH of the hydrochloric acid is found using a pH probe.

Describe **one other** way of finding the pH of dilute hydrochloric acid.

.....

.....

..... [2]

(v) Suggest the pH of the dilute hydrochloric acid.

pH ..... [1]

(b) Table 5.1 shows information about three Group VII elements.

Table 5.1

element	formula	melting point / °C	physical state at 20 °C
chlorine	Cl_2	–101	gas
bromine	Br_2	–7	liquid
iodine	.....	113	.....

(i) Complete Table 5.1. [2]

(ii) State the name given to Group VII of the Periodic Table.

..... [1]

(iii) Explain why chlorine, bromine and iodine are all in Group VII of the Periodic Table.

Use ideas about electrons in your answer.

.....

.....

..... [1]

[Total: 11]

6 **(a)** α-particles, β-particles and γ-rays are all used in hospitals to treat cancer.

Table 6.1 gives information about the nature and charge of these three radiations.

Table 6.1

radiation	nature	charge
α-particles	.....	positive
β-particles	electron	.....
γ-rays	electromagnetic wave	.....

(i) Complete Table 6.1. [3]

(ii) Place the three radiations in order of their ionising ability, from most ionising to least ionising.

most ionising .....

.....

least ionising .....

[1]

(iii) State which radiation is the most penetrating.

..... [1]

(b) X-rays and ultrasound waves are also used in hospitals.

(i) State **one** use of X-rays in hospitals.

.....

..... [1]

(ii) Ultrasound waves have a frequency that is too high for a human to hear.

Use your knowledge of the range of audible frequencies for a human to suggest the frequency of ultrasound waves.

frequency = ... Hz [1]

(c) A doctor in the hospital uses some sanitising hand liquid. The liquid contains ethanol, which evaporates from the skin of the doctor and cools the doctor's hands.

Explain why the evaporation of the ethanol causes the doctor's skin to cool.

Use ideas about molecules in your answer.

.....

.....

.....

.....

..... [3]

[Total: 10]

7 **(a)** Table 7.1 shows some information about five different enzymes.

Table 7.1

enzyme	pH range where the enzyme is active	pH value where the enzyme is the **most** active
A	4.5–8.5	6.5
B	1.0–4.0	2.5
C	7.0–11.0	9.0
D	1.0–3.0	1.5
E	6.0–8.5	7.0

(i) Identify the enzyme(s) from Table 7.1 that:

- have the widest pH range of activity ..... and .....
- is active at pH 5.5 .....
- is most active in alkaline conditions. .....

[3]

(ii) State **one other** factor, apart from pH, that affects the activity of enzymes.

..... [1]

(b) Circle **two** words that are used to describe enzymes.

carbohydrates **catalysts** **fats**

hormones **proteins** **solvents**

[2]

(c) The list shows some parts of the alimentary canal and associated organs.

anus **gall bladder** **mouth**

oesophagus **pancreas** **small intestine**

Choose words from the list to identify where each process occurs.
Each word may be used once, more than once or not at all.

mechanical digestion .....

egestion .....

ingestion .....

[3]

(d) Describe **one** similarity between absorption and assimilation.

.....

.....

..... [1]

[Total: 10]

8 **(a)** Copper is a metal in high demand that is now often recycled.

To recycle copper, it must be melted down into a liquid.

(i) Suggest **one** reason other than cost why copper and other metals are recycled.

.....

..... [1]

(ii) Describe **two** differences between the arrangement and motion of atoms in molten copper and the arrangement and motion of atoms in solid copper.

arrangement

.....

.....

motion

.....

.....

[2]

(b) A metal coin is covered with a layer of copper by electroplating.

(i) The coin is used as one of the electrodes.

State for which electrode the coin is used.

..... [1]

(ii) Suggest a suitable solution to be used as the electrolyte for electroplating the coin.

..... [1]

(iii) Electroplating uses the process of electrolysis; a definition is provided.

Electrolysis is the breakdown of a covalent compound when solid or in aqueous solution by the passage of electricity.

This definition of electrolysis is **not** correct.

Circle the **two** words in the definition that are **not** correct.

[2]

[Total: 7]

9 **(a)** The two boxes on the left each contain the name of an energy resource.

The four boxes on the right contain advantages or disadvantages of the energy resources.

Draw **two** lines from each energy resource to the advantages or disadvantages of the energy resource.

name of energy resource	**advantages or disadvantages of energy resource**
	non-polluting
coal	
	non-renewable
	polluting
geothermal	
	renewable

[2]

(b) The statements, **A** to **E**, describe processes in a coal-burning power station.

They are **not** in the correct order.

A Coal burns to produce thermal energy.

B A turbine drives a generator.

C Steam is produced.

D Steam turns a turbine.

E Thermal energy boils water.

(i) Use the letters **B** to **E** to complete the sequence to describe how the power station generates electricity.

A → ..... → ..... → ..... → ..... → electricity is generated

[2]

(ii) State the boiling point of water.

..... °C [1]

(c) When coal is burned in a power station, the energy in the coal is transferred to the energy outputs shown in Table 9.1.

The energy outputs are shown as percentages of the total energy from the coal.

Table 9.1

energy output	%
electrical energy	25
thermal energy in gases released	15
thermal energy from the cooling tower	60

(i) Explain why Table 9.1 shows that energy is conserved in the processes in the power station.

.....

..... [1]

(ii) The power station in Table 9.1 produces a lot of thermal energy.

Explain why the power station is **not** efficient.

.....

..... [1]

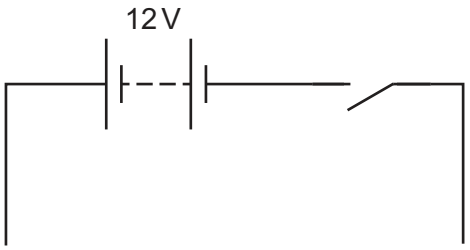
(d) The electricity generated from the power station is supplied to a house to power the lighting circuit.

Lamps for lighting in the house are connected in a parallel circuit and **not** in a series circuit.

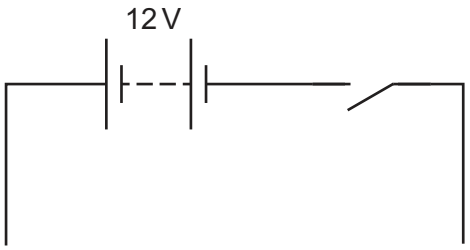
(i) Complete the circuit diagrams to show the difference between a series circuit and a parallel circuit.

Use two lamps in each circuit.

parallel circuit



series circuit



[3]

(ii) State **one** advantage of connecting lamps in parallel in a lighting circuit.

.....

..... [1]

[Total: 11]

10 (a) Scientists record the mass of each baby at birth in one country.

The results are shown in Fig. 10.1

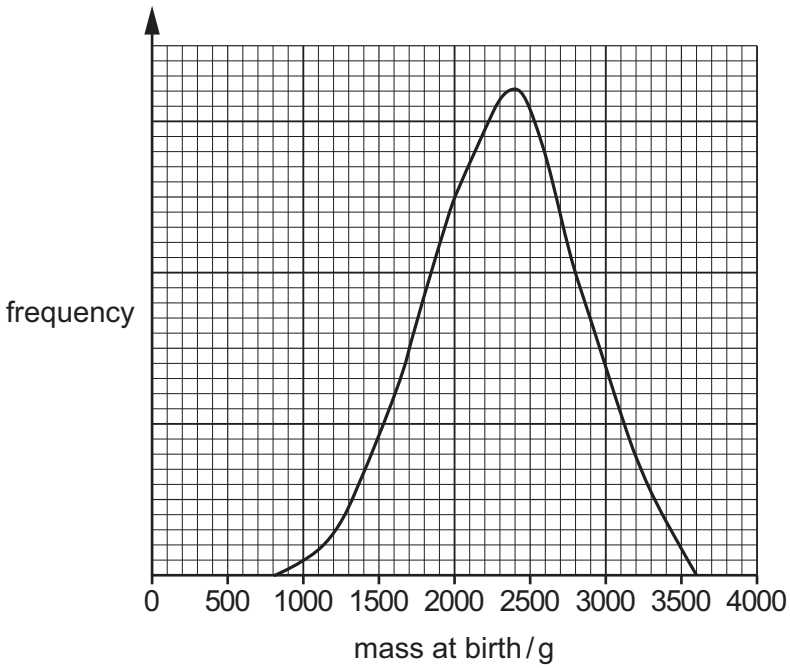


Fig. 10.1

(i) Complete the sentences about the mass of babies at birth as shown in Fig. 10.1.

The lowest mass at birth was ..... g.

The most frequent mass at birth was ..... g.

Fig. 10.1 shows that mass of babies at birth is an example of continuous variation.

This is because there is a ..... of phenotypes between two extremes.

A phenotype is defined as the ..... features of an organism.

[4]

(ii) State **one other** example of continuous variation in humans.

.....

..... [1]

(b) The statements **A–E** describe stages of natural selection.

They are **not** in the correct order.

A There is competition for resources.

B Those with adaptations best suited to their environment survive and reproduce.

C This process is repeated over several generations.

D There is variation in a population.

E Alleles are passed on to the next generation.

Complete the answer spaces to show the correct order.

One has been done for you.

..... → **A** → ..... → ..... → .....

[2]

(c) Alleles are made of DNA.

(i) Define the term allele.

.....

..... [1]

(ii) State where alleles are found in a cell.

..... [1]

[Total: 9]

11 **(a)** The proton numbers and nucleon numbers of carbon and hydrogen are shown in Table 11.1.

Table 11.1

	proton number	nucleon number
carbon	6	12
hydrogen	1	1

(i) State the number of neutrons in a carbon atom and the number of neutrons in a hydrogen atom.

carbon .....

hydrogen .....

[2]

(ii) State the number of electrons in a carbon atom.

..... [1]

(b) **(i)** State the difference between a saturated hydrocarbon and an unsaturated hydrocarbon.

.....

..... [1]

(ii) Aqueous bromine is used to show the difference between a saturated hydrocarbon and an unsaturated hydrocarbon.

Describe the result of the test with a saturated hydrocarbon.

.....

..... [1]

(c) Fig. 11.1 shows the apparatus used for the catalytic cracking of a saturated hydrocarbon.

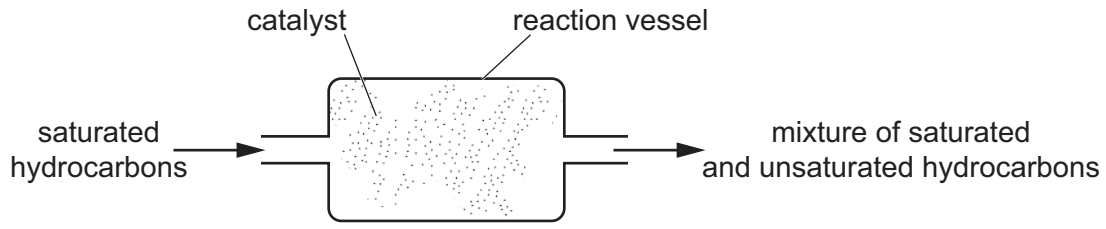


Fig. 11.1

(i) State the purpose of the catalyst in the cracking of a saturated hydrocarbon.

.....

..... [1]

(ii) Cracking is an endothermic reaction.

State what is meant by an endothermic reaction.

.....

.....

..... [1]

(d) The complete combustion of hydrocarbons produces the greenhouse gas carbon dioxide.

(i) Name **one other** greenhouse gas.

..... [1]

(ii) Identify the gas in the air that reacts with hydrocarbons during combustion.

..... [1]

(iii) Carbon dioxide is one of the gases found in clean air.

State the name of the **two** gases found in clean air in the greatest proportions.

1 .....

2 .....

[2]

[Total: 11]

12 **(a)** Fig. 12.1 shows an electric heater used in a classroom in a school.

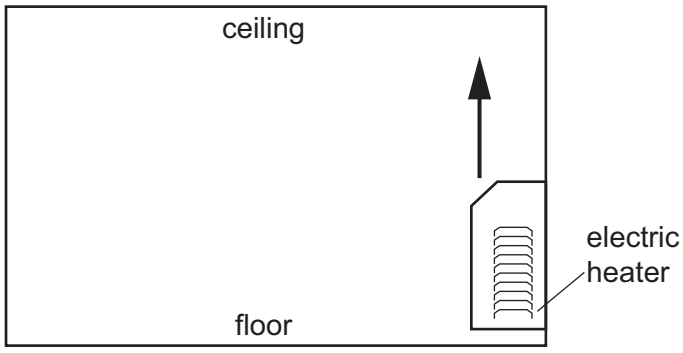


Fig. 12.1

The air around the heater is warmed.

(i) On Fig. 12.1 draw three more arrows to show how the warmed air moves around the classroom.

One arrow has been drawn for you. [2]

(ii) State the name of the method of thermal energy transfer you have drawn in **(a)(i)**.

..... [1]

(b) The teacher in the classroom measures the temperature in the room with a thermometer.

Fig. 12.2 shows the thermometer.

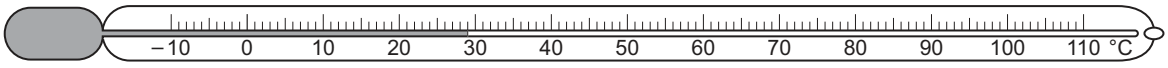


Fig. 12.2

(i) State the name of the temperature scale used on the thermometer.

..... [1]

(ii) State the name of a liquid that is used in thermometers.

..... [1]

(iii) State the physical property of the liquid that varies with temperature.

..... [1]

(c) (i) In the school an electric bell rings to show that the lesson has ended.

The bell makes sound waves that travel through the air.

Sound waves cannot travel through a vacuum.

Explain why sound **cannot** travel through a vacuum.

.....

..... [1]

(ii) Inside the electric bell there is a solenoid.

The solenoid coil is shown in Fig. 12.3.

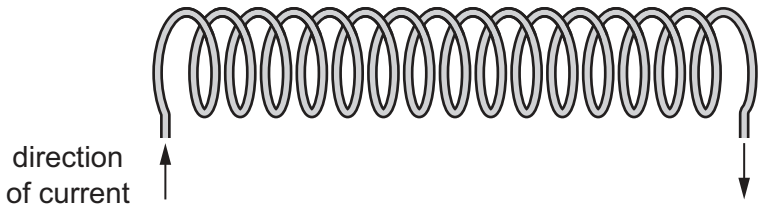


Fig. 12.3

On Fig. 12.3, draw the pattern of the magnetic field that is produced when an electric current passes through the solenoid as shown. [2]

[Total: 9]

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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 –	113 Nh nihonium –	114 Fl flerovium –	115 Mc moscovium –	116 Lv livermorium –	117 Ts tennessine –	118 Og oganesson –

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.).