Cambridge Assessment International Education

# Cambridge IGCSE™ (9–1)

**CO-ORDINATED SCIENCES** **0973/21**

Paper 2 Multiple Choice (Extended) **May/June 2023**

**45 minutes**

You must answer on the multiple choice answer sheet.

You will need: Multiple choice answer sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)

**INSTRUCTIONS**

- There are **forty** questions on this paper. Answer **all** questions.
- For each question there are four possible answers **A**, **B**, **C** and **D**. Choose the **one** you consider correct and record your choice in soft pencil on the multiple choice answer sheet.
- Follow the instructions on the multiple choice answer sheet.
- Write in soft pencil.
- Write your name, centre number and candidate number on the multiple choice answer sheet in the spaces provided unless this has been done for you.
- Do **not** use correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.

**INFORMATION**

- The total mark for this paper is 40.
- Each correct answer will score one mark.
- Any rough working should be done on this question paper.
- The Periodic Table is printed in the question paper.



IB23 06_0973_21/FP


**[Turn over**

**1** What is meant by respiration?

**A** protein synthesis

**B** sweating to lose heat

**C** the function of lungs

**D** the release of energy

**2** What is meant by osmosis?

**A** the net movement of water molecules from a region of higher water potential to a region of lower water potential through a cell wall

**B** the net movement of water molecules from a region of higher water potential to a region of lower water potential through a partially permeable membrane

**C** the net movement of water molecules from a region of lower water potential to a region of higher water potential through a cell wall

**D** the net movement of water molecules from a region of lower water potential to a region of higher water potential through a partially permeable membrane

**3** Linoleic acid is a fatty acid.

Which larger molecule may contain linoleic acid?

**A** glycogen

**B** oil

**C** protein

**D** starch

**4** Which row about enzymes is correct?

| | each enzyme catalyses many different reactions | the active site is the part of the enzyme where the substrate binds | enzymes are complex carbohydrates | enzymes are denatured at their optimum temperature | enzymes can work outside of cells |
|---|---|---|---|---|---|
| **A** | ✓ | ✓ | ✗ | ✗ | ✗ |
| **B** | ✓ | ✗ | ✓ | ✗ | ✓ |
| **C** | ✗ | ✓ | ✗ | ✗ | ✓ |
| **D** | ✗ | ✓ | ✓ | ✓ | ✗ |

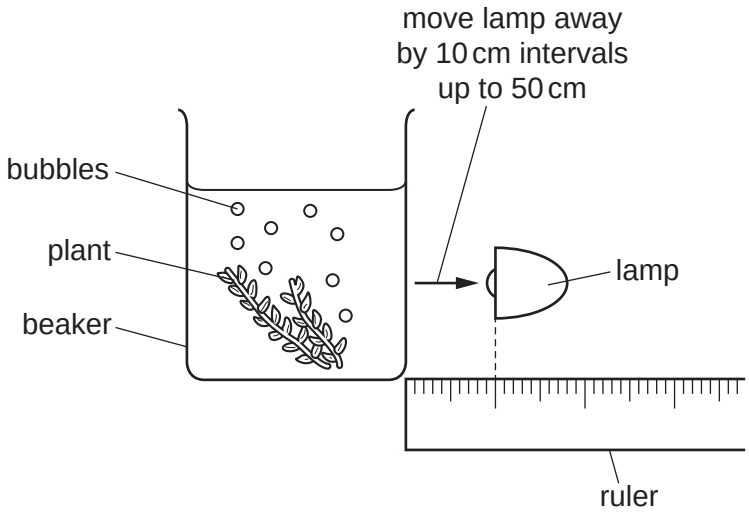
key

✓ = true

✗ = false

**5** An experiment is set up to investigate the effect of changing the light intensity on the rate of photosynthesis.

The lamp is moved in 10 cm intervals away from the plant and the number of bubbles of gas recorded in 60 seconds.




What will be the result of moving the lamp further away from the beaker containing the plant?

**A** The number of bubbles of carbon dioxide will decrease.

**B** The number of bubbles of carbon dioxide will increase.

**C** The number of bubbles of oxygen will decrease.

**D** The number of bubbles of oxygen will increase.

**6** Some processes that occur in the alimentary canal and associated organs are listed.

1 absorption

2 assimilation

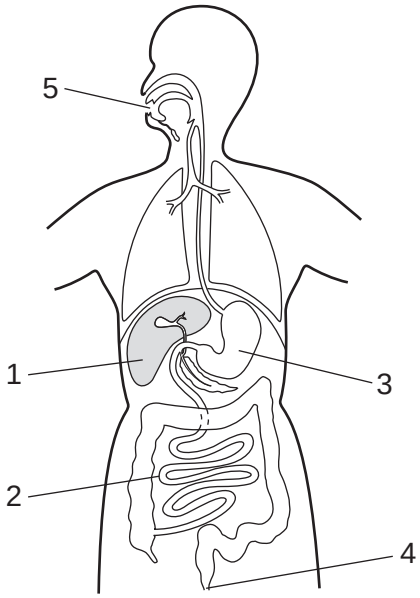
3 digestion

4 egestion

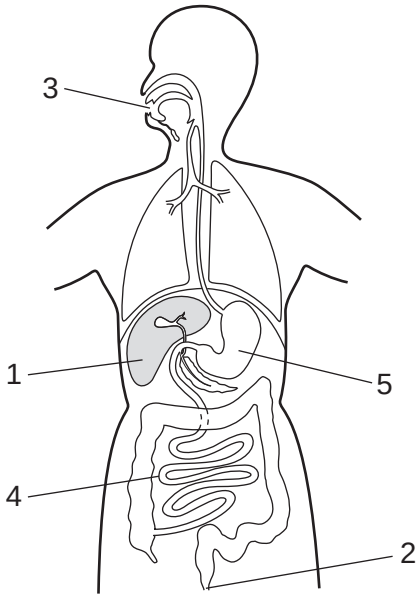
5 ingestion

Which diagram correctly links each process to the part of the alimentary canal or associated organs?

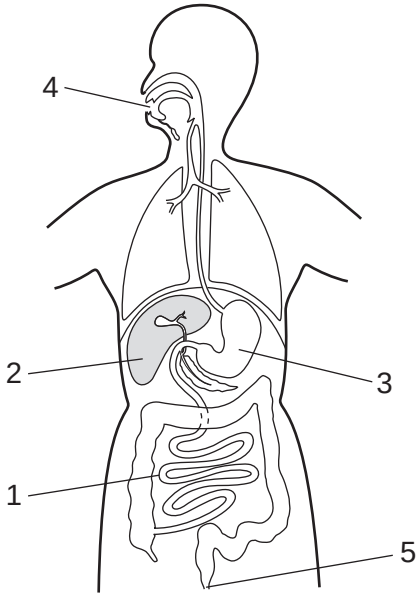
**A**



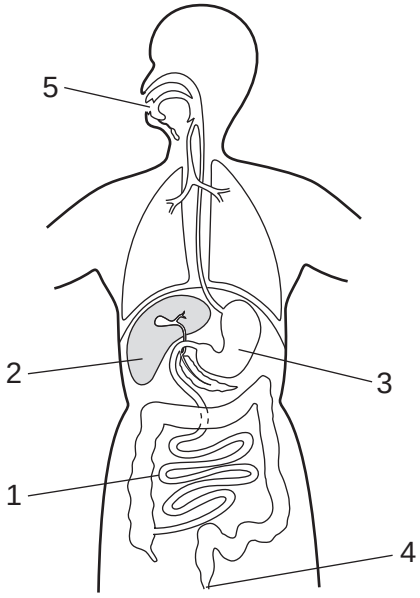

**B**




**C**




**D**



**7** What is the sequence of blood vessels that a red blood cell passes through as it travels from the vena cava to the kidney?

**A** pulmonary artery → pulmonary vein → aorta → renal artery

**B** pulmonary artery → pulmonary vein → aorta → renal vein

**C** pulmonary vein → pulmonary artery → aorta → renal artery

**D** pulmonary vein → pulmonary artery → aorta → renal vein

**8** Which statement about anaerobic respiration is correct?

**A** It does not cause an oxygen debt.

**B** It occurs in the muscles during vigorous exercise.

**C** It uses oxygen to release energy from nutrient molecules.

**D** It releases more energy per glucose molecule compared to aerobic respiration.

**9** What is the function of the cornea?

**A** It carries impulses to the brain.

**B** It controls how much light enters the pupil.

**C** It focuses light onto the retina.

**D** It refracts light.

**10** In a plant, what leads to offspring that are genetically identical to the parent?

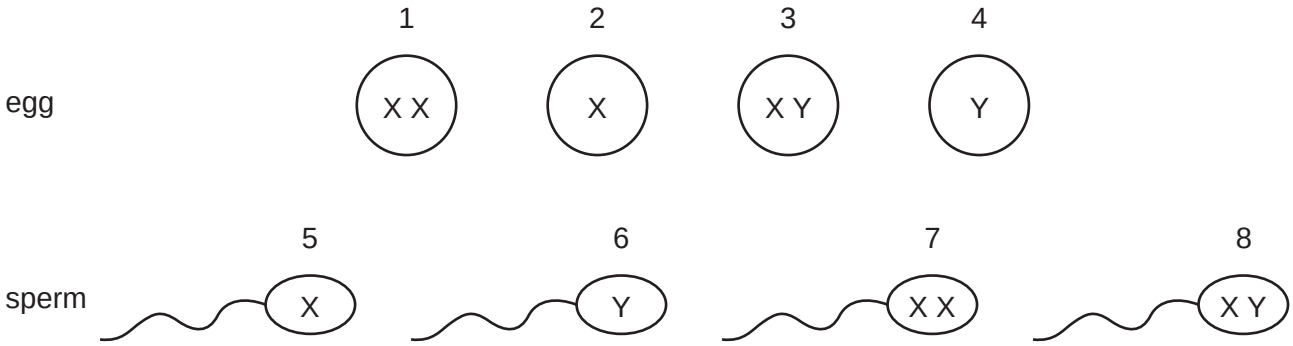
**A** asexual reproduction

**B** insect pollination

**C** seed germination

**D** sexual reproduction

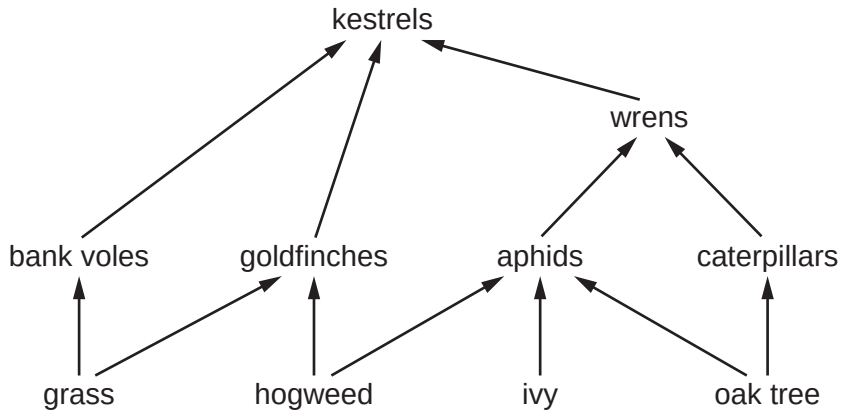
**11** The diagram shows eggs and sperm containing sex chromosomes.




Which row gives the correct combination of sex chromosomes for a male and female offspring?

| | male offspring | female offspring |
|---|---|---|
| **A** | 1 and 8 | 3 and 7 |
| **B** | 2 and 6 | 2 and 5 |
| **C** | 3 and 8 | 1 and 7 |
| **D** | 4 and 6 | 2 and 5 |

**12** The diagram shows a food web.




How many primary consumers, secondary consumers, tertiary consumers and quaternary consumers are present?

| | primary | secondary | tertiary | quaternary |
|---|---|---|---|---|
| **A** | 1 | 1 | 4 | 4 |
| **B** | 2 | 4 | 2 | 0 |
| **C** | 4 | 2 | 1 | 0 |
| **D** | 4 | 4 | 1 | 1 |

**13** What causes eutrophication?

**A** combustion of fossil fuels

**B** cutting down of forests

**C** discarded plastic rubbish

**D** overuse of nitrogen-containing fertiliser

**14** An aqueous salt solution contains an insoluble impurity.

Which processes are used to obtain pure salt crystals?

**A** distillation then crystallisation

**B** distillation then chromatography

**C** filtration then crystallisation

**D** filtration then chromatography

**15** The element phosphorus burns in air, as shown.

$$4P + 5O_2 \rightarrow P_4O_{10}$$

What does the formula $P_4O_{10}$ show?

**A** a mixture of atoms of two elements

**B** a mixture of molecules of two elements

**C** a molecule of a compound

**D** an atom of a compound

**16** Which row describes an atom that has the nucleon number 24?

| | number of protons | number of neutrons | number of electrons |
|---|---|---|---|
| **A** | 8 | 8 | 8 |
| **B** | 12 | 12 | 12 |
| **C** | 21 | 24 | 21 |
| **D** | 24 | 28 | 24 |

**17** Which symbol equation is **not** balanced?

**A** $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

**B** $Fe_3O_4 + 2H_2 \rightarrow 3Fe + 2H_2O$

**C** $Mg(OH)_2 + 2HCl \rightarrow MgCl_2 + 2H_2O$

**D** $2Na + 2H_2O \rightarrow 2NaOH + H_2$

**18** Sodium hydroxide is manufactured by the electrolysis of concentrated aqueous sodium chloride.

During the process, a gas is given off at each electrode and the aqueous sodium hydroxide collects around one of the electrodes.

Which row identifies the gas at each electrode and the electrode around which the aqueous sodium hydroxide collects?

| | at the anode | at the cathode | electrode at which sodium hydroxide collects |
|---|---|---|---|
| **A** | chlorine | hydrogen | cathode |
| **B** | chlorine | hydrogen | anode |
| **C** | oxygen | chlorine | cathode |
| **D** | oxygen | chlorine | anode |

**19** Which row explains why increasing the concentration of a reactant increases the rate of reaction?

| | proportion of particles with the minimum energy to react | collision frequency between reacting particles |
|---|---|---|
| **A** | increases | increases |
| **B** | increases | stays the same |
| **C** | stays the same | increases |
| **D** | stays the same | stays the same |

**20** Which statements about neutralisation are correct?

1 Acids and bases produce water when they neutralise each other.

2 During neutralisation, bases transfer protons to acids.

3 Neutral solutions turn universal indicator green.

4 During neutralisation, acids transfer hydroxide ions to bases.

**A** 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

**21** The properties of some substances are listed.

1 form acidic oxides

2 have high melting points

3 act as catalysts

4 form coloured compounds

What are the properties of transition metals?

**A** 1, 2 and 3 **B** 1, 2 and 4 **C** 1, 3 and 4 **D** 2, 3 and 4

**22** Which atmospheric pollutant is removed from air by lime?

**A** ammonia

**B** carbon monoxide

**C** hydrocarbons

**D** sulfur dioxide

**23** Which row describes how hydrogen and nitrogen are obtained for use in the Haber process?

| | hydrogen | nitrogen |
|---|---|---|
| **A** | electrolysis of sulfuric acid | catalytic reduction of nitrogen oxides |
| **B** | electrolysis of sulfuric acid | distillation of air |
| **C** | reaction of methane and steam | catalytic reduction of nitrogen oxides |
| **D** | reaction of methane and steam | distillation of air |

**24** Equations representing reactions in the Contact process are listed.

reaction 1 $S + O_2 \rightarrow SO_2$

reaction 2 $2SO_2 + O_2 \rightleftharpoons 2SO_3$

reaction 3 $H_2SO_4 + SO_3 \rightarrow H_2S_2O_7$

reaction 4 $H_2S_2O_7 + H_2O \rightarrow 2H_2SO_4$

Which row identifies the reactions that use the stated conditions?

| | requires a vanadium(V) oxide catalyst | requires a temperature of 450 °C | requires a pressure of 2 atmospheres |
|---|---|---|---|
| **A** | reaction 2 | reaction 1 | reaction 4 |
| **B** | reaction 2 | reaction 2 | reaction 2 |
| **C** | reaction 3 | reaction 1 | reaction 2 |
| **D** | reaction 3 | reaction 2 | reaction 4 |

**25** Which statements about limestone are correct?

1 Its main constituent is calcium oxide.

2 It can be used to manufacture lime.

3 It thermally decomposes to release carbon dioxide.

4 It is used to neutralise alkaline soils.

**A** 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

**26** Petroleum is separated into fractions by fractional distillation.

Information about uses of some fractions and positions in the fractionating column where they are collected is shown.

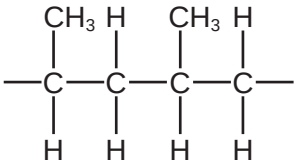
| | fraction | use | position |
|---|---|---|---|
| 1 | gasoline | making roads | below refinery gas |
| 2 | bitumen | petrol for car engines | bottom of column |
| 3 | naphtha | making chemicals | below gasoline |
| 4 | refinery gas | heating and cooking | top of column |

Which rows are correct?

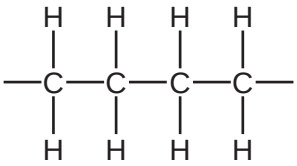
**A** 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

**27** Which structure represents the addition polymer made from the monomer propene, $C_3H_6$?

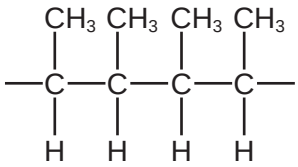
**A**



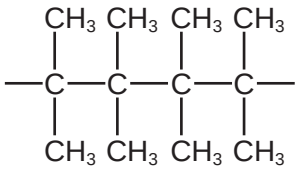
**B**



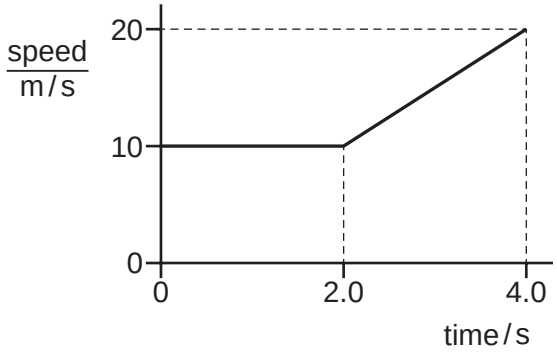
**C**



**D**



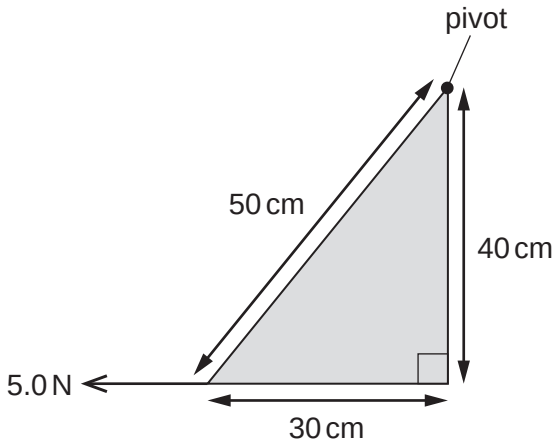
**28** The diagram shows the speed–time graph for a moving object.




What is the distance travelled by the object in 4.0 s?

**A** 30 m **B** 40 m **C** 50 m **D** 80 m

**29** The diagram shows a triangular sheet of metal with sides of length 50 cm, 40 cm and 30 cm. The sheet is free to move about a pivot at the top corner, as shown.




A cord is attached to the bottom left corner of the sheet and pulled with a horizontal force of 5.0 N to the left.

What is the moment of the 5.0 N force about the pivot?

**A** 150 N cm **B** 200 N cm **C** 250 N cm **D** 600 N cm

**30** A machine has useful output energy of 1000 J and wasted energy of 300 J.

Which expression is used to calculate the efficiency of the machine?

**A** $\frac{300}{1000 + 300} \times 100\%$

**B** $\frac{300}{1000} \times 100\%$

**C** $\frac{1000 - 300}{1000} \times 100\%$

**D** $\frac{1000}{1000 + 300} \times 100\%$

**31** Which statement about thermal radiation is correct?

**A** A dull surface is a good absorber and a good reflector of thermal radiation.

**B** A dull surface is a poor absorber and a poor reflector of thermal radiation.

**C** A shiny surface is a good absorber but a poor reflector of thermal radiation.

**D** A shiny surface is a poor absorber but a good reflector of thermal radiation.

**32** A student stands in front of a plane mirror on a wall.

Which statement about the image of the student is **not** correct?

**A** The image is laterally inverted (left to right).

**B** The image is smaller than the student.

**C** The image is upright.

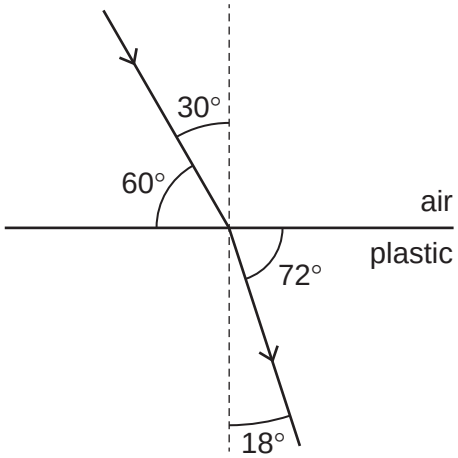
**D** The student and the image are equal distances from the mirror.

**33** A wave has a frequency of 3.0 MHz and a speed of 1500 m / s.

What is the wavelength of the wave?

**A** $5.0 \times 10^{-4}$ m **B** 0.50 m **C** 500 m **D** 4500 m

**34** The diagram shows a ray of light passing from air into plastic. The sizes of four angles are given.




The table gives the value of the sine of each angle.

| angle / ° | sine |
|---|---|
| 18 | 0.31 |
| 30 | 0.50 |
| 60 | 0.87 |
| 72 | 0.95 |

What is the refractive index of the plastic?

**A** 0.62 **B** 0.92 **C** 1.6 **D** 1.7

**35** Two insulators are charged by rubbing them with a cloth.

After this, the charged insulators repel each other.

Which statement is a possible description of how the insulators become charged?

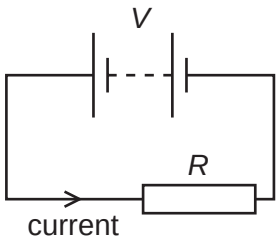
**A** One gained electrons and the other gained protons.

**B** One gained electrons and the other lost electrons.

**C** They both lost electrons.

**D** They both lost protons.

**36** A battery of e.m.f. $V$ is connected across a resistor of resistance $R$. There is a current in the resistor.




Which row shows two changes that **both** increase the current in the resistor?

| | change 1 | change 2 |
|---|---|---|
| **A** | decrease $V$ | decrease $R$ |
| **B** | decrease $V$ | increase $R$ |
| **C** | increase $V$ | decrease $R$ |
| **D** | increase $V$ | increase $R$ |

**37** An electric kettle is connected to a 250 V supply. The current in the heating element of the kettle is 10 A.

How much electrical energy is transferred in 3.0 minutes?

**A** 75 J **B** 4500 J **C** 7500 J **D** 450 000 J

**38** Fuses are used in domestic electric circuits.

Which statement about fuses is correct?

**A** A fuse is connected in the live wire.

**B** A fuse is connected in the neutral wire.

**C** A 3.0 A fuse produces a current of exactly 3.0 A in the circuit.

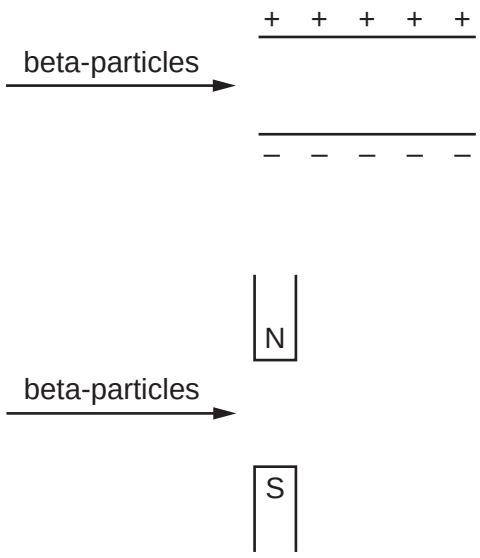
**D** A 3.0 A fuse produces a minimum current of 3.0 A in the circuit.

**39** A radioactive nucleus $^{238}_{92}U$ decays into a thorium (Th) nucleus by emitting an alpha-particle.

What is the symbol for the thorium nucleus formed?

**A** $^{234}_{90}Th$ **B** $^{234}_{92}Th$ **C** $^{238}_{90}Th$ **D** $^{238}_{92}Th$

**40** The diagrams show a beam of beta-particles passing into an electric field and another beam of beta-particles passing into a magnetic field.




In which direction is the beam deflected in each case?

| | electric field | magnetic field |
|---|---|---|
| **A** | towards the negative plate | into the page |
| **B** | towards the negative plate | out of the page |
| **C** | towards the positive plate | into the page |
| **D** | towards the positive plate | out of the page |

## 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.).