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Cambridge Assessment International Education

Cambridge IGCSE™ (9–1)

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CO-ORDINATED SCIENCES **0973/41**

Paper 4 Theory (Extended) **October/November 2025**

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.
- Take the weight of 1.0 kg to be 9.8 N (acceleration of free fall = 9.8 m/s^2).

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 (WW) 363254

[Turn over

1 **(a)** Hormones are chemical substances produced in the body.

(i) Complete the sentences about hormones.

Hormones are chemical substances, produced by a type of organ

called a ..... .

Hormones are carried by the ..... .

Hormones alter the activity of one or more specific ..... organs.

[3]

(ii) Fig. 1.1 is a diagram showing some of the organs of the body that produce hormones.

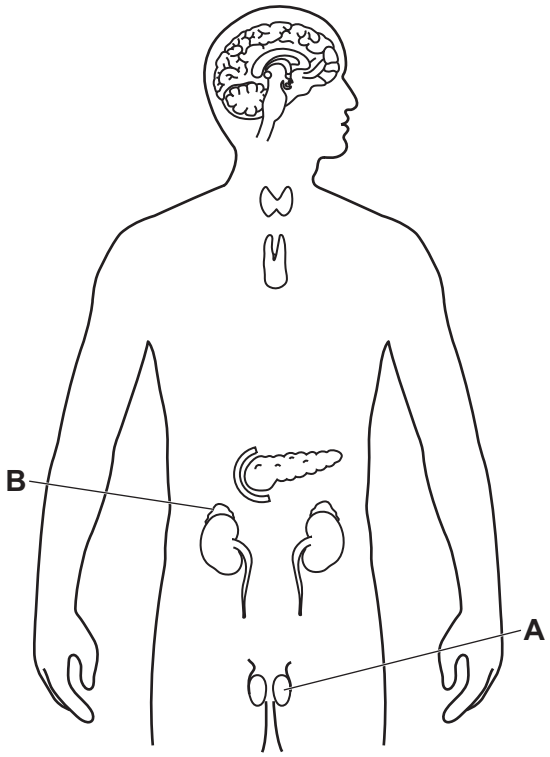

Fig. 1.1

Use Fig. 1.1 to complete Table 1.1.

Table 1.1

letter	name of organ	hormone produced
A	.....	.....
B	.....	.....

[4]

(b) The concentration of glucose in the blood must be kept within a very narrow range.

Fig. 1.2 shows the control of blood glucose concentration by hormone **J** and hormone **K**.

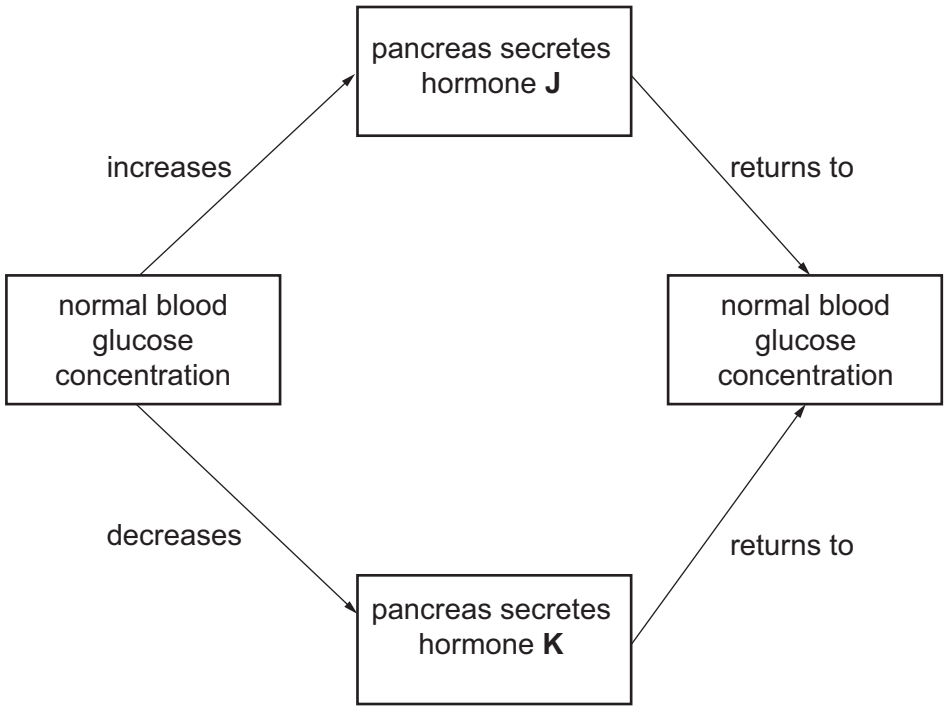

Fig. 1.2

(i) Use Fig. 1.2 to identify:

hormone **J** .....

hormone **K**. .....

[2]

(ii) Identify the type of homeostatic control shown in Fig. 1.2.

..... [1]

[Total: 10]

2 **(a)** Fig. 2.1 is a diagram of the breathing system in humans.

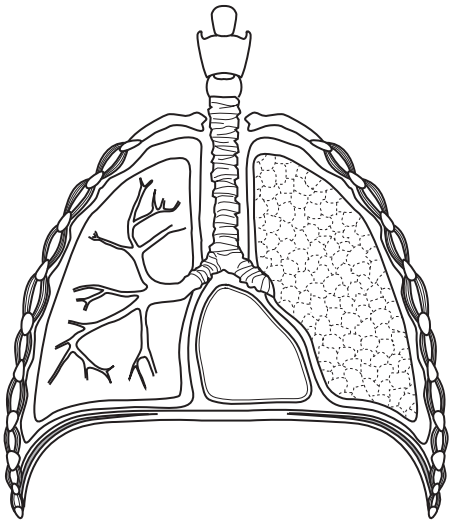

Fig. 2.1

(i) On Fig. 2.1:

draw a label line and letter **L** to identify the larynx

draw a label line and letter **B** to identify a bronchus.

[2]

(ii) Describe **two** features of the gas exchange surface in humans.

1 .....

.....

2 .....

.....

[2]

(b) **(i)** State the balanced symbol equation for aerobic respiration.

..... + ... → ..... + ...

[2]

(ii) Anaerobic and aerobic respiration occur in the human body.

Describe **two** ways anaerobic respiration is different from aerobic respiration in the human body.

difference 1 .....

.....

difference 2 .....

.....

[2]

(c) Fig. 2.2 shows a diagram of the adaptive features of a sperm.

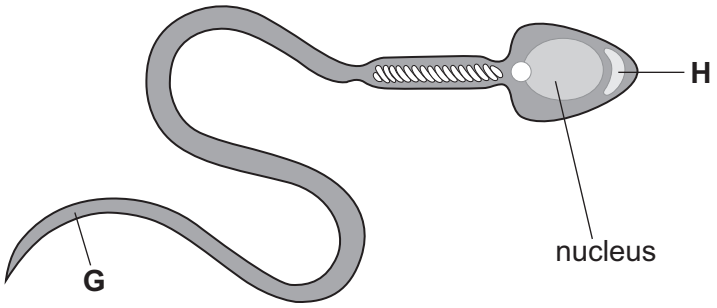

Fig. 2.2

(i) State the function of the part labelled **G** in Fig. 2.2.

..... [1]

(ii) Name structure **H** shown in Fig. 2.2 and state its function.

name .....

function .....

..... [2]

(iii) The nucleus of the sperm cell is haploid.

Describe what is meant by a haploid nucleus.

.....

..... [1]

[Total: 12]

3 Fig. 3.1 is a diagram showing some of the organisms in the Arctic ecosystem.

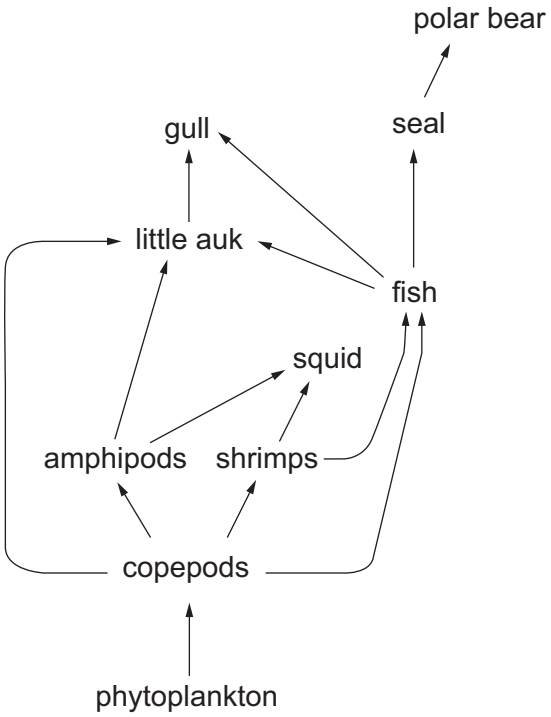

Fig. 3.1

(a) (i) State the name of the type of diagram shown in Fig. 3.1.

..... [1]

(ii) Identify the producer in Fig. 3.1.

..... [1]

(iii) Identify **one** organism that occupies the **second** trophic level in Fig. 3.1.

..... [1]

(iv) Identify **one** organism that is **both** a secondary and a tertiary consumer in Fig. 3.1.

..... [1]

(v) The squid is a carnivore.

Describe what is meant by the term carnivore.

.....

..... [1]

(vi) Explain why the energy transfer from one trophic level to another is **not** efficient.

.....

.....

.....

.....

..... [2]

(b) Deforestation on land can lead to a loss of soil as shown in Fig. 3.2.

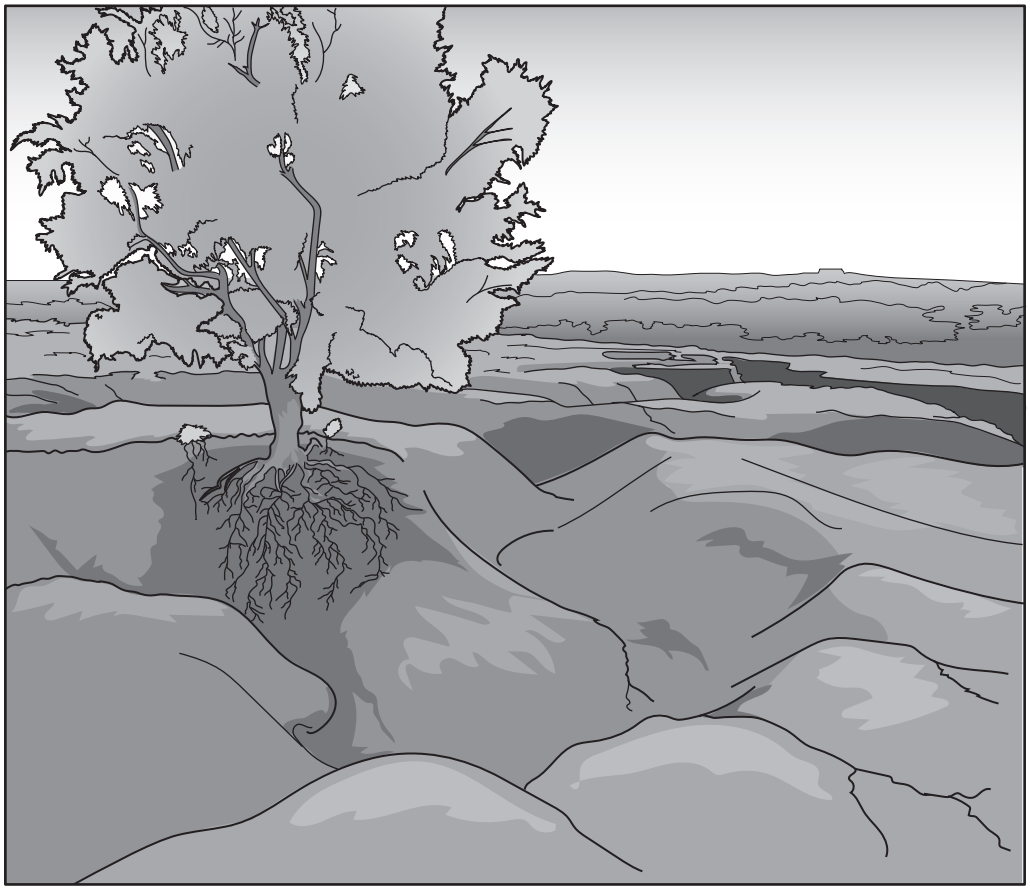

Fig. 3.2

(i) Explain how deforestation can increase the concentration of carbon dioxide in the atmosphere.

.....

.....

.....

.....

..... [2]

(ii) Explain how deforestation can lead to flooding.

.....

.....

.....

.....

..... [2]

[Total: 11]

4 **(a)** **(i)** Mitosis is a type of cell division.

State **two** roles of mitosis in the human body.

1 .....

2 .....

[2]

(ii) Describe what happens to the chromosomes before mitosis occurs.

.....

..... [1]

(b) Meiosis is another type of cell division.

Place **one** tick (✓) in each row to show if the process occurs in mitosis, meiosis or both.

process	mitosis	meiosis	both
produces diploid cells			
produces genetically different cells			
separates chromosomes			
produces pollen			

[2]

(c) Pathogens infect human cells.

Describe how active immunity is gained after an infection by a pathogen.

.....

.....

.....

.....

..... [2]

[Total: 7]

5 **(a)** Different substances can be elements, compounds, or mixtures.

Draw a line from each substance to the definition.

substance	definition
element	contains atoms of two or more elements joined together chemically
compound	contains two or more substances that are joined together physically
mixture	contains only one type of atom

[2]

(b) The properties of the Group I alkali metals show trends down the group.

Tick (✓) the correct box in each row of Table 5.1 to show the trends **down** the group.

Table 5.1

	increases	decreases	stays the same
density			
melting point			
reactivity with water			

[3]

(c) The Group I element sodium reacts with oxygen to make sodium oxide, Na_2O.

Fig. 5.1 shows the electronic structures of a sodium atom and an oxygen atom.

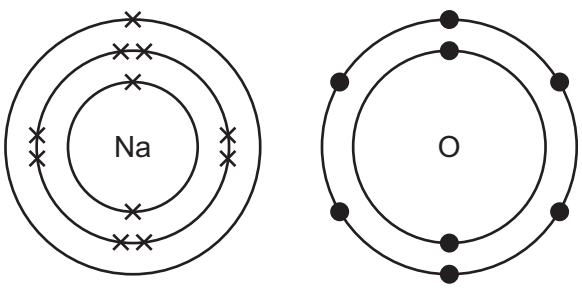

Fig. 5.1

Draw the electronic structures of the sodium ion and oxide ion in sodium oxide.

Include the charges on the ions.

[3]

(d) Explain why **molten** sodium oxide conducts electricity, but **solid** sodium oxide does not conduct electricity.

.....

.....

.....

..... [2]

[Total: 10]

6 Hydrogen-oxygen fuel cells use hydrogen and oxygen to produce electricity.

(a) The reactions at the electrodes in a hydrogen-oxygen fuel cell are shown.

anode: $H_2 \rightarrow 2H^+ + 2e^-$

cathode: $4H^+ + O_2 + 4e^- \rightarrow 2H_2O$

(i) State the **name** of the only chemical product in a hydrogen-oxygen fuel cell.

..... [1]

(ii) Explain why the reaction between hydrogen and oxygen in a fuel cell involves oxidation.

.....

..... [1]

(b) Table 6.1 shows information about using a hydrogen-oxygen fuel cell and a petrol engine for powering cars.

Table 6.1

	availability of fuel	cost of fuel refill	refuelling time	range / km	pollution
hydrogen-oxygen fuel cell	limited	£47	3–5 minutes	502	no pollution
petrol engine	excellent	£70	1–2 minutes	563	high levels of carbon dioxide and oxides of nitrogen

Suggest which fuel would be most suitable to power a car.

Explain your answer.

fuel .....

explanation .....

.....

.....

.....

.....

[3]

(c) Oxides of nitrogen are formed in petrol car engines.

(i) State one adverse effect of oxides of nitrogen.

..... [1]

(ii) Explain how oxides of nitrogen form in petrol car engines.

.....

.....

..... [2]

(iii) Oxides of nitrogen and carbon monoxide are removed from a car engine by a catalytic converter.

Complete the balanced symbol equation for the reaction that takes place.

$2CO + 2NO \rightarrow$ ..... + ...

[2]

[Total: 10]

7 **(a)** A student tests three different solutions to identify the ion in each solution.

Draw lines to match each **test** to the **observation** and the **ion** in each solution.

test	observation	ion
add aqueous sodium hydroxide	cream precipitate	SO_4^{2-}
acidify with dilute nitric acid and then add aqueous silver nitrate	blue precipitate	Br^-
acidify with dilute nitric acid and then add aqueous barium nitrate	white precipitate	Cu^{2+}

[3]

(b) Dilute sulfuric acid, H_2SO_4, reacts with solid copper oxide, CuO.

Copper sulfate solution and water are made.

(i) Construct the balanced symbol equation for this reaction.

Include state symbols.

..... (.....) + ... (.....) → ..... (.....) + ... (.....) [3]

(ii) Tick (✓) the correct box to identify the type of reaction that takes place.

combustion ☐

cracking ☐

neutralisation ☐

thermal decomposition ☐

[1]

(iii) The reaction between dilute sulfuric acid and copper oxide is faster when more concentrated acid is used.

Explain why, using collision theory.

.....

.....

..... [2]

(iv) The enthalpy change, ΔH, for the reaction is negative.

Fig. 7.1 shows two reaction pathway diagrams, **A** and **B**.

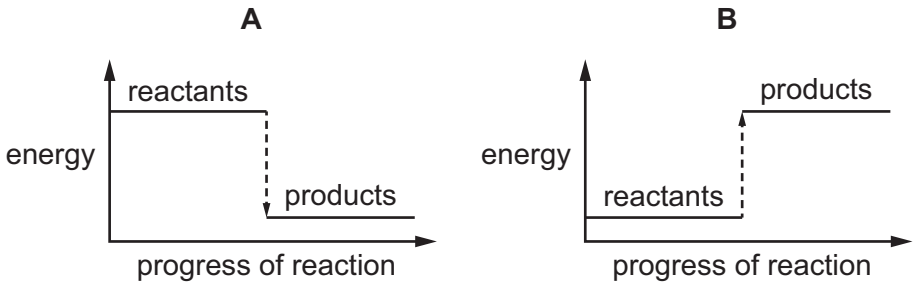

Fig. 7.1

State which of these reaction pathway diagrams, **A** or **B**, represents the energy change for this reaction.

Explain your answer.

diagram .....

explanation .....

.....

.....

[2]

[Total: 11]

8 Petroleum is separated into useful fractions by fractional distillation.

(a) Table 8.1 shows the boiling point range of three fractions obtained from petroleum.

Table 8.1

fraction	boiling point range / °C
naphtha	90 to 200
refinery gas	less than 25
diesel oil	150 to 380

State which fraction is obtained at the top of the fractionating column.

..... [1]

(b) The diesel oil fraction can be cracked to make hydrocarbon molecules containing seven and eight carbon atoms.

State which pair of hydrocarbon molecules would both turn aqueous bromine colourless.

Tick (✓) one box.

C_7H_{14} and C_8H_{18} ☐

C_7H_{14} and C_8H_{16} ☐

C_7H_{16} and C_8H_{16} ☐

C_7H_{16} and C_8H_{18} ☐

[1]

(c) Another fraction obtained from crude oil is petrol.

Petrol contains alkane molecules with the formula C_9H_{20}.

(i) Complete the sentence about alkane molecules.

The bonding between carbon atoms in alkanes is ..... covalent and

alkanes are ..... hydrocarbons.

[2]

(ii) The equation for the complete combustion of petrol is shown.

$$C_9H_{20} + 14O_2 \rightarrow 9CO_2 + 10H_2O$$

Calculate the maximum volume of carbon dioxide, in dm^3 measured at room temperature and pressure, that is made from 6.4 kg of petrol.

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

[A_r: C, 12; H, 1; O, 16]

volume of carbon dioxide = ... dm^3 [3]

(d) Refinery gas contains propane, C_3H_8.

Draw a diagram to show the displayed formula of propane.

[2]

[Total: 9]

9 **(a)** **(i)** Define the moment of a force.

.....

..... [1]

(ii) State **two** conditions for an object to be in equilibrium.

1 .....

.....

2 .....

.....

[2]

(b) A metre ruler is pivoted about a point 22 cm from one end.

An object of mass 40 g is suspended 5.0 cm from the same end so that the system is in equilibrium. This is shown in Fig. 9.1.

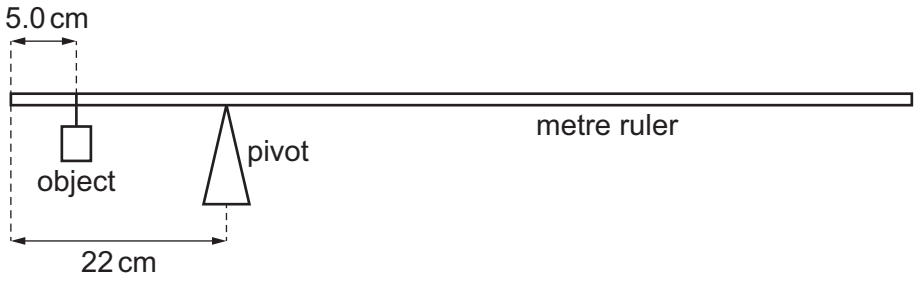

Fig. 9.1 (not to scale)

(i) Calculate the weight of the object.

weight = ... N [2]

(ii) Calculate the weight of the metre ruler.

weight = ... N [3]

[Total: 8]

Question 10 starts on the next page.

10 (a) A student investigates a simple d.c. motor.

Fig. 10.1 shows a diagram of a simple d.c. motor.

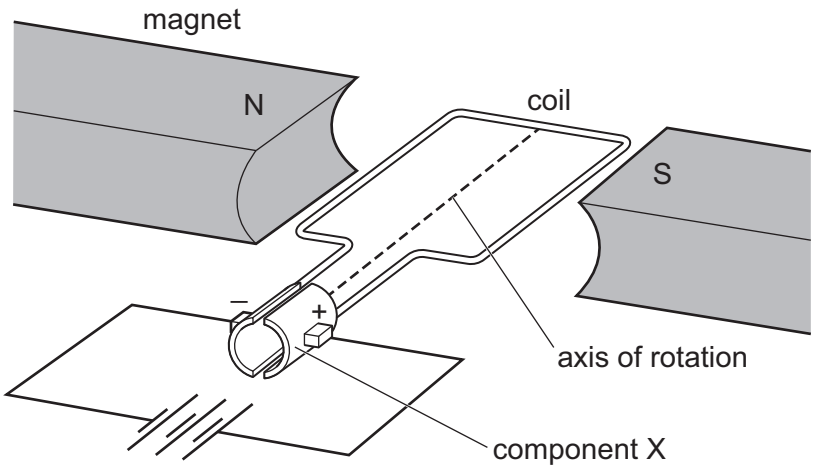

Fig. 10.1

(i) The motor consists of a current-carrying coil in a magnetic field. The coil experiences a turning effect.

State three ways the turning effect can be increased.

1 .....

2 .....

3 .....

[3]

(ii) State the name of component X.

..... [1]

(iii) Describe how component X is used to give continuous rotation of the coil.

.....

.....

..... [2]

(b) Transformers are used in the distribution of electricity.

(i) State the type of transformer used at power stations to supply power to the electricity network.

..... [1]

(ii) Explain why the use of this transformer means power losses in transmission cables are smaller.

.....

.....

..... [3]

(c) A transformer is connected to a 230 V mains supply.

An output of 3.6 V is required.

The secondary coil has 720 turns.

Calculate the number of turns on the primary coil.

number of turns = ... [2]

[Total: 12]

11 **(a)** The isotope carbon-14 (C-14) decays to form an isotope of nitrogen (N) by emitting a beta particle.

Complete the decay equation for this nuclear decay.

$$^{14}_{6}C \rightarrow \begin{matrix}\cdots\cdots\\ \cdots\cdots\end{matrix}\beta + \begin{matrix}\cdots\cdots\\ \cdots\cdots\end{matrix}N$$

[2]

(b) Thin aluminium foil is manufactured by passing thick sheets of aluminium between rollers.

Radioactive sources are used to measure and control the thickness of the aluminium foil, as shown in Fig. 11.1.

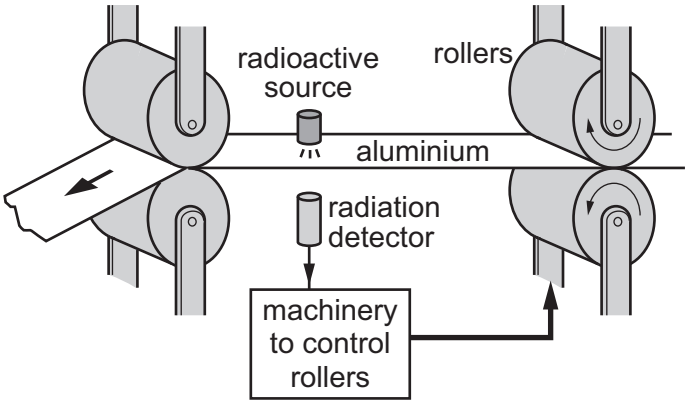

Fig. 11.1

Suggest which type of radiation would be suitable for use in measuring and controlling the thickness of the aluminium foil.

Explain your answer.

radiation .....

explanation .....

.....

.....

[3]

(c) Carbon-14 has a half-life of 5700 years.

A 5.0 g sample of wood from a living tree has an activity of 28 counts per minute due to the decay of carbon-14.

A 5.0 g sample of dead wood from the hull of an ancient wooden boat has an activity of 7 counts per minute due to the decay of carbon-14.

Calculate the age of the wood from the hull of the boat.

age = ... years [2]

(d) Nuclear reactions occur in stable stars.

(i) State the type of nuclear reactions that take place in a stable star.

..... [1]

(ii) State what is produced in these nuclear reactions.

.....

..... [2]

[Total: 10]

12 (a) (i) Seismic P-waves are longitudinal waves.

Describe a longitudinal wave.

.....

..... [2]

(ii) P-waves travel at 6200 m / s in rock. The frequency of a P-wave is 12 Hz.

Calculate the wavelength of the P-wave.

wavelength = ... m [2]

(b) Waves spread out when they pass through a narrow gap.

(i) State the name of this effect.

..... [1]

(ii) Explain whether sound waves with wavelength of 1.2 m will spread out when passing through a 1.0 m wide doorway.

.....

.....[1]

(iii) The wavelength of red light is 700 nm.

Explain why red light travels in a straight line through the doorway in **(b)(ii)**.

.....

..... [1]

(c) Light waves travelling in air refract when incident on a boundary with a transparent material.

A light ray incident on the boundary at an angle of 57° is refracted at an angle of 44°, as shown in Fig. 12.1.

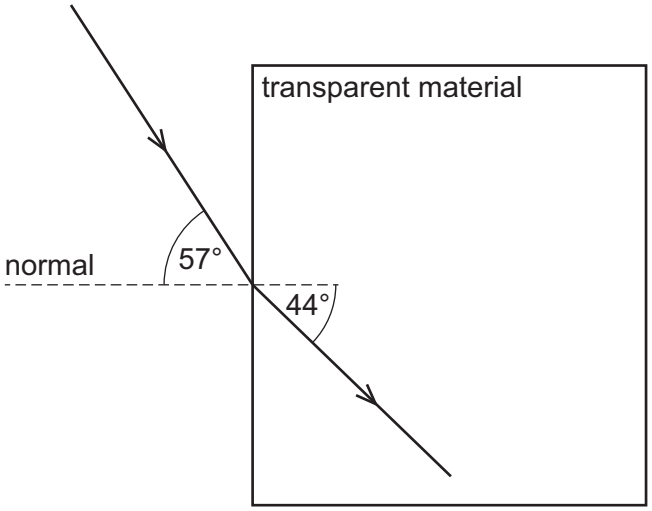

Fig. 12.1

(i) Define refractive index.

.....

..... [1]

(ii) Calculate the refractive index of the transparent material.

refractive index = ... [2]

[Total: 10]

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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 –	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.).