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COMBINED SCIENCE

0653/03

Paper 3 Theory (Core)

For examination from 2025

SPECIMEN PAPER

1 hour 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.
- 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 80.
- 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 (a) Fig. 1.1 shows an animal cell and a plant cell.

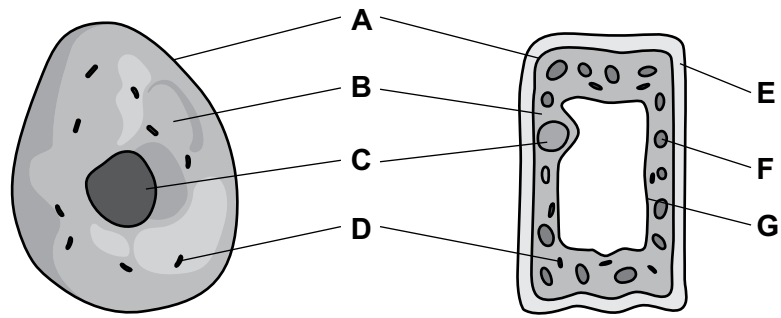


Fig. 1.1

Table 1.1 shows the names and functions of some of the structures of the cells labelled in Fig. 1.1.

Complete Table 1.1.

Table 1.1

letter in Fig. 1.1	name of structure	function
A	controls the movement of substances into and out of cells
D	mitochondria
.....	vacuole

[4]

(b) Fig. 1.2 shows some structures organised in order of increasing size, starting with the smallest size.

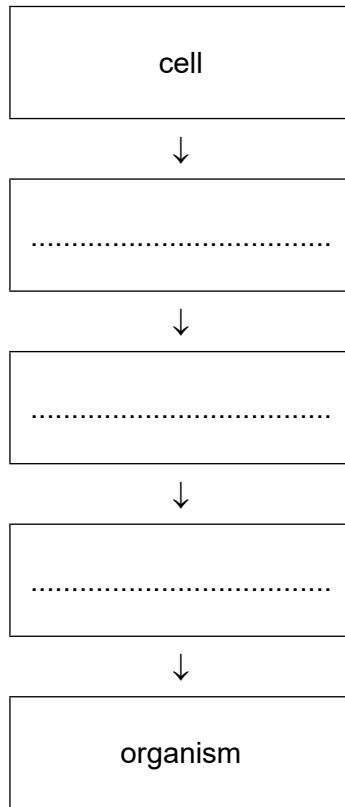


Fig. 1.2

Use the words from the list to complete Fig. 1.2.

- organ organ system tissue**

[2]

(c) The heart is the organ that pumps blood around the body.

(i) State the name of an upper chamber of the heart.

..... [1]

(ii) State the type of blood vessel that transports blood to the heart.

..... [1]

(iii) State the function of red blood cells.

..... [1]

(d) White blood cells defend the human body against pathogens.

State **one** other way the human body defends itself against pathogens.

..... [1]

[Total: 10]

- 2 (a) A student investigates photosynthesis using the set-up shown in Fig. 2.1.

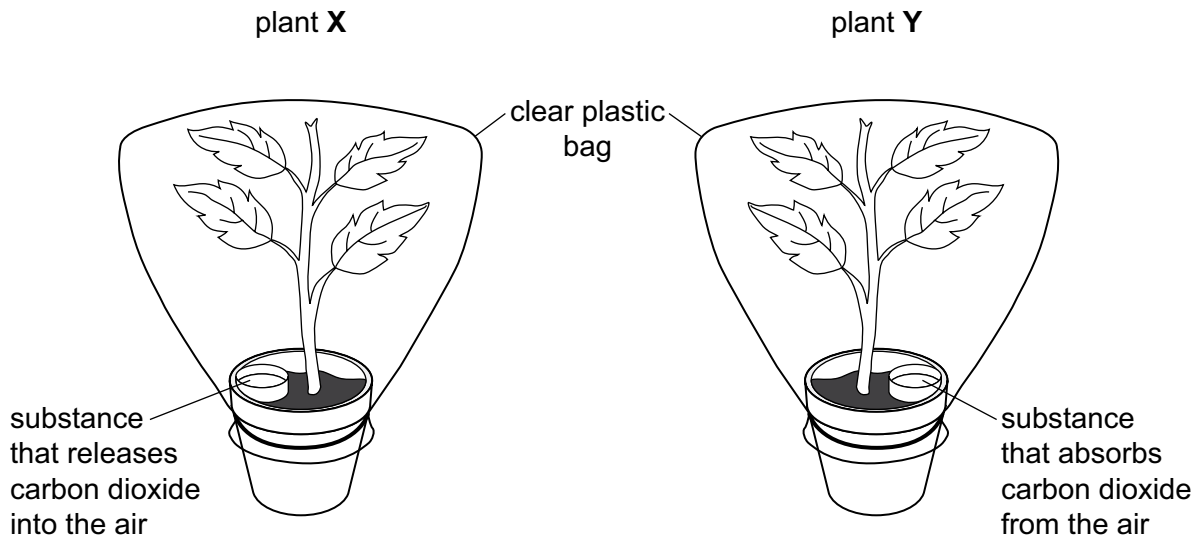


Fig. 2.1

The student puts the plants in the same warm room with plenty of light.

After three days, the student uses iodine solution to test a leaf from each plant.

Fig. 2.2 shows the results.



Fig. 2.2

- (i) Complete the sentences to explain the results in Fig. 2.2.

The colour of the iodine solution shows that only the leaf from plant **X** contains

.....

This investigation shows that photosynthesis requires the presence of

.....

[2]

- (ii) State the name of the green pigment needed for photosynthesis.

..... [1]

(b) Photosynthesis is an enzyme-controlled reaction.

Fig. 2.3 shows the effect of temperature on the rate of photosynthesis for three different plants.

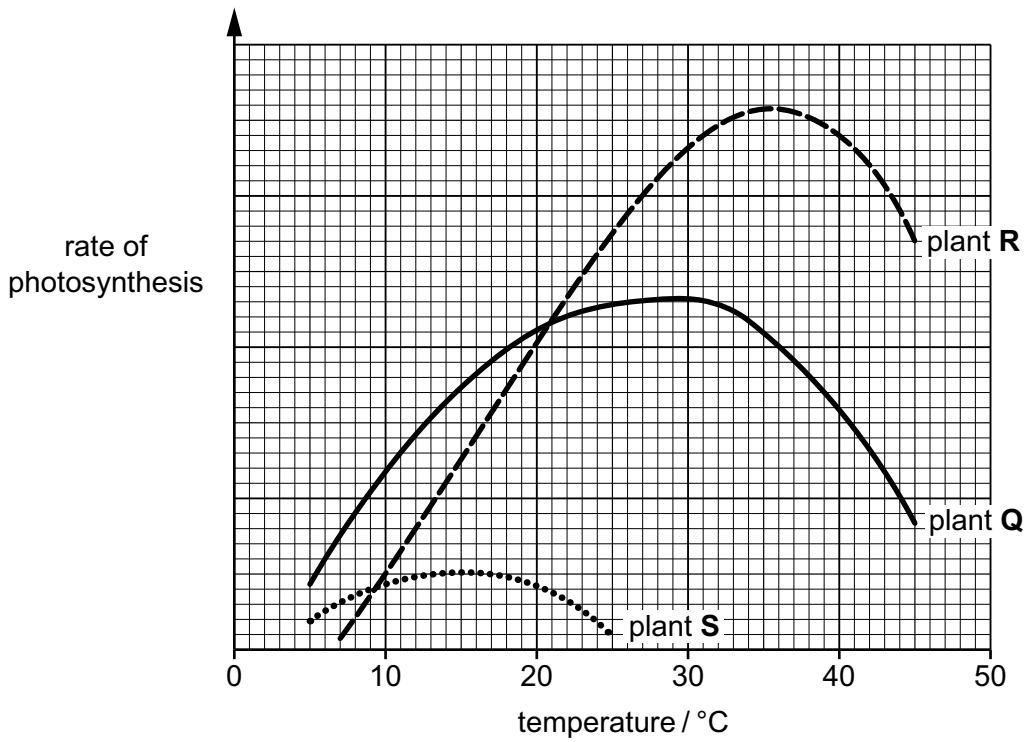


Fig. 2.3

(i) Identify the temperature at which the rate of photosynthesis for plant Q is highest.

..... °C [1]

(ii) In a desert, temperatures are often higher than 40 °C.

Explain why plant S would **not** survive in a desert.

Use the word enzyme in your answer.

.....

 [2]

(c) Fig. 2.4 shows a drawing of the carpel from an insect-pollinated flower.

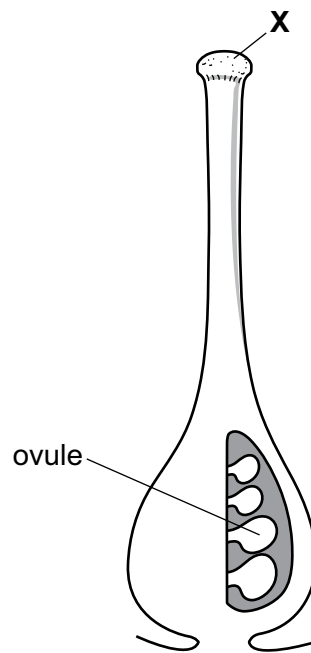


Fig. 2.4

(i) Identify the part labelled **X** on Fig. 2.4.

..... [1]

(ii) Describe fertilisation in an ovule.

.....

 [1]

[Total: 8]

3 (a) Fig. 3.1 shows a food web.

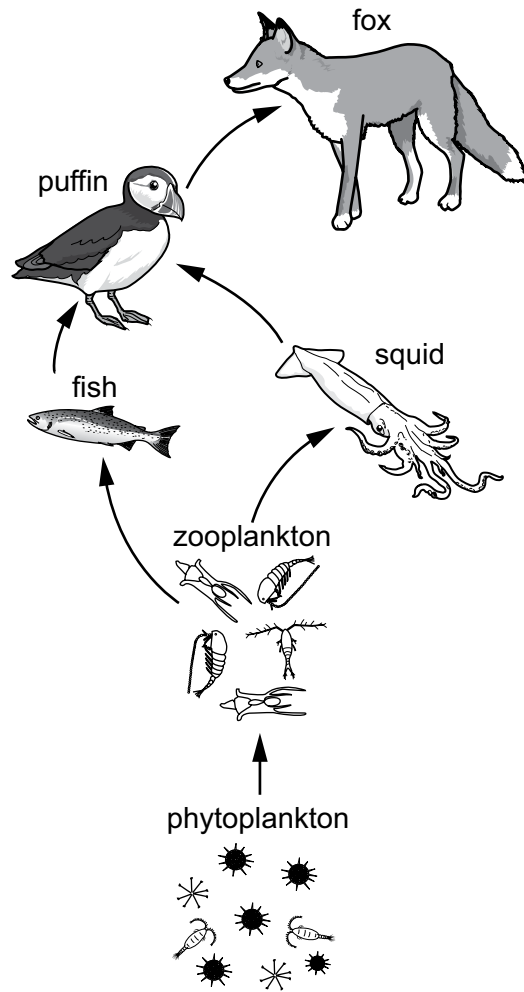


Fig. 3.1

(i) Identify the producer in Fig. 3.1.

..... [1]

(ii) Place a tick (✓) in each box that describes the puffin in Fig. 3.1.

- | | |
|--------------------|--------------------------|
| carnivore | <input type="checkbox"/> |
| herbivore | <input type="checkbox"/> |
| primary consumer | <input type="checkbox"/> |
| secondary consumer | <input type="checkbox"/> |
| tertiary consumer | <input type="checkbox"/> |

[2]

(iii) Pollution in the ocean can kill squid.

Explain how this may reduce the number of foxes.

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

(iv) Pollution is one reason why squid may become endangered.

State **two** other reasons why squid may become endangered.

1
.....
2
..... [2]

(b) Decomposers are important organisms in ecosystems.

Complete the description of a decomposer.

A decomposer is an organism that gets its from dead or
waste material.

[2]

[Total: 9]

- 4 Fig. 4.1 shows the electrolysis of concentrated aqueous sodium chloride using inert electrodes.

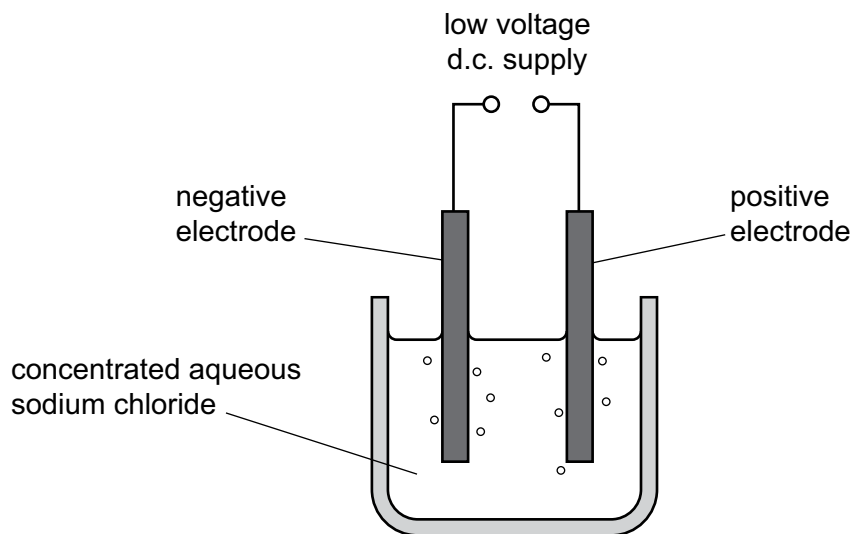


Fig. 4.1

- (a) State the name of the positive electrode.

..... [1]

- (b) Identify the gases produced at the electrodes.

positive electrode

negative electrode

[2]

- (c) The electrolysis of concentrated aqueous sodium chloride produces a solution containing an alkali.

- (i) State what is meant by an alkali.

.....
 [1]

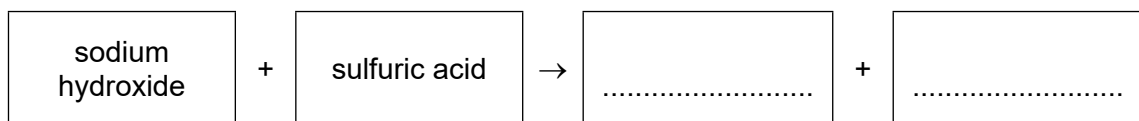
- (ii) State what colour change is observed when methyl orange is added to a solution containing an alkali.

from orange to [1]

(d) The electrolysis shown in Fig. 4.1 produces the alkali sodium hydroxide.

Aqueous sodium hydroxide reacts with dilute sulfuric acid.

(i) Complete the word equation for this reaction.



[1]

(ii) The reaction between aqueous sodium hydroxide and dilute sulfuric acid is exothermic.

State what is meant by an exothermic reaction.

.....

..... [2]

[Total: 8]

5 Petroleum is a mixture of hydrocarbons.

The mixture is separated using the fractional distillation apparatus shown in Fig. 5.1.

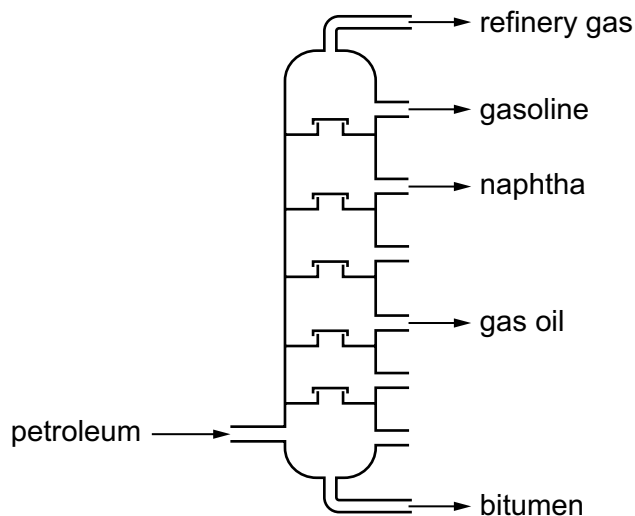


Fig. 5.1

(a) Two fractions obtained from the distillation of petroleum are refinery gas and gasoline.

State **one** use of each of these fractions.

refinery gas

gasoline

[2]

(b) Fig. 5.2 shows two hydrocarbon molecules.

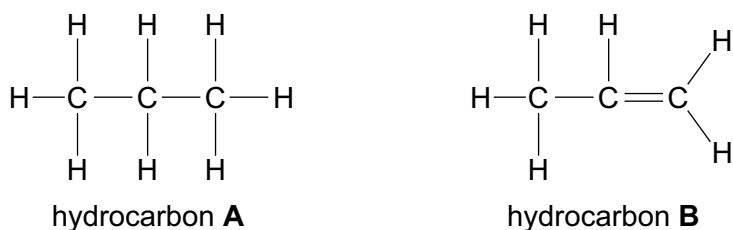


Fig. 5.2

(i) State the molecular formula of hydrocarbon **A**.

..... [1]

- (ii) State which hydrocarbon is saturated.

Give a reason for your answer.

hydrocarbon

reason

[1]

- (iii) State the chemical test that is used to distinguish between hydrocarbon **A** and hydrocarbon **B**.

State the observation for each hydrocarbon.

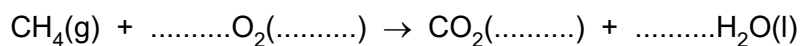
test

observation for hydrocarbon **A**

observation for hydrocarbon **B**

[2]

- (c) The symbol equation for the complete combustion of the hydrocarbon methane, CH_4 , is shown.



Complete the balanced equation and write the missing state symbols. [2]

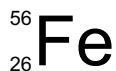
- (d) Methane is a simple molecular compound.

State **one** physical property of methane.

..... [1]

[Total: 9]

6 The symbol for an atom of iron is shown.



(a) Deduce the number of electrons and the number of neutrons in this atom.

electrons

neutrons

[2]

(b) Iron(II) ions, Fe^{2+} , are formed from atoms of iron, Fe.

(i) Describe how Fe^{2+} ions are formed from iron atoms.

.....
 [1]

(ii) Describe what is observed when aqueous sodium hydroxide is added to aqueous iron(II) ions.

.....
 [2]

(c) Iron reacts with dilute hydrochloric acid to form hydrogen and a salt.

(i) Explain why this is a chemical change.

.....
 [1]

(ii) State the test for hydrogen and give the observation for a positive result.

test

observation

..... [1]

(d) Iron is used as a catalyst in some chemical reactions.

Describe what is meant by a catalyst.

.....

.....

.....

..... [2]

[Total: 9]

7 (a) Fig 7.1 shows an electric heater connected in a circuit.

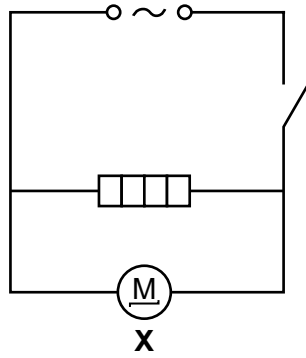


Fig. 7.1

(i) State the name of component X.

..... [1]

(ii) The current in component X is 0.5 A.

The current in the heater is 8.3 A.

Circle the value of the current from the source.

- 0.5 A 7.8 A 8.3 A 8.8 A

[1]

(iii) The electric heater uses 2.0 kW of electrical power.

Electrical energy costs \$0.15 per kW h.

Calculate the cost of using the heater for 5.5 hours.

cost = \$ [2]

- (b) Fig. 7.2 shows a wind turbine used to generate electricity from the power of the wind.

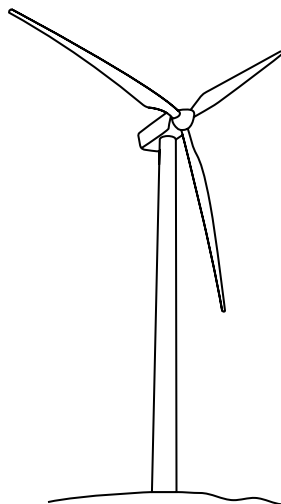


Fig. 7.2

The wind turbine produces electrical power of 2200 W at a voltage of 240 V.

Calculate the energy transferred by the wind turbine in 15 seconds.

energy = J [2]

- (c) Solar power can also be used to generate electricity.

- (i) Visible light from the Sun contains all the colours of the visible spectrum.

State the colour with the longest wavelength.

..... [1]

- (ii) Most of the energy from the Sun is radiated in three regions of the electromagnetic spectrum.

One of these regions is visible light.

State the name of **one** of the other two regions.

..... [1]

[Total: 8]

- 8 (a) (i) A spacecraft has a mass of 3.1×10^3 kg.

Calculate the weight of the spacecraft on the surface of the Earth.

Include the unit in your answer.

weight = unit [3]

- (ii) The spacecraft is launched into space. The spacecraft accelerates as it moves upwards through the Earth's atmosphere.

State what is meant by accelerates.

..... [1]

- (iii) The spacecraft travels from the Earth to the Moon in 3.2 days.

Calculate the number of hours in 3.2 days.

number of hours = [1]

- (iv) The distance from the Earth to the Moon is 384 000 km.

Use your answer to (a)(iii) to calculate the average speed of the spacecraft in km / h.

speed = km / h [2]

- (v) The spacecraft is controlled by radio waves sent from the Earth.

State whether the radio waves travel to the spacecraft faster, slower or at the same speed as visible light.

Give a reason for your answer.

speed

reason

[1]

(b) The Earth orbits the Sun as part of the Solar System.

State the name of the planet that orbits closest to the Sun.

..... [1]

(c) State the name of the galaxy that contains the Sun.

..... [1]

[Total: 10]

- 9 Table 9.1 gives some data about five substances.

Table 9.1

	aluminium	ethanol	poly(ethene)	sulfur	water
density in g / cm^3	2.7	0.8	0.9	2.0	1.0
state at 25°C	solid	liquid	solid	solid	liquid
electrical property	conductor	insulator		insulator	insulator

- (a) State the electrical property of poly(ethene).

Give a reason for your answer.

electrical property

reason

[1]

- (b) A ball made of poly(ethene) has a density of 0.9 g / cm^3 .

Predict what happens to the ball when placed in a beaker of water and in a beaker of ethanol.

Use the data in Table 9.1 to explain your answer.

water

ethanol

explanation

.....

[2]

(c) Fig. 9.1 shows the arrangements of particles in ethanol and sulfur at a temperature of 25 °C.

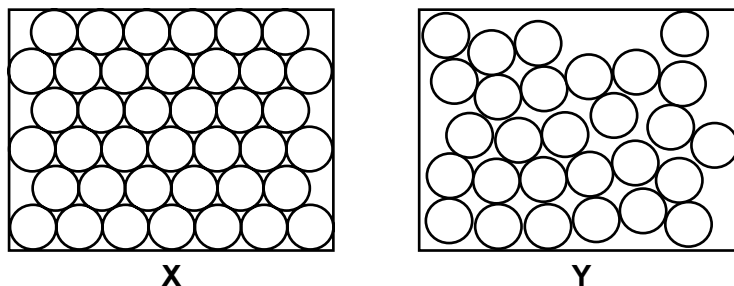


Fig. 9.1

Use Fig. 9.1 and information from Table 9.1 to state which diagram, **X** or **Y**, shows the structure of ethanol and of sulfur at 25°C.

Explain your answer in terms of particles.

ethanol

sulfur

explanation

.....

.....

[2]

(d) A thin, flat piece of aluminium is used as a mirror.

(i) The piece of aluminium has a mass of 9.0 g.

Use information from Table 9.1 to calculate the volume of the piece of aluminium.

volume = cm³ [2]

- (ii) Fig. 9.2 shows a person's eye looking at the reflection of an object placed in front of the aluminium mirror.

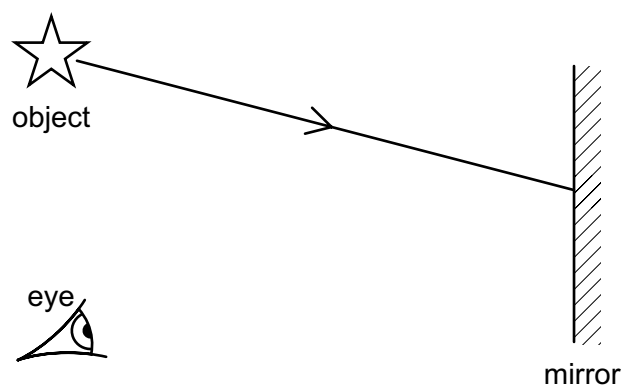


Fig. 9.2

On Fig. 9.2:

- draw the normal line and label the angle of incidence of the incident ray with the letter i .
- draw the reflected ray to show how the eye is able to see the reflected image of the object.

[2]

[Total: 9]

The Periodic Table of Elements

		Group															
I	II											III	IV	V	VI	VII	VIII
3 Li lithium 7	4 Be beryllium 9	Key atomic number atomic symbol name relative atomic mass										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 —

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
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 dm³ at room temperature and pressure (r.t.p.).

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