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COMBINED SCIENCE

0653/32

Paper 3 Theory (Core)

May/June 2025

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 **20** pages. Any blank pages are indicated.

1 (a) Fig. 1.1 shows a white blood cell.

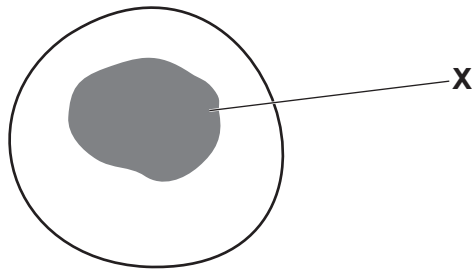


Fig. 1.1

(i) Name the part labelled **X** on Fig. 1.1.

..... [1]

(ii) State **one** function of white blood cells.

..... [1]

(iii) **Circle two** structures found in both white blood cells and bacterial cells.

cell membrane

cell wall

cytoplasm

circular DNA

large vacuole

plasmid

[2]

(b) Blood is part of the circulatory system.

Complete the sentence to describe the circulatory system.

The circulatory system is a system of blood with a pump

and to ensure one-way flow of blood.

[2]



(c) Fig. 1.2 is a graph that shows the heart rate of a person during and after physical activity.

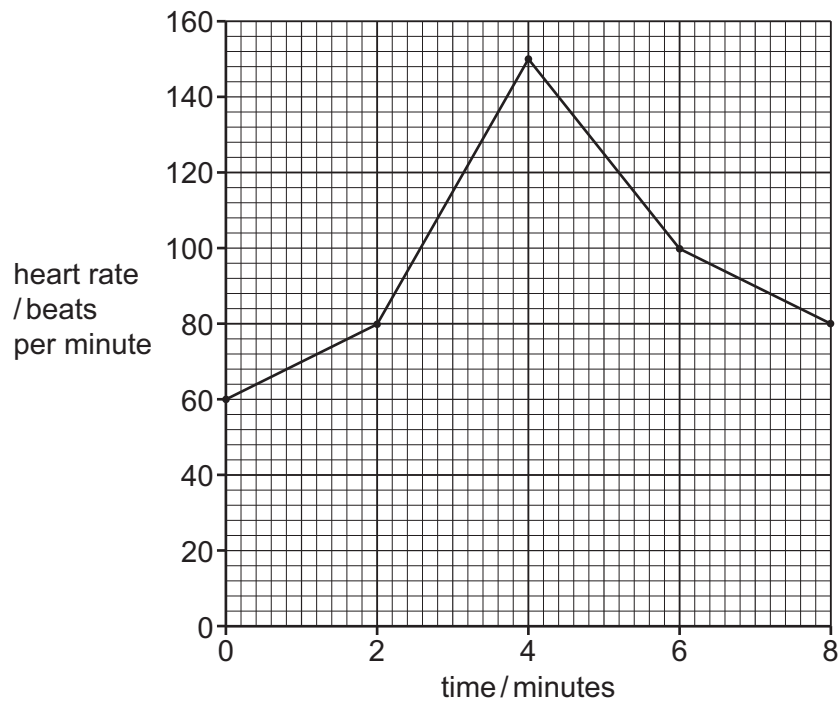


Fig. 1.2

Calculate the percentage increase in heart rate between 0 minutes and 4 minutes of physical activity.

heart rate at 0 minutes of physical activity = beats per minute

heart rate at 4 minutes of physical activity = beats per minute

change in heart rate = beats per minute

percentage increase in heart rate = [3]

[Total: 9]



- 2 (a) Fig. 2.1 is a diagram of a cross-section through a leaf.

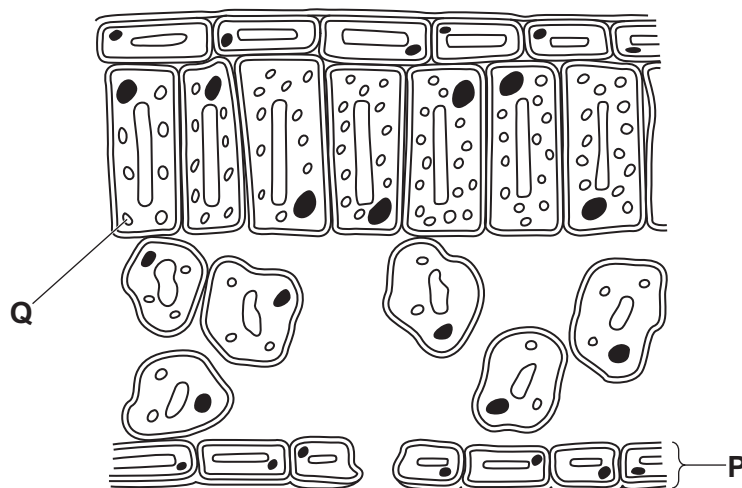


Fig. 2.1

- (i) Name the part labelled **P** on Fig. 2.1.

..... [1]

- (ii) Draw a label line and the letter **S** to identify a spongy mesophyll cell on Fig. 2.1. [1]

- (iii) Name the pigment found in the part labelled **Q** on Fig. 2.1.

..... [1]

- (b) A plant is left in a warm dark room for three days.

After three days, a leaf from the plant is tested with iodine solution.

The iodine solution stays yellow-brown in colour.

Complete the sentences to explain this result.

The yellow-brown colour of the iodine solution indicates that the leaf does **not** contain

.....

The plant has **not** photosynthesised because there is no

[2]



(c) Fig. 2.2 shows part of a food web.

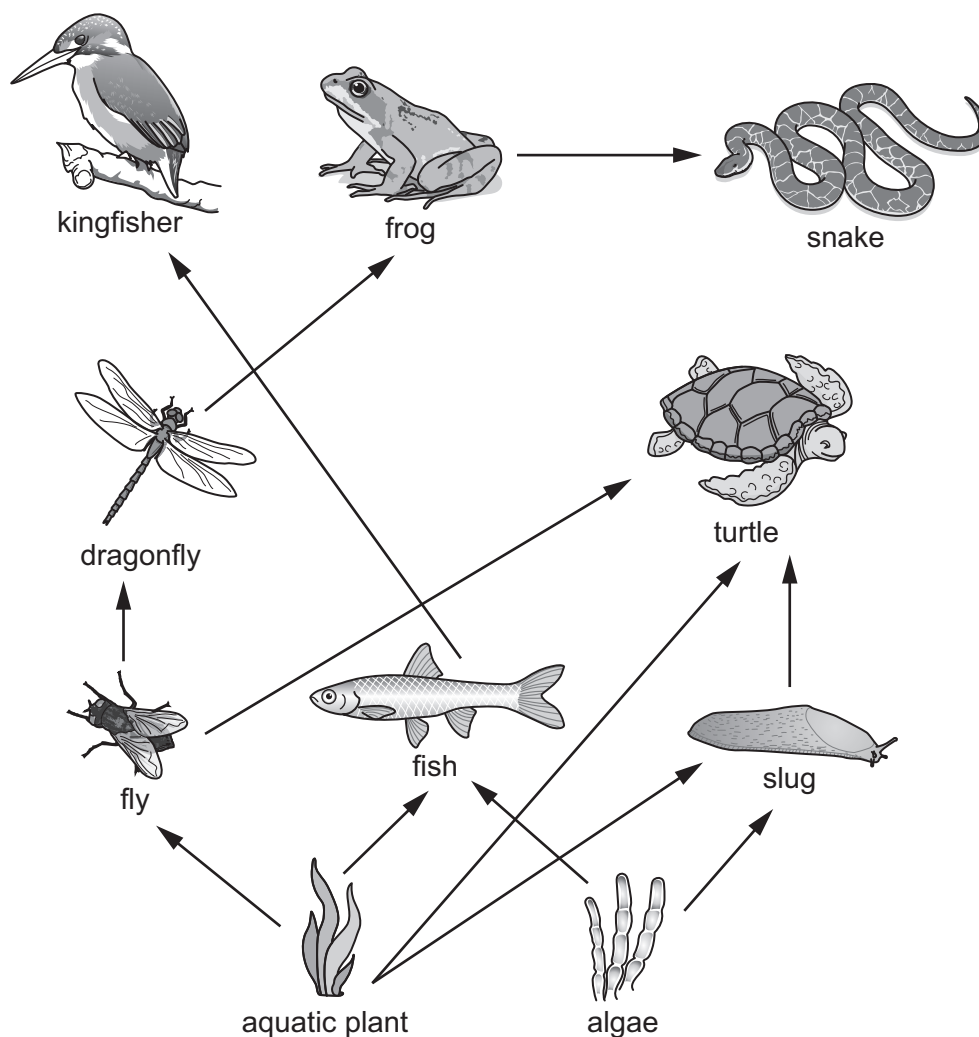


Fig. 2.2

(i) Identify **one** herbivore in Fig. 2.2.

..... [1]

(ii) Identify **one** tertiary consumer in Fig. 2.2.

..... [1]

(iii) Animals in the food web produce waste organic material.

Name the type of organism that gets its energy from waste organic material.

..... [1]

[Total: 8]



- 3 (a) Nutrition is one of the characteristics of living organisms.

State **two** other characteristics of living organisms.

1

2 [2]

- (b) Table 3.1 shows some information about the digestive system in humans.

- (i) Complete Table 3.1.

Table 3.1

organ	function of organ
mouth and digestion of food
small intestine	digestion and of food into the blood
.....	egestion of undigested food

[3]

- (ii) Fats are digested in the small intestine.

Name the **two** smaller molecules that fats are made from.

..... and [2]



(c) Enzymes are used to digest food in the digestive system.

(i) Fig. 3.1 is a graph that shows the effect of pH on the enzyme activity of one enzyme.

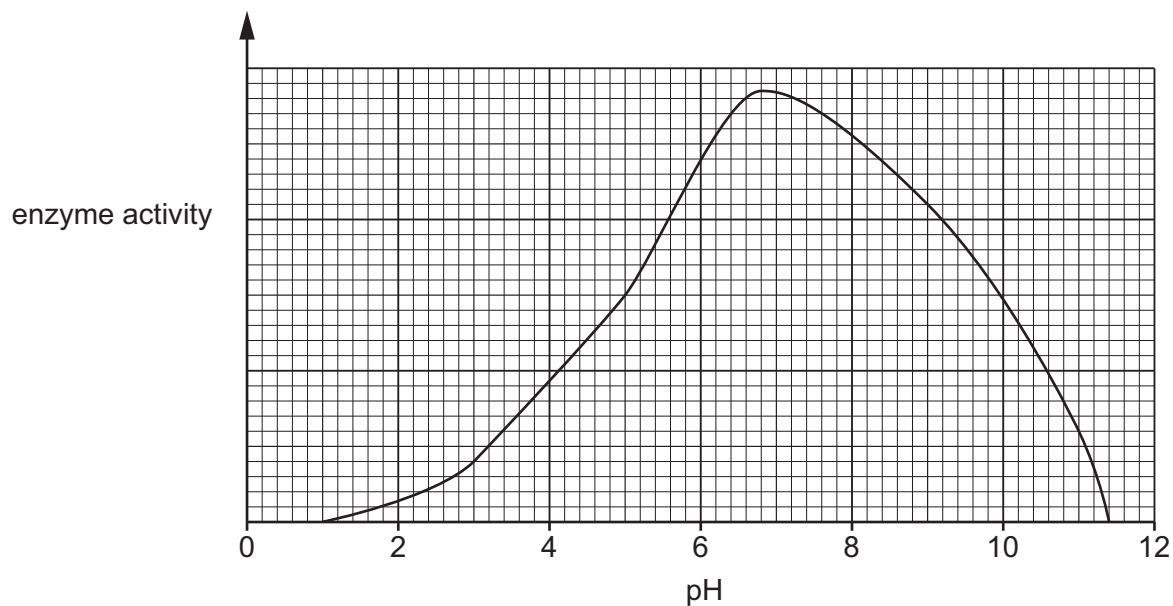


Fig. 3.1

Describe the effect of pH on enzyme activity shown in Fig. 3.1.

Include data in your answer.

.....

.....

.....

..... [2]

(ii) State **one** factor that affects enzyme activity, other than pH.

..... [1]

[Total: 10]



4 (a) Solid sodium reacts with water.

(i) Circle the gas that forms when sodium reacts with water.

carbon dioxide

chlorine

hydrogen

oxygen

[1]

(ii) State **one** way the reaction of potassium with water is different from the reaction of sodium with water.

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

(b) Aqueous sodium chloride is a mixture of two compounds, sodium chloride and water.

State **one** similarity and **one** difference between a compound and a mixture.

similarity

.....

difference

.....

[2]

(c) Solid sodium is heated to form a liquid.

(i) Tick (✓) **all** the boxes that show correct properties of a liquid.

A liquid cannot be squashed.

☐

A liquid has no fixed volume.

☐

A liquid takes the shape of its container.

☐

[1]

(ii) The symbol for solid sodium is Na(s).

Complete the symbol for **liquid** sodium by adding the missing state symbol.

Na(.....)

[1]



- (d) The noble gases are in Group VIII of the Periodic Table.

Explain how the electronic configuration of neon affects its reactivity.

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

- (e) Nitrogen is a gas.

- (i) State the percentage of nitrogen gas in clean, dry air.

..... % [1]

- (ii) Oxides of nitrogen are air pollutants.

State **one** source of these oxides of nitrogen.

..... [1]

- (iii) State **one** adverse effect of oxides of nitrogen.

..... [1]

[Total: 10]



5 (a) Iron is a transition element.

Tick (✓) **two** boxes that show correct statements about the properties of iron and Group I elements.

Iron and Group I elements conduct electricity.

☐

Iron has a higher melting point than Group I elements.

☐

Group I elements have a higher density than iron.

☐

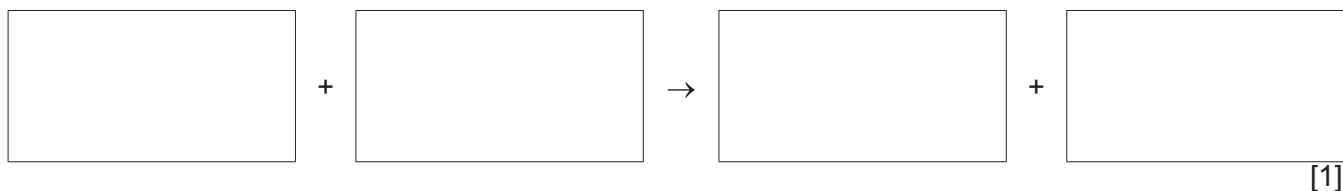
Group I elements form coloured compounds but iron compounds are white.

☐

[2]

(b) Iron reacts with dilute hydrochloric acid.

Write the word equation for the reaction.



(c) Fig. 5.1 shows three identical iron nails, each in a different test-tube, **A**, **B** and **C**.

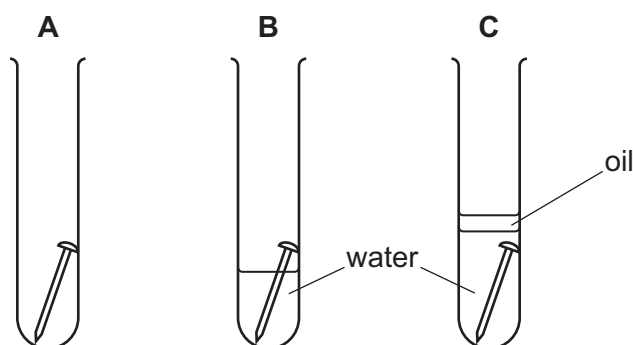


Fig. 5.1

Predict in which test-tube the iron nail rusts most quickly.

Explain your answer.

test-tube

explanation

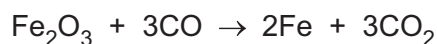
.....

.....

[2]



(d) Iron is extracted from iron(III) oxide in a blast furnace.



Circle the type of reaction when iron(III) oxide forms iron.

combustion

oxidation

reduction

separation

[1]

(e) Aluminium is extracted by electrolysis.

Name the main ore of aluminium.

..... [1]

(f) Part of the reactivity series is shown.

sodium

magnesium

carbon

zinc

hydrogen

copper

(i) Use this reactivity series to name:

- **one** metal that must be extracted by electrolysis
- **one** metal that is extracted by heating with carbon.

metal extracted by electrolysis

metal extracted by heating with carbon

[2]

(ii) Explain why different methods of extraction are needed for the two metals in (f)(i).

.....

.....

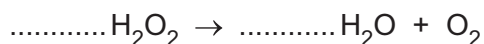
[1]

[Total: 10]



- 6 Hydrogen peroxide, H_2O_2 , decomposes into water and oxygen when a catalyst is added.

(a) Balance the symbol equation for the reaction.



[1]

(b) The oxygen is collected and tested.

Describe the test for oxygen gas.

State the observation for the positive result.

test

observation

[1]

(c) Anhydrous cobalt(II) chloride is used to test for water.

State the colour observed for a positive result.

..... [1]

(d) Describe what is meant by a catalyst.

.....

.....

.....

..... [2]

(e) The temperature of the hydrogen peroxide is increased. All other conditions stay the same.

Predict the effect of this change on the reaction.

..... [1]

[Total: 6]





- 7 Fig. 7.1 shows a tram powered by electricity supplied through overhead cables.

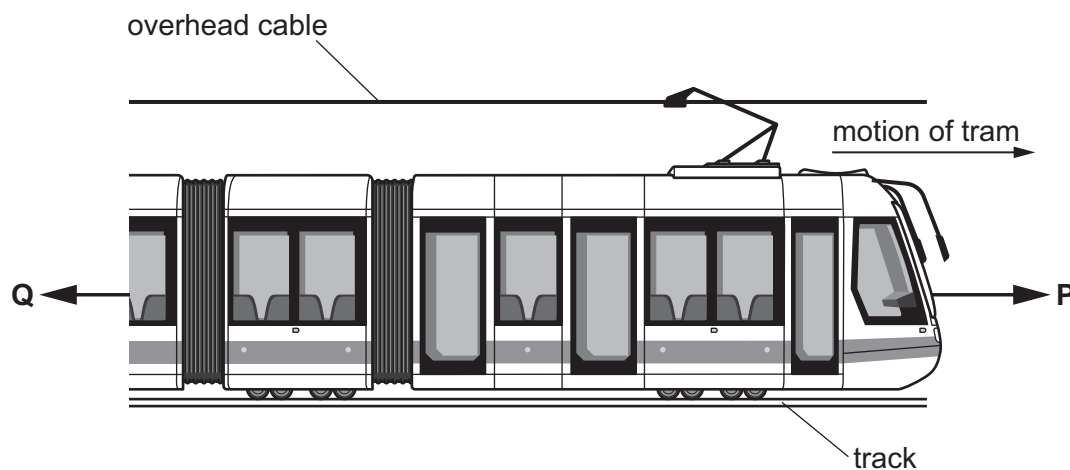


Fig. 7.1

- (a) Forces **P** and **Q** act on the tram as it moves along a level track.

Force **P** has a magnitude of 2400 N.

Force **Q** has a magnitude of 1900 N.

- (i) Name force **Q**.

..... [1]

- (ii) Calculate the resultant force acting on the tram.

resultant force = N [1]

- (iii) Describe the motion of the tram.

..... [1]



- (b) The mass of the tram is 35 000 kg.

Calculate the weight of the tram.

weight = N [2]

- (c) Later in its journey, the tram moves up a hill at constant speed.

Complete the sentence about energy transfers.

Energy is transferred to the energy store of the tram
and the thermal energy stores of the tram and the surroundings.

[1]

- (d) On one journey, the tram travels for 0.24 h.

The electrical power input to the tram is 55 kW.

Energy is supplied at a cost of \$0.25 per kWh.

Calculate the total energy cost for this journey.

total energy cost = \$ [3]

[Total: 9]



8 Fig. 8.1 shows an electric heater that heats a room.

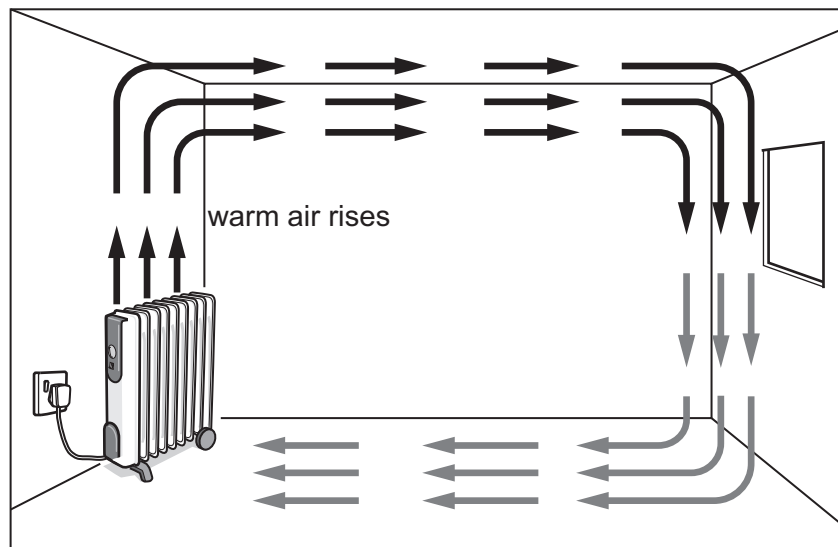


Fig. 8.1

- (a) (i) Circle the correct word in **bold** to complete the sentence.

The warm air above the electric heater rises. Thermal energy is mainly transferred around the room by **conduction** / **convection** / **radiation** .

[1]

- (ii) When air is heated, its temperature and volume increase.

Explain why this happens.

Use ideas about particle motion and separation in your answer.

temperature increases because

.....

volume increases because.....

.....

[2]



(b) Fig. 8.2 shows a circuit diagram for the electric heater.

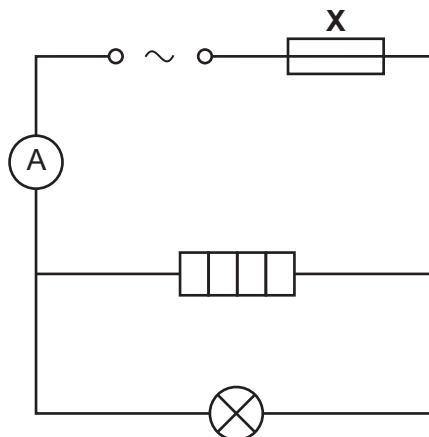


Fig. 8.2

The current in the electric heater is 3.2 A.

(i) Name component X.

..... [1]

(ii) The resistance of the heater is $35\ \Omega$.

Calculate the voltage of the power supply.

voltage = V [2]

(iii) The current in the lamp is 0.20 A.

Determine the reading on the ammeter.

reading = A [1]

(c) State the difference between direct current (d.c.) and alternating current (a.c.).

.....

 [2]

[Total: 9]



- 9 (a) Fig. 9.1 is a drawing of our galaxy showing the approximate location of the Sun.

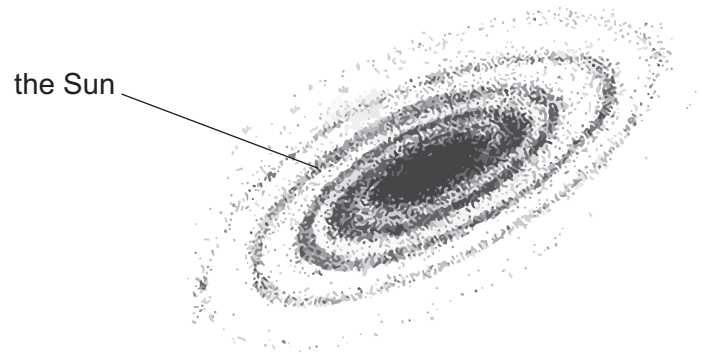


Fig. 9.1

- (i) Name our galaxy.

..... [1]

- (ii) The Sun is a distance of 25 000 light-years from the centre of our galaxy.

State the time taken for light to travel from the Sun to the centre of our galaxy.

Include the unit in your answer.

time = unit [1]

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

One of these regions is visible light.

On Fig. 9.2, tick (✓) **two** boxes to show the other two regions.

gamma radiation	X-rays	ultraviolet	visible light	infrared	microwaves	radio waves
			✓			

Fig. 9.2

[2]



- (b) Electromagnetic radiation of wavelength $6.0 \times 10^{-7} \text{ m}$ travels through space at a speed of $3.0 \times 10^8 \text{ m/s}$.

Calculate the frequency of the radiation.

Include the unit in your answer.

frequency = unit [3]

- (c) An astronomer looks at a distant star.

Fig. 9.3 shows the astronomer's eye and two parallel rays of light from the distant star.

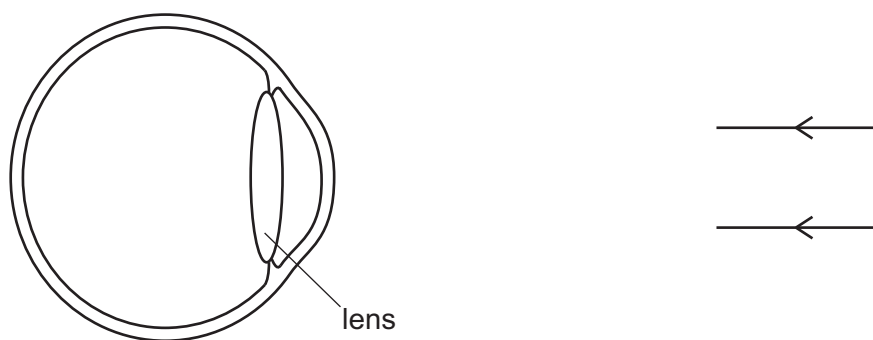


Fig. 9.3

Complete Fig. 9.3 to show the two rays focused onto the back of the astronomer's eye by the lens.

[2]

[Total: 9]

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The Periodic Table of Elements

Group																			
I	II	Key										III	IV	V	VI	VII	VIII		
		<div>atomic number atomic symbol name relative atomic mass</div>										<div>1 H hydrogen 1</div>							
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			
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 —	

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
	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.).