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8303338686

COMBINED SCIENCE **0653/33**

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.

DC (PB/SG) 345644/2

[Turn over

1 **(a)** Fig. 1.1 is a diagram of the female reproductive system.

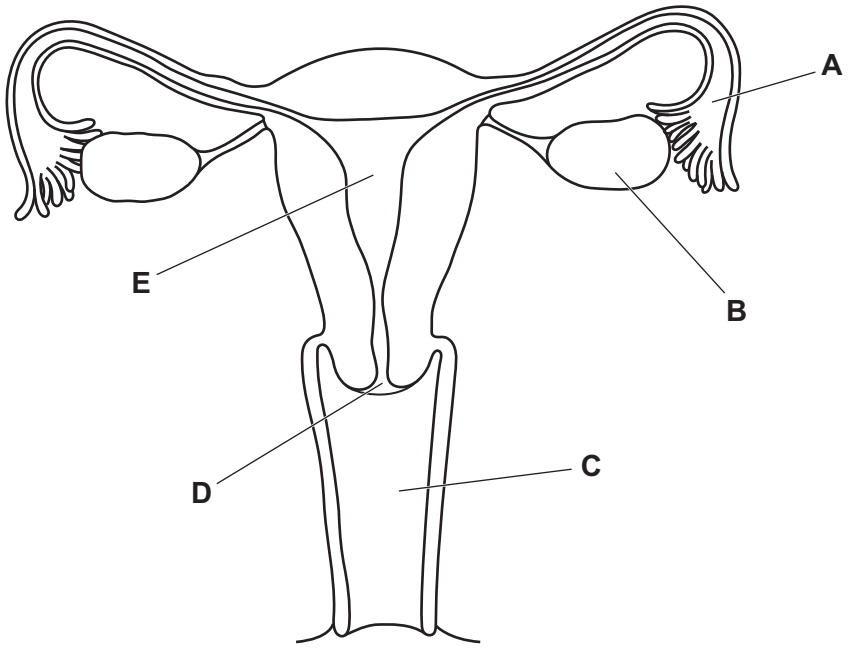

Fig. 1.1

State the letter on Fig. 1.1 that identifies:

the cervix .....

the oviduct .....

where female gametes are produced. .....

[3]

(b) The boxes on the left show some parts of the male reproductive system.

The boxes on the right show different functions of the parts.

Draw one straight line from each part to its function.

part	function
scrotum	holds testes outside the body
prostate gland	passes sperm-containing fluid out of the body
urethra	produces fluid that mixes with sperm

[2]

(c) Fig. 1.2 shows the carpel from an insect-pollinated flower.

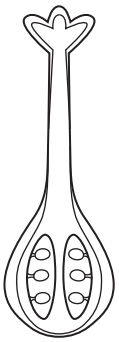

Fig. 1.2

(i) Draw a label line and the letter **S** on Fig. 1.2 to identify the style. [1]

(ii) Describe pollination.

.....

.....

.....

..... [2]

(d) A scientist describes an area of insect-pollinated flowers as having a high biodiversity.

Describe what is meant by biodiversity.

.....

.....

.....

..... [2]

[Total: 10]

2 **(a)** A student investigates the effect of different physical activity on heart rate.

Fig. 2.1 is a bar chart of the results.

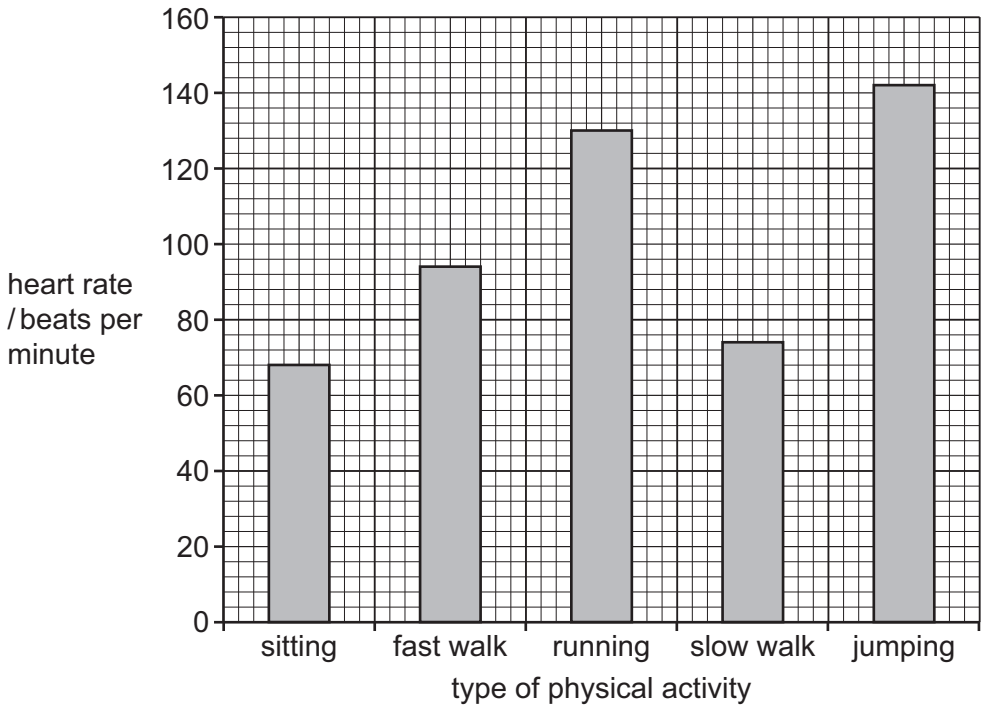

Fig. 2.1

(i) Identify the type of physical activity in Fig. 2.1 that:

results in the highest heart rate .....

results in a heart rate of 68 beats per minute. .....

[2]

(ii) Calculate the difference in heart rate between fast walking and slow walking in Fig. 2.1.

..... beats per minute [1]

(iii) The student measures pulse rate to monitor the activity of the heart.

State **one** other way to monitor the activity of the heart.

..... [1]

(b) Physical activity uses energy from respiration.

(i) State the word equation for aerobic respiration.

..... [2]

(ii) Name the structures inside cells where aerobic respiration takes place.

..... [1]

(c) Biological molecules in the diet are a source of energy.

Chemical digestion breaks down large biological molecules into smaller ones.

Complete the sentences about chemical digestion.

Choose words from the list.

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

absorption **amino acids** **assimilation** **egestion**

fatty acids **glycerol** **ingestion** **sugars**

Proteins are large molecules made from smaller molecules called

…… .

The smaller molecules move from the small intestine into the blood by the process of

…… .

The smaller molecules travel in the blood to cells.

The smaller molecules are taken up by the cells and used. This process is called

…… .

[3]

[Total: 10]

3 Fig. 3.1 shows part of a food web from a coral reef habitat.

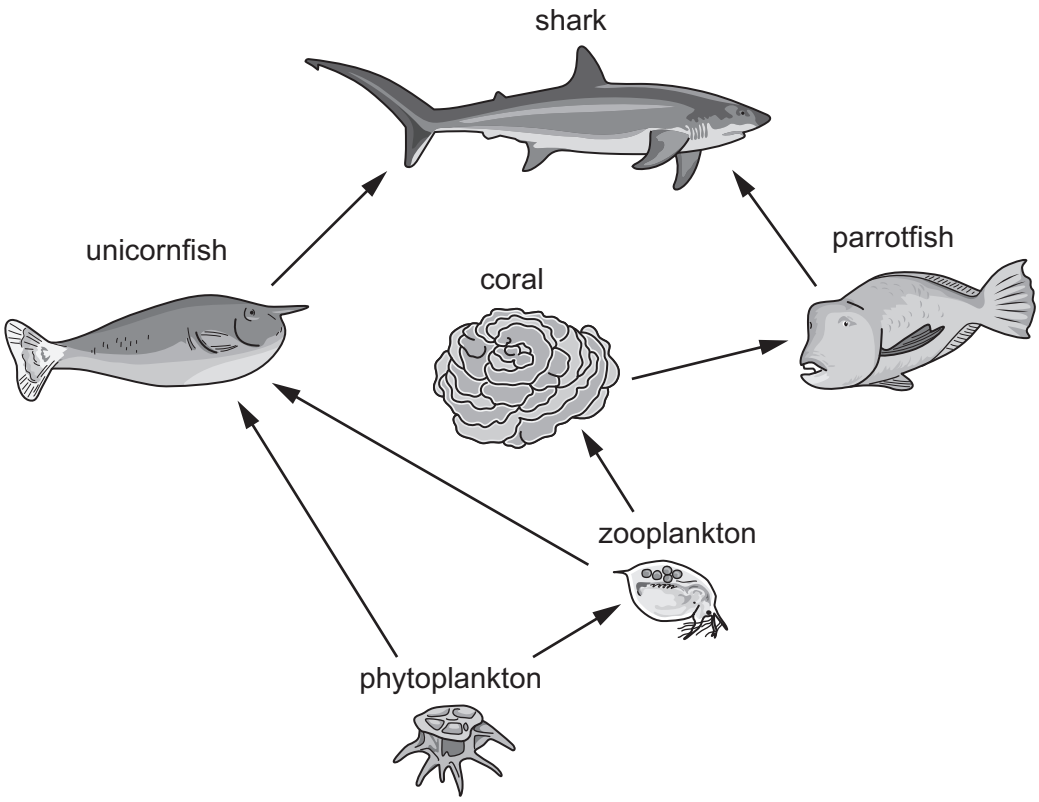

Fig. 3.1

(a) (i) Circle the word that describes the phytoplankton in the food web in Fig. 3.1.

animal **decomposer** **herbivore** **producer**

[1]

(ii) Identify **one** primary consumer shown in Fig. 3.1.

..... [1]

(iii) Explain why the shark shown in Fig. 3.1 is described as a carnivore.

.....

..... [1]

(b) Coral is being damaged by marine pollution.

(i) Use Fig. 3.1 to explain the effect this has on the number of parrotfish in the habitat.

.....

.....

..... [2]

(ii) Pollution of freshwater and marine environments is one cause of habitat destruction.

Describe **one** other cause of habitat destruction.

.....

..... [1]

(c) Coral reef habitats release carbon dioxide into the atmosphere.

State a process in the carbon cycle that removes carbon dioxide from the atmosphere.

..... [1]

[Total: 7]

4 Lithium fluoride, LiF, is an ionic compound.

(a) Complete the sentences to explain why lithium fluoride has a high melting point.

Choose words from the list.

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

configuration **attraction** **conduction** **gases**

molecules **weak** **strong** **solids**

An ionic bond is a ..... electrostatic ..... between ions with opposite charges.

Ionic compounds are ..... at room temperature and pressure.

[3]

(b) Lithium fluoride contains lithium ions, Li^+, and fluoride ions, F^-.

Fig. 4.1 shows the dot-and-cross diagram for lithium fluoride.

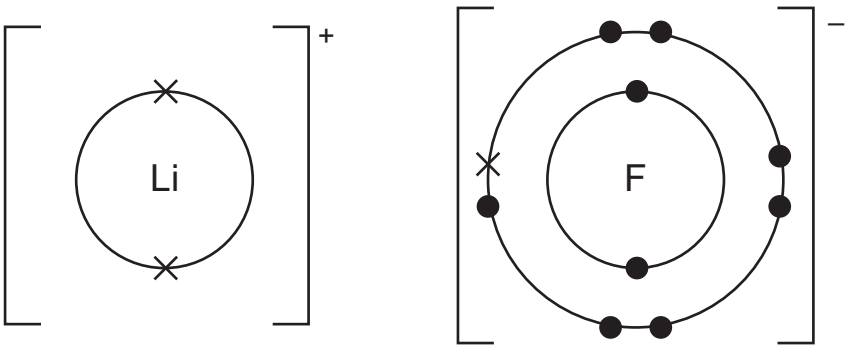

Fig. 4.1

Use Fig. 4.1 to describe what happens when a lithium atom and a fluorine atom form ions.

lithium .....

.....

fluorine .....

.....

[2]

(c) The Periodic Table gives information about an atom of fluorine, as shown in Fig. 4.2.

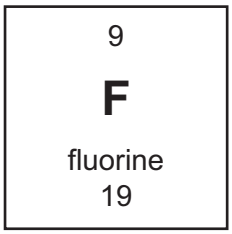

Fig. 4.2

Deduce the number of protons and neutrons in this atom of fluorine.

number of protons .....

number of neutrons .....

[2]

(d) Fluorine is in Group VII of the Periodic Table.

Complete the sentences about elements in Group VII.

Choose phrases from the list.

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

more than **less than** **the same as**

The reactivity of bromine is …….. the reactivity of fluorine.

The density of iodine is …….. the density of fluorine.

The number of electrons in the outer shell of fluorine is …….. the number of electrons in the outer shell of chlorine.

[2]

[Total: 9]

5 Dilute sulfuric acid is used in an electrolysis experiment.

(a) Universal indicator is used to measure the pH of the dilute sulfuric acid.

Describe how to use universal indicator to measure pH.

.....

.....

..... [2]

(b) Fig. 5.1 shows the electrolysis.

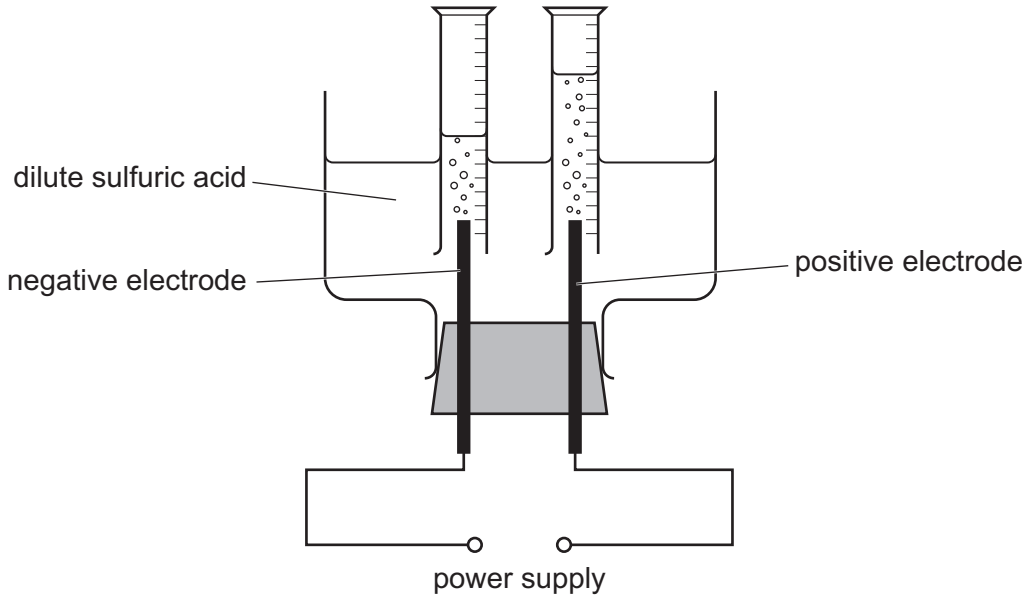

Fig. 5.1

(i) Identify the gas formed at each electrode.

negative electrode .....

positive electrode .....

[2]

(ii) State the name of the positive electrode.

..... [1]

(iii) Identify the electrolyte in this electrolysis.

..... [1]

(c) The volume of gas formed at each electrode is measured every 30 s for 2 min. The results are shown in Table 5.1.

Table 5.1

time / s	volume of gas at the negative electrode / cm^3	volume of gas at the positive electrode / cm^3
0	0	0
30	18	9
60	36	18
90	54	27
120		36

(i) Use Table 5.1 to predict the volume of gas given off at the negative electrode at 120 s.

volume = ... cm^3 [1]

(ii) Use Table 5.1 to calculate the volume of gas formed per second at the positive electrode.

volume = ... cm^3/s [1]

[Total: 8]

6 Scientists are investigating the use of iron as a fuel in cars.

Iron reacts with oxygen, as shown in equation 1. This reaction releases energy.

The iron oxide formed is converted back to iron, as shown in equation 2.

equation 1 .....Fe(s) + ...O_2(.....) → $2Fe_2O_3$(s)

equation 2 $Fe_2O_3(s) + 3H_2(g) \rightarrow 2Fe(s) + 3H_2O(l)$

(a) Balance equation 1 and add the missing state symbol for oxygen. [2]

(b) State the name given to a chemical reaction that releases thermal energy.

..... [1]

(c) Use the substances in equation 1 and equation 2 to answer the following questions.

(i) Identify the compound that exists as simple molecules.

..... [1]

(ii) Identify the transition element.

..... [1]

(d) Explain why equation 1 shows that iron is oxidised.

.....

..... [1]

(e) Most cars burn fuels that contain carbon.

Explain why using iron as a fuel may cause less harm to the environment than using fuels that contain carbon.

.....

.....

.....

..... [3]

[Total: 9]

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7 Fig. 7.1 shows a toy car, powered by a battery.

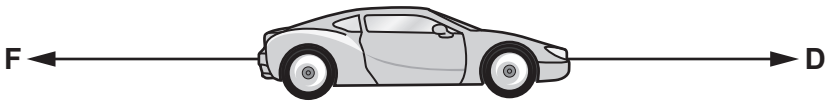


Fig. 7.1

(a) Fig. 7.1 shows the driving force **D** and the total friction force **F** acting on the car.

(i) On Fig. 7.1, draw a force arrow labelled **W** to show the weight of the car. [1]

(ii) The car moves at a constant speed along a level surface.

Force **D** is 16 N.

State the value of force **F**.

F = ... N [1]

(b) The car travels a total distance of 18 m at a constant speed of 1.2 m/s.

(i) Calculate the time taken for the car to travel 18 m.

time = ... s [2]

(ii) The driving force acting on the car is 16 N.

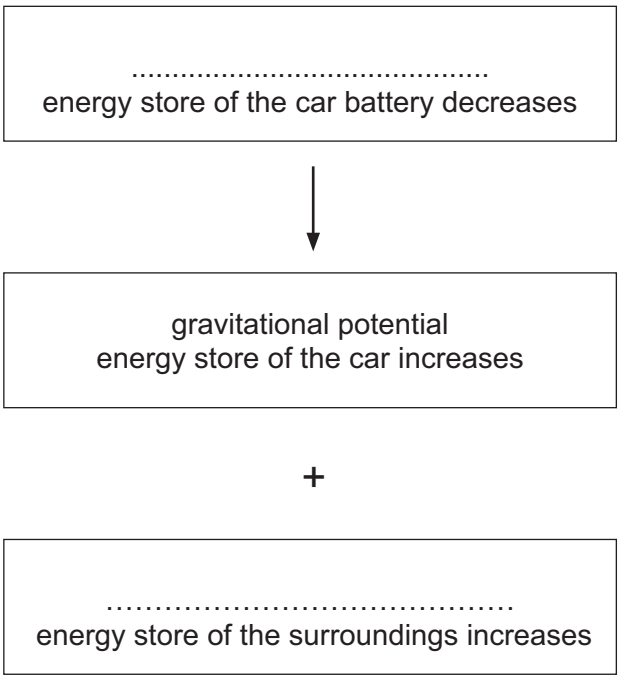
Calculate the work done in moving the car a distance of 18 m.

Include the unit in your answer.

work done = …….. unit …….. [3]

(c) The car now travels up a slope **at constant speed**.

Complete the boxes to show the changes in energy stores.



[2]

[Total: 9]

8 Fig. 8.1 shows a Bunsen burner with the air hole closed, burning with a yellow flame.

X

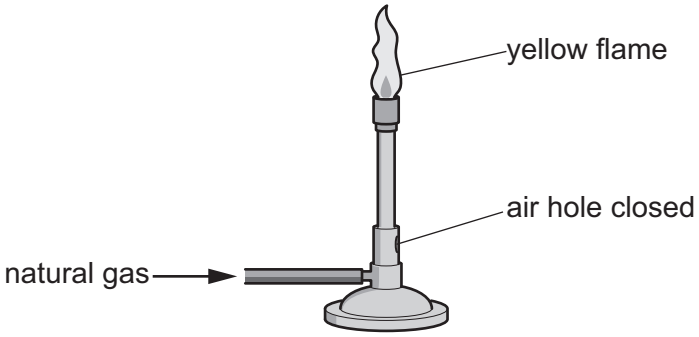
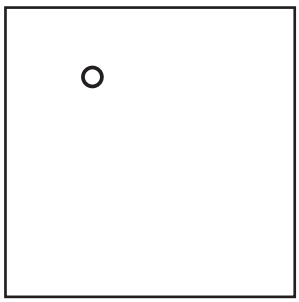


Fig. 8.1

(a) The Bunsen burner uses natural gas.

Draw a simple particle diagram in the box to show the arrangement of particles in a gas.

Draw 5 particles similar in size to the one that has been drawn for you.



[1]

(b) An object is placed at position **X** in Fig. 8.1, about 20 cm above the flame.

State the main method of thermal energy transfer from the flame to the object in position **X**.

..... [1]

(c) Circle the correct word or phrase in **bold** in each sentence to describe what happens to a gas when it is heated at constant pressure.

When a gas is heated at constant pressure, the temperature of the gas

increases / **decreases** / **stays the same**.

The kinetic energy of the gas particles **increases** / **decreases** / **stays the same**.

The speed of the gas particles **increases** / **decreases** / **stays the same**.

The gas expands and the volume of the gas **increases** / **decreases** / **stays the same**.

[2]

(d) When the air hole on the Bunsen burner is opened, the flame turns from yellow to blue.

State the colour in the visible spectrum between yellow and blue.

..... [1]

(e) The blue flame produces sound waves with a range of frequencies.

(i) State the approximate range of frequencies audible to humans.

from ..... Hz

to ..... Hz

[1]

(ii) The speed of sound in air is 340 m / s.

Calculate the wavelength of a sound wave with a frequency of 810 Hz.

wavelength = ... m [2]

[Total: 8]

9 Fig. 9.1 shows a large telescope used for studying the Solar System.

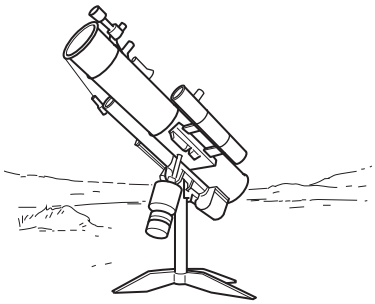
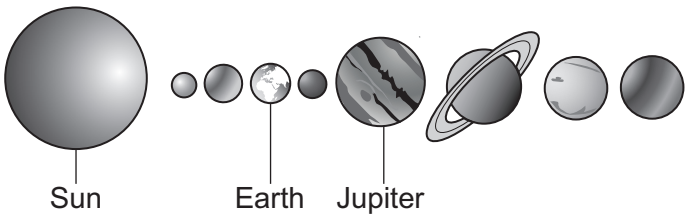


Fig. 9.1

(a) Fig. 9.2 shows the Sun and the eight planets in the Solar System.



not to scale

Fig. 9.2

(i) Name the planet between Earth and Jupiter.

..... [1]

(ii) State **two** other types of objects in the Solar System that are **not** shown in Fig. 9.2.

1 .....

2 .....

[2]

(iii) The Sun is a small mass star.

Complete the labels in Fig. 9.3 to show the stages in the life cycle of a small mass star.

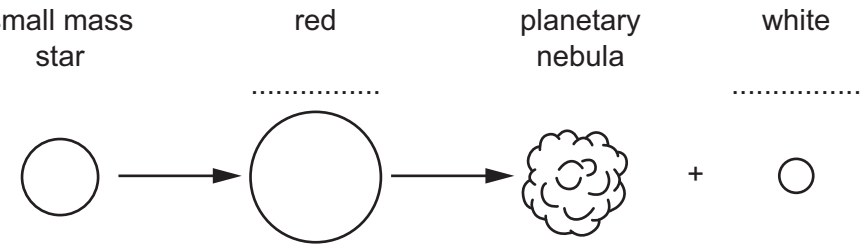


Fig. 9.3

[2]

(b) The telescope contains an electric motor that is powered by a battery.

Fig. 9.4 shows the circuit diagram.

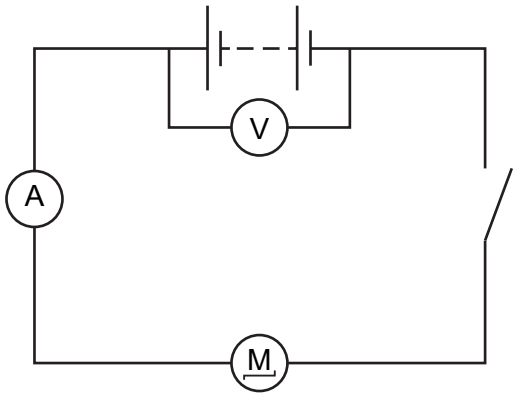


Fig. 9.4

The circuit is switched on.

The voltmeter reading is 3.2 V.

The ammeter reading is 0.080 A.

(i) Calculate the resistance of the electric motor.

resistance = …….. Ω [2]

(ii) When fully charged, the battery stores 4600 J of energy.

Calculate the time, in hours, that the battery can supply energy to the motor.

time = ……..h [3]

[Total: 10]

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.).