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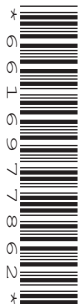
CANDIDATE
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COMBINED SCIENCE

0653/33

Paper 3 Theory (Core)

May/June 2022

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.

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.

- 1 (a) The boxes on the left show different parts of the male and female reproductive system in humans.

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

Draw one straight line from each part to its function.

part	function
cervix	holds testes outside the body
scrotum	receives penis during sexual intercourse
vagina	ring of muscle at the opening of the uterus

[2]

- (b) Fig. 1.1 is a diagram of an insect-pollinated flower.

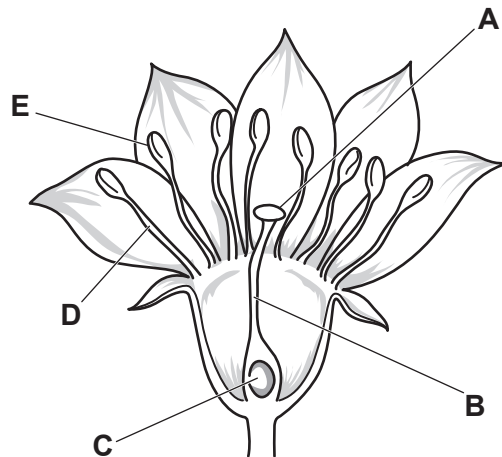


Fig. 1.1

State the letter on Fig. 1.1 that shows:

the part that makes pollen

where pollination takes place.

[2]

(c) Describe the process of fertilisation in **flowering** plants.

.....

.....

..... [2]

(d) Fig. 1.2 shows a potato plant reproducing **without** fertilisation.

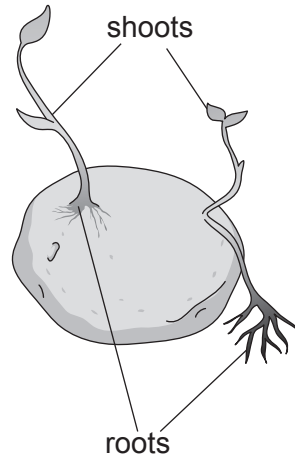


Fig. 1.2

(i) Identify the type of reproduction shown in Fig. 1.2.

..... [1]

(ii) A gardener decides to grow potato plants.

She chooses the best potatoes from a plant she has already grown.

She then uses the method shown in Fig. 1.2 to grow new plants from her best potatoes, rather than using seeds.

Place a tick (✓) in **one** box to show the advantage of using this method.

all the offspring will be genetically identical	<input type="checkbox"/>
the plants will grow slower	<input type="checkbox"/>
the plants will not need water to grow	<input type="checkbox"/>
the potatoes will taste different	<input type="checkbox"/>

[1]

[Total: 8]

2 A student investigates the gases in air.

(a) The student leaves blue cobalt(II) chloride paper in air for a few hours.

The cobalt(II) chloride paper turns pink.

(i) Identify the substance in air that makes the cobalt(II) chloride paper turn pink.

..... [1]

(ii) The student also leaves a small sample of anhydrous copper(II) sulfate in air for a few hours.

State the colour change that is observed when anhydrous copper(II) sulfate is left in air for a few hours.

from to [1]

(b) The student passes clean air through one sample of limewater.

Then he blows air from his lungs through another sample of limewater, as shown in Fig. 2.1.

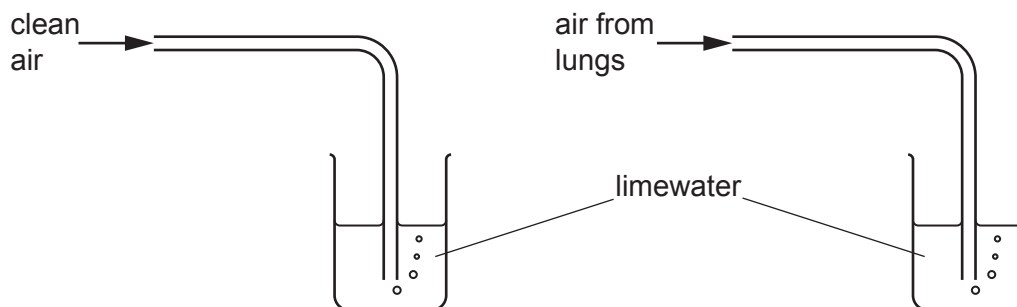


Fig. 2.1

Carbon dioxide from the student's lungs turns the limewater milky within a few seconds.

The clean air takes a long time to turn the limewater milky.

Suggest why the air from the student's lungs turns the limewater milky faster than the clean air does.

.....
 [1]

- (c) The student leaves damp blue litmus paper in polluted air for a few hours.

The litmus paper turns red.

Suggest **one** common pollutant in the air, other than carbon dioxide, that makes the litmus paper turn red.

State **one** adverse effect of this pollutant on people's health.

common pollutant

adverse effect

[2]

- (d) The student increases the temperature of water in a beaker, as shown in Fig. 2.2.

The Bunsen burner uses natural gas.

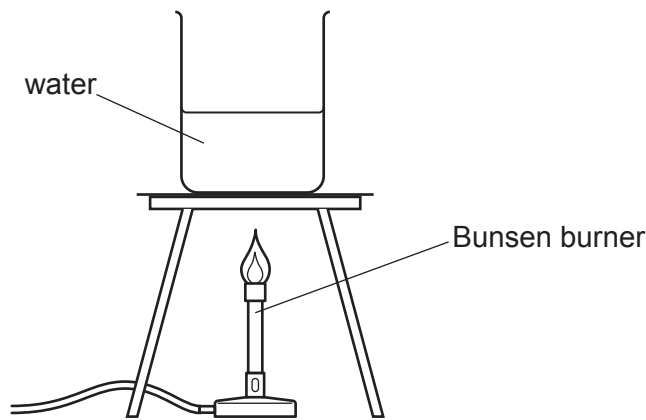


Fig. 2.2

- (i) State the name of the main constituent of natural gas.

..... [1]

- (ii) Name **one** piece of apparatus that can be used to measure the temperature of the water.

..... [1]

- (iii) State the name given to any chemical reaction that causes a temperature increase.

..... [1]

[Total: 8]

3 Fig. 3.1 shows a solid block at rest on a table.

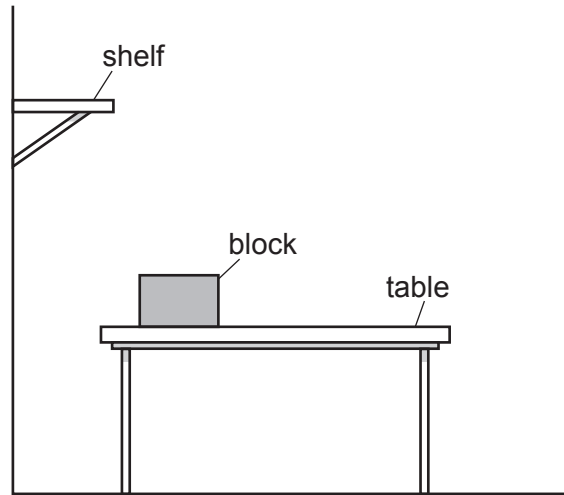


Fig. 3.1

(a) (i) On Fig. 3.1, draw a force arrow to show the gravitational force acting on the block. Label this force **A**. [1]

(ii) On Fig. 3.1, draw a force arrow to show the force exerted by the table on the block. Label this force **B**. [1]

(iii) The gravitational force on the block is 30 N.

State the magnitude of the force exerted by the table on the solid block.

Give a reason for your answer.

force = N

reason

.....

[1]

(iv) Calculate the mass of the block.

The gravitational force on unit mass is 10 N/kg.

mass = kg [2]

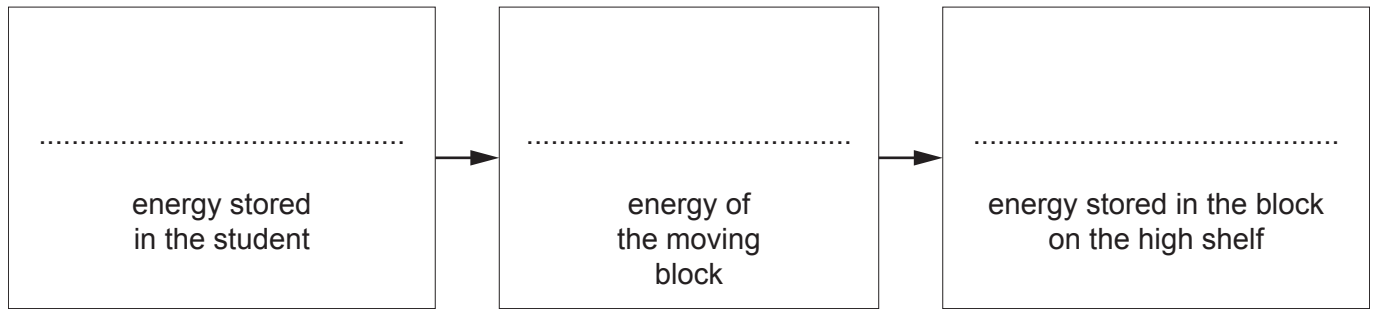
(v) The block has a volume of 0.0040 m³.

Use your answer from (a)(iv) to calculate the density of the block.

density = kg/m³ [2]

(b) A student lifts the block up onto a high shelf.

Complete the boxes to show the sequence of useful energy transfers that occur.



[3]

[Total: 10]

4 (a) Fig. 4.1 is a diagram of the human heart.

(i) Complete the labels on Fig. 4.1.

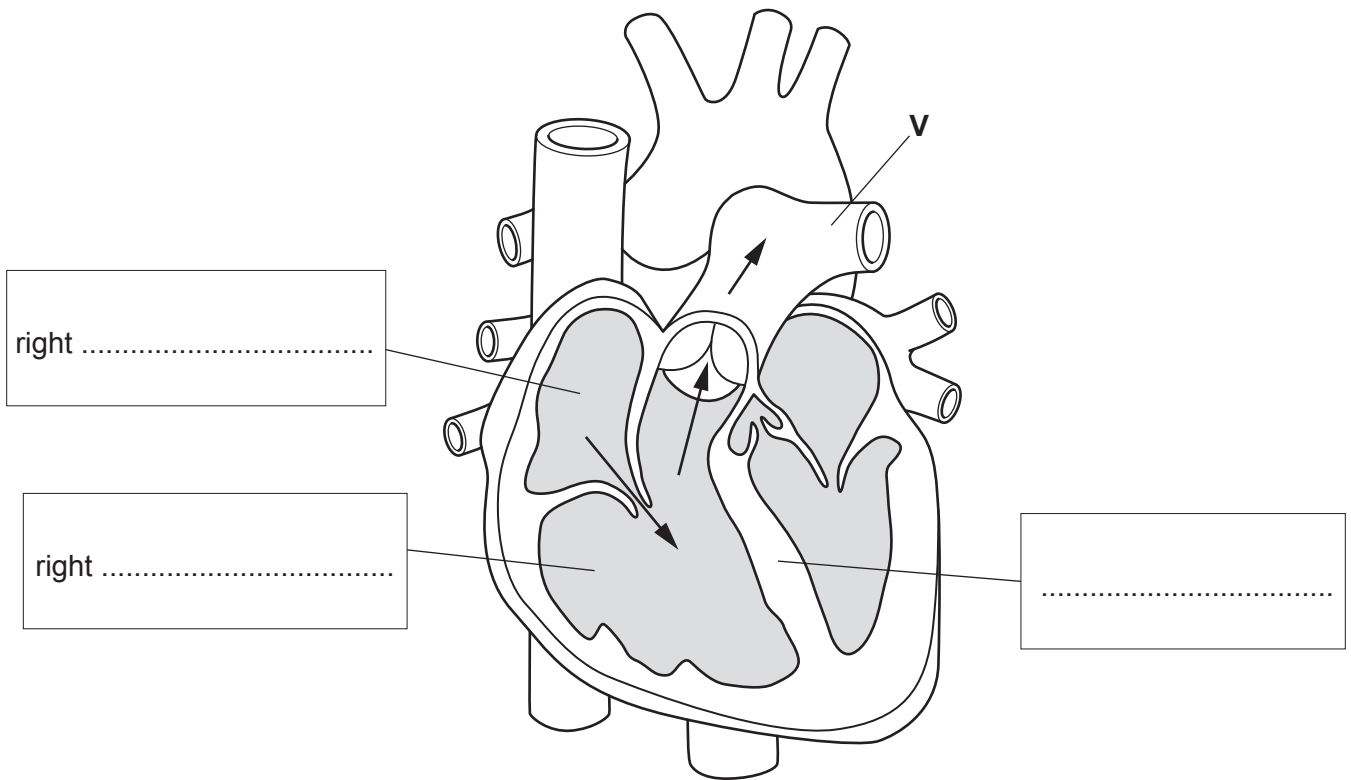


Fig. 4.1

[3]

(ii) The arrows on Fig. 4.1 show the direction of blood flow.

Use this information to state why vessel V is an artery.

..... [1]

(iii) The heart is part of the transport system in humans.

State the name of this transport system.

..... [1]

(b) Arteries and veins transport substances in the human body.

State the name of the **two** transport vessels in plants.

1

2

[2]

(c) A student investigates water transport in plants using two leaves from the same plant.

Fig. 4.2 shows the apparatus the student uses.

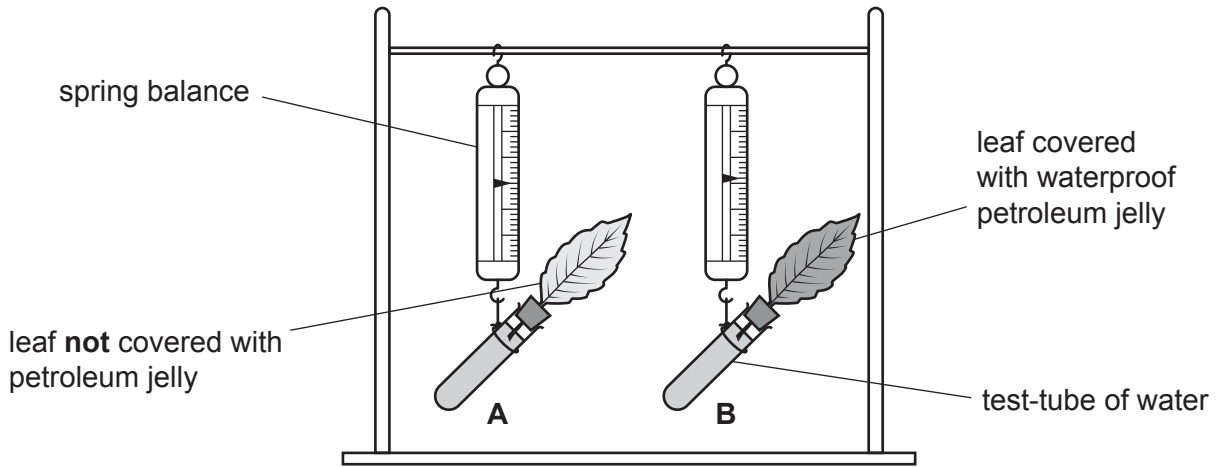


Fig. 4.2

The student uses the spring balance to measure the mass of each leaf at the start. Both leaves are placed in the same conditions. The mass of each leaf is then measured again 24 hours later.

Table 4.1 shows the results.

Table 4.1

leaf	mass at start /g	mass at end /g	change in mass /g
A	31	25	
B	32	31	-1

(i) Calculate the change in mass for leaf **A**.

change in mass =g [1]

(ii) Explain the results in Table 4.1. Use ideas about stomata in your answer.

.....

.....

.....

.....

..... [3]

[Total: 11]

- 5 (a) Lithium, sodium and potassium are three elements in Group I of the Periodic Table, as shown in Fig. 5.1.

3 Li lithium 7
11 Na sodium 23
19 K potassium 39

Fig. 5.1

Identify which of these three elements has:

the lowest density

the highest reactivity

the highest melting point.

[2]

- (b) Chlorine, bromine and iodine are three elements in Group VII of the Periodic Table.

They exist as diatomic molecules.

- (i) Describe what is meant by diatomic.

.....

..... [1]

- (ii) Complete the dot-and-cross diagram in Fig. 5.2 to show all the outer shell electrons in a molecule of chlorine, Cl_2 .



Fig. 5.2

[2]

(iii) State the type of chemical bonding in a molecule of chlorine.

..... [1]

(c) When sodium and chlorine react together, they form sodium chloride, NaCl.

(i) Describe what happens to sodium atoms and to chlorine atoms when they react together.

Use ideas about electrons in your answer.

sodium atoms

.....

chlorine atoms

.....

[2]

(ii) Complete Table 5.1 by stating whether each substance conducts or does **not** conduct electricity when solid, molten (liquid) or gas.

Use a tick (✓) for conducts or a cross (✗) for does **not** conduct in each empty box.

Table 5.1

	solid	molten (liquid)	gas
sodium			
sodium chloride			
chlorine			

[3]

[Total: 11]

6 Fig. 6.1 shows an ice cube floating in a glass of water.

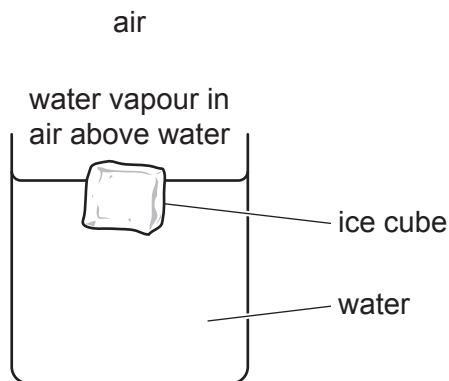


Fig. 6.1

(a) (i) Fig. 6.1 shows four substances: air, ice, water and water vapour.

Identify which substance in Fig. 6.1 fits this description:

‘It is made of molecules which are closely packed, arranged in a regular pattern, and cannot move around.’

substance [1]

(ii) The ice slowly disappears.

Name the process by which molecules in the ice cube become molecules in water and state the temperature at which this happens.

process

temperature °C [2]

(b) Fig. 6.2 shows a ray of light passing through the ice cube.

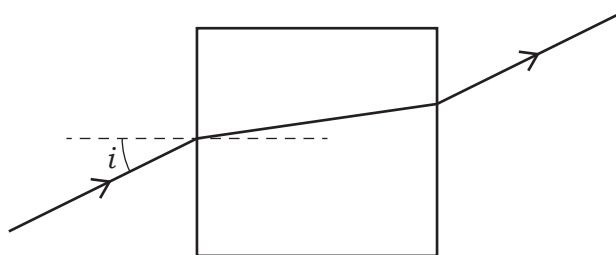


Fig. 6.2

(i) State the property of light shown in Fig. 6.2.

..... [1]

(ii) State the name of the angle marked *i* on Fig. 6.2.

..... [1]

(c) A glacier is a very large area of ice that moves slowly down a slope or valley.

One glacier in Antarctica is 95 km wide.

An explosion causes a loud sound on one side of the glacier.

(i) Calculate the time taken for the sound to travel through the ice of the glacier to the other side.

The speed of sound in ice is 3800 m/s.

time = s [3]

(ii) A human explorer is studying some penguins on the glacier.

Penguins have a range of hearing from 100 Hz to 15 kHz.

The sound wave from the explosion has a frequency of 30 Hz.

Explain why the human explorer can hear the explosion but the penguins **cannot** hear the explosion.

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

[Total: 10]

7 (a) The nuts in Fig. 7.1 are a good source of fats.



Fig. 7.1

(i) List the **three** chemical elements that make up fats.

..... [1]

(ii) Fats are large molecules made from smaller molecules.

Circle the **two** smaller molecules that make up fat molecules.

- | | | |
|--------------------|--------------------|----------------|
| amino acids | fatty acids | glucose |
| glycerol | glycogen | starch |

[2]

(b) Fats are digested in the alimentary canal.

Complete these sentences about digestion.

Choose words from the list.

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

- | | | | |
|-------------------|-----------------|-----------------|------------------|
| absorption | anus | egestion | excretion |
| mouth | pancreas | stomach | |

Food is taken into the by the process of ingestion.

The food then passes down the oesophagus to the

The food then passes into the small intestine to complete the digestion process.

The digested food is then moved into the blood by the process of

[3]

(c) Enzymes are used in the process of digestion.

Fig. 7.2 shows the effect of pH on the activity of one enzyme.

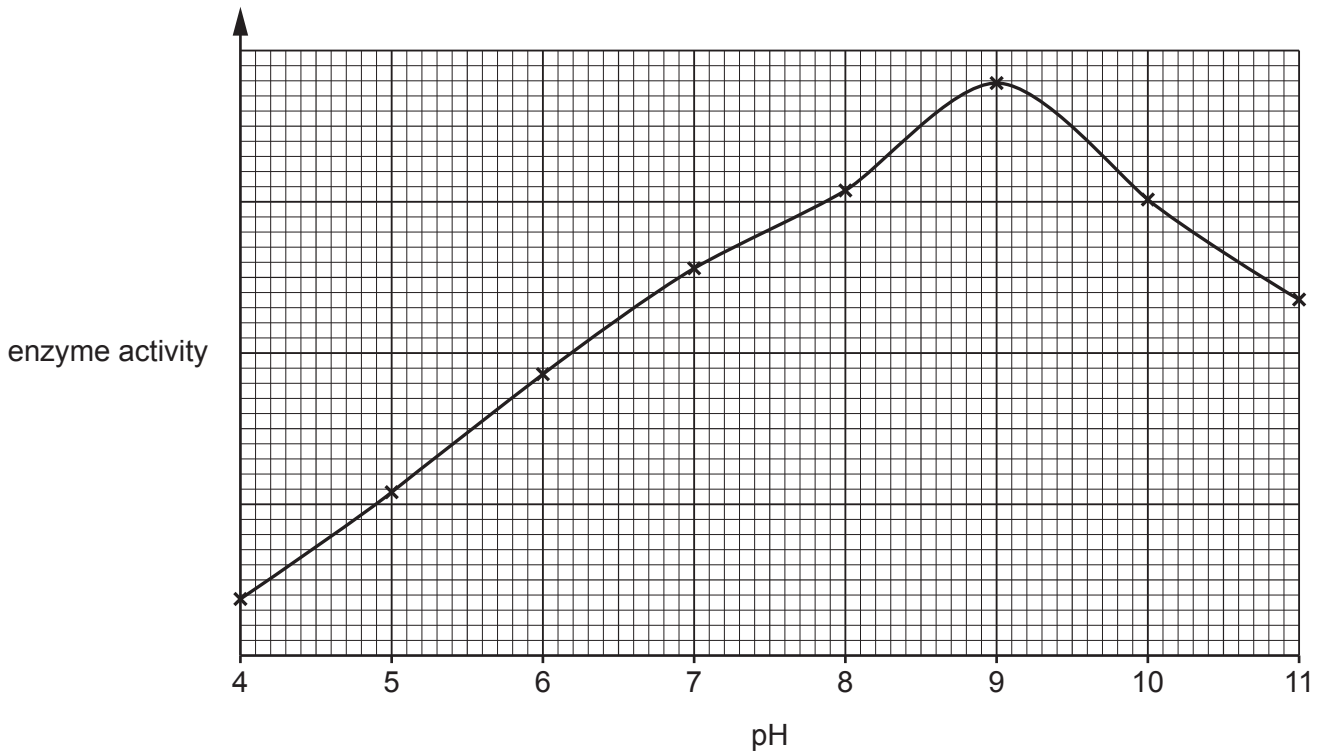


Fig. 7.2

Describe the effect of pH on enzyme activity in Fig. 7.2.

Use data to support your answer.

.....

.....

..... [2]

[Total: 8]

- 8 Petroleum is separated into useful fractions by the process shown in Fig. 8.1.

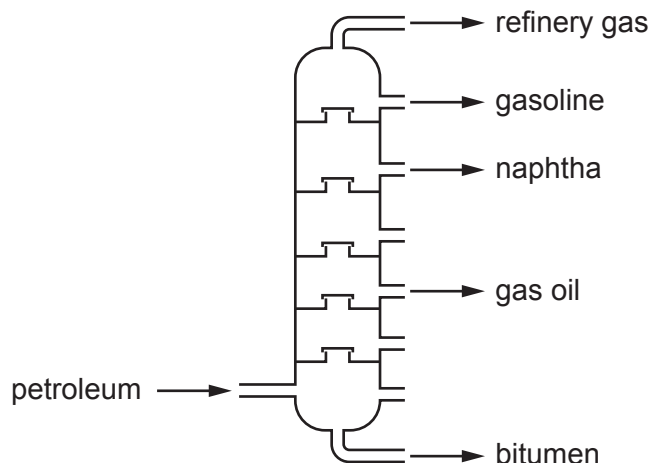


Fig. 8.1

Each fraction is a mixture of different hydrocarbons.

- (a) These hydrocarbons are generally unreactive. They burn in air, but they do not react with aqueous bromine.

- (i) Name the type of hydrocarbons that do **not** react with aqueous bromine.

..... [1]

- (ii) State **one** use for gas oil.

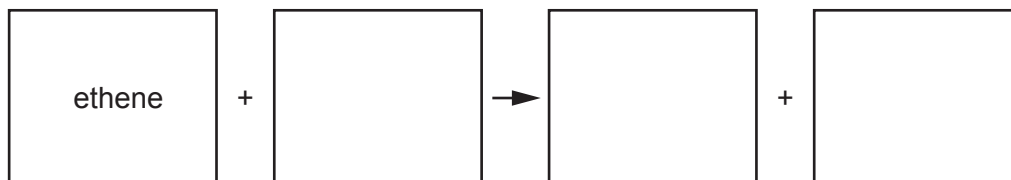
..... [1]

- (b) Naphtha is used to make ethene.

- (i) Name the process used to make ethene from naphtha.

..... [1]

- (ii) Complete the word equation for the complete combustion of ethene, C_2H_4 .



[2]

(c) Ethene is used to make a polymer.

(i) State the name of the polymer that is made from ethene.

..... [1]

(ii) State the type of polymerisation reaction that makes this polymer from ethene.

..... [1]

[Total: 7]

9 Two 1.5V cells are connected to two lamps and a switch.

Fig. 9.1 shows the circuit.

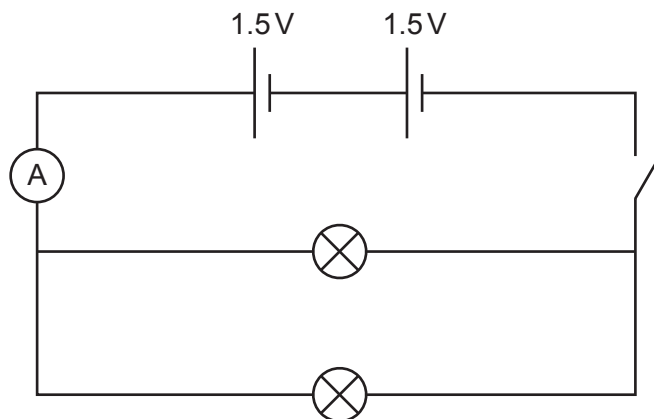


Fig. 9.1

(a) On Fig. 9.1, draw a voltmeter to measure the potential difference across one cell. [2]

(b) (i) The current in each lamp is 1.2A.

The potential difference across each lamp is 3.0V.

Calculate the resistance of each lamp.

resistance = Ω [2]

(ii) The lamps operate at 3.0V.

Suggest why two cells are needed to light the lamps.

.....

 [2]

(iii) State which of these values could be the reading on the ammeter.

0.3A 0.6A 1.2A 2.4A

current = A

Give a reason for your answer.

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

[Total: 7]

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The Periodic Table of Elements

		Group															
I	II											III	IV	V	VI	VII	VIII
3 Li lithium 7	4 Be beryllium 9	<p style="text-align: center;">Key</p> <p style="text-align: center;">atomic number</p> <p style="text-align: center;">atomic symbol</p> <p style="text-align: center;">name</p> <p style="text-align: center;">relative atomic mass</p>										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 —	114 Fl flerovium —	116 Lv livermorium —	—	—	—	—

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 —

lanthanoids

actinoids

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).