Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

0123456789

COMBINED SCIENCE **0653/04**

Paper 4 Theory (Extended) **For Examination from 2019**

SPECIMEN PAPER

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.
A copy of the Periodic Table is printed on page 20.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **20** printed pages.

CAMBRIDGE International Examinations

1 **(a)** Fig. 1.1 shows a section through a leaf.

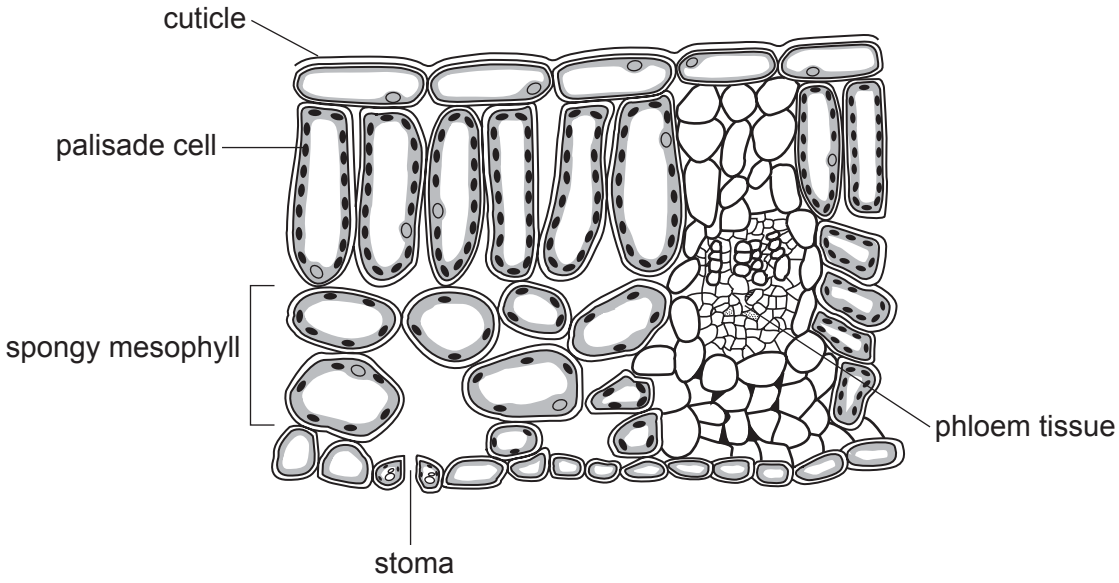


Fig. 1.1

Fig. 1.2 names some structures found in a leaf and states a function of each of these structures.

On Fig. 1.2 draw **one** straight line between **each** structure and the function it carries out.

structure	**function**
cuticle	allows gaseous exchange with surroundings
stoma	allows diffusion of gases within the leaf
palisade cell	waterproofs the leaf
phloem tissue	transports sucrose out of the leaf
spongy mesophyll	produces glucose

Fig. 1.2 [4]

(b) Xylem vessels transport water into the leaf.

State two other functions of xylem vessels.

1. .....

2. .....
[2]

(c) Some of the glucose made in the leaf is changed into another compound and stored by the plant.

Name this other compound.

..... [1]

(d) The mesophyll cells and stomata of the leaf are involved in *transpiration*.

Describe the process of *transpiration*.

Use the terms *mesophyll cells* and *stomata* in your answer.

.....

.....

.....

.....

.....

..... [2]

[Total: 9]

2 **(a)** Table 2.1 gives some facts about the element astatine and its position in the Periodic Table.

Table 2.1

element	Period	Group	proton number
astatine	6	VII	85

From the information in Table 2.1, deduce the number of electrons in the outer shell of an astatine atom.

Explain your answer.

number .....

explanation .....

.....

[2]

(b) A burning splint is placed over a gas jar containing a mixture of hydrogen and air.

The cover is removed. The mixture explodes.

Fig. 2.1 shows the reaction.

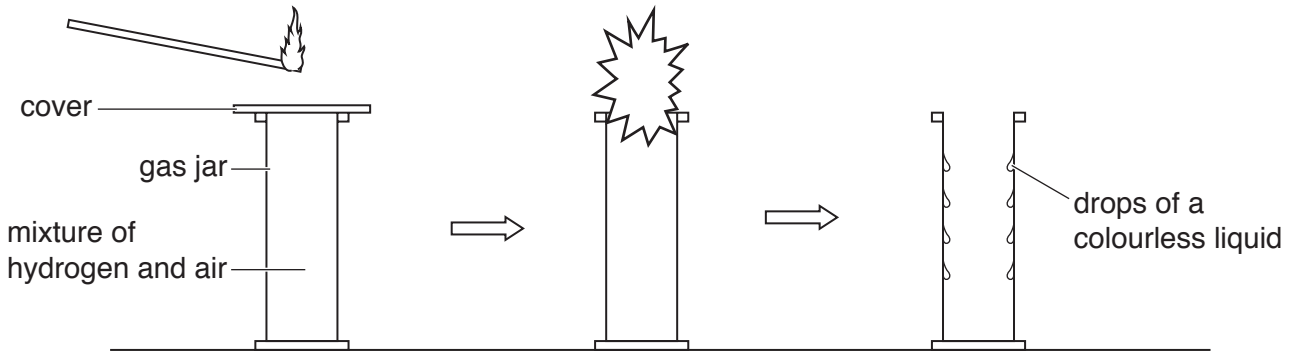


Fig. 2.1

(i) Write the balanced symbol equation for the reaction between hydrogen and oxygen.

..... [2]

(ii) Explain why a burning splint is needed to start this reaction.

..... [1]

(iii) Fig. 2.2 shows the arrangement of electrons in the outer shell of an oxygen atom.

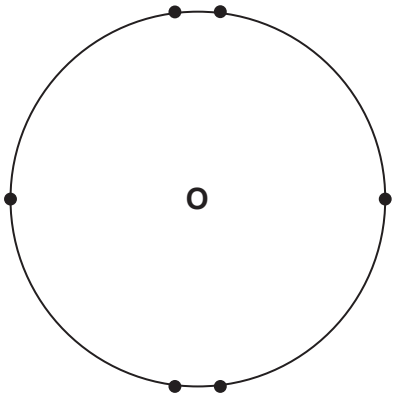


Fig. 2.2

Draw a dot-and-cross diagram in the box to show the arrangement of outer electrons in an oxygen molecule, O_2.

[2]

[Total: 7]

3 **(a)** A stone has a mass of 0.40 kg.

Calculate the weight of the stone.

Gravitational field strength g = 10 N / kg

Show your working and give the unit.

weight = ... unit ..... [2]

(b) The stone is dropped from the top of a high building. The graph in Fig. 3.1 shows the speed-time graph for the stone as it falls.

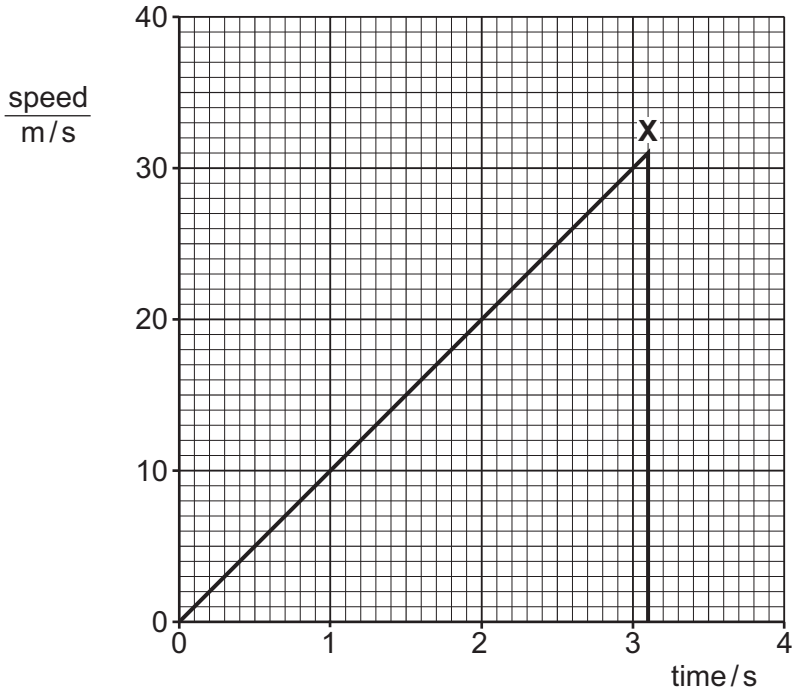


Fig. 3.1

X shows the point at which the stone hits the ground.

(i) Use the graph to find the height of the building.

Show your working.

height = ... m [2]

(ii) Calculate the kinetic energy of the stone as it hits the ground.

Show your working.

kinetic energy = ... J [3]

(iii) After the stone hits the ground, it is found to be slightly warmer than when it was released from the top of the building.

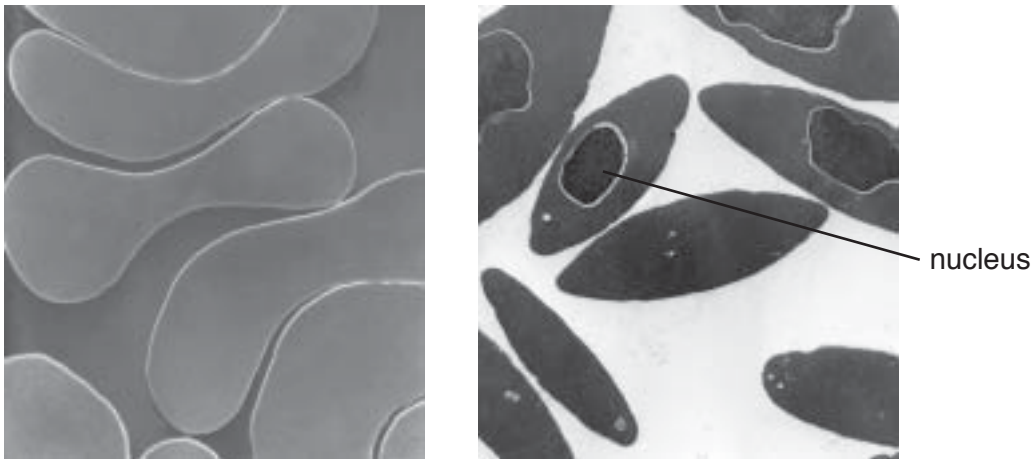
Suggest a reason for this increase in temperature.

.....

..... [1]

[Total: 8]

4 Fig. 4.1 shows images of red blood cells from a human, **A**, and a bird, **B**.



A **B**

Fig. 4.1

(a) State the function of red blood cells.

..... [1]

(b) There is a nucleus present in each of the red blood cells of the bird, as shown in Fig. 4.1.

Human red blood cells do not contain a nucleus.

State an advantage of this.

.....

..... [1]

(c) Red blood cells from humans are placed into four test-tubes. Each test-tube contains a salt solution of a different concentration.

A sample is taken from each test-tube and viewed using a microscope.

The results are shown in Fig. 4.2.

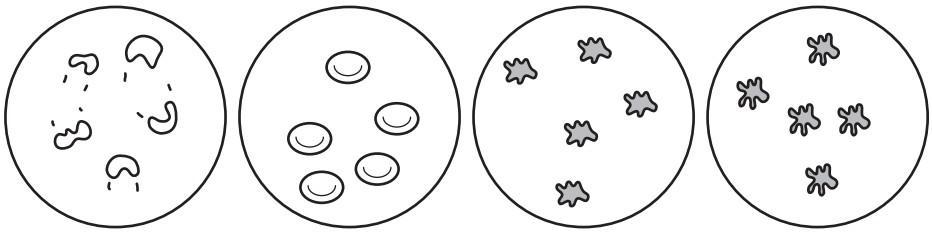


Fig. 4.2

The concentration of the salt solution in each test-tube increases from **A** to **D**.

(i) Describe the appearance of the red blood cells in test-tubes **B** and **D**.

B .....

.....

D .....

.....

[2]

(ii) Suggest why the red blood cells in test-tube **A** burst.

.....

.....

.....

.....

..... [3]

(iii) A plant cell is now put into test tube **A**.

Suggest why this plant cell does not burst.

.....

.....

..... [2]

[Total: 9]

5 Cobalt(II) carbonate reacts with dilute hydrochloric acid to form cobalt(II) chloride.

(a) Table 5.1 shows information about the formulae and ions present in cobalt(II) carbonate and cobalt(II) chloride.

Complete the table.

Table 5.1

name of compound	formula	formula of positive ion	formula of negative ion
cobalt(II) carbonate	.....	Co^{2+}	CO_3^{2-}
cobalt(II) chloride	$CoCl_2$	Co^{2+}	.....

[2]

(b) Cobalt(II) carbonate is insoluble. Cobalt(II) chloride is soluble.

Complete this method to prepare dry crystals of cobalt(II) chloride from cobalt(II) carbonate.

step 1

Add an excess of cobalt(II) carbonate to hot dilute hydrochloric acid.

step 2

.....

.....

step 3

.....

.....

step 4

.....

.....

[4]

(c) The rate of reaction between cobalt(II) carbonate and dilute hydrochloric acid is faster if a higher concentration of acid is used.

Explain, in terms of particles, why increasing the concentration of acid increases the rate of reaction.

.....

.....

.....

..... [3]

[Total: 9]

[Turn over

6 Fig. 6.1 shows apparatus used to investigate water waves.

The electric motor causes the board to vibrate which produces waves at a constant rate.

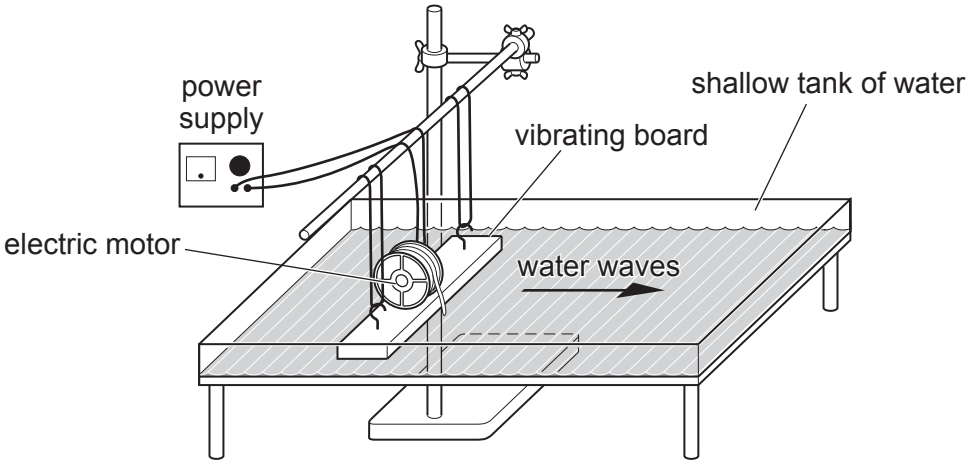


Fig. 6.1

(a) (i) State what is meant by a *transverse wave*.

.....

..... [1]

(ii) Give an example of a longitudinal wave.

..... [1]

(b) Fig. 6.2 shows a close-up side view of some water waves in the tank which refract at point **P**.

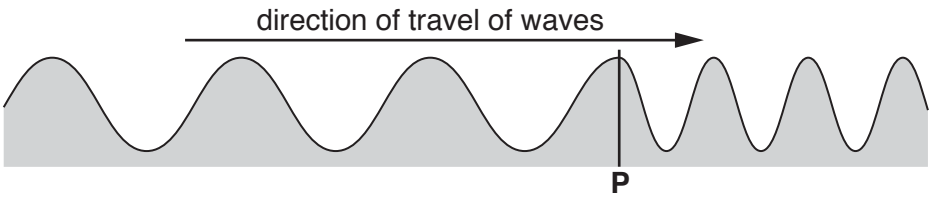


Fig. 6.2

State **one** property of the wave motion that

changes after point **P**,

.....

remains the same after point **P**.

.....

[2]

(c) When the speed of the motor increases, the board vibrates more rapidly.

When the board is vibrating at 5 Hz, the students cannot hear any sound.

When the board vibrates at 50 Hz, the students can hear a sound.

(i) State why the students cannot hear any sound when the board vibrates at 5 Hz.

.....

..... [1]

(ii) Describe how the sound is transmitted from the vibrating board through the air.

.....

.....

..... [2]

(d) In another demonstration the board vibrates at 30 Hz. The wavelength of the water waves is 0.80 cm.

Calculate the speed of the waves.

Show your working.

speed = ... cm/s [2]

(e) State the speed at which all electromagnetic waves travel in a vacuum.

speed = ... m/s [1]

[Total: 10]

7 Fig. 7.1 shows a diagram of an enzyme molecule and some other smaller molecules.

Enzymes function as biological catalysts.

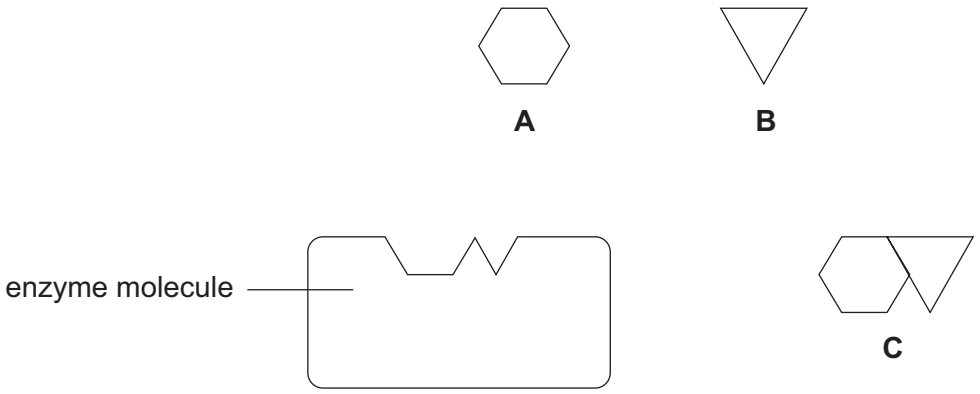


Fig. 7.1

(a) (i) The enzyme molecule in Fig. 7.1 catalyses the joining together of small molecules.

From Fig. 7.1 state the letter of a possible substrate for this reaction and explain your answer.

substrate .....

explanation.....

..... [1]

(ii) Describe how the shape of the enzyme molecule shown in Fig. 7.1 helps it with its function in this reaction.

.....

.....

..... [2]

(b) The activity of this enzyme changes as the temperature increases. The optimum temperature for the enzyme is 40 °C.

Explain why enzyme activity is lower

(i) at 20 °C

.....

.....

..... [2]

(ii) at 50 °C

.....

.....

..... [2]

(c) Enzymes also catalyse the breakdown of larger molecules during chemical digestion.

Name the enzyme that catalyses the chemical digestion of protein.

.....

Name the products of this reaction.

.....
[2]

[Total: 9]

8 Petroleum (crude oil) is a mixture of compounds.

It can be separated into fractions by fractional distillation.

(a) Complete Table 8.1 to show the fractions of petroleum and their uses.

Table 8.1

fraction	use
.....	fuel for portable cooking stoves
bitumen	.....
.....	feedstock for making chemicals

[3]

(b) Fig. 8.1 shows some of the fractions obtained by fractional distillation.

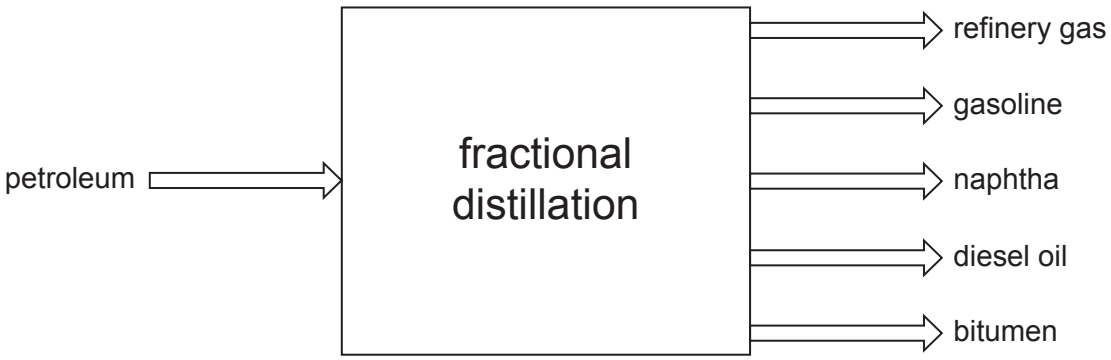


Fig. 8.1

The fractions have different boiling point ranges.

Describe how and why the properties of these fractions differ from each other.

.....

.....

.....

..... [3]

(c) Fig. 8.2 shows a model of the molecular structure of one of the hydrocarbons in petroleum.

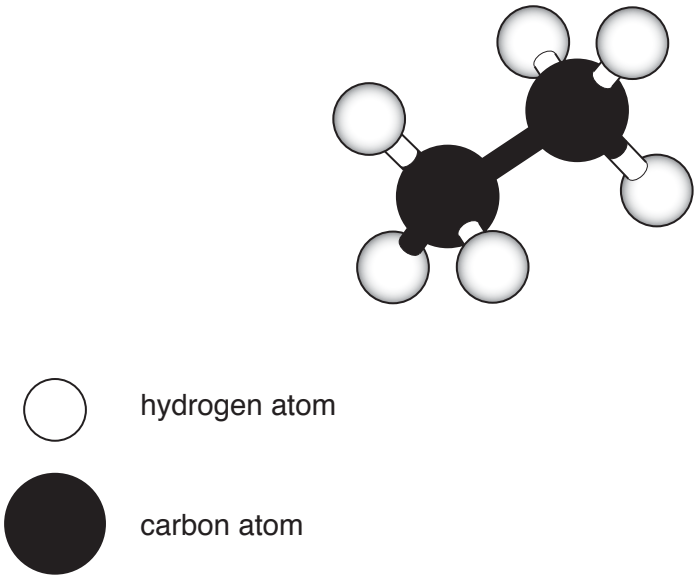


Fig. 8.2

The general formula for alkanes is $C_nH_{(2n + 2)}$.

Describe how the formula of the molecule in Fig. 8.2 fits the general formula for an alkane.

.....

..... [2]

(d) Alkanes are *saturated hydrocarbons*.

Explain what this term means.

.....

..... [2]

[Total: 10]

9 A student builds a model car.

Fig. 9.1 shows a circuit he designs for the electrical equipment he wants in the car.

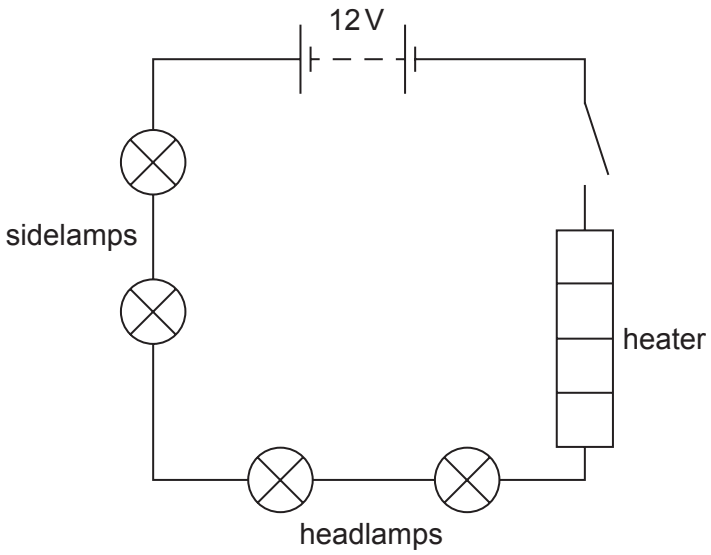


Fig. 9.1

(a) Fig. 9.2 shows the lamps and heater he uses for his model. The ratings of the lamps and heater are shown.

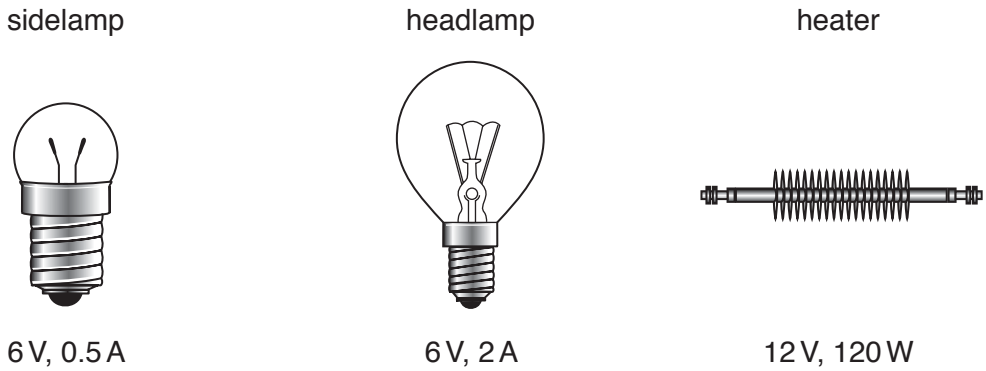


Fig. 9.2

Explain what is meant by the ratings:

6 V .....

.....

120 W .....

.....

[4]

(b) The student closes the switch in the circuit shown in Fig. 9.1. The lamps glow very faintly.

Complete Fig. 9.3 to show the sidelamps, headlamps and heater connected so that all the lamps glow brightly.

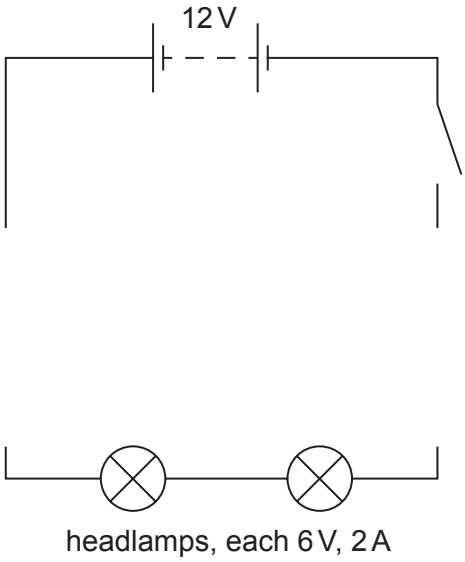


Fig. 9.3 [2]

(c) The current in the battery is 12.5 A. Calculate the charge which flows in two minutes.

Show your working.

charge = ... C [2]

(d) The heater is designed to transfer thermal energy to the air to warm the inside of the model car.

Name the main method of thermal energy transfer when warm air circulates inside the car.

..... [1]

[Total: 9]

The Periodic Table of Elements

I	II											III	IV	V	VI	VII	VIII
							1 H hydrogen 1										2 He helium 4
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 –		114 Fl flerovium –		116 Lv livermorium –		

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.).