Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

6720938139

COMBINED SCIENCE **0653/42**

Paper 4 (Extended) **May/June 2018**

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 24.

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 **21** printed pages and **3** blank pages.

CAMBRIDGE International Examinations

1 **(a)** Fig. 1.1 shows an experiment with a germinating seed. At the start, a seed is pinned to a wall and is placed in the dark.

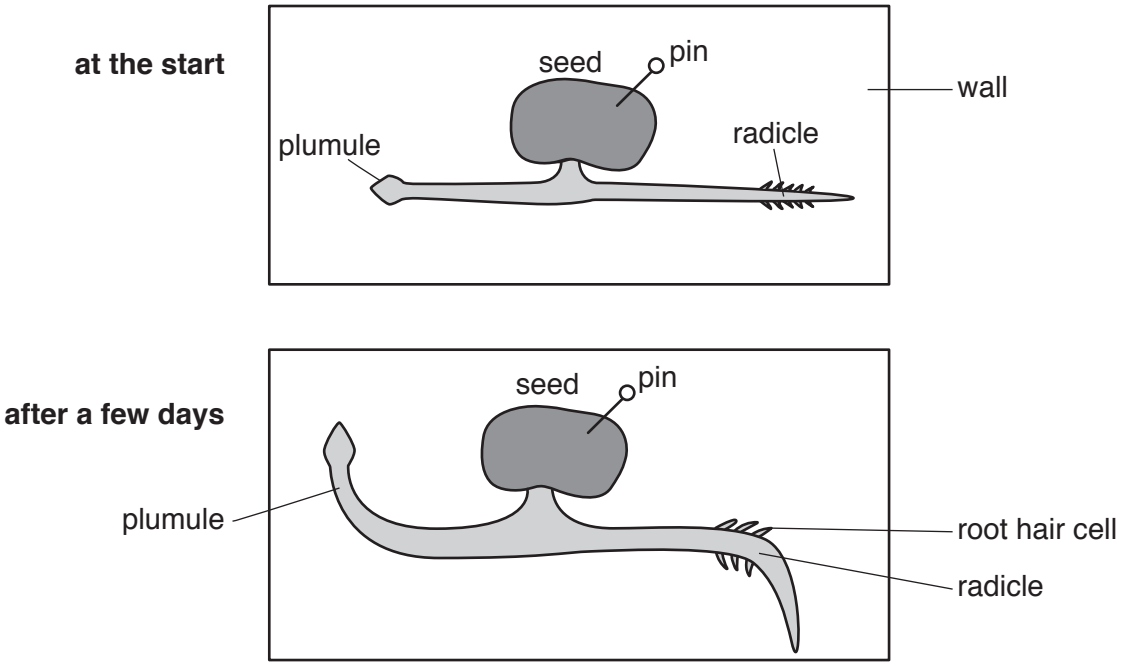


Fig. 1.1

(i) Name the response shown by the seed in Fig. 1.1 after a few days.

.....[1]

(ii) Explain the response of the plumule in Fig. 1.1 after a few days in terms of the action of auxin hormones.

.....

.....

.....[2]

(iii) Describe how the action of auxin hormones is different in the cells of the radicle.

.....

.....[1]

(b) A radicle has root hair cells which are used in water uptake from the soil.

(i) Explain how the shape of the root hair cell helps it with its function of water uptake.

.....

.....

.....[2]

(ii) Explain why water moves into the root hair cell from the soil.

.....

.....

.....[2]

(c) State the tissue which carries water through the plant.

.....[1]

[Turn over

2 **(a)** A student investigates the combustion of a hydrocarbon, as shown in Fig. 2.1.

Gases move through the apparatus in the direction shown by the arrows.

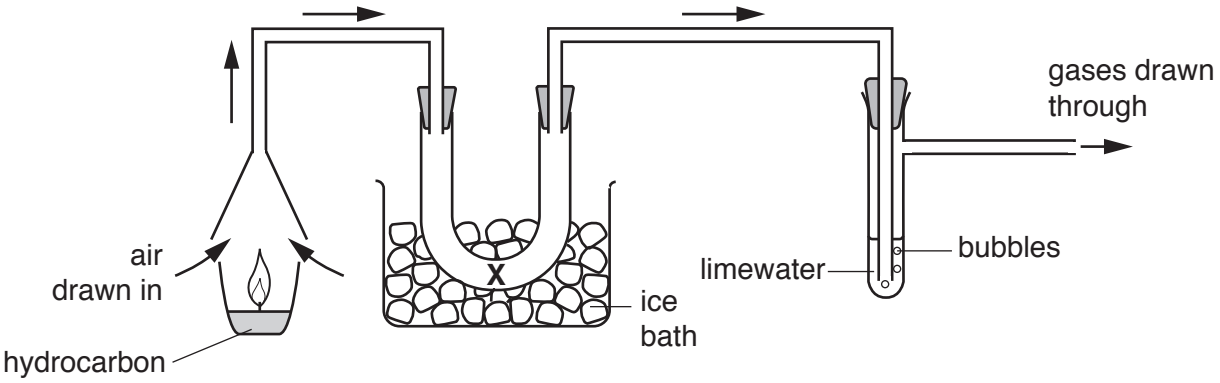


Fig. 2.1

The student thinks that carbon dioxide and water are formed when the hydrocarbon burns.

(i) Suggest a chemical that the student uses at position **X** to test for the presence of water.

State the observation that shows that water is present.

chemical .....

observation .....

.....

[2]

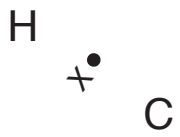
(ii) Limewater contains calcium hydroxide, $Ca(OH)_2$.

Calcium hydroxide reacts with carbon dioxide to form calcium carbonate, $CaCO_3$.

Write the symbol equation with state symbols for this reaction.

.....[2]

(b) **(i)** Complete the dot-and-cross diagram for the hydrocarbon C_2H_4, showing the bonding electrons.



[2]

(ii) Carbon and hydrogen are non-metallic elements.

State the type of chemical bond that forms between these two elements.

.....[1]

(c) An atom of carbon is represented by:

$$^{12}_{6}C$$

State the electronic structure of carbon.

..... [1]

[Turn over

3 Fig. 3.1 and Fig. 3.2 show two circuit diagrams each connected to operate an electric motor and a lamp.

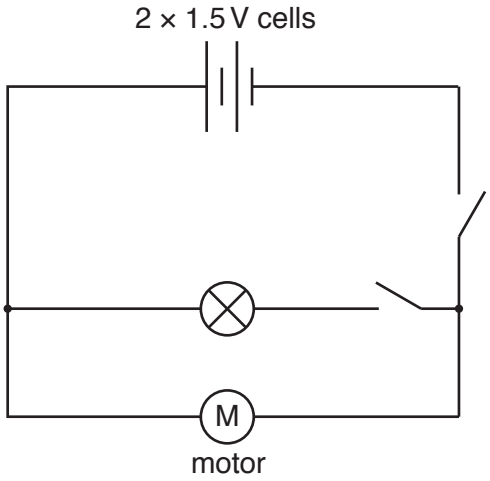


Fig. 3.1

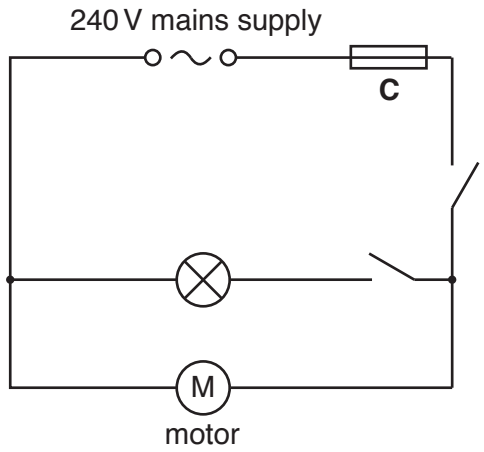


Fig. 3.2

(a) Identify component **C and** explain why it is necessary in the circuit in Fig. 3.2, but not in the circuit in Fig. 3.1.

component **C** .....

explanation .....

.....

.....

.....[3]

(b) **(i)** In Fig. 3.1, when the motor is switched on, but the lamp is not, a current of 0.2 A flows through the motor.

Calculate the resistance of the motor.

State the formula you use and show your working.

formula

working

resistance = ... Ω [2]

(ii) In Fig. 3.2, the motor has a power rating of 20 W and the lamp has a power rating of 100 W.

Calculate the current in the main circuit when both the motor and the lamp are switched on.

State the formula you use and show your working.

formula

working

current = ... A [3]

(c) A lamp is placed in front of a mirror. A student tries to look at the reflection of the lamp in the mirror, as shown in Fig. 3.3.

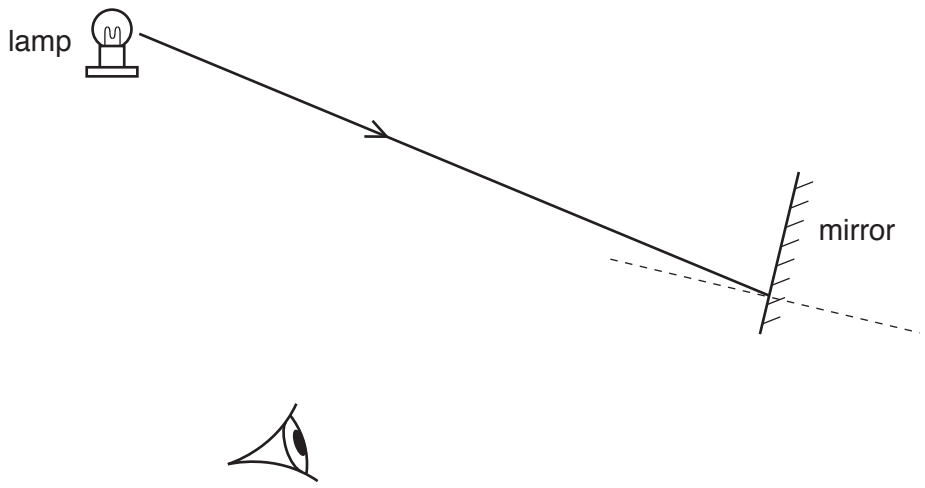


Fig. 3.3

On Fig. 3.3, complete the ray diagram to show whether the student can see the image of the lamp in the mirror or not. [1]

4 **(a)** During inspiration air passes through different parts of the airway to reach the alveoli.

Use the list of words to show the correct order of structures through which the air passes.

bronchiole **bronchus** **diaphragm** **heart**

oesophagus **rib** **trachea**

nose

↓

.....

.....

.....

↓

alveoli

[1]

(b) Fig. 4.1 shows drawings of the alveoli in healthy lungs. Fig. 4.1 also shows the alveoli of a person with a lung infection such as bronchitis.

alveoli of a healthy person alveoli of a person with bronchitis

Fig. 4.1

People who smoke are more likely to suffer from bronchitis.

Describe how cigarette smoke encourages bronchitis by its effect on

1. the amount of mucus produced by cells lining the airway,

.....

.....

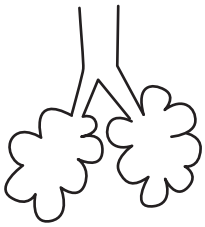
2. the cilia on the surface of cells lining the airway.

.....

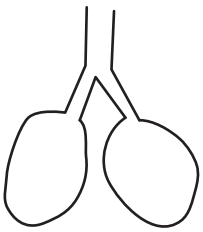
.....

[3]

(c) Fig. 4.2 shows a drawing of the alveoli in healthy lungs. Fig. 4.2 also shows the alveoli of a person with emphysema, a lung disease caused by smoking.



alveoli in healthy lungs



alveoli of a person with emphysema

Fig. 4.2

Suggest how the rate of gas exchange is affected in a person with emphysema.

Explain your answer.

.....

.....[1]

(d) Smoking is also a possible cause of coronary heart disease.

(i) Describe changes in the heart which cause coronary heart disease.

.....

.....

.....[2]

(ii) List **two** other possible causes of coronary heart disease.

1. .....

2. .....
[2]

5 **(a)** A student adds magnesium powder to dilute hydrochloric acid.

She then uses a balance to investigate the rate of this reaction, as shown in Fig. 5.1.

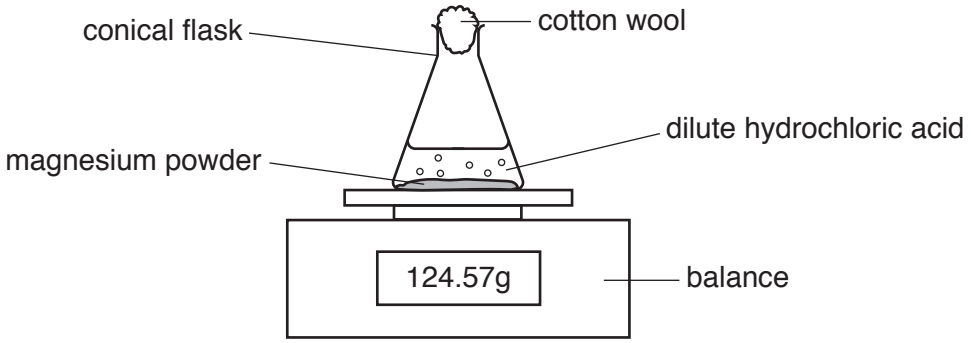


Fig. 5.1

(i) Describe the change in the mass, if any, of the conical flask and its contents.

Explain your answer.

change .....

explanation .....

.....

[2]

(ii) State the effect of increasing the temperature on the rate of this reaction.

Explain your answer.

effect .....

explanation .....

.....

[2]

(iii) Predict the effect of using calcium, rather than magnesium, on the rate of reaction.

Explain your answer using ideas about reactivity.

effect .....

explanation .....

.....

[2]

(b) Magnesium is produced by the electrolysis of molten magnesium chloride.

Magnesium chloride consists of magnesium ions, Mg^{2+}, and chloride ions, Cl^{-}.

(i) Name the electrode at which magnesium forms.

.....[1]

(ii) Describe, in terms of electrons, how chloride ions turn into chlorine atoms in this process.

.....

.....[1]

(iii) Predict the formula of magnesium chloride.

..... [1]

(iv) Magnesium is also produced by heating magnesium oxide with silicon.

In this process, oxygen is removed from magnesium oxide.

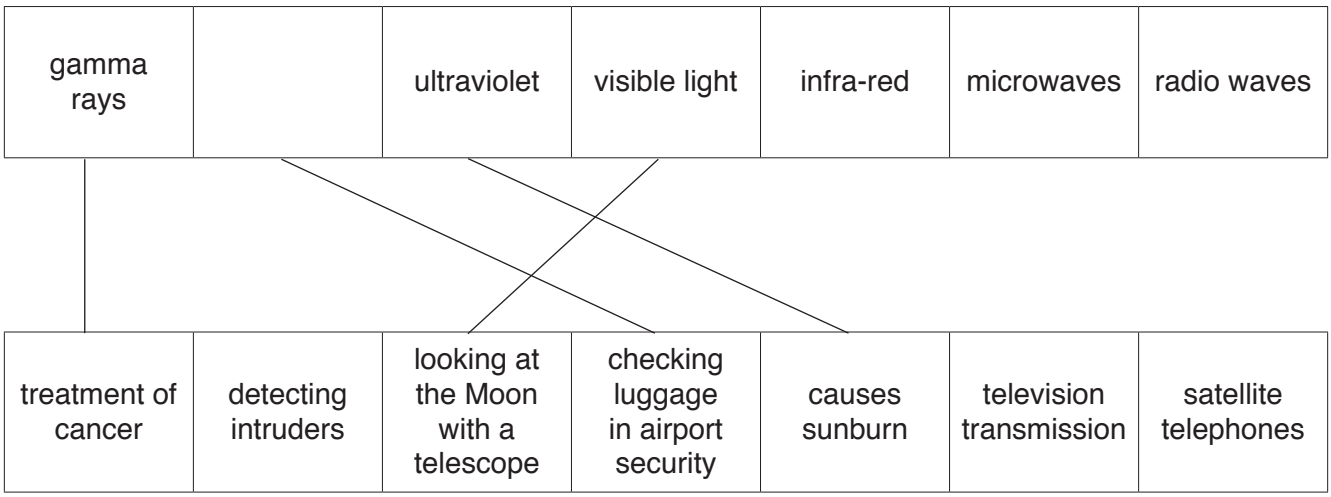
State the type of reaction that leads to the loss of oxygen from a substance.

.....[1]

[Turn over

6 **(a)** Fig. 6.1 shows an incomplete electromagnetic spectrum linked to some uses of different parts of the electromagnetic spectrum.

electromagnetic spectrum



uses

Fig. 6.1

(i) On Fig. 6.1 complete the empty box in the electromagnetic spectrum. [1]

(ii) On Fig. 6.1 draw **three more** lines so that each type of electromagnetic wave is linked to a use of that type.

Four lines have already been done for you. [1]

(b) Infra-red radiation is also used in remote controls for television sets and other electronic devices in the home.

An astronaut on a space walk outside the International Space Station uses the same type of remote control to operate an electronic device in space.

Explain why it is possible for a remote control to work in space.

.....

.....[1]

(c) Fig. 6.2a and Fig. 6.2b show an experiment to investigate the transfer of thermal energy (heat).

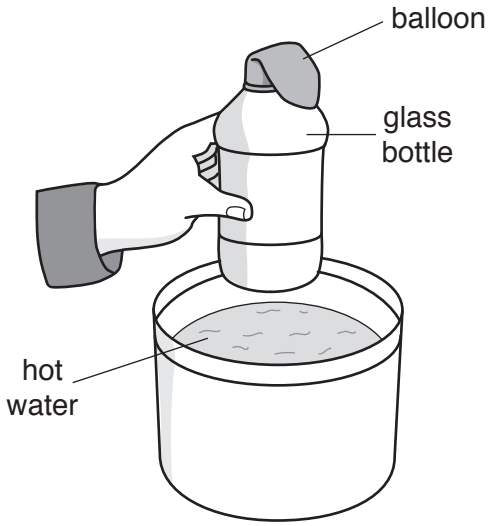


Fig. 6.2a

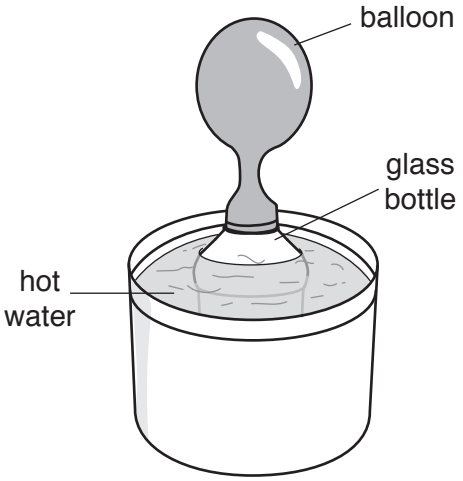


Fig. 6.2b

Fig. 6.2a shows the apparatus before the glass bottle is lowered into the hot water.

Fig. 6.2b shows the apparatus after the bottle has been in the water for 5 minutes.

The bottle and the air inside are slowly heated as thermal energy is conducted through the glass and warms the air inside. As the bottle is heated, the balloon fills with air.

(i) Suggest why the heating of the air in the bottle is slow.

.....[1]

(ii) Explain in terms of the arrangement and the speed of molecules why the balloon above the glass bottle fills with warm air as the air is heated.

.....

.....

.....

.....

.....[3]

[Turn over

7 Fig. 7.1 shows a simplified version of the carbon cycle. The numbers represent processes involved in the cycle.

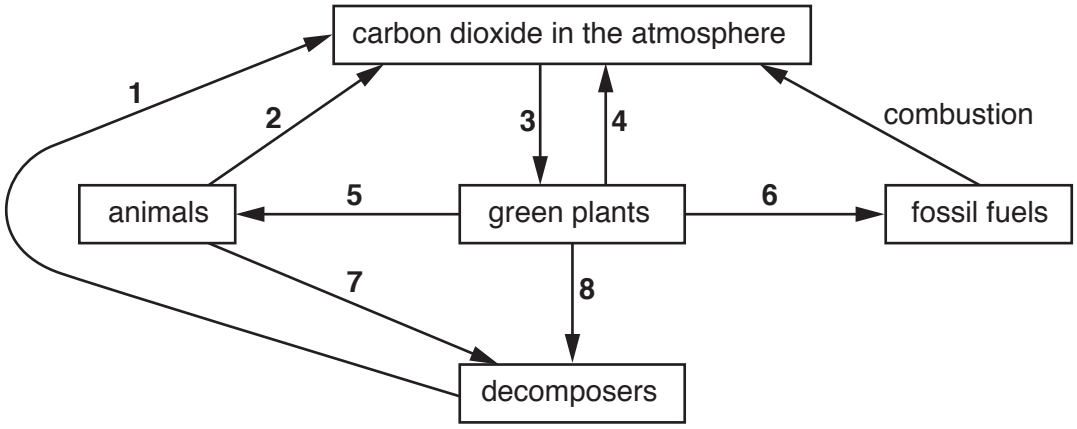


Fig. 7.1

(a) (i) State the source of the energy input to the carbon cycle.

.....[1]

(ii) Name process **7**.

.....[1]

(iii) Using Fig. 7.1 state the numbers which represent respiration.

.....[1]

(b) (i) Name process **3**.

.....[1]

(ii) With reference to process **3**, explain the effect of deforestation on the carbon dioxide concentration in the atmosphere.

.....

.....

.....

.....[2]

(c) The gas sulfur dioxide is released into the atmosphere during the combustion of fossil fuels.

Explain the consequences of adding sulfur dioxide to the atmosphere.

.....

.....

.....

.....[3]

8 **(a)** **(i)** Elements are arranged in the Periodic Table in atomic number order.

State the relationship between the group number of an element and the number of outer-shell electrons in an atom of the element.

.....[1]

(ii) Describe the relationship between the number of outer-shell electrons and the metallic/non-metallic character of an element.

.....

.....[1]

(b) Rubidium is a Group I metal below potassium in the Periodic Table.

Rubidium is a solid at room temperature, 20 °C.

Potassium melts at 63 °C and reacts vigorously with water.

(i) Suggest the melting point of rubidium.

..... °C [1]

(ii) Compare the reactivities of rubidium and of potassium with cold water.

.....

.....[1]

(c) Explain the use of chlorine in water purification.

.....

.....[1]

(d) The reaction between sodium and chlorine is exothermic.

Sodium chloride is formed in this reaction.

(i) State what is meant by *exothermic*.

Use ideas about energy transformations in your answer.

.....

.....[2]

(ii) Suggest **one** substance that reacts safely with dilute hydrochloric acid to form sodium chloride.

.....[1]

9 Fig. 9.1 shows a crane carrying a load.

The crane is floating in the sea on a calm day.

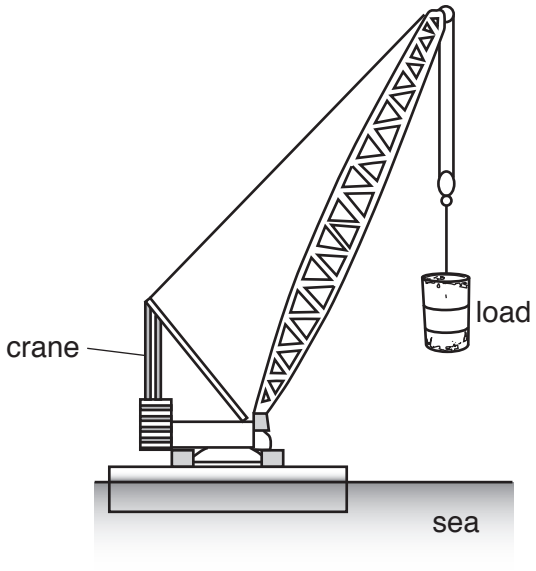


Fig. 9.1

(a) (i) The load is stationary.

On Fig. 9.1 draw two force arrows to show the vertical forces acting on the load. [2]

(ii) One of the forces acting on the load is called *tension*.

Name the other force acting on the load.

.....[1]

(b) The crane lifts the load vertically upwards from the sea bed to a position above the sea surface.

Fig. 9.2 shows a speed-time graph for the load during this operation.

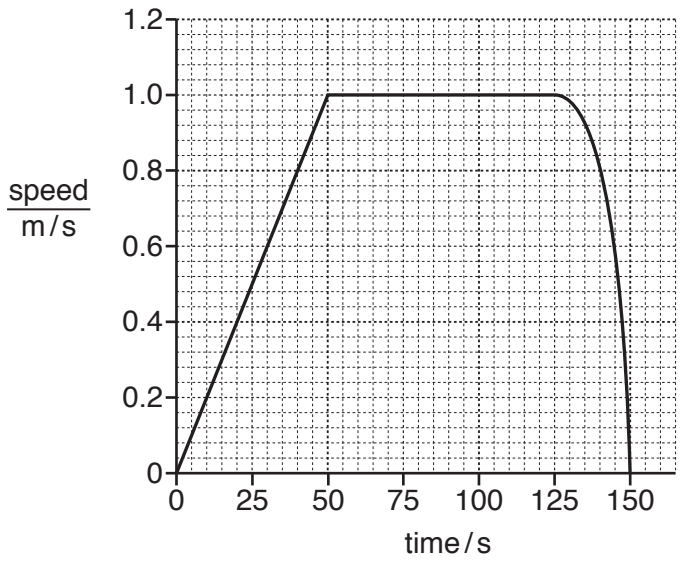


Fig. 9.2

(i) Use terms from this list to complete the statements below.

changing acceleration **constant acceleration** **constant speed**

Between 0 s and 50 s the load travels with

..... .

Between 50 s and 125 s the load travels with

..... .

Between 125 s and 150 s the load travels with

..... .

[1]

(ii) The load reaches the sea surface after 125 s.

Use Fig. 9.2 to calculate the depth of the sea from the sea bed to the sea surface.

Show your working.

depth of sea = ... m [2]

(iii) The total work done by the crane in 150 s is 2 000 000 J.

Calculate the average power output of the crane during this time.

State the formula you use and show your working.

formula

working

power output = ... W [2]

[Turn over

(c) The load being lifted by the crane is a container full of sea water.

The volume inside the container is 5000 dm^3. The density of sea water is 1025 kg/m^3.

Calculate the mass of sea water being lifted.

State the formula you use and show your working.

formula

working

mass = ... kg [3]

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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 –		114 Fl flerovium –		116 Lv livermorium –		

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.).