



Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

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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.

- 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.

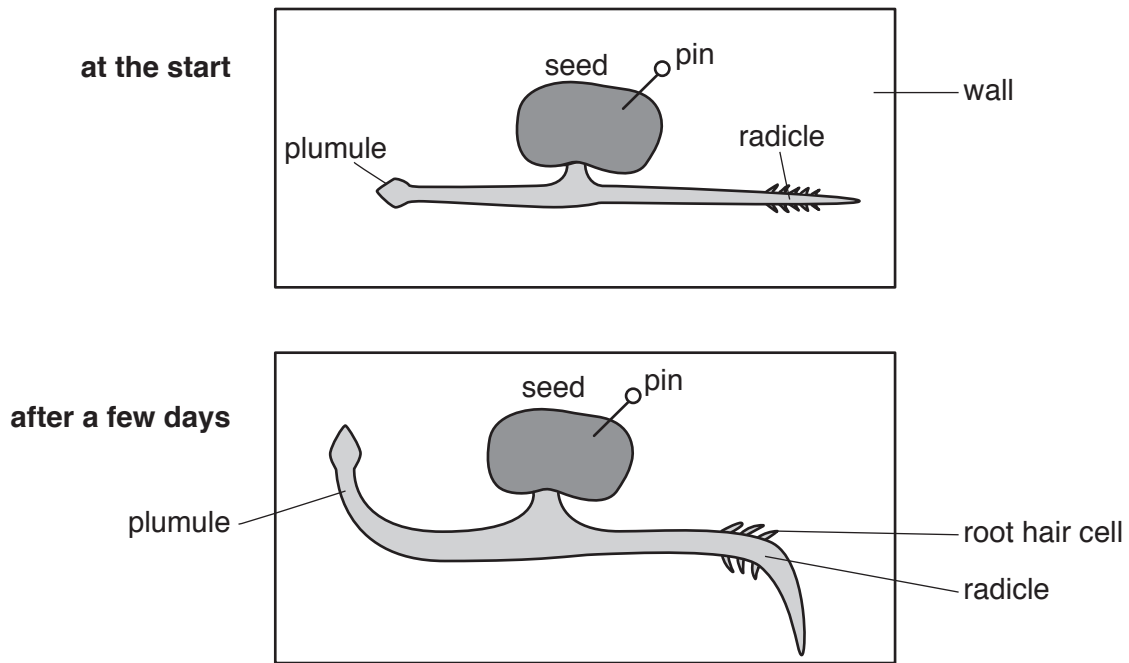


Fig. 1.1

- (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]

- 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.

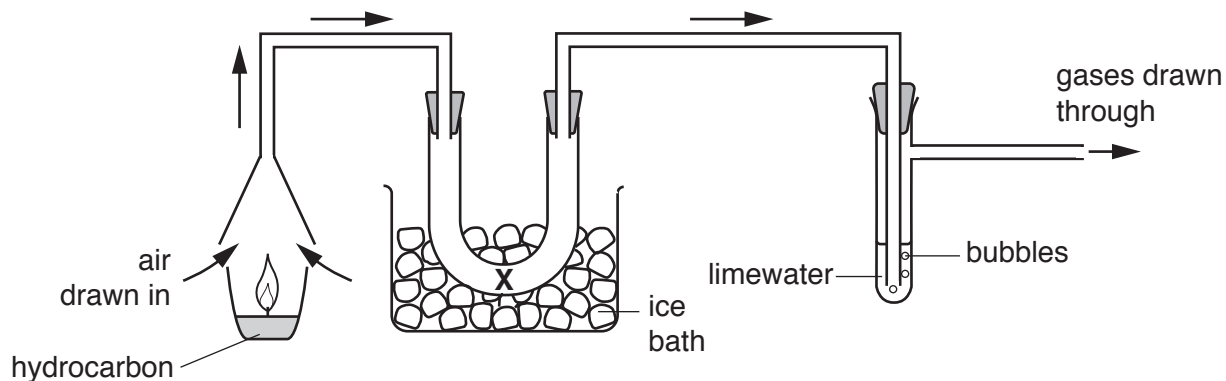


Fig. 2.1

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]

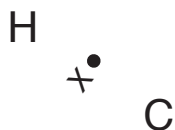
- (ii) Limewater contains calcium hydroxide, $\text{Ca}(\text{OH})_2$.

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:



State the electronic structure of carbon.

..... [1]

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

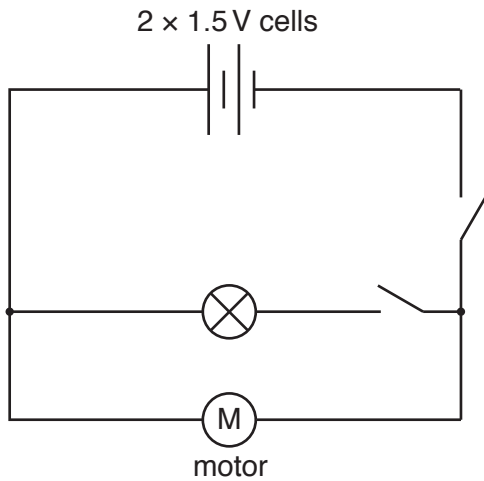


Fig. 3.1

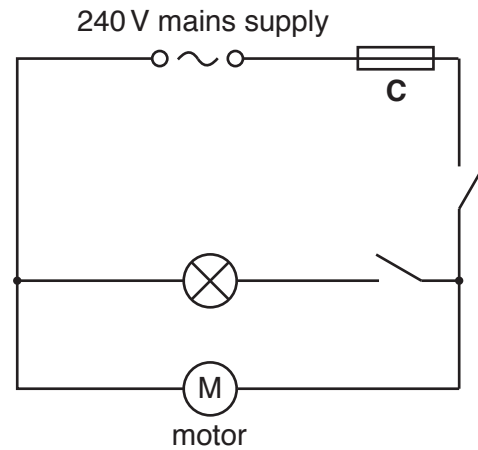


Fig. 3.2

- (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 0.2A 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 20W and the lamp has a power rating of 100W.

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.

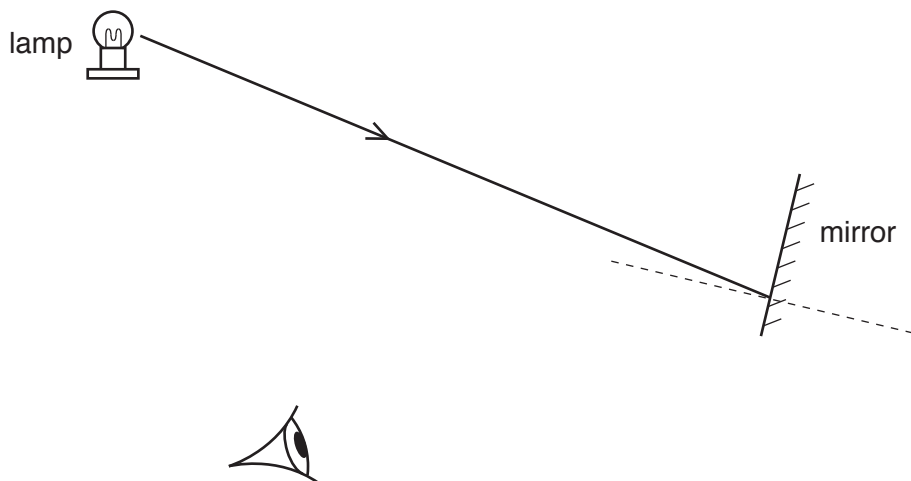
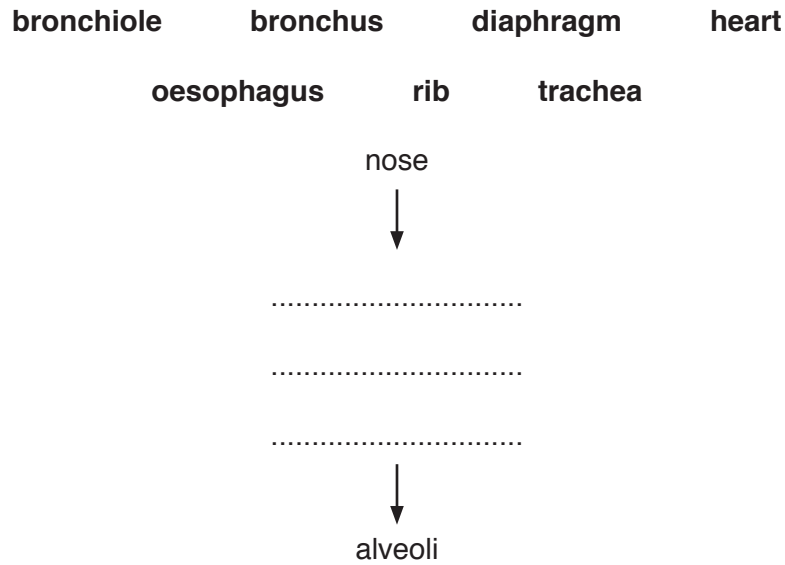


Fig. 3.3

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.



[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.

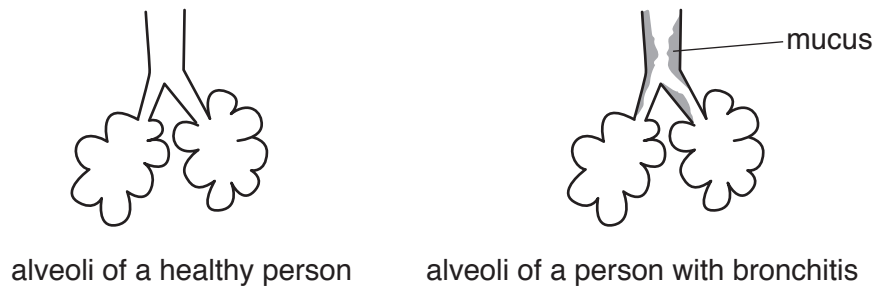


Fig. 4.1

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.

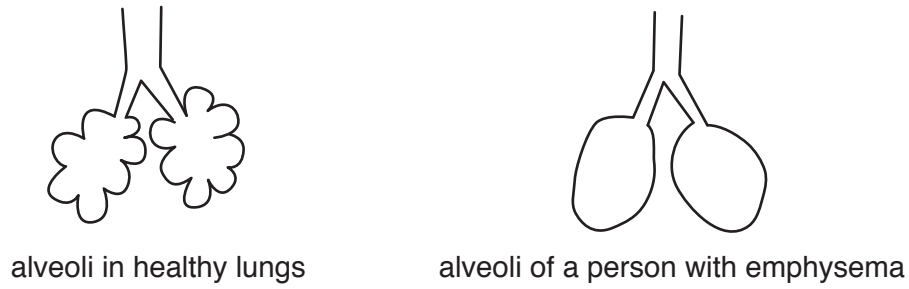


Fig. 4.2

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.

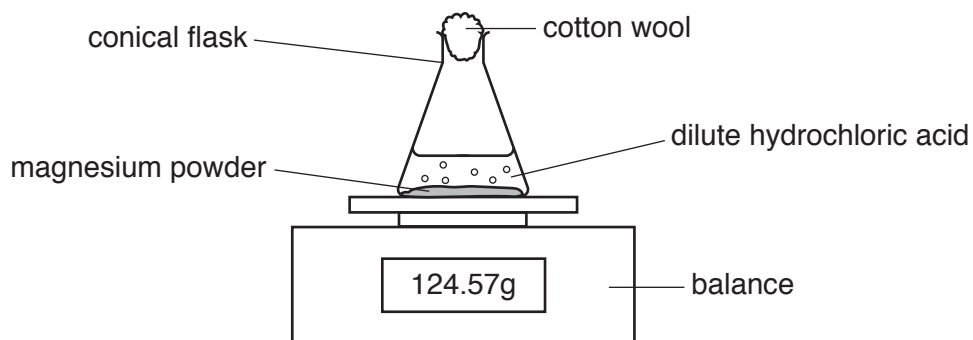


Fig. 5.1

- (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]

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

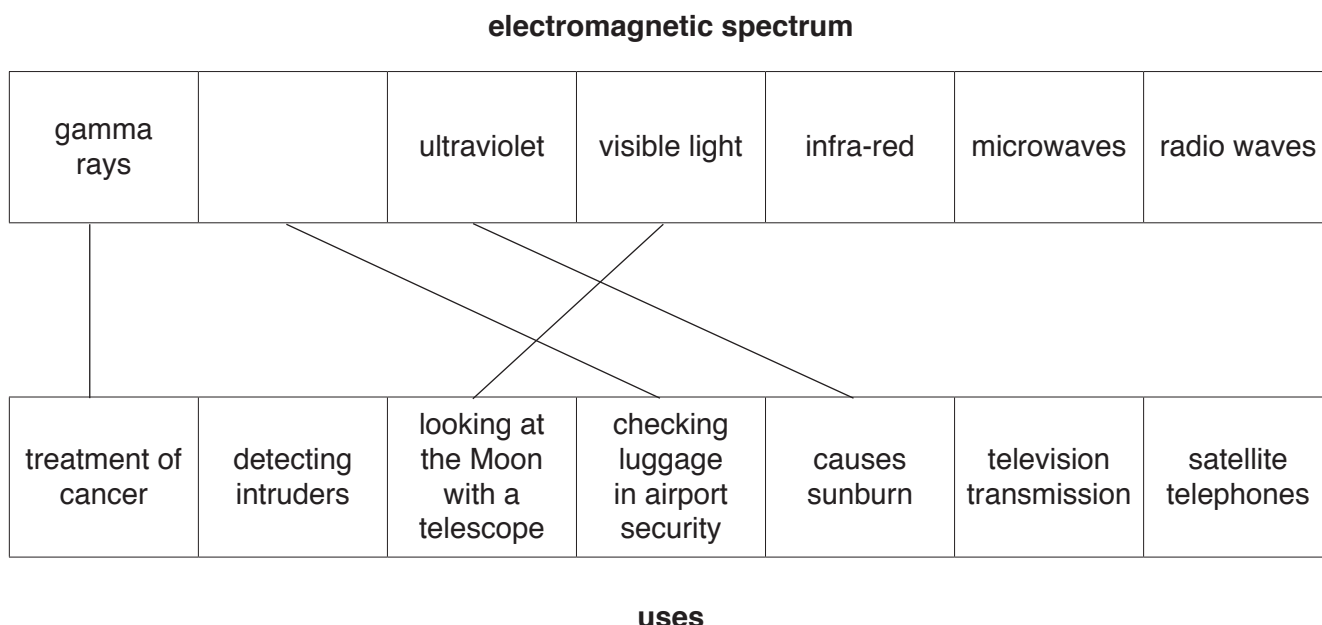


Fig. 6.1

- (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).

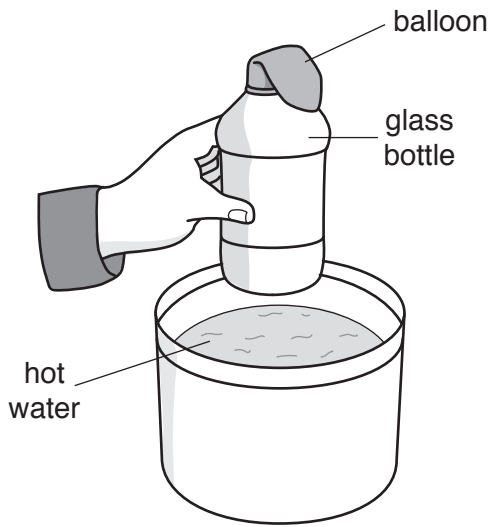


Fig. 6.2a

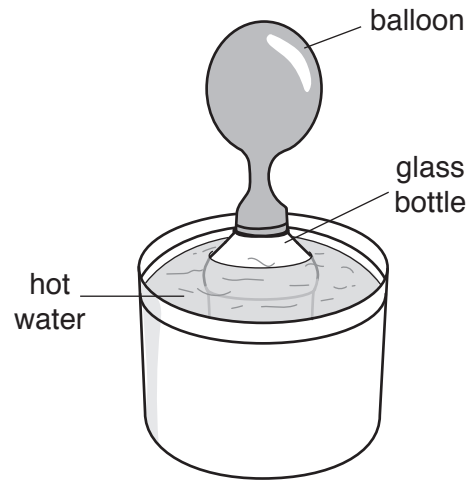


Fig. 6.2b

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]

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

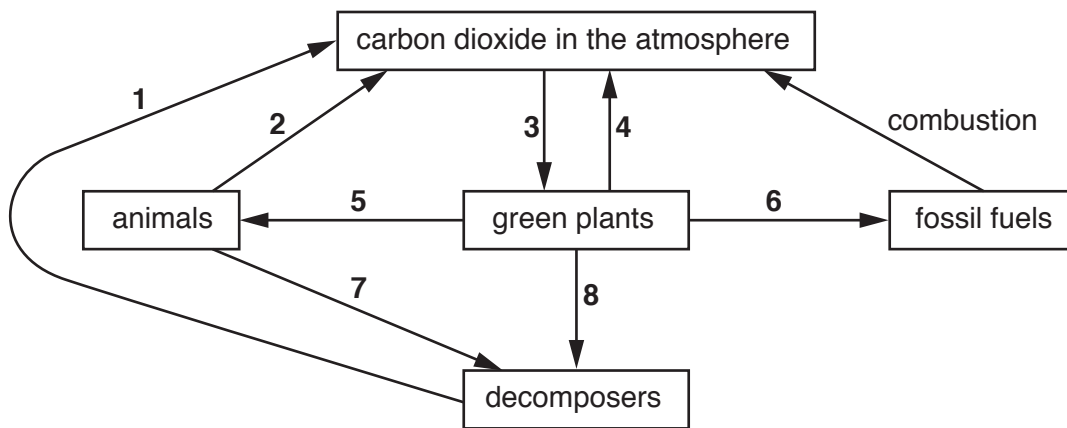


Fig. 7.1

(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.

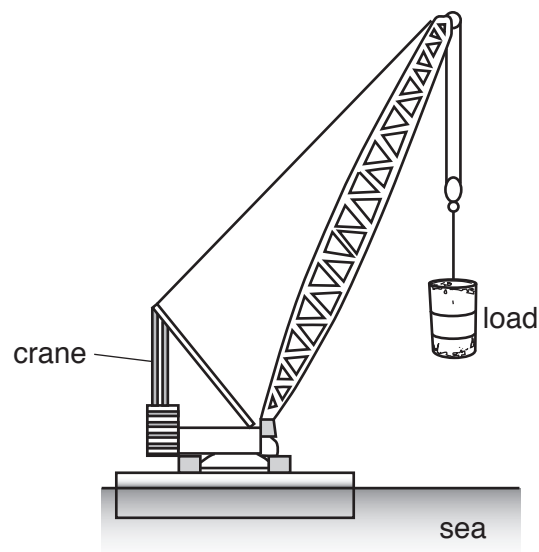


Fig. 9.1

(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.

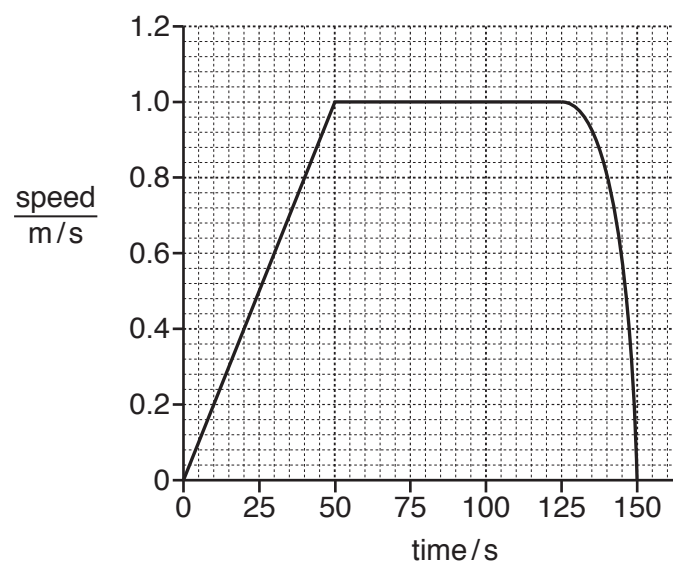


Fig. 9.2

- (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]

(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 | II | | | | | | | | | | | III | IV | V | VI | VII | VIII | | | | | | | | | | | | | | | | | | |
| 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 | | | | | | | | | | | 1 H hydrogen 1 | 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 |
| 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 |
| 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 dm³ at room temperature and pressure (r.t.p.).