



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

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CO-ORDINATED SCIENCES

0654/32

Paper 3 (Extended)

October/November 2011

2 hours

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 a soft pencil for any diagrams, graphs, tables or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Answer **all** questions.

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.

For Examiner's Use	
1	
2	
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4	
5	
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7	
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9	
Total	

This document consists of **22** printed pages and **2** blank pages.



1 Houseflies are common insect pests. Fig. 1.1 shows a housefly.

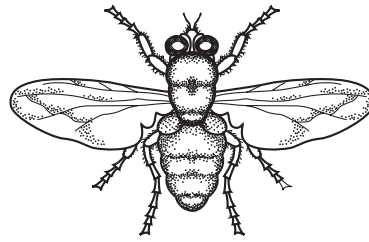


Fig. 1.1

(a) On Fig. 1.1, label and name **two** features that are characteristic of insects. [2]

(b) Houseflies feed by spitting saliva onto food, such as meat. Enzymes in the saliva turn insoluble substances into soluble ones. The flies can then suck up the liquid into their digestive system.

(i) Suggest **one** enzyme in a housefly's saliva that could digest a substance in meat.
..... [1]

(ii) State the soluble product or products that this enzyme would produce.
..... [1]

(c) Houseflies spread diseases such as typhoid fever. They leave harmful microorganisms on food that will later be eaten by a person.

Describe **two** ways in which white blood cells can destroy microorganisms that have entered a person's body.

1
.....
2
..... [2]

(d) When a housefly flies, its wings produce a buzzing sound.

(i) Suggest how a movement such as that of a fly's wings produces sound.
.....
.....
..... [2]

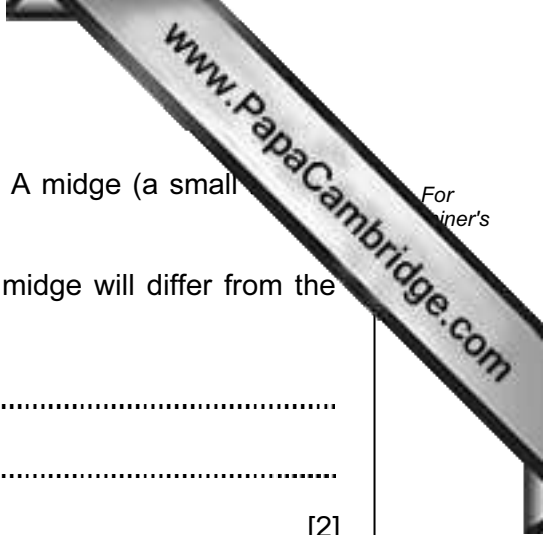
- (ii) A housefly beats its wings about 200 times per second. A midge (a small fly) beats its wings about 1000 times per second.

State and explain how the sound produced by a flying midge will differ from the sound produced by a flying housefly.

.....

.....

..... [2]



- 2 Nordic gold is an alloy of four metals used to make coins.



Table 2.1 shows information about the metals contained in Nordic gold.

Table 2.1

metal	% by mass in Nordic gold	compound from which the metal is extracted
aluminium	5	Al_2O_3
copper	89	CuFeS_2
tin	1	SnO_2
zinc	5	ZnS

- (a) Nordic gold has properties which make it suitable for making coins.

Suggest **one** property Nordic gold is likely to have, other than its appearance, that makes it suitable for making coins.

Explain briefly why this property is important.

property

importance

..... [2]

- (b) The method used to extract a metal from its compounds depends on the reactivity of the metal.

- (i) Tin may be extracted from tin oxide, SnO_2 , by heating a mixture of tin oxide and carbon. The other product of this reaction is carbon monoxide, CO .

Construct a balanced, symbolic equation for this reaction.

..... [2]

(ii) When aluminium oxide is heated with carbon, no reaction occurs.

Explain why it is possible to extract tin but **not** aluminium by heating their oxides with carbon.

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

(iii) Aluminium is extracted from the insoluble compound aluminium oxide by electrolysis.

Outline the stages by which aluminium oxide, containing aluminium ions, is converted into metallic aluminium, containing aluminium atoms, using electrolysis.

.....
.....
.....
.....
..... [3]

(c) A coin made of Nordic gold has a mass of 7.80 g.

Calculate the number of moles of copper in the coin.

Show your working.

..... [2]

3 Yaks are animals that live in the cold mountainous region of the Himalayas.

Fig. 3.1 shows a yak.

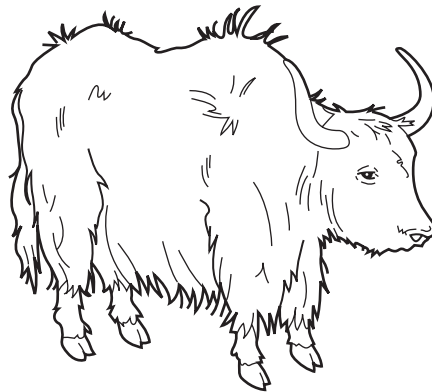


Fig. 3.1

(a) Explain how the long hair of the yak keeps it warm during the cold weather.

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

(b) Yaks are used as 'beasts of burden'. They can be ridden or used to carry or pull heavy objects.

A yak of mass 1000 kg is carrying a load of 80 kg.

(i) The yak carries its load up a mountain slope and finishes 100 m higher up the mountain.

Calculate the work done gaining this height.

The Earth's gravitational field strength is 10 N/kg.

State the formula that you use and show your working.

formula used

working

..... [3]

(ii) While the yak is carrying the load, it travels at a speed of 0.2 m/s .

Calculate the kinetic energy of the yak and its load at this time.

State the formula that you use and show your working.

formula used

working

..... [2]

(c) A yak has a mass of 1000 kg . It has four feet, each of area 300 cm^2 .

Calculate the average pressure that the yak exerts on the ground.

State the formula that you use and show your working.

formula used

working

..... [3]

4 Hydrocarbons are compounds which contain only the elements hydrogen and carbon.

(a) The simplest hydrocarbon is methane, CH_4 , which is an important fuel.

(i) State **two** natural sources of methane.

1

2 [2]

(ii) A free (unbonded) carbon atom has four electrons in its outer shell.

State the number, and describe the arrangement, of the electrons in the outer shell of a carbon atom in a methane molecule.

You may wish to draw a diagram to help you answer this question.

.....

..... [2]

- (b) Table 4.1 shows the displayed formulae and boiling points of four hydrocarbons, **C** and **D**.

Table 4.1

	displayed formula	boiling point/°C
A	$ \begin{array}{cccccc} \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} \\ & & & & & \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{C}-\text{C}-\text{C}-\text{H} \\ & & & & & \\ \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} \end{array} $	69
B	$ \begin{array}{cccc} \text{H} & \text{H} & \text{H} & \text{H} \\ & & & \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{C}-\text{H} \\ & & & \\ \text{H} & \text{H} & \text{H} & \text{H} \end{array} $	-0.5
C	$ \begin{array}{cccc} \text{H} & \text{H} & \text{H} & \text{H} \\ & & & \\ \text{H}-\text{C}-\text{C}-\text{C}=\text{C}-\text{H} \\ & & & \\ \text{H} & \text{H} & & \end{array} $	-6.3
D	$ \begin{array}{cccccc} \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} \\ & & & & & \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{C}-\text{C}=\text{C}-\text{H} \\ & & & & & \\ \text{H} & \text{H} & \text{H} & \text{H} & & \end{array} $	63

- (i) Name the **two** homologous series to which the hydrocarbons in Table 4.1 belong.

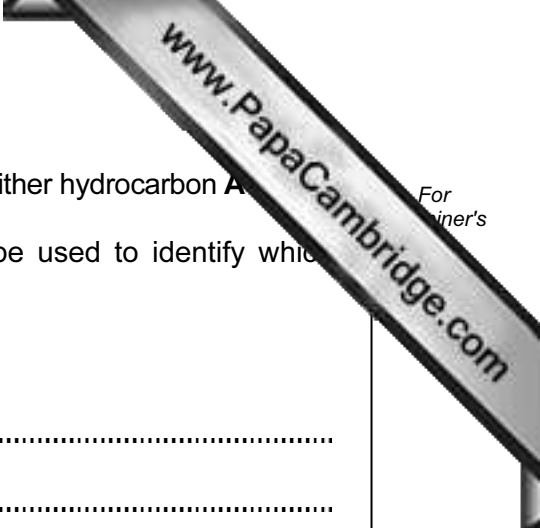
..... and [1]

- (ii) Use the information in Table 4.1 to suggest **one** way in which the boiling point of a hydrocarbon is affected by its molecular structure.

.....

.....

..... [2]



(iii) A bottle contains a colourless liquid which is thought to be either hydrocarbon A or hydrocarbon B. Describe a **chemical** test, and its result, which could be used to identify which hydrocarbon is in the bottle.

Explain your choice of test.

.....

.....

.....

..... [3]

5 Fig. 5.1 shows two plants that are grown as crops.

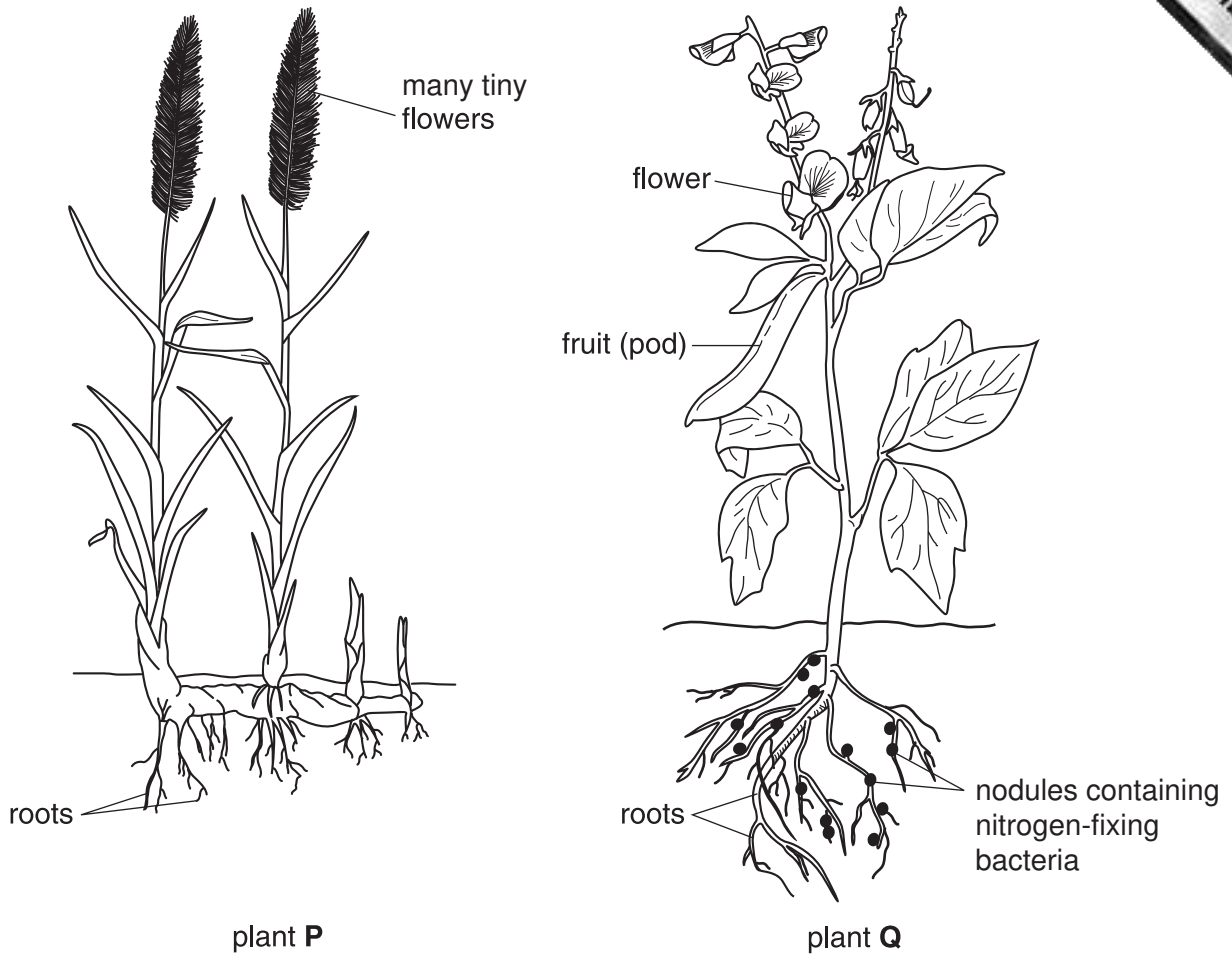


Fig. 5.1

(a) Describe what would happen in a flower of plant Q after pollination, in order to form a fruit.

.....

.....

.....

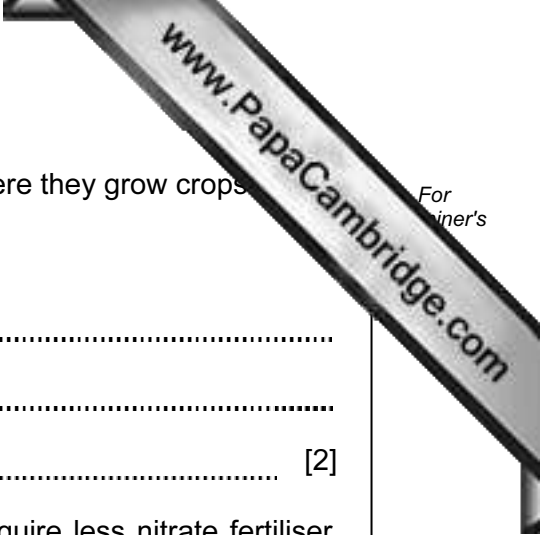
.....

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.....

[4]



(b) Farmers often add fertilisers containing nitrates to the soil where they grow crops

(i) Explain why this is done.

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

(ii) Explain why fields in which plant **Q** is growing would require less nitrate fertiliser than fields in which plant **P** is growing.

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

(iii) Explain why using large amounts of nitrate fertiliser near a river could cause harm to the environment.

.....
.....
.....
.....
..... [3]

- 6 Fig. 6.1 shows the inside of a refrigerator. The temperature inside the freezing compartment is -20°C and the temperature in the rest of the refrigerator is $+5^{\circ}\text{C}$.

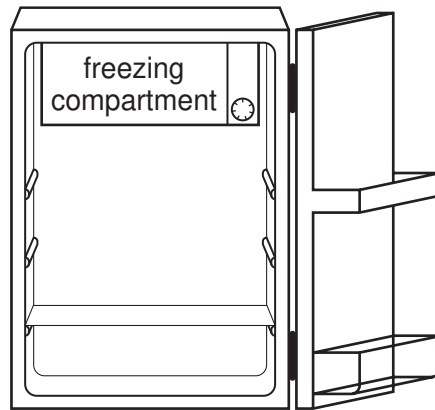


Fig. 6.1

- (a) (i) Draw arrows on Fig. 6.1 to show what happens to the air cooled by the freezing compartment. [1]

- (ii) Explain, with reference to air particles, why this happens.

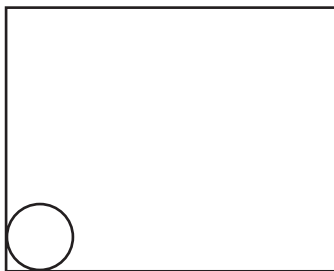
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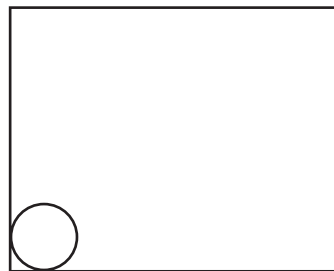
..... [2]

- (b) Ice is formed in the freezer when water freezes.

Draw diagrams to show the arrangement of water molecules in solid ice and in liquid water. One molecule has been drawn for you in each box.

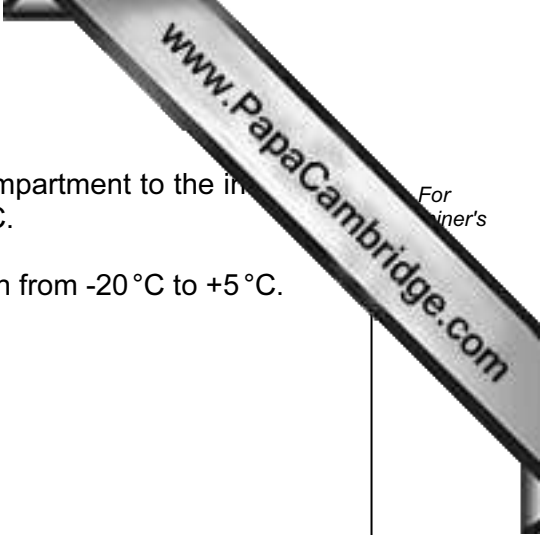


solid ice



liquid water

[2]



- (c) A steel spoon of mass 0.05 kg is moved from the freezing compartment to the inside of the fridge. The specific heating capacity of steel is $450 \text{ J/kg } ^\circ\text{C}$.

Calculate how much heat energy is needed to warm the spoon from -20°C to $+5^\circ\text{C}$.

State the formula that you use and show your working.

formula used

working

..... [3]

- (d) The refrigerator has two identical lamps. The supply voltage is 250 V and the current passing through each lamp when lit is 0.05 A.

- (i) Show that the resistance of one lamp when lit is 5000Ω .

State the formula that you use and show your working.

formula used

working

..... [1]

- (ii) The lamps are connected together in parallel.

Calculate the combined resistance of the two lamps.

State the formula that you use and show your working.

formula used

working

..... [3]

7 Coral reefs are made of living individuals (coral polyps) on top of the skeletons of dead corals. When a coral polyp dies, its skeleton remains and a new polyp takes its place.

(a) The coral polyp takes in calcium ions and carbonate ions from the surrounding seawater to produce calcium carbonate, CaCO₃, which it uses to build its skeleton.

(i) Some of the calcium ions present in seawater were once part of limestone rocks on the Earth's surface.

Describe **one** sequence of natural, **physical** processes which is involved in moving calcium ions from limestone to the sea.

.....
.....
.....
.....
.....
..... [3]

(ii) Some of the carbonate ions present in seawater are formed when carbon dioxide from the air dissolves and reacts.

State **two** processes that add carbon dioxide to the atmosphere.

1
2 [2]

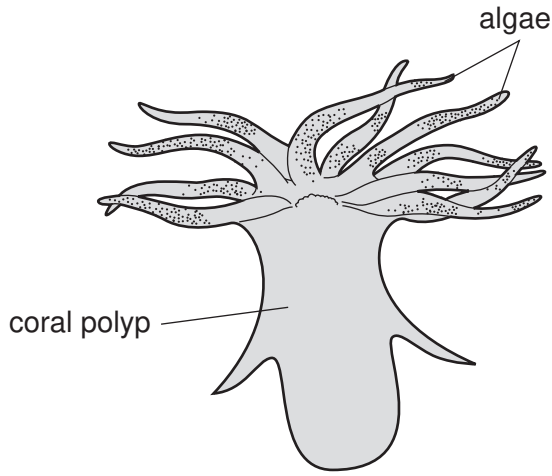
(iii) Some ships have been seriously damaged when they have collided with coral reefs.

Use your knowledge of the structure and properties of ionic compounds such as calcium carbonate to explain why ships are seriously damaged if they hit a coral reef.

.....
.....
.....
.....
..... [3]

- (b) Coral polyps and certain algae (microscopic plants) live closely together and organisms help each other to survive.

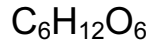
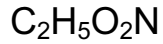
The algae in the coral polyps produce oxygen in the presence of sunlight. The coral polyps produce carbon dioxide as a waste product.



- (i) Name the process, occurring in the algae, that produces oxygen.

..... [1]

- (ii) Underline **one** of the formulae below which represents a compound also formed by the process in (i).

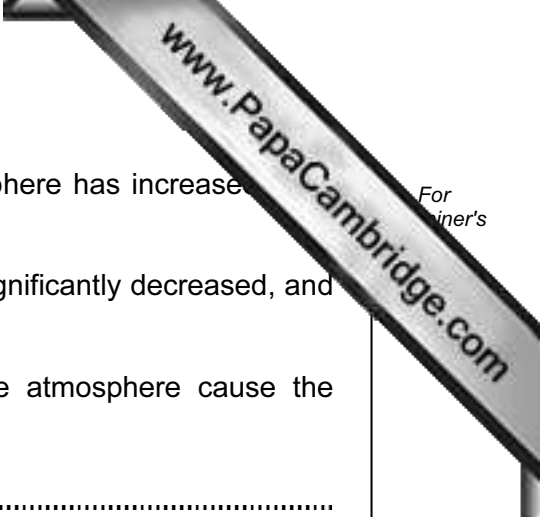


Name the compound you have underlined. [2]

- (iii) Explain briefly why it is beneficial for the coral polyps and the algae to live closely together.

.....

 [2]



- (c) In recent years, the amount of carbon dioxide in the atmosphere has increased. This has contributed to a decrease in the average pH of seawater.

During this period, the growth rate of many coral reefs has significantly decreased, and many others are no longer part of a successful ecosystem.

- (i) Explain why increased levels of carbon dioxide in the atmosphere cause the average pH of seawater to decrease.

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

- (ii) Suggest a possible reason why a decrease in the average pH of seawater could damage coral reefs.

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

Please turn over for Question 8.

8 Most cells obtain energy from carbohydrates and other nutrients by aerobic respiration.

(a) Describe how a cell in a human muscle obtains the oxygen that it needs for respiration.

.....

 [2]

(b) When a person runs, muscles generate heat energy which increases the body temperature. Body temperature can be lowered by sweating. Sweat contains potassium ions, sodium ions and chloride ions dissolved in water.

The core temperature of an athlete was measured as she ran steadily for 120 minutes, drinking no fluids while running. She repeated the run the next day but this time drank fluids throughout the run. The environmental temperature and humidity were the same on both days.

The results are shown in Fig. 8.1.

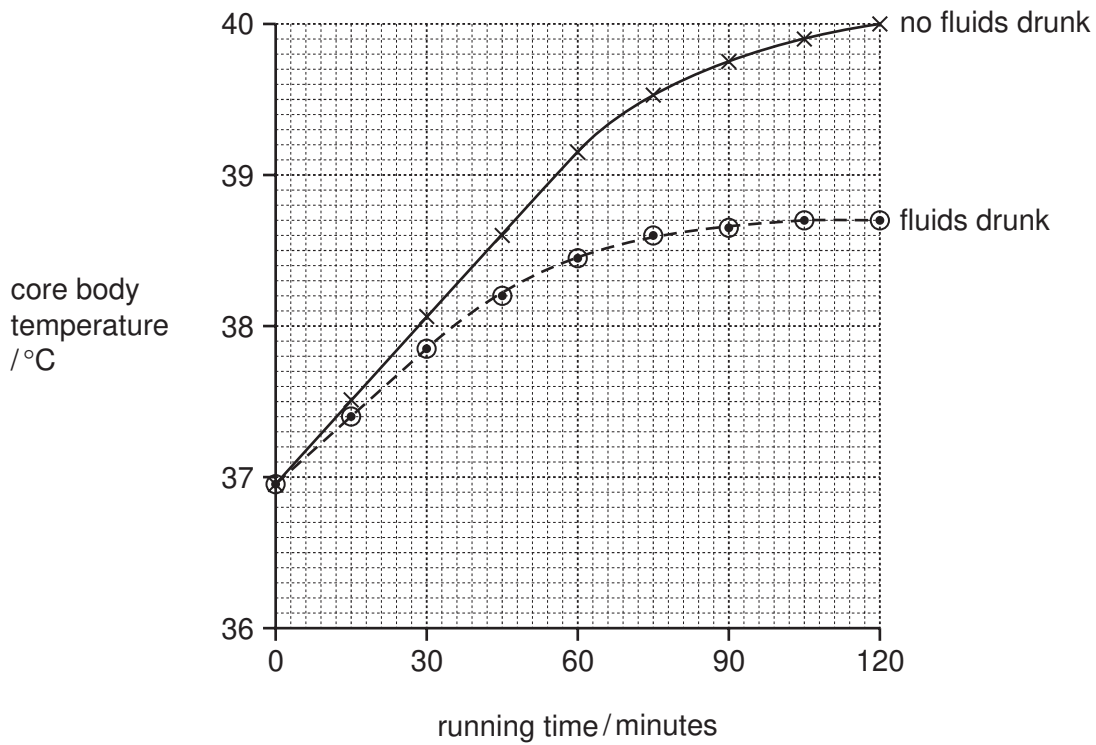


Fig. 8.1

(i) Explain how sweating can reduce body temperature.

.....

 [2]



(ii) Compare the body temperature of the athlete when she ran without drinking to her body temperature when she ran while drinking fluids.

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

(iii) Suggest an explanation for the differences you have described in (ii).

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

(iv) During a long run, athletes prefer to drink fluids containing glucose, potassium ions, sodium ions and chloride ions rather than pure water.

Suggest how this can help them to perform better.

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

- 9 (a) An aircraft has a mass of 400 000 kg. It has four engines each capable of producing a maximum force of 300 000 N.

Calculate the maximum acceleration of the aircraft.

State the formula that you use and show your working.

formula used

working

..... [3]

- (b) People who fly frequently have greater exposure to ionising radiation than those who do not fly.

Explain why exposure to ionising radiation can be harmful.

.....

 [2]

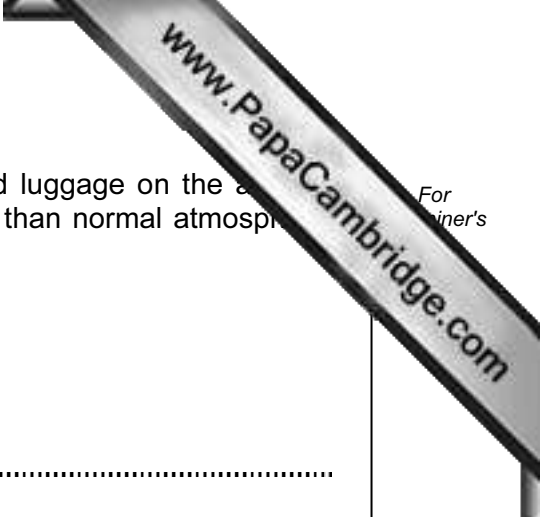
- (c) Potato snacks are packed in airtight packets and filled with nitrogen gas at atmospheric pressure.



- (i) Suggest why nitrogen gas is used, rather than air.

.....

 [2]



- (ii) A passenger has a packet of potato snacks in his hand luggage on the airplane. During the flight, the aircraft cabin is at a pressure less than normal atmospheric pressure.

The passenger notices that the packet has expanded.

Explain, in terms of particles, why this happens.

.....

.....

.....

.....

..... [3]

DATA SHEET

The Periodic Table of the Elements

Group																					
I	II											III	IV	V	VI	VII	0				
										1 H Hydrogen 1											4 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10				
23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18				
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36				
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	96 Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54				
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57 *	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	210 Po Polonium 84	210 At Astatine 85	210 Rn Radon 86				
87 Fr Francium	226 Ra Radium	227 Ac Actinium †																			

*58-71 Lanthanoid series

†90-103 Actinoid series

Key

a
X
b

a = relative atomic mass

X = atomic symbol

b = proton (atomic) number

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	Pa Protactinium 91	238 U Uranium 92	Np Neptunium 93	Pu Plutonium 94	Am Americium 95	Cm Curium 96	Bk Berkelium 97	Cf Californium 98	Es Einsteinium 99	Fm Fermium 100	Md Mendelevium 101	No Nobelium 102	Lr Lawrencium 103

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

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