



Centre Number	Candidate Number	Name
---------------	------------------	------

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

COMBINED SCIENCE

0653/03

Paper 3 Extended

May/June 2006

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

Answer **all** questions.
You may use a pencil for any diagrams, graphs, tables or rough working.
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	
3	
4	
5	
6	
7	
8	
9	
Total	

1 (a) Each box below contains a description of a solid, a liquid or a gas.

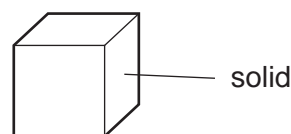
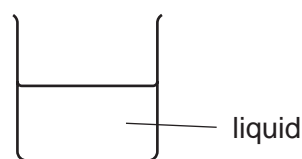
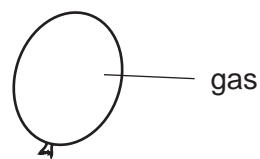
Join each box to the correct diagram.

It takes up the shape of its container and has a constant volume.

It expands the most when heated.

The particles are only very weakly attracted to each other.

The particles have very strong forces of attraction between them.



[3]

(b) Fig. 1.1 shows a cylinder containing carbon dioxide held in by a piston.

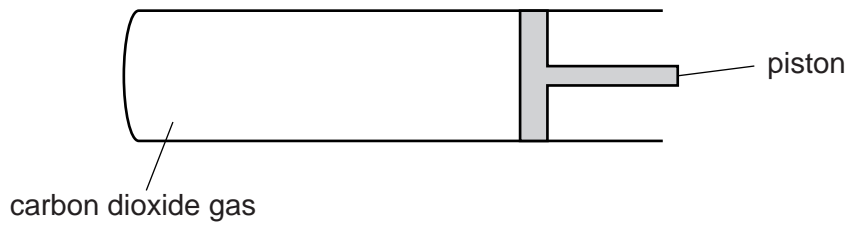


Fig. 1.1

The volume in the cylinder is reduced by pushing in the piston.

Explain, in terms of particles, how this affects the pressure on the walls of the cylinder.

.....

.....

.....

.....

.....

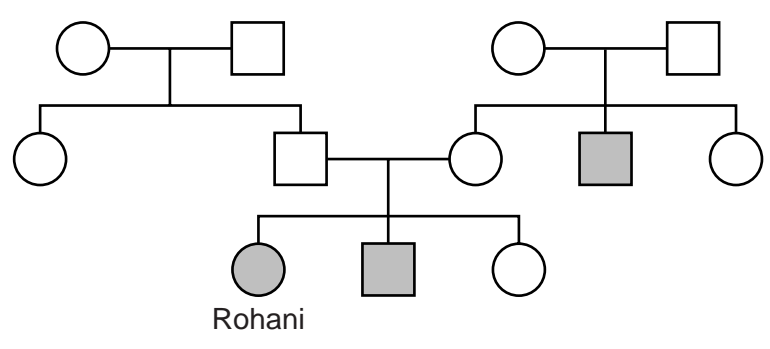
..... [3]

2 Several members of Rohani's family have an illness called PKU. PKU is caused by a recessive allele, **a**. The normal allele is **A**.

(a) Explain what is meant by a *recessive allele*.

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

(b) Rohani has PKU. She has collected information about her parents and grandparents. This is the family tree that she has drawn.



key

- unaffected female
- female with PKU
- unaffected male
- male with PKU

(i) What is Rohani's genotype?

..... [1]

(ii) Rohani's parents have the same genotype as each other.

Draw a genetic diagram to show how Rohani inherited PKU from her parents.

(c) The bodies of people with PKU cannot use amino acids properly. If they have too much of a particular amino acid in their blood, it can cause brain damage. Rohani has to eat a special diet to make sure this does not happen.

Suggest which kinds of foods Rohani must be especially careful about.
Explain your answer.

.....

.....

..... [2]

- 3 (a) Table 3.1 shows some information about the elements in Group VII of the Periodic Table. Use the Periodic Table on page 24 to help you with this question.

Complete the table.

Table 3.1

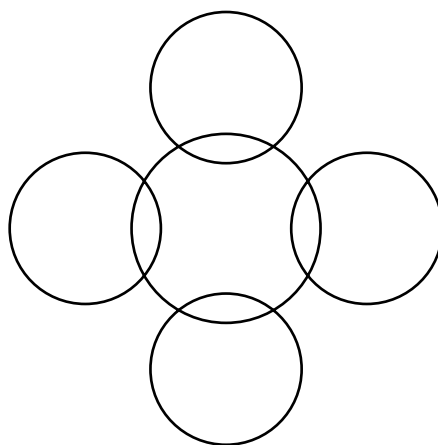
symbol	solid, liquid or gas at 25 °C
Cl	
Br	
I	

[1]

- (b) Chlorine exists as diatomic molecules, Cl_2 . Chlorine molecules react with methane, CH_4 , to form a compound having the formula CCl_4 .

- (i) Complete the bonding diagram below to show

- the chemical symbols of the elements in a molecule of methane,
- the arrangement of the outer electrons of each atom.



[2]

- (ii) The symbolic equation below showing the reaction between chlorine and methane is not balanced.

Balance the equation.



(iii) Fluorine and bromine also react with methane. Suggest which of the elements, fluorine, chlorine or bromine, reacts with methane most vigorously.

Explain your answer.

element

explanation

..... [1]

(c) The chemical symbols below represent isotopes of chlorine.



(i) Describe how the nuclei of these isotopes differ from one another.

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

(ii) Calculate the relative molecular mass of the compound CCl_4 . Show your working.

..... [2]

- 4 (a) Sodium -21 and sodium -24 are two radioactive isotopes that decay with half-lives of 15 minutes and 15 hours respectively.

Sodium -24 can be used to detect leaks in water pipes. Sodium chloride containing sodium -24 is placed in the pipe and a radiation detector is used to check for radiation coming from water leaking out of the pipe.



- (i) Explain the meaning of the term *radioactive decay*.

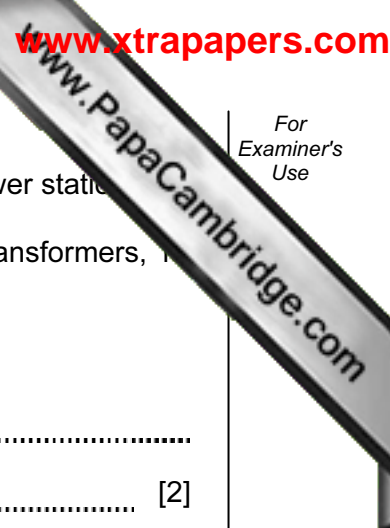
.....
 [2]

- (ii) Explain why sodium -24 is more suitable than sodium -21 as a radioactive isotope for detecting leaks in water pipes.

.....
 [1]

- (iii) A sample of sodium -24 of mass 1.6 g was stored for a few days.
 Calculate the mass of sodium -24 that will remain after 45 hours.
 Show your working.

..... [2]



(b) Some radioactive isotopes are used to generate electricity in nuclear power stations.

(i) The voltage of the electricity generated is increased by using transformers, and the electricity is then transmitted through power lines to the users.

Explain why this is done.

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

(ii) The electrical supply to a house is at a voltage of 220 V.
An electric kettle is plugged into the supply.
The current flowing through the heating element of the kettle is 10 A.

Calculate the resistance of the heating element.

Show your working and state the formula that you use.

formula used

working

..... [2]

5 (a) The list below contains descriptions of some different parts of cells.

- A contains genes made of DNA
- B controls what enters and leaves the cell
- C is fully permeable

Write the **letter** or **letters** of the descriptions that fit each of these parts of cells. Each part may have one letter, two letters or no letters at all.

nucleus

cell wall

chloroplast

cell surface membrane

[2]

(b) Fig. 5.1 shows an experiment to investigate osmosis.

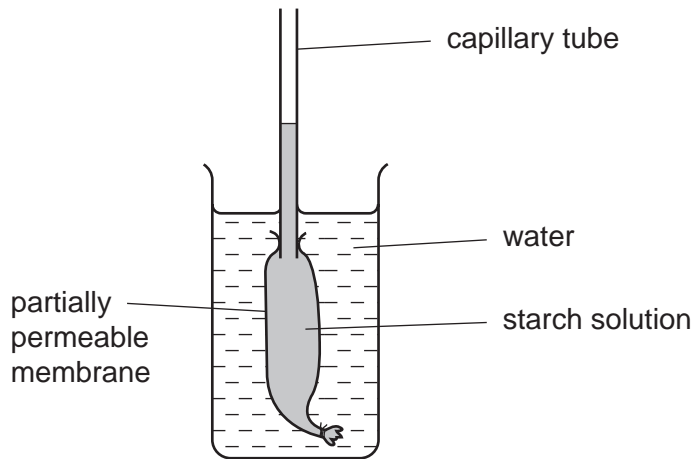


Fig. 5.1

After five minutes, the level of the liquid inside the capillary tube had risen.

(i) Explain why the liquid rose up the tube.

.....

.....

.....

.....

[3]

(ii) At the end of the experiment, the liquid outside the membrane was tested for starch.

Describe how this test would be carried out and the colour you would expect to see.

how the test is carried out

.....

colour expected [2]

(c) Plants take up water from the soil into their roots by osmosis. The water is then carried up to the leaves in the xylem vessels.

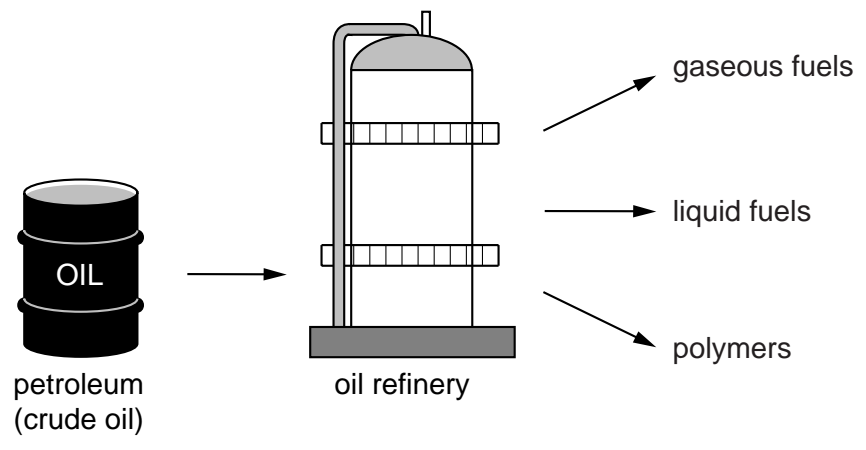
Describe the pathway that the water takes as it travels from the soil into the xylem vessels in the root.

.....

.....

..... [2]

6 Petroleum (crude oil) provides many important products including fuels and polymers.



(a) Butane is a gaseous fuel obtained from petroleum.

Name **two** products that are formed when butane burns in the air.

..... [1]

(b) Table 6.1 shows the total number of atoms which are combined in molecules of four compounds **A**, **B**, **C** and **D**.

Table 6.1

compound	A	B	C	D
number of atoms in one molecule	60 000	5	26	2

(i) Suggest and explain briefly which one of these compounds is methane (natural gas).

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

(ii) Suggest and describe the type of chemical reaction that has occurred to form molecules of compound **A**.

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

(c) Cracking is a process which converts large hydrocarbon molecules into smaller ones, some of which contain double covalent bonds in their molecules.

(i) Describe briefly how hydrocarbon molecules are cracked.

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

(ii) A colourless hydrocarbon is shaken with aqueous bromine. After some time the bromine has **not** changed colour.

What does this result suggest about the bonding in the hydrocarbon?

Explain your answer.

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

7 Fig. 7.1 shows sugar cane growing in Fiji.



Fig. 7.1

(a) In Fiji, much of the land is hilly. It often rains very hard.

With reference to Fig. 7.1, explain how the fields of sugar cane can help to reduce soil erosion.

.....

.....

..... [2]

(b) Sugar cane has flowers that are pollinated by the wind. Suggest **one** feature you would expect these flowers to have.

.....

..... [1]

(c) Sugar cane produces glucose by photosynthesis. The glucose is changed into sugars. These sugars can be used to make sweet foods such as cakes and chocolate.

A man eats a cake containing glucose.

(i) Describe how the glucose is absorbed into his blood.

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

(ii) Explain how his blood sugar level will be prevented from rising too high after he has eaten the cake.

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

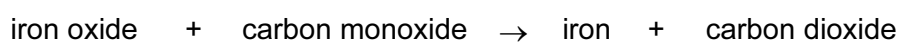
(iii) The process that controls the level of blood sugar is an example of negative feedback.

Explain the meaning of the term *negative feedback*.

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

8 The element iron is extracted from iron ore, which is a rock found in the Earth's crust.

(a) The main iron compound in iron ore is iron oxide. When iron oxide reacts with carbon monoxide, iron is produced. The word equation for this reaction is shown below.



(i) State **one** difference between an element such as iron and a compound such as iron oxide.

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

(ii) The formula of iron oxide is Fe₂O₃ and the formula of oxide ions is O²⁻.

Deduce the formula of the iron ions in iron oxide.

Explain your working.

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

(b) Fig. 8.1 shows a diagram of a car.

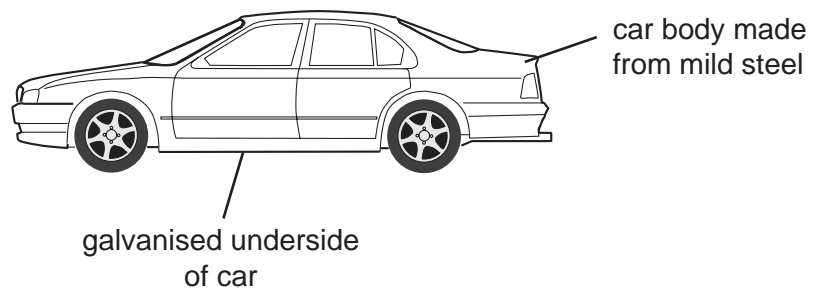


Fig. 8.1

Explain how galvanising prevents the steel on the underside of the car from rusting.

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

(c) Fig. 8.2 shows a test-tube containing dilute sulphuric acid reacting with pieces of zinc. The zinc was in excess and eventually all of the acid had reacted.

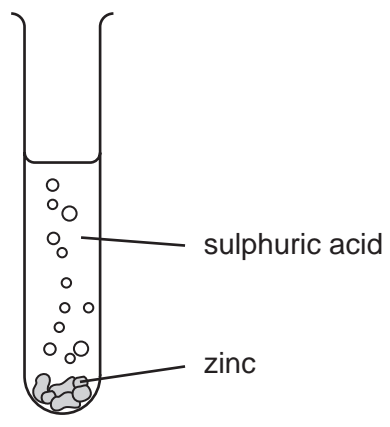


Fig. 8.2

(i) State the formula and charge of an ion which is present in **all** acidic solutions.

..... [1]

(ii) State **one** observation which would show that all of the acid had reacted.

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

(iii) Predict and explain what would be observed if a piece of magnesium is added to the solution remaining in the test-tube.

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

9 (a) An athlete takes part in a race. His performance is shown on the speed-time graph in Fig. 9.1.

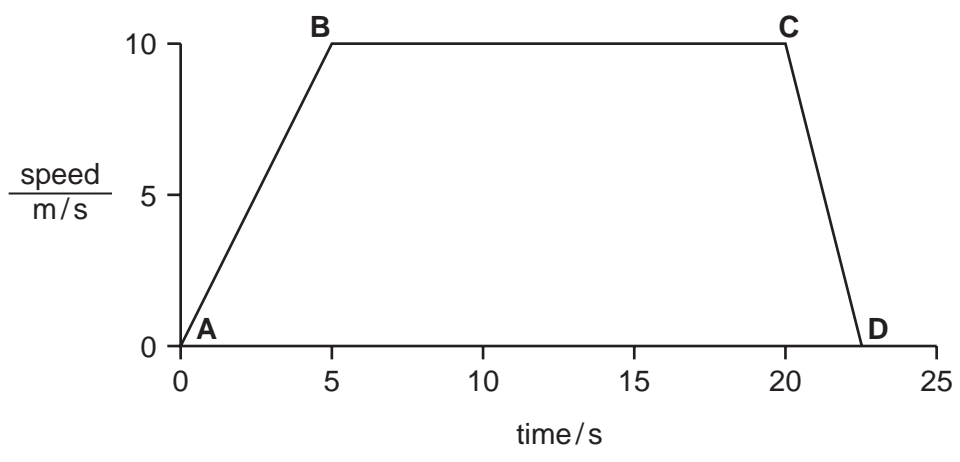


Fig. 9.1

Use the graph to describe the motion of the athlete between

(i) A and B,

(ii) B and C.

[2]

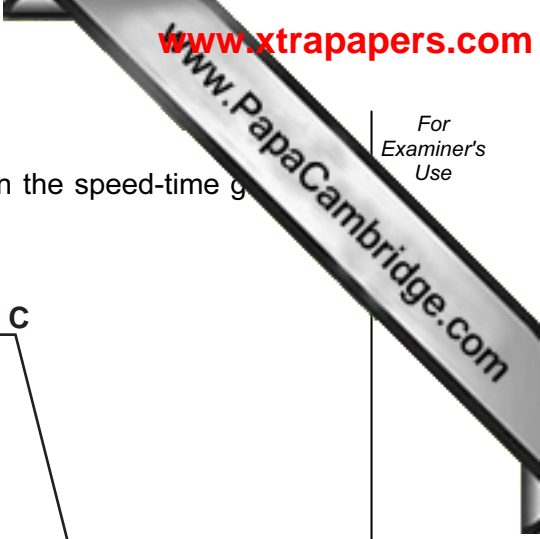
(b) Calculate the distance travelled between 0 seconds and 20 seconds.

Show your working.

..... [2]

(c) During part of the race, the athlete is travelling at a constant speed. What can be said about the forward and backward forces acting on the athlete at this time?

..... [1]





(d) The mass of the athlete is 60 kg.

(i) His initial forward acceleration is 2 m/s^2 . Calculate the force required to give this acceleration.

Show your working and state the formula that you use.

formula used

working

..... [2]

(ii) The athlete does 3000 J of work in 5 seconds. Calculate the power developed by the athlete.

Show your working and state the formula that you use.

formula used

working

..... [2]

(e) Fig. 9.2 shows three designs for a trophy, **P**, **Q** and **R**. The position of the centre of mass of each trophy is marked with an **X**.

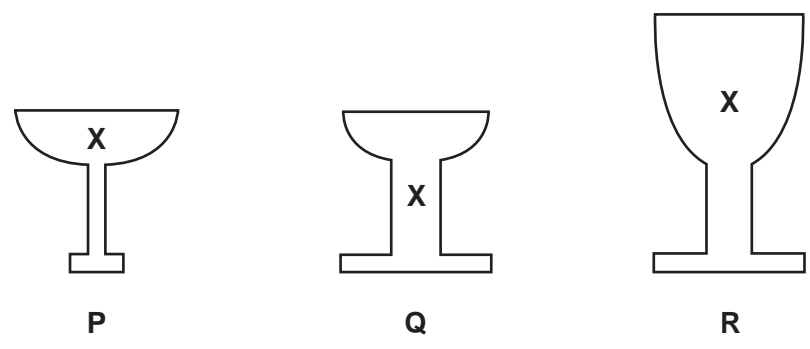


Fig. 9.2

State and explain which trophy would be the most stable. You may draw diagrams if it helps your answer.

.....

..... [2]

Copyright Acknowledgements:

Question 7 © John Mead/Science Photo Library.

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

University of Cambridge International Examinations is part of the University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department

DATA SHEET The Periodic Table of the Elements

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

140 Ce Cerium	141 Pr Praseodymium	144 Nd Neodymium	150 Sm Samarium	152 Eu Europium	157 Gd Gadolinium	159 Tb Terbium	162 Dy Dysprosium	165 Ho Holmium	167 Er Erbium	169 Tm Thulium	173 Yb Ytterbium	175 Lu Lutetium					
58	59	60	62	63	64	65	66	67	68	69	70	71					
232 Th Thorium	238 U Uranium	90	91 Pa Protactinium	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			
87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104

*58-71 Lanthanoid series
90-103 Actinoid series

Key

a	X	b
---	----------	---

 a = relative atomic mass
 X = atomic symbol
 b = proton (atomic) number

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