

Candidate Name _____

Centre Number	Candidate Number

International General Certificate of Secondary Education
CAMBRIDGE INTERNATIONAL EXAMINATIONS
CO-ORDINATED SCIENCES
PAPER 3

0654/3

OCTOBER/NOVEMBER SESSION 2002

2 hours

Candidates answer on the question paper.
No additional materials are required.

TIME 2 hours

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided on the question paper.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [] at the end of each question or part question.

A copy of the Periodic Table is printed on page 20.

FOR EXAMINER'S USE	
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	

This question paper consists of 20 printed pages.



- 1 (a) Sound travels at 330 m/s in air.

The table in Fig. 1.1 shows some information about three tuning forks. Complete Fig. 1.1 by calculating the missing values.

Show your working in the space underneath the table.

tuning fork	frequency / Hz	wavelength in air / m
1	288	1.146
2	320	
3		0.773

Fig. 1.1

[3]

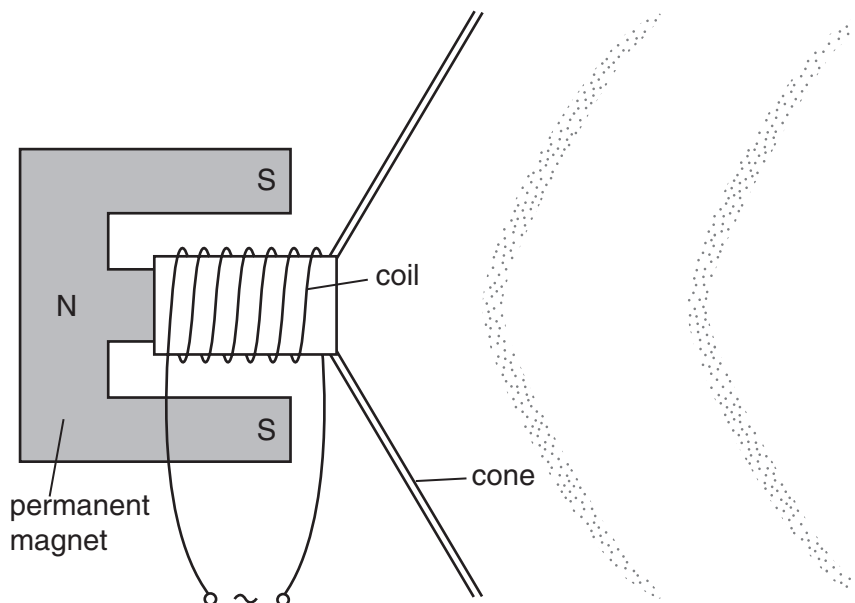
- (b) The frequencies of the tuning forks in (a) are easily heard by humans. State the maximum and minimum frequency which humans can usually hear.

maximum frequency

minimum frequency

[2]

- (c) A loudspeaker works in the same way as an earphone.



Number the statements below from one to six to explain how a loudspeaker works. The first has been completed for you.

The coil becomes an electromagnet. The strength of the electromagnet varies with the current.	
This makes the coil move backwards and forwards to correspond with the electrical signal.	
The movement of the coil makes the cone move in and out.	
A variable electrical signal is passed through a coil that is held loosely in the magnetic field of a permanent magnet.	1
A variable force occurs between the electromagnet and the permanent magnet.	
The moving paper cone makes the air vibrate, making sound waves.	

[3]

(d) When sound signals need to be transmitted over long distances, they are first converted to radio waves. The radio waves are modulated.

Explain what is meant by wave modulation.

.....

.....

.....

.....[2]

2 In Canada, where it is cold at some times of year, cucumbers are grown in greenhouses. Growers usually increase the concentration of carbon dioxide in the atmosphere in the greenhouse to about 0.1%, because this increases the yield of fruit from the plants.

(a) (i) State the normal concentration of carbon dioxide in the atmosphere.

..... [1]

(ii) Explain why increasing the concentration of carbon dioxide increases the yield of fruit from the cucumber plants.

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

(b) In winter, the greenhouses are heated and are kept completely closed. In summer however, when it is warmer outside, ventilators in the greenhouse roof have to be opened to prevent the temperature from getting too high. This means that it is wasteful to add extra carbon dioxide to the greenhouse in summer, because much of it would escape through the open ventilators.

The ventilators open automatically when the temperature reaches a certain level. An experiment was carried out to find the best temperature at which the ventilators should open, when the atmosphere in the greenhouse contains 0.1% CO₂. The table in Fig. 2.1 shows the results.

temperature at which ventilators open / °C	mean number of fruit per plant	mean mass of fruit per plant / kg
23	9.9	4.48
25	11.4	5.20
27	11.1	5.14

Fig. 2.1

(i) Explain how opening the ventilators would allow the greenhouse to cool down.

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

(ii) Using the information above, and also your own knowledge about how temperature affects living organisms, explain why there is a better yield of cucumbers when the ventilators open at 25 °C than when they open at 23 °C.

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

- (iii) Suggest an explanation for the differences between the yield of fruit when the ventilators open at 27 °C and when they open at 25 °C.

.....

[2]

- (c) The investigation also looked at the best kind of material from which to make the greenhouses. Four identical greenhouses were constructed, using either glass or poly(ethene). In one of each type of greenhouse, extra light was provided. No extra carbon dioxide was provided, and the greenhouses were not heated. The results are shown in Fig. 2.2.

	glass		poly(ethene)	
	no extra light	extra light	no extra light	extra light
mean number of fruit per plant	4.83	7.00	4.75	7.42
mean mass of fruit per plant / kg	2.26	3.38	3.71	4.96

Fig. 2.2

- (i) State one property shared by glass and poly(ethene) that makes them suitable for constructing greenhouses.

.....[1]

- (ii) Suggest why the yields from the cucumber plants in this experiment are almost all lower than the yields shown in the first experiment.

.....
[1]

- (iii) Using all the results from both experiments, suggest the growing conditions that would produce the highest yield of cucumbers when grown in a greenhouse.

.....

[2]

3 Fig. 3.1 shows some data about the elements in the second period of the Periodic Table.

symbol	Li	Be	B	C	N	O	F	Ne
melting point / °C	181	1283	2027	3727	-210	-219	-220	-248
electron configuration of atoms	2,1	2,2	2,3	2,4	2,5	2,6	2,7	2,8

Fig. 3.1

- (a) (i) The melting points and electron configurations of the elements lithium to neon are part of a periodic pattern.

Explain briefly what is meant by the term *periodic pattern*.

.....

.....

.....

.....[2]

- (ii) Predict which element in the third period, sodium to argon, will have the highest melting point.

Explain your answer briefly.

.....

.....

.....[2]

- (b) Explain in terms of their structures why the melting point of carbon is much higher than that of neon. You may wish to draw diagrams to help your answer.

.....

.....

.....

.....[3]

- (c) Nitrogen, N_2 , combines with fluorine, F_2 , to form the covalent compound nitrogen trifluoride, NF_3 .
- (i) Draw a diagram of one molecule of nitrogen trifluoride, showing how all the outer electrons are arranged.

[2]

- (ii) Write a balanced equation for the formation of nitrogen trifluoride.

.....[1]

4 Fig. 4.1 shows a circuit containing three identical 6 ohm resistors.

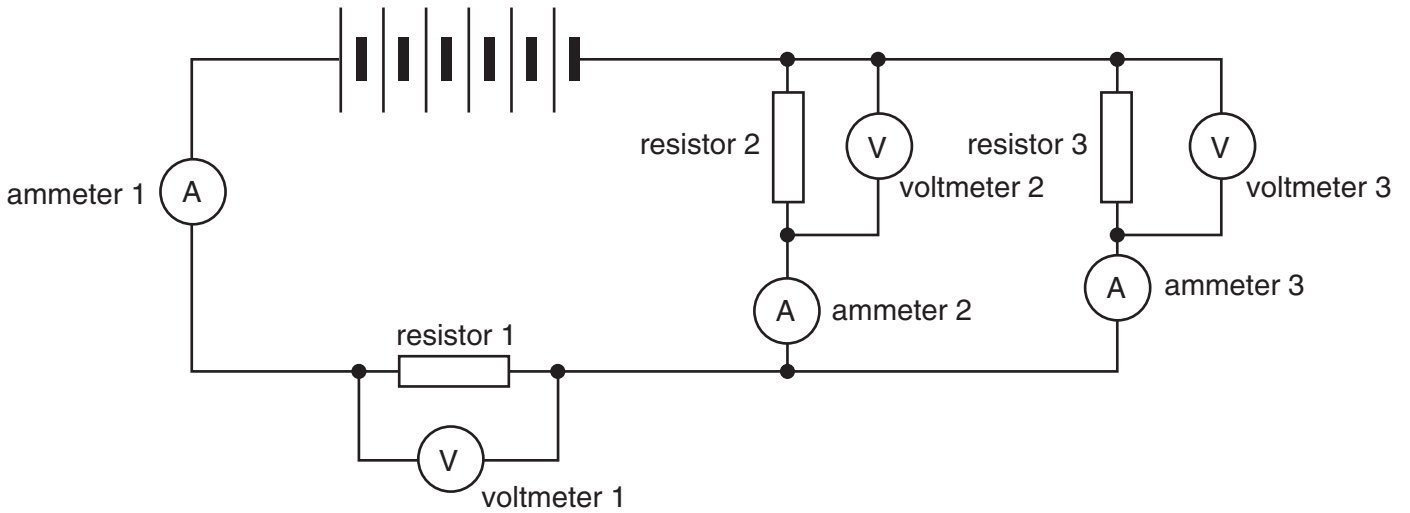


Fig. 4.1

(a) Ammeter 1 reads 1 A.

State the reading on

ammeter 2

ammeter 3

[2]

(b) Each cell supplies 1.5 V.

What is the total voltage supplied?

.....

[1]

(c) Voltmeter 2 reads 3 V.

State the reading on

voltmeter 1

voltmeter 3

[2]

(d) Calculate the combined resistance of resistors 2 and 3.

Show your working.

Combined resistance =[3]

(e) When a poly(ethene) rod is rubbed with a cloth, it acquires a negative electrostatic charge. During this process a very small electric current flows.

Explain what is happening.

.....

.....

.....

.....

.....

.....

.....[4]

5 Fig. 5.1 shows the human excretory system.

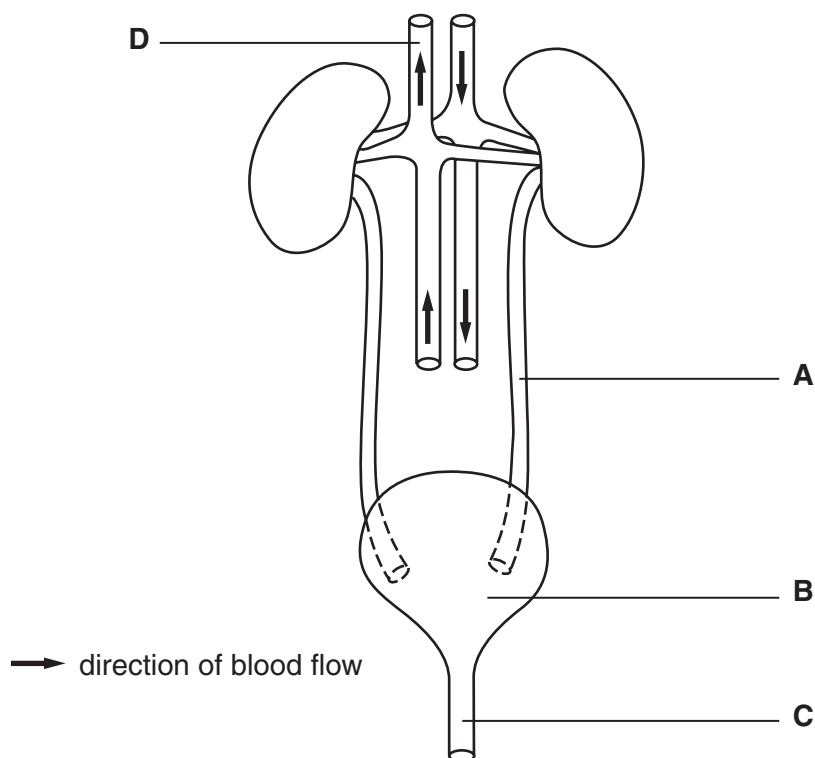


Fig. 5.1

(a) (i) Name the structures labelled **A**, **B** and **C**.

A

B

C

[3]

(ii) On Fig. 5.1, draw a label line to a blood vessel that contains a relatively high concentration of urea, and label it **U**. [1]

(iii) State the chamber of the heart into which blood in vessel **D** will flow.

.....[1]

(b) Explain why the volume of urine that is excreted by the kidneys is likely to be much greater on a cold day than on a hot day.

.....

[3]

- (c) Waste liquid from a house, including urine, is carried to a sewage works where it is treated and then released into the sea.

With reference to the processes taking place in the water cycle, explain how some of the water in urine could become part of a tree many miles away from the sea.

.....

.....

.....

.....[3]

- 6 Fig. 6.1 shows an electrochemical cell in which pieces of zinc and copper are used as the electrodes. The diagram also shows the direction that electrons move in the circuit.

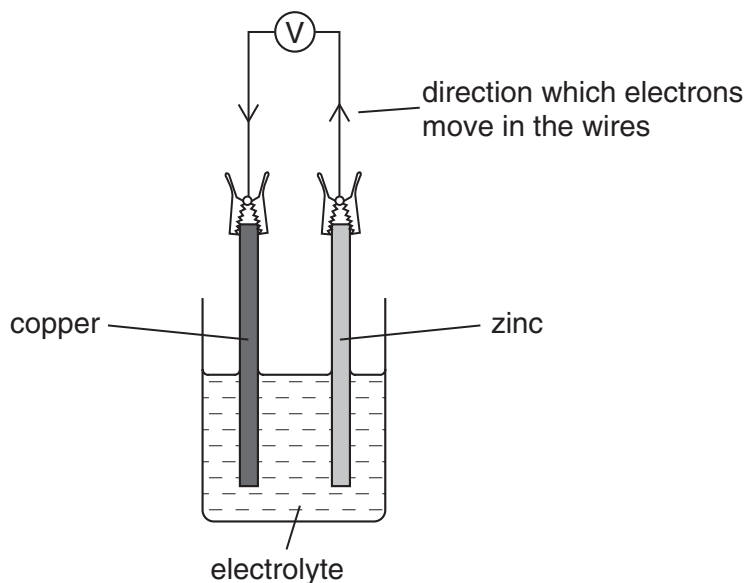


Fig. 6.1

Electrons move through the wires when metal atoms in the electrodes change into ions.

- (a) Suggest how a suitable electrolyte for this cell could be made.

.....
[1]

- (b) (i) Explain why the zinc electrode is described as being oxidised when the cell is working.

.....
[1]

- (ii) How does the direction of the electron flow in this cell show that zinc is a more reactive metal than copper?

.....

[2]

- (iii) Copper is more reactive than silver.

State and explain how the voltmeter reading will change if the copper electrode is replaced by silver.

.....

[2]

- (c) Describe the bonding in a typical metal such as copper, and explain briefly why metals are good conductors of electricity. You should draw a diagram to help your answer.

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

- (d) Magnesium reacts with copper sulphate solution according to the equation below.



- (i) Describe one observation which could be made during this reaction.

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

- (ii) Calculate the mass of copper which is produced when 0.48 g of magnesium react in excess copper sulphate solution.

Show your working.

.....[3]

(e) Fig. 6.2 represents atoms in some pieces of magnesium, calcium and strontium.

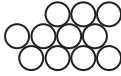
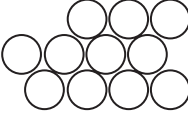
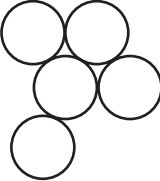
			
element	magnesium	calcium	strontium
combined mass of these atoms / atomic mass units	264	440	440

Fig. 6.2

Explain which two of these elements a chemist would say are present in the *same amount*.

.....

.....

.....[2]

7 (a) For each of the four proteins listed below, describe where they are found and explain their functions.

(i) haemoglobin

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

(ii) antibody

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

(iii) protease

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

(iv) insulin

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

(b) Describe how you would find out if a sample of food contained protein.

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

8 Fig. 8.1 shows a car lift being used to lift a car, which weighs 10 000 N.

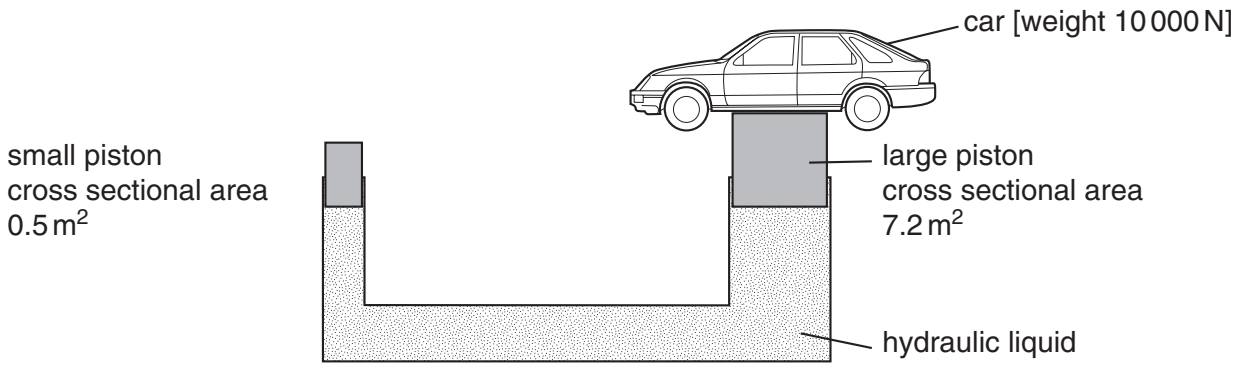


Fig. 8.1

(a) (i) Calculate the pressure that is exerted on the large piston.
Show your working and state any formula that you use.

.....[3]

(ii) State the pressure that the small piston exerts on the fluid.
Explain your answer.

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

(b) The car lift is an example of a hydraulic lift, which is a *force multiplier*.
With reference to Fig. 8.1, explain the meaning of this term.

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

(c) A hydraulic lift uses a liquid to transmit pressure.

(i) Explain in terms of particles why liquids can be used to transmit pressure in this way.

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

(ii) Explain why it is important that hydraulic liquids should contain no gas bubbles.

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

(d) (i) Describe what happens to the pressure of a fixed volume of gas when the temperature is raised.

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

(ii) At what temperature would a gas have zero pressure? Explain your answer.

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

- 9 The chemical formulae of three ionic compounds are shown below.

NaCl
sodium chloride

CaCl_2
calcium chloride

Na_2CO_3
sodium carbonate

- (a) The symbols and charges of some of the ions in these compounds are shown below.

Na^+

Ca^{2+}

Cl^-

Deduce the formula and charge of the carbonate ion.

Show your working.

.....[2]

- (b) The presence of calcium chloride in water causes permanent hardness. Washing soda contains sodium carbonate and may be added to hard water in order to soften it.

The reaction between calcium chloride and sodium carbonate produces a precipitate.

- (i) Complete the word equation.

calcium chloride + sodium carbonate \rightarrow

[2]

- (ii) Explain why this reaction softens the water.

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

- (iii) Describe a simple experiment, using soap solution, which could show that sodium carbonate softens permanently hard water.

.....
.....
.....
.....
.....
.....
.....
.....
.....[4]

(iv) State **one** other method of softening permanently hard water and explain briefly how it works.

.....

.....

.....

.....

.....[3]

DATA SHEET The Periodic Table of the Elements

		Group																								
		I	II	III	IV	V	VI	VII	0																	
3	7	9	11	13	14	15	16	17	18	20	2	4														
Li Lithium	Be Beryllium	B Boron	C Carbon	N Nitrogen	O Oxygen	F Fluorine	Ne Neon	Na Sodium	Mg Magnesium	Al Aluminium	Si Silicon	P Phosphorus	S Sulphur	Cl Chlorine	Ar Argon	He Helium										
19	39	40	45	48	51	52	55	56	59	64	65	70	73	75	79	84	86									
K Potassium	Ca Calcium	Sc Scandium	Ti Titanium	V Vanadium	Cr Chromium	Mn Manganese	Fe Iron	Co Cobalt	Ni Nickel	Cu Copper	Zn Zinc	Ga Gallium	Ge Germanium	As Arsenic	Se Selenium	Br Bromine	Kr Krypton									
37	85	88	89	91	93	96	101	103	106	108	112	115	119	122	128	131	136									
Rb Rubidium	Sr Strontium	Y Yttrium	Zr Zirconium	Nb Niobium	Mo Molybdenum	Tc Technetium	Ru Ruthenium	Rh Rhodium	Pd Palladium	Ag Silver	Cd Cadmium	In Indium	Sn Tin	Sb Antimony	Te Tellurium	I Iodine	Xe Xenon									
55	133	137	139	178	181	184	190	192	195	197	201	204	207	209	210	222	226									
Cs Caesium	Ba Barium	La Lanthanum	Hf Hafnium	Ta Tantalum	W Tungsten	Re Rhenium	Os Osmium	Ir Iridium	Pt Platinum	Au Gold	Hg Mercury	Tl Thallium	Pb Lead	Bi Bismuth	Po Polonium	At Astatine	Rn Radon									
87	Fr Francium	Ra Radium	Ac Actinium																							
													140	141	144	150	152	157	159	162	165	167	169	173	175	
													Ce Cerium	Pr Praseodymium	Nd Neodymium	Pm Promethium	Sm Samarium	Eu Europium	Gd Gadolinium	Tb Terbium	Dy Dysprosium	Ho Holmium	Er Erbium	Tm Thulium	Yb Ytterbium	Lu Lutetium
													58	59	60	61	62	63	64	65	66	67	68	69	70	71
													Th Thorium	Pa Protactinium	U Uranium	Np Neptunium	Pu Plutonium	Am Americium	Cm Curium	Bk Berkelium	Cf Californium	Es Einsteinium	Fm Fermium	Md Mendelevium	No Nobelium	Lr Lawrencium
													90	91	92	93	94	95	96	97	98	99	100	101	102	103

*58-71 Lanthanoid series
†90-103 Actinoid series

Key

a	X	=	relative atomic mass
b	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.).