Candidate Name Mark Scheme

Centre Number	Candidate Number

International General Certificate of Secondary Education
UNIVERSITY OF CAMBRIDGE LOCAL EXAMINATIONS SYNDICATE

CO-ORDINATED SCIENCES 0654/3

PAPER 3

Monday 19 MAY 1997 Afternoon 2 hours

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

TIME 2 hours

Biol ✓
Chem ✓
Phys ✓

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.
You may use a calculator.

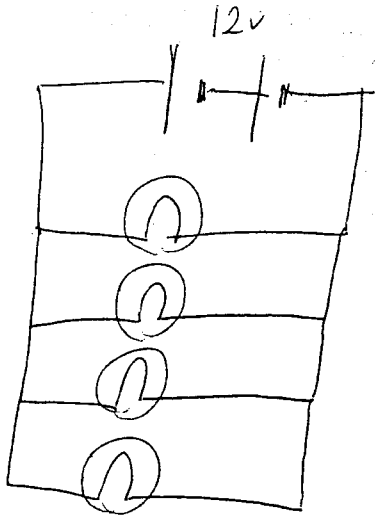
FOR EXAMINER'S USE	
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	

This paper consists of 20 printed pages.

For Examiner's Use

1 (a) A car has two headlight bulbs at the front and two rear light bulbs at the back. All four bulbs are connected in parallel with each other across a 12 V battery.

(i) Draw a circuit to show how the four bulbs are connected to the battery. Include in your circuit a switch which controls all four bulbs together.



[2]

(ii) If one bulb fails, the other three stay lit. Explain why this happens. Refer to your diagram if it helps your answer.

Each still has a complete path to and from the battery

.....[1]

(iii) Each headlight bulb takes a current of 5 A and each rear light bulb takes a current of 0.5 A. What is the total current taken by these four light bulbs?

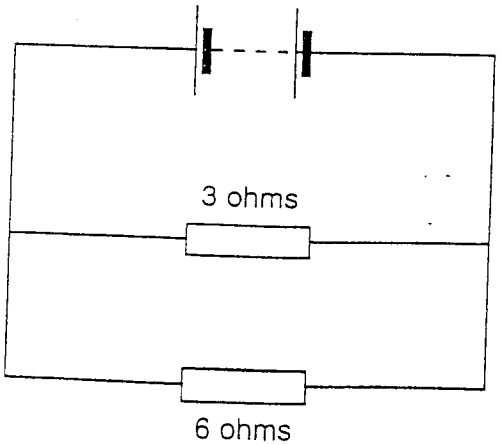
11 A

Explain your answer.

In parallel, the total current is the sum of the currents in the branches

.....[2]

(b) The diagram shows two resistors in a circuit.



For Examiner's Use

Calculate the combined resistance of the two resistors as shown in the circuit.

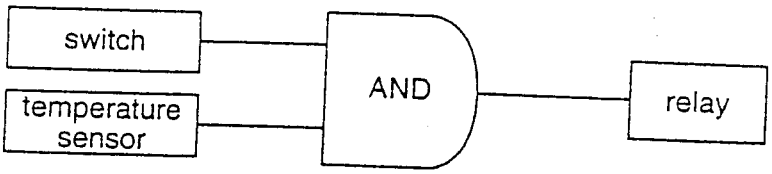
Show your working and state any formula which you use.

$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{6} + \frac{1}{3} = \frac{3}{6} = \frac{1}{2}$ ..

$R = 2\,\Omega$

.....[3]

(c) The diagram below shows part of a circuit containing an AND gate and a relay coil.



The input from the temperature sensor is **on** when the temperature rises above 25 °C.

The input from the switch is **on** when it is pressed.

(i) State the **two** conditions required for the relay to operate.

1. Temp. > 25°C

2. Switch pressed.

.....[1]

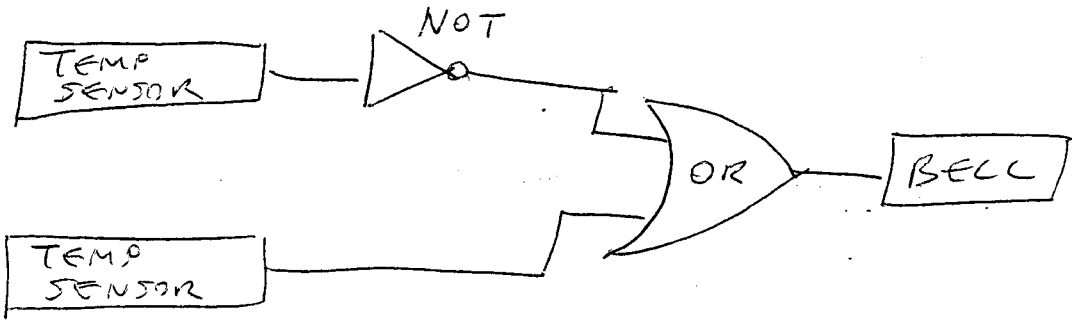
(ii) Describe a suitable use for this electronic system.

Explain your answer.

Eg. temperature regulator for air-con. When the room temp rises above 25°C, the air-con is switched on. The switch allows the entire system to be switched off.

.....[2]

(d) Draw a logic diagram which would operate a bell when the temperature is either too hot or too cold.



(The operating temps of the two sensors would need to be different!)

[3]

For Examiner's Use

4 (a) A mother uses a force of 80 N to push her child in a push-chair.

(i) She pushes the push-chair 1500 m.

Calculate how much work has been done in pushing the push-chair.

Show your working and state any formula which you use.

$W = F \times d \quad = 80 \times 1500$

$120\,000$ J ..... [3]

(ii) She takes 20 minutes to push the push-chair 1500 m.

Calculate the average power needed to push the push-chair.

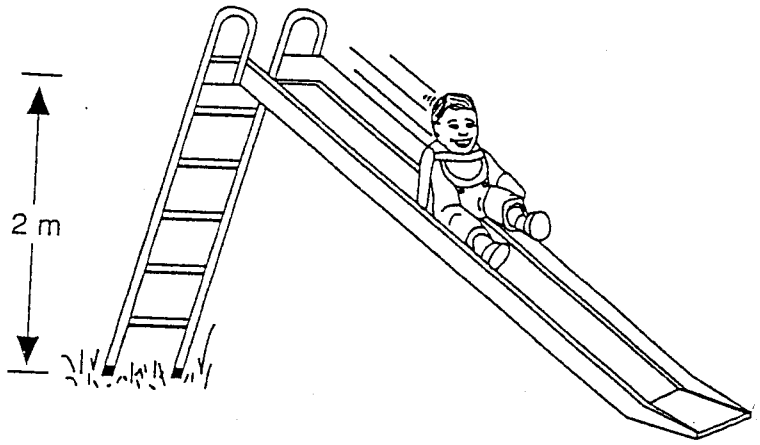
Show your working and state any formula which you use.

$P = \frac{W}{t} \quad = \frac{120\,000}{20 \times 60}$

$= 100$ W ..... [3]

For Examiner's Use

(b) The mother and child arrive at a children's playground.
The child climbs a ladder to the top of a slide.
The child sits on the top and goes down the slide.
The child has a mass of 10 kg.
The vertical height of the slide is 2 m.
When the child reaches the bottom of the slide she has 5 J of kinetic energy.



(i) How fast is she travelling when she reaches the bottom of the slide? Show your working and state any formula which you use.

$KE = \frac{1}{2}mv^2$ $\therefore$ $v = \sqrt{\frac{2 \times KE}{m}}$

$= \sqrt{\frac{2 \times 5}{10}}$

$= 1\ ms^{-1}$

.....[2]

(ii) Explain why the child's kinetic energy at the bottom is less than her gravitational potential energy at the top.

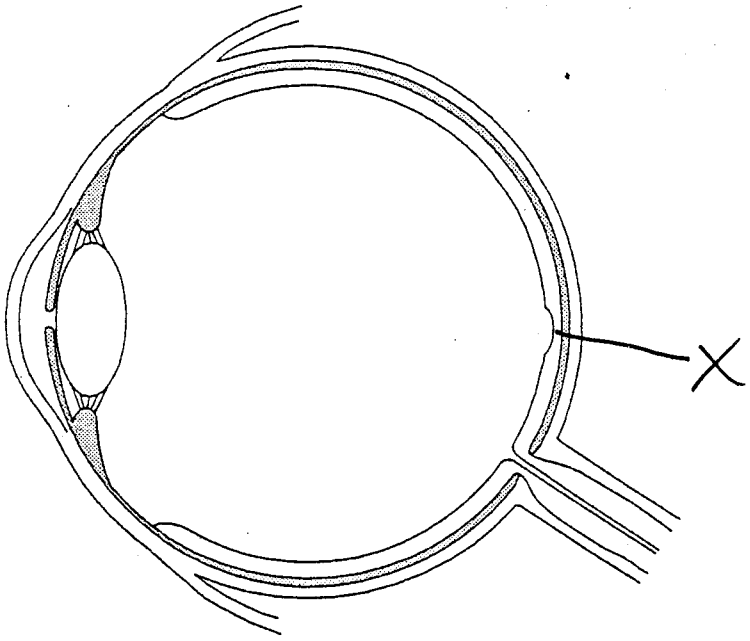
• Energy lost due to friction

• as heat

.....[2]

For Examiner's Use

5 The diagram shows a section through a human eye.



(a) A boy looked out of a window at a building in the distance. He then looked down at his book, and began to read.

Using the diagram to help you, explain the changes which would take place in his eyes to help him to focus on the book. Label on the diagram the parts of the eye which you mention in your explanation.

light from close up objects must be refracted more;
Ciliary Muscles Contract;
Suspensory Ligaments Not pulled/relax;
Lens Becomes Fatter More Rounded;
Light rays refracted more;
Focused on the Retina;
On the Fovea;

[6]

For Examiner's Use

(b) (i) On the diagram, draw a label line to a region where a large number of cones would be found, and write **X** next to your line. [1]

(ii) Explain how the lighting conditions would determine whether the rods or cones in the eye would be used when the boy looked out of the window at the building.

Rods stimulated by light of low intensity/

Cones stimulated by high intensity light. [1]

(iii) What difference would this make to what he could see?

Rods Black + White /

Cones Colour [1]

For Examiner's Use

6 In dry countries, drinking water is often produced by removing salts from sea water in a process called desalination.

One method is to heat the sea water to produce water vapour which is then condensed.

(a) Suggest how the boiling point of sea water would compare with that of pure water.

Give a reason for your answer.

boiling point of sea water would be higher since impurities (salt) dissolved in water raises the boiling point [2]

(b) The concentration of sodium chloride, NaCl, in a sample of sea water is found to be 0.5 mol per dm^3.

Calculate the mass of dry sodium chloride crystals which could be obtained by evaporating 0.5 dm^3 of this water.

(Relative atomic masses are shown on the Periodic Table on page 20.)

0.5 mol per dm^3

$\Rightarrow$ 0.5 mols present in 0.5 dm^3 = 0.25 mols (1)

mass = moles × M_r = 0.25 × 58.5 = 14.6 g (1) (1) [3]

(c) When a solution of silver nitrate, $AgNO_3$, is added to sodium chloride solution a white precipitate of silver chloride, AgCl, is formed.

Deduce the balanced equation for the reaction between sodium chloride and silver nitrate.

$AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$ [2]

(d) Hardness in water is caused by soluble compounds of calcium or magnesium. If calcium hydrogencarbonate, $Ca(HCO_3)_2$, is present in the water supply, limescale forms when the water is heated.

(i) Give the chemical name for limescale, and explain why water containing calcium hydrogencarbonate loses its hardness when heated.

Calcium carbonate (1)

calcium hydrogen carbonate decomposes (1) and produces insoluble calcium carbonate (1)

or equation [3]

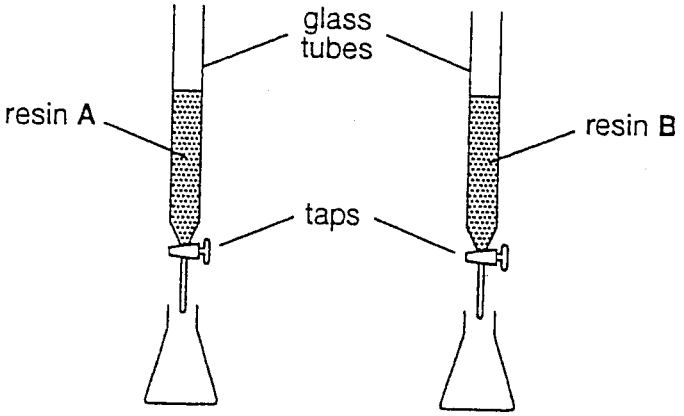
Calcium hydrogen carbonate → calcium carbonate + water + carbon dioxide

$Ca(HCO_3)_2 \rightarrow CaCO_3 + CO_2 + H_2O$

For Examiner's Use

(ii) One way of treating hard water is to pass the water through an ion-exchange resin. This replaces any calcium or magnesium ions in the water with sodium ions.

A chemist wishes to compare two different ion-exchange resins to find out which one is the more effective in removing hardness. She places the two resins, **A** and **B**, into glass tubes as shown below.



Suggest how the chemist could use this apparatus and a supply of soap solution to compare the resins.

pass through equal quantities of the same sample of hard water through the resin (at equal rates)
Add an equal volume of each softened water sample into 2 test tubes. Add drops of water, one at a time until and shake between each addition until a permanent lather appears. Compare the two samples. The sample with the least amount of soap required has passed through the most effective resin
(alternative fair test involving comparison of height of lather with fixed amount of soap acceptable)

any 6

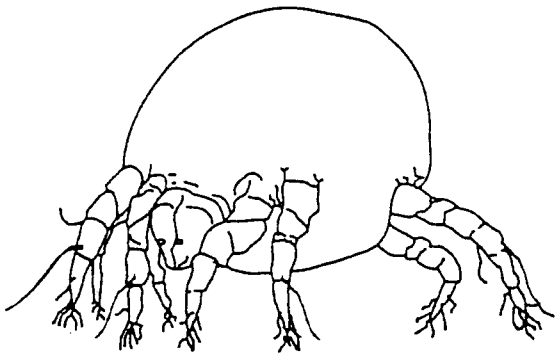
[6]

[Turn over

For Examiner's Use

9 Read the passage, and then answer the questions which follow.

Dust mites are arthropods, too small to see with the naked eye, which live in houses all over the world. Dust mites like warm, moist conditions, such as those found in houses with carpets, central heating and air conditioning. The diagram shows a dust mite, greatly magnified.



Children who live in houses where there are many dust mites are more likely to develop asthma than children who are not exposed to dust mites. For example, when blankets were given to people in villages in New Guinea in the 1980s, many children developed asthma.

Asthma is an illness in which the body's defence system reacts too strongly to foreign substances in air which is breathed in, such as the droppings of dust mites. The body behaves as though these substances were microorganisms invading the body. In an asthma attack, the muscle in the walls of the bronchioles contracts, making the bronchioles much narrower, so that it is difficult to get enough air into the lungs. At the same time, the cells lining the bronchioles produce a lot of extra mucus, which makes the problem even worse. A little while later, many white cells arrive on the scene. These white cells produce chemicals which may damage the cells lining the bronchioles.

(a) (i) State **one** feature of dust mites, visible in the diagram, which shows that they are arthropods.

Jointed limbs [1]

(ii) To which group of arthropods do dust mites belong?

Arthropods - arachnids

State **one** reason for your answer.

4 pairs legs

No antennae [2]

(b) Name **two** parts of the human gas exchange system through which air passes, after it has passed through the mouth or nose and before it reaches the bronchioles.

Trachea / Bronchi [1]

For Examiner's Use

(c) (i) Describe the normal function of mucus in the bronchioles.

Traps dust particles / Microorganisms ;
+ is moved up the throat;

[2]

(ii) Explain how the production of extra mucus can cause breathing problems.

Mucus could block Bronchioles ;
less space for air to get in + out;

[2]

(d) Suggest why white cells accumulate in the bronchioles during an asthma attack.

To "eat" up the particles ;
Ref to Phagocytes;

[2]

(e) Asthma is becoming more common all over the world. Using the information in the passage, and also your own knowledge about changes in people's living conditions, suggest why this is so.

~~More particles in the atmosphere~~
More Central heating;
Warmer conditions ;
Greater use carpets;
So more dust mites;
More particles in atmosphere in general ; [3]
due to pollution;
∴ more asthma

DATA SHEET
The Periodic Table of the Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 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 Sulphur 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	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	Po Polonium 84	At Astatine 85	Rn Radon 86
Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 †															

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

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

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

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.)