UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

7629302318

CO-ORDINATED SCIENCES **0654/03**

Paper 3 (Extended) **October/November 2008**

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 28.

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	

This document consists of **25** printed pages and **3** blank pages.

For Examiner's Use

1 Fig. 1.1 shows a blood capillary between alveoli in the lungs. The alveoli provide the gas exchange surface.

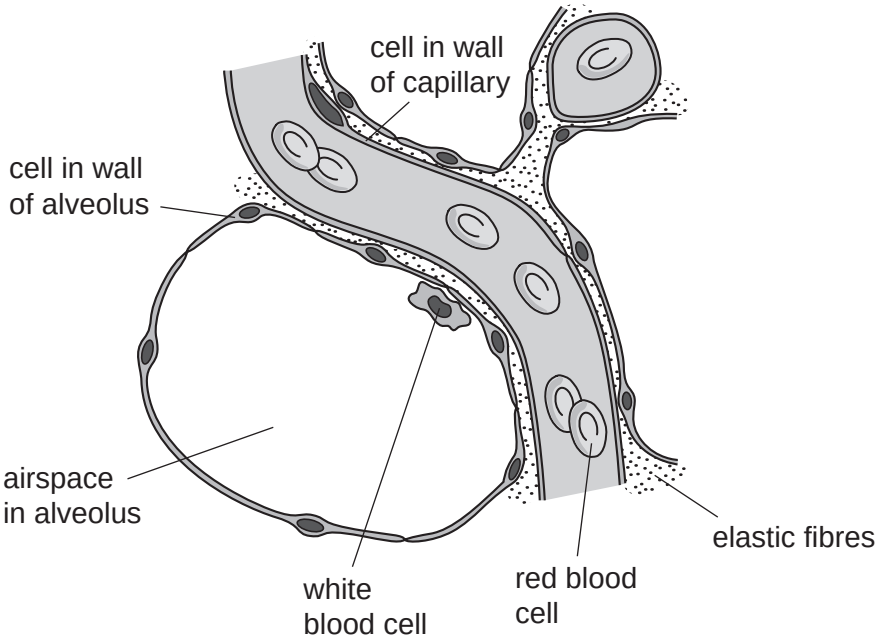

Fig. 1.1

(a) Describe what happens in the red blood cells as they pass through the capillaries in the lungs.

.....

.....

..... [2]

(b) White blood cells are able to move out of blood capillaries through tiny gaps in their walls. Suggest the function of the white blood cell in the alveolus.

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..... [1]

For Examiner's Use

(c) (i) Describe how air is made to move into the lungs during inhalation.

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..... [3]

(ii) Suggest why there are elastic fibres around the alveoli.

.....

..... [1]

(d) Explain how the structures shown in Fig. 1.1 make the alveoli an efficient surface for gaseous exchange.

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.....

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..... [3]

(e) Describe how gas exchange takes place in the leaf of a plant.

.....

.....

.....

..... [3]

[Turn over

For Examiner's Use

2 **(a)** A student is given the apparatus shown in Fig. 2.1.

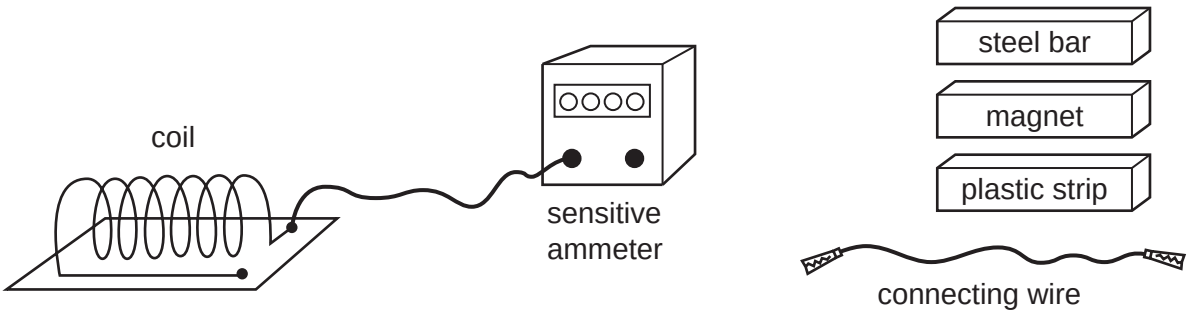

Fig. 2.1

Describe as fully as you can, how the student would select from the apparatus provided, and use it to produce an electric current.

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..... [3]

(b) Electric power is produced at power stations using generators.

A simple generator is shown in Fig. 2.2.

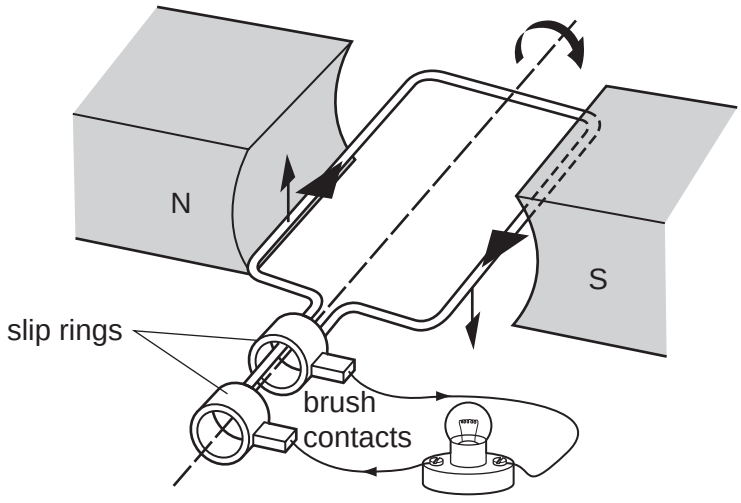

Fig. 2.2

(i) Explain why a current is induced in the coil when it rotates.

.....

..... [1]

(ii) Explain why the current is at a maximum when the coil is horizontal, and at a minimum when the coil is vertical.

For Examiner's Use

.....

.....

..... [2]

For Examiner's Use

3 A student investigates the reaction between magnesium and dilute acid **Y**.
Fig. 3.1 shows the metal being added to the acid contained in a test-tube, and also the same tube some time later.

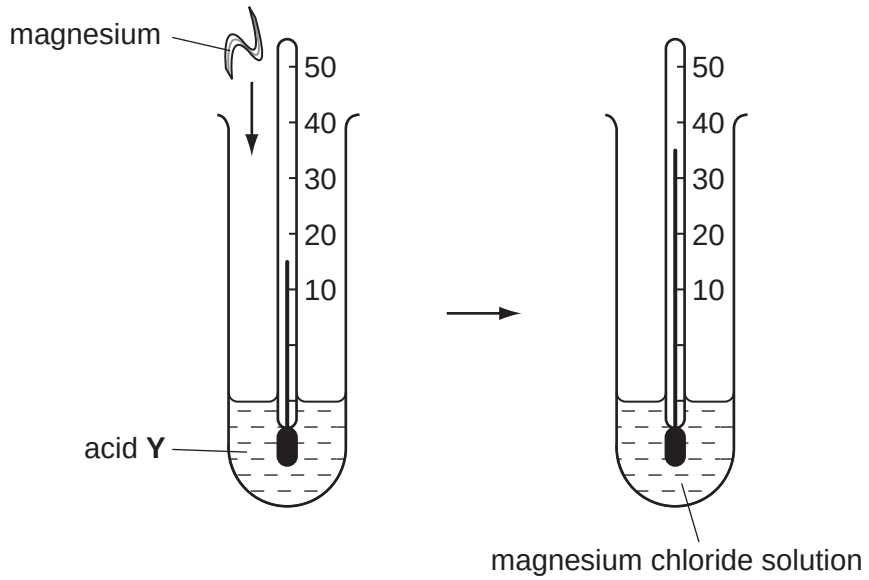

Fig. 3.1

(a) (i) Name acid **Y**.

.....

[1]

(ii) Describe and explain **one** observation which the student would have made during the reaction.

.....

.....

[2]

(iii) The student noticed that, within a short time, the piece of magnesium completely reacted.

Predict and explain what would be observed if another small piece of magnesium were added to the solution in the tube shown on the right of Fig. 3.1.

.....

.....

.....

[2]

(b) Explain why a metal such as magnesium is a good conductor of electricity. You should draw a labelled diagram to help your explanation.

For Examiner's Use

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.....

..... [3]

PLEASE TURN OVER FOR QUESTION 3(c)

(c) Magnesium alloys are widely used in making parts for aircraft and racing car engines.

Table 3.1 shows some incomplete data about one type of magnesium alloy.

Table 3.1

element	moles in 100 g of alloy	mass in 100 g of alloy /g
magnesium		
zinc	0.055	3.575
zirconium	0.011	

(i) Calculate the mass of zirconium in 100 g of the alloy. Zirconium is in Period 5 of the Periodic Table.

Show your working.

..... [2]

(ii) Calculate the mass and hence the number of moles of magnesium in 100 g of the alloy.

Show your working.

..... [3]

For Examiner's Use

4 In the 1930s, farmers growing sugar cane in tropical parts of Australia had problems with insect pests, such as lacebugs, that ate the crop. Cane toads, *Bufo marinus*, were introduced from central America to try to solve the problem. Cane toads kill and eat insects and other small animals.

Fig. 4.1 shows a cane toad.

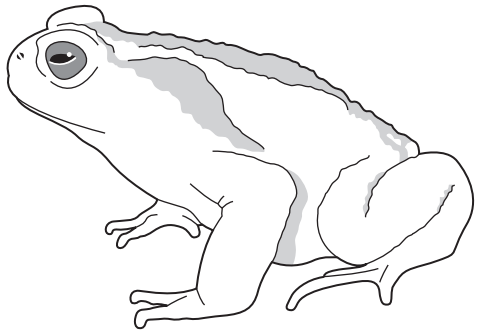

Fig. 4.1

(a) State **one** feature of a cane toad, visible in Fig. 4.1, which shows that it is an amphibian.

.....

[1]

(b) Name the genus to which cane toads belong.

.....

[1]

(c) Use the information above to write a food chain involving cane toads. For each organism, state whether it is a producer or a consumer.

.....

[2]

For Examiner's Use

(d) The cane toads did help to control the insect population. However, they also ate many other small animals, including species of rare and endangered mammals. The cane toads have spread rapidly from the place to which they were introduced, into other areas of Australia. Cane toads have become a serious pest.

Biologists noticed that the cane toads that first arrived in a new area tended to have longer legs than the original cane toads that were introduced into Queensland. They thought that perhaps this happened because toads with longer legs could travel faster than other toads. They collected toads with different leg lengths, and measured the distance the toads travelled in 24 hours. The results are shown in Fig. 4.2.

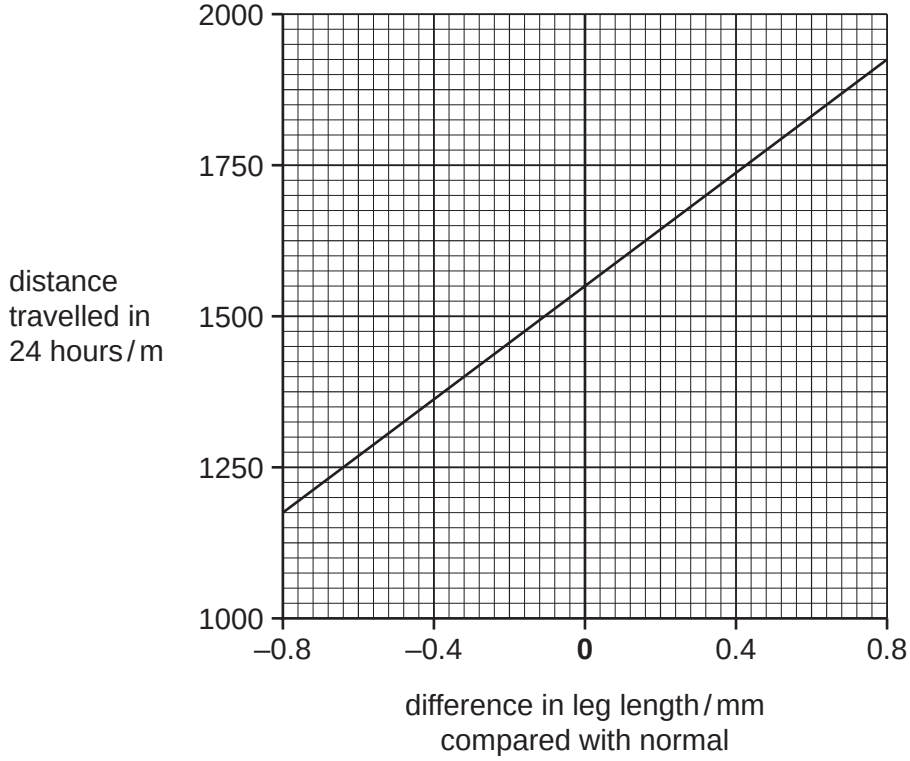

Fig. 4.2

(i) Calculate the speed at which a toad with normal leg length travelled. Show your working.

..... [2]

(ii) Suggest why it could be an advantage to a cane toad to move into a new area where there are no other cane toads present.

.....

..... [1]

For Examiner's Use

(iii) The researchers suggested that cane toads might be evolving into toads with longer legs. Using all the information provided, outline how this might happen.

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..... [4]

For Examiner's Use

5 **(a)** Some countries use nuclear fission reactors to generate electricity.

(i) What is meant by the term *nuclear fission*?

.....

..... [1]

(ii) State **one** advantage and **one** disadvantage of generating electricity using nuclear reactors.

advantage .....

.....

disadvantage .....

..... [2]

(b) When nuclear fuel is used in a power station, ionising radiation is released.

Table 5.1 shows some information about three types of ionising radiation.

Table 5.1

radiation	ionising power	deflection by electric field
alpha	very strong	small
beta	moderate	large
gamma	weak	none

(i) Explain how alpha, beta and gamma radiations can be separated from each other by passing them across an electric field.

.....

..... [4]

For Examiner's Use

(ii) Explain why alpha radiation is the most ionising.

.....

..... [1]

(iii) Describe the effect of ionising radiation on living things.

.....

..... [1]

(iv) Why are radioactive sources stored in lead containers?

..... [1]

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For Examiner's Use

6 Fig. 6.1 shows crude oil (petroleum) being extracted from sedimentary rock under the sea.

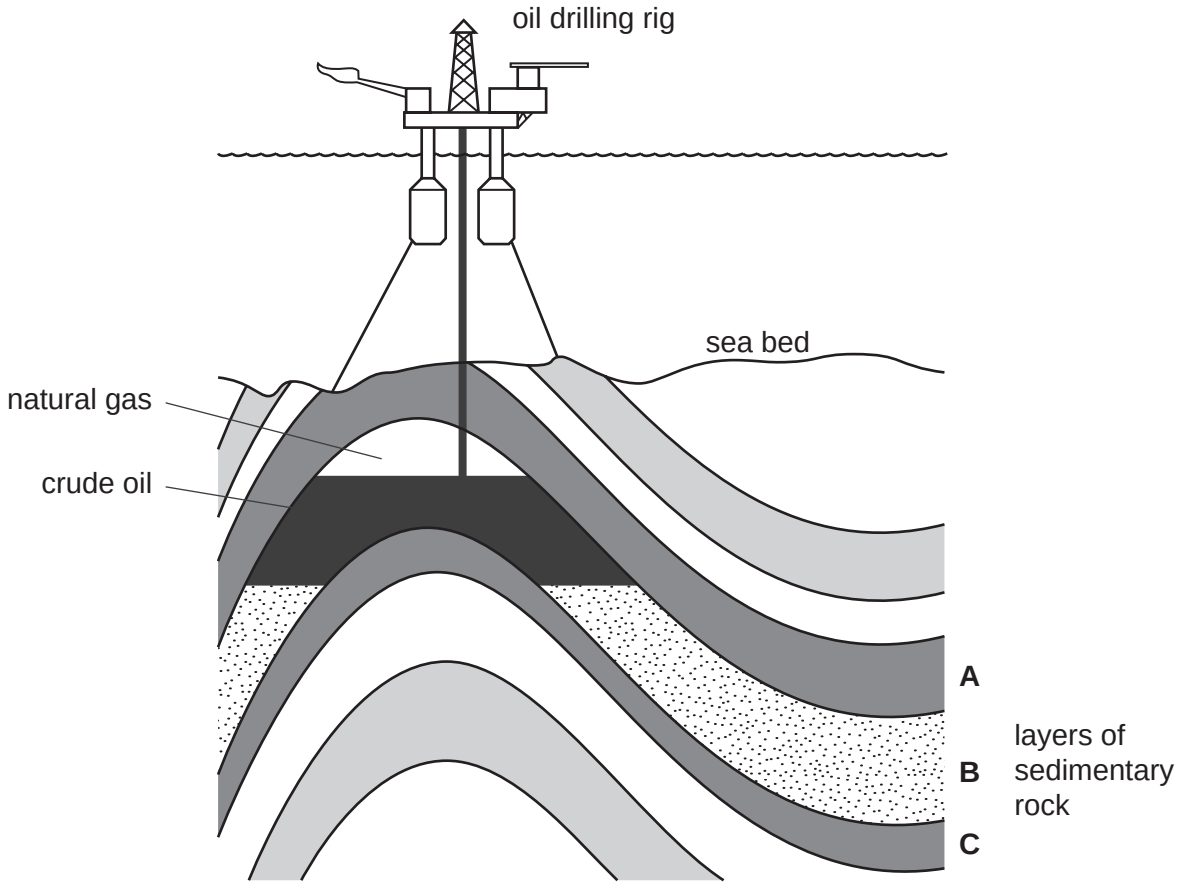

Fig. 6.1

(a) The oil shown in Fig. 6.1 is found only in rock layer **B** and not in layers **A** or **C**.

Suggest the property of rock **B** which is different from rocks **A** and **C**, and which allows it to contain oil.

.....

..... [1]

(b) Crude oil is a mixture of different hydrocarbon molecules. A typical hydrocarbon molecule is shown in Fig. 6.2.

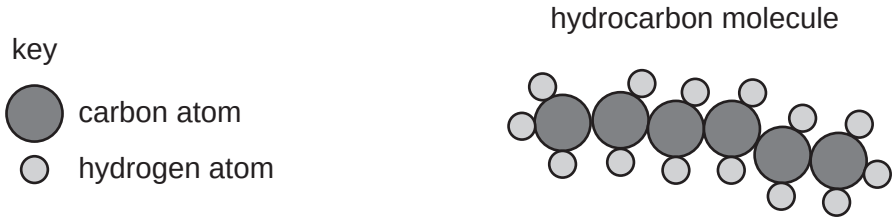

Fig. 6.2

Write the graphical (displayed) formula of the hydrocarbon shown in Fig. 6.2, and explain whether it is an alkane or an alkene.

.....

..... [2]

(c) Fig. 6.3 shows a simplified diagram of an important industrial process involving hydrocarbons.

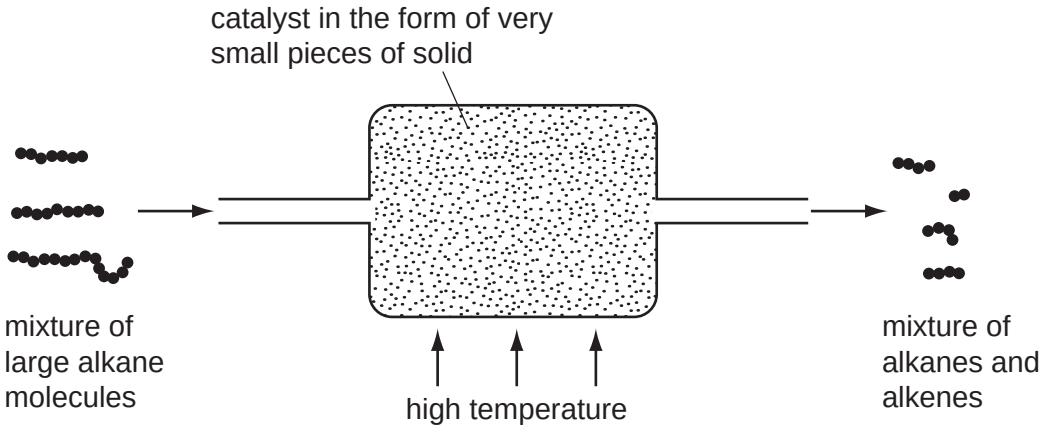

Fig. 6.3

(i) Name the process shown in Fig. 6.3.

..... [1]

(ii) Suggest a process which could be used to separate the mixture of alkanes and alkenes.

..... [1]

For Examiner's Use

(iii) A research chemist is investigating two catalysts, **P** and **Q**, for use in the process shown in Fig. 6.3.

Describe a simple chemical test for alkenes. Suggest how the chemist could use this test to discover which catalyst, **P** or **Q**, produces a mixture containing the larger amount of alkenes.

.....

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.....

.....

..... [3]

For Examiner's Use

7 Fig. 7.1 shows the female reproductive system.

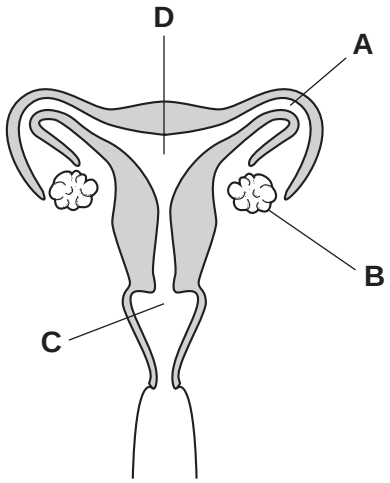

Fig. 7.1

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

A .....

B .....

C .....

D ..... [2]

(b) Fig. 7.2 shows how the thickness of the uterus lining changes during the menstrual cycle.

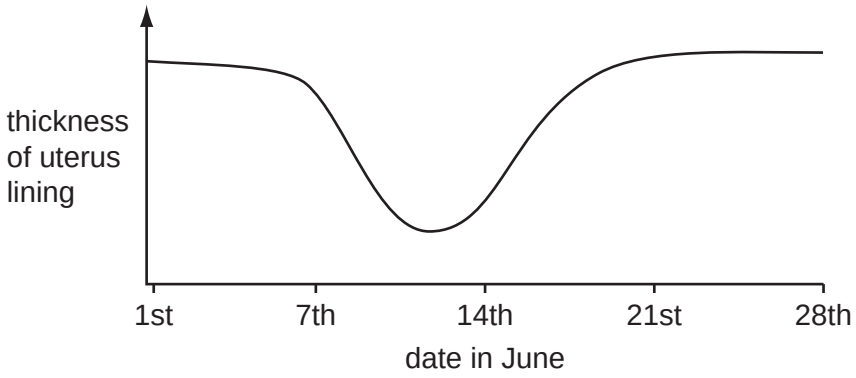

Fig. 7.2

(i) Suggest the date on which menstruation began.

..... [1]

For Examiner's Use

(ii) Suggest the date on which ovulation (the release of an egg from an ovary) occurred.

..... [1]

(c) AIDS can be transmitted from one person to another during sexual intercourse. Explain how this transmission can take place.

.....

.....

..... [2]

(d) Humans, like all mammals, use internal fertilisation, whereas fish use external fertilisation.

(i) Explain what is meant by *external fertilisation*.

.....

.....

..... [2]

(ii) Explain why external fertilisation is used only by animals that reproduce in water.

.....

..... [1]

(iii) Mammals produce only a few eggs at a time, whereas fish produce thousands. Suggest why.

.....

.....

..... [2]

For Examiner's Use

8 An airline passenger enters an airport.

(a) He buys some hot food at the restaurant and carries it away in a polystyrene container.

Explain why a polystyrene container is used to keep food hot.

.....

..... [1]

(b) He then moves up an escalator (moving staircase) as shown in Fig. 8.1.

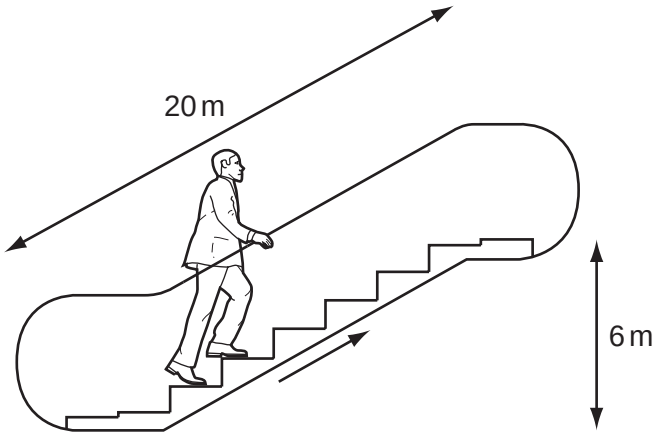

Fig. 8.1

(i) The passenger weighs 900 N. Calculate the work done lifting the passenger a vertical distance of 6 m up the escalator.

State the formula that you use and show your working.

formula

working

..... [2]

(ii) State the potential energy the passenger has gained when he reaches the top of the escalator.

..... [1]

For Examiner's Use

(c) The passenger places three pieces of luggage onto a conveyor belt as shown in Fig. 8.2.

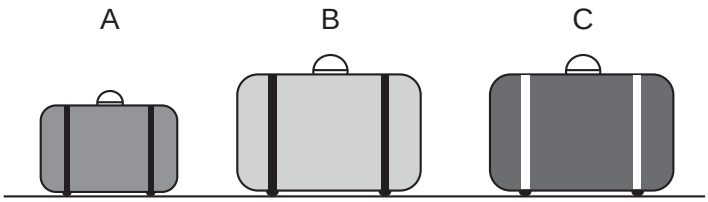

Fig. 8.2

Each piece of luggage has a different mass.

mass of **A** = 12 kg

mass of **B** = 15 kg

mass of **C** = 22 kg

(i) What is the momentum of the luggage before the conveyor belt starts to move?

Explain your answer.

.....

..... [2]

(ii) When the conveyor belt is switched on, the luggage moves at a constant speed of 0.5 m / s.

Which piece of luggage **A**, **B** or **C** has the most momentum?

Explain your answer.

.....

..... [1]

(iii) At one point the conveyor belt turns left. The luggage on the belt continues to move at a constant speed.

Does the momentum of the luggage change as it turns left on the conveyor belt?

Explain your answer.

.....

..... [1]

(d) Radar uses microwaves with a frequency of about 10 000 MHz (10^{10} Hz). A short pulse is sent from a transmitter, reflected by an aircraft and picked up by a receiver next to the transmitter.

(i) Explain the meaning of the term *frequency*.

.....

..... [1]

(ii) Microwaves travel at 300 000 000 m / s ($3x10^8$ m / s).
Calculate the wavelength of the microwaves.

State the formula that you use and show your working.

formula

working

..... [2]

(iii) Radio signals are electromagnetic waves. They can be either *digital* or *analogue*.

State the difference between these two terms.

.....

.....

..... [1]

(e) A large crane is being used to build a new terminal building at the airport. The crane in Fig. 8.3 is balanced.

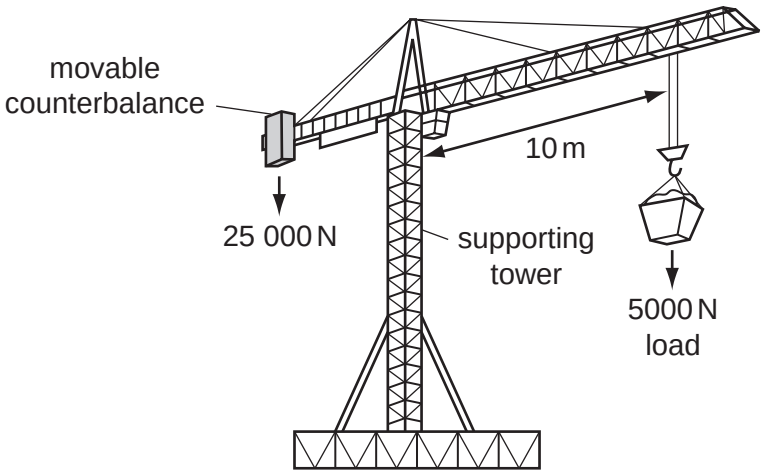

Fig. 8.3

(i) Calculate the moment of the load about the supporting tower of the crane.

State the formula that you use and show your working.

formula

working

..... [2]

(ii) Calculate the distance of the crane's counterbalance from the crane's supporting tower.

Show your working.

..... [2]

For Examiner's Use

9 Fig. 9.1 shows the apparatus and substances used by a student to make an electrical cell.

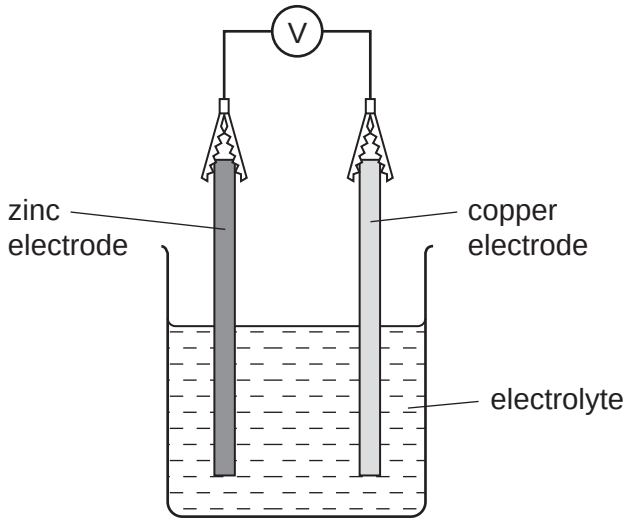

Fig. 9.1

(a) Suggest a compound which the student could dissolve in water to make the electrolyte.

Explain your answer briefly.

.....

..... [2]

(b) The student knows that the electrode made from the more reactive metal is the negative electrode of the cell.

The student has three other electrodes made of unknown metals **X**, **Y** and **Z**. The results of experiments involving all five metals are shown in Table 9.1.

Table 9.1

experiment	negative electrode	positive electrode	cell voltage / volts
1	zinc	copper	1.1
2	**X**	copper	2.7
3	**Y**	copper	1.5
4	**X**	**Z**	3.2

For Examiner's Use

(i) Use the results shown in Table 9.1 to place the metals in order of reactivity. Copper has already been placed in position.

..... (most reactive)

.....

.....

copper .....

..... (least reactive) [2]

(ii) State and explain briefly which one of the metals above has atoms which change into ions most easily.

.....

.....

..... [2]

(c) Copper is a transition metal which forms two oxides. The chemical formulae of these oxides are:

Cu_2O	copper(I) oxide
CuO	copper(II) oxide

The formula and electrical charge of an oxide ion is O^{2-}.

Deduce the difference between the copper ion in copper(I) oxide and that in copper(II) oxide. Show how you obtained your answer.

.....

.....

.....

..... [3]

(d) Zinc can be obtained industrially by the electrolysis of concentrated zinc sulphate solution which contains zinc ions, Zn^{2+}.

Describe and explain what happens to zinc ions in the solution in order to convert them into zinc atoms.

.....

.....

.....

..... [3]

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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** 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 above, **X** in the centre, b at the bottom left

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.).