UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

7220549260

CO-ORDINATED SCIENCES **0654/23**

Paper 2 (Core) **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 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 **26** printed pages and **2** blank pages.

1 **(a)** Fig. 1.1 shows a flowering plant, and two cells from the plant.

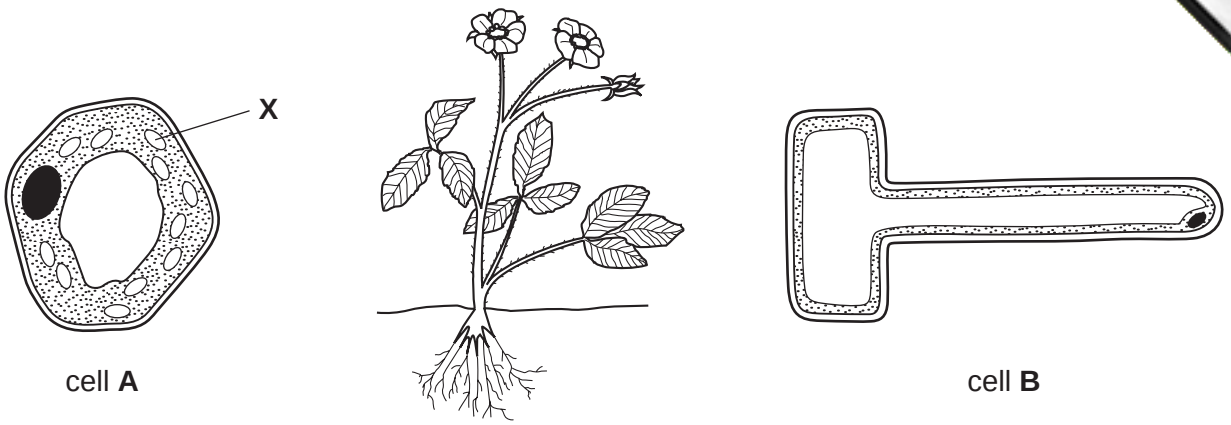


Fig. 1.1

(i) On Fig. 1.1, draw a line from each cell to a part of the plant in which it could be found. [2]

(ii) Explain why cell **A** contains the structures labelled **X**, while cell **B** does not.

.....

.....

.....

..... [3]

(iii) Explain how the shape of cell **B** adapts it for its function.

.....

.....

..... [2]

(b) The colour of the flower petals is determined by a gene with two alleles, **R** and **r**. **R** is dominant and produces red flowers, and allele **r** produces white flowers.

(i) Complete Table 1.1 to show the phenotype produced by each of the three possible genotypes.

Table 1.1

genotype	phenotype
RR	
Rr	
rr	

[1]

(ii) On Table 1.1, draw a circle around **one heterozygous** genotype. [1]

(iii) Predict the ratio of red to white flowers that would be produced if two plants with the genotypes **Rr** were crossed.

..... [1]

(c) A grower has a rare variety of orchid with unusual flowers. She decides to produce new plants from this orchid using tissue culture.

Suggest the advantages to the grower of using tissue culture to produce new plants, rather than sowing seeds she has collected from the orchid plant.

.....

.....

..... [2]

2 **(a)** Fig. 2.1 shows the forces acting on a moving car.

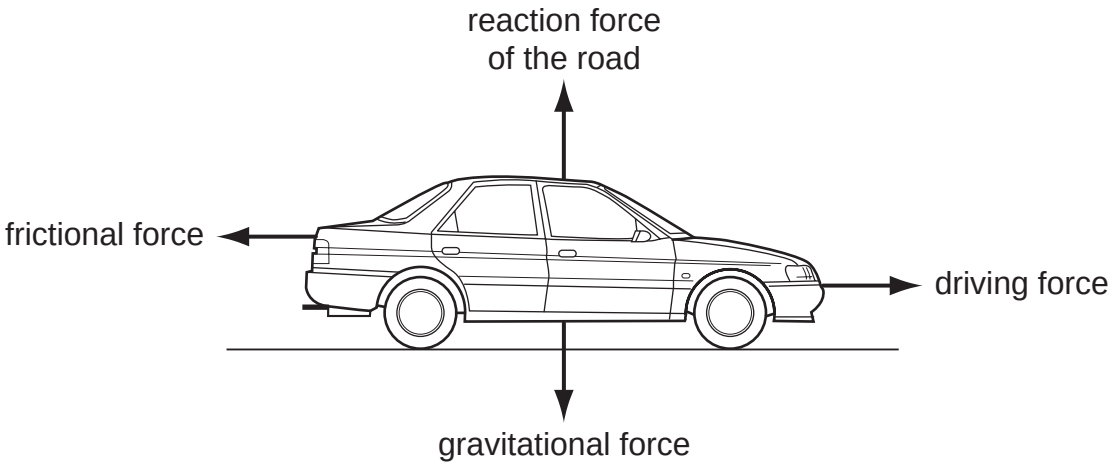


Fig. 2.1

(i) The car is accelerating.

What can be stated about the sizes of the driving force and frictional force?

.....

..... [1]

(ii) The car reaches a steady speed of 20 m / s.

What can be stated about the sizes of the driving force and frictional force now?

.....

..... [1]

(iii) The mass of the car is 1500 kg.

Calculate the kinetic energy of the car when it is travelling at a steady speed of 20 m / s.

State the formula that you use and show your working.

formula used

working

..... J [2]

(iv) The car travels at 20 m / s for 2 minutes.

Calculate the distance travelled.

State the formula that you use and show your working.

formula used

working

..... m [2]

(b) Fig. 2.2 shows a speed-time graph for part of the car's journey, during which the brakes are used.

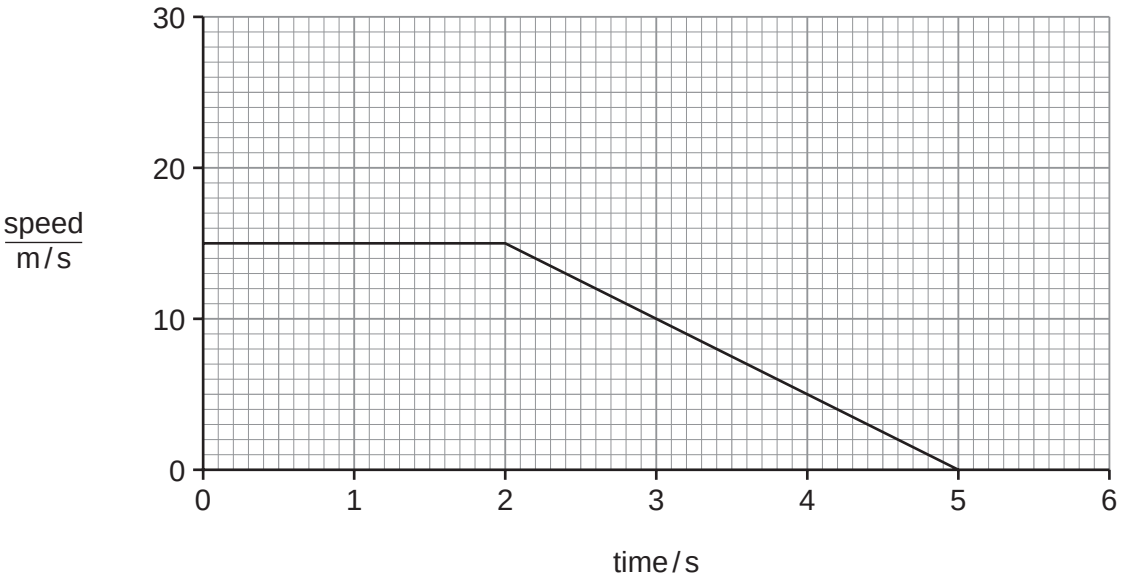


Fig. 2.2

(i) Mark with an **X** the point on the graph at which the brakes are applied. [1]

(ii) Calculate the deceleration of the car.

Show your working.

..... m/s^2 [2]

3 **(a)** Table 3.1 shows the electron arrangements of atoms of five elements, **P** to **T**. In these atoms the number of protons is the same as the number of electrons.

Table 3.1

atom	1st shell	2nd shell	3rd shell	4th shell
P	2	1		
Q	2	8	1	
R	2	8	7	
S	2	8	8	1
T	2	8	8	2

(i) Explain which element in Table 3.1 would **not** be a good conductor of electricity.

element .....

explanation .....

..... [2]

(ii) State and explain which **one** of the elements **P**, **Q** or **S** is the most reactive.

most reactive .....

explanation .....

..... [2]

(iii) An atom of element **P** has a nucleon (mass) number of 7.

State the number of neutrons in this atom and explain your answer.

number of neutrons .....

explanation .....

..... [2]

(iv) Suggest **two** elements in Table 3.1 which would react together to form an ionic compound.

Explain your answer.

elements ..... and .....

explanation .....

..... [2]

(b) Fig. 3.1 shows a working electrochemical cell that was made by a student in a laboratory.

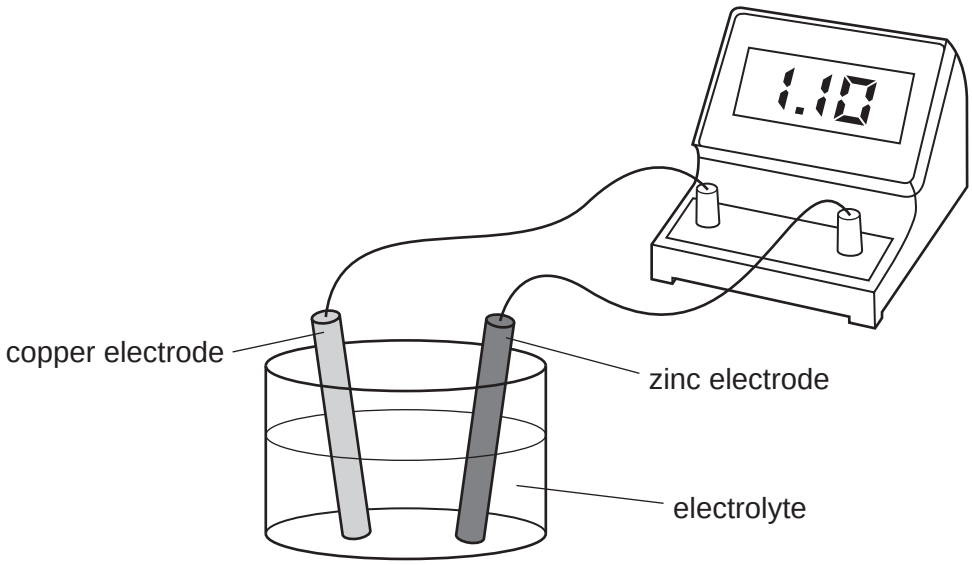


Fig. 3.1

(i) The student used one of the liquids shown below as the electrolyte in her cell.

gasoline (a hydrocarbon) sodium chloride solution water

State which liquid the student used and explain briefly why the other liquids would **not** have been suitable.

liquid the student used .....

explanation .....

.....

..... [2]

(ii) State and explain briefly what would happen to the voltmeter reading if the zinc electrode was replaced by an electrode made of copper.

.....

..... [2]

4 A man enters a theatre and then moves up an escalator (moving staircase) as sh
Fig. 4.1.

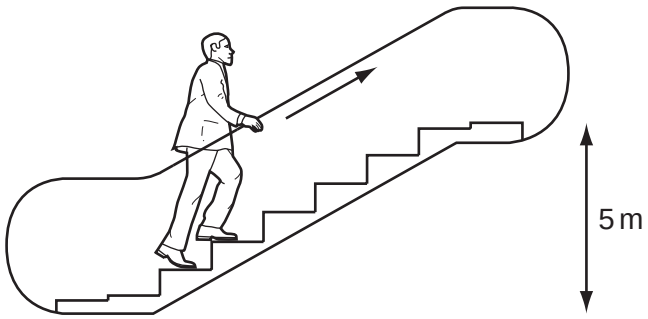


Fig. 4.1

The man weighs 1000 N.

(a) (i) Calculate the work done lifting the man a vertical distance of 5 m.

State the formula that you use and show your working.

formula used

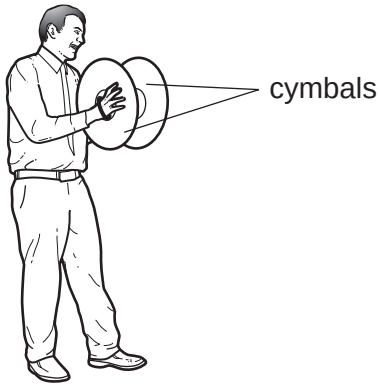
working

..... J [2]

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

..... J [1]

(b) In the theatre, a musician is playing the cymbals.



The man in the audience thought that the sound from the cymbals was loud because of its high frequency. He was wrong.

Explain why the man was wrong.

.....

.....

..... [2]

(c) Blue light and red light are being shone on the musician.

These are two of the primary colours of light.

(i) Name the third primary colour of light. ..... [1]

(ii) Name one of the secondary colours of light. ..... [1]

(d) The theatre measures 50 m x 50 m x 20 m. The air inside it has a density of 1.3 kg

(i) Calculate the volume of the air in the theatre.

..... m^3 [1]

(ii) Show that the mass of the air in the theatre is 65 000 kg.

State the formula that you use and show your working.

formula used

working

[2]

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Please turn over for Question 5.

5 PTFE is an important plastic which has many uses in the home and industry.

Wool consists of fibres which are made of protein molecules.

(a) Both PTFE and wool are made of polymer molecules.

Explain the meanings of the terms *monomer* and *polymer*.

.....

.....

.....

..... [3]

(b) The chemical formula of the monomer used to make PTFE is C_2F_4.

(i) Explain the meaning of the formula C_2F_4.

.....

.....

..... [2]

(ii) Explain why the monomer, C_2F_4, is **not** an example of a hydrocarbon.

.....

..... [1]

(iii) Name the type of compound which polymerises to form the proteins that make up wool.

..... [1]

(c) PTFE is a thermoplastic material.

Describe how PTFE behaves when it is heated and then cooled.

.....

.....

..... [2]

(d) Fig. 5.1 shows a magnified section of a wool fibre. The fibre has been washed
hard water. The fibre is covered with tiny crystals of limescale.

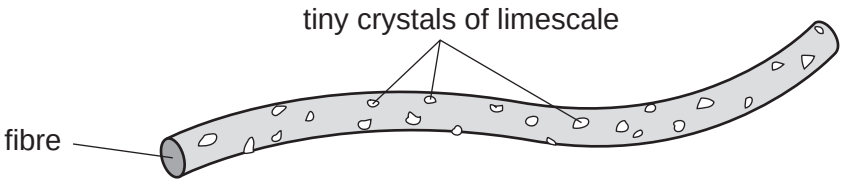


Fig. 5.1

(i) Explain which **one** of the chemical formulae below is of a compound which causes hardness in water.

$NaCl$ K_2CO_3 $Ca(HCO_3)_2$ Li_2SO_4

formula .....

explanation .....

..... [1]

(ii) In many countries the water supplied to homes and industry does not contain compounds which cause hardness.

Suggest **one** advantage of a water supply which does **not** contain compounds which cause hardness.

.....

..... [1]

6 **(a)** Fig. 6.1 shows a section through part of a person's lungs.

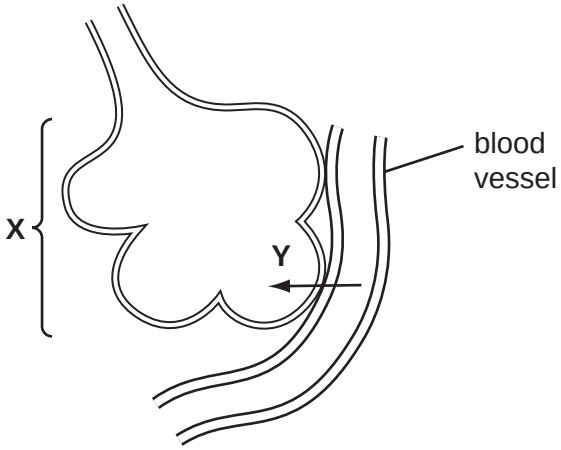


Fig. 6.1

(i) Name the structure labelled **X**. ..... [1]

(ii) Name the type of blood vessel that is shown in Fig. 6.1. ..... [1]

(iii) On Fig. 6.1, draw an arrow to show the direction in which air flows when the person breathes out. [1]

(iv) Carbon dioxide diffuses out of the blood down its concentration gradient, as shown by arrow **Y**.

Explain why there is more carbon dioxide in the blood that is brought to the lungs than in the air inside structure **X**.

.....

.....

..... [2]

(v) Describe how blood travels from the heart to the lungs. Your description should include the role of the heart in this process.

.....

.....

.....

.....

..... [3]

(b) Many people who regularly smoke tobacco get bronchitis. This happens when builds up in the lungs. Bacteria breed in the mucus.

(i) Explain why mucus builds up in the lungs of a person who smokes tobacco.

.....

.....

..... [2]

(ii) Explain why a build-up of mucus inside structure **X** in Fig. 6.1 would make gas exchange difficult.

.....

.....

..... [2]

7 **(a)** **(i)** Caffeine is a compound contained in coffee. Many people who consume c
during the day often find that they have difficulty in getting to sleep at night.

Explain why it is correct to refer to caffeine as a *drug*.

.....

..... [1]

(ii) Some drugs are analgesics.

Why might a person need to take an analgesic?

..... [1]

(b) Some coffee drinks are sold in self-heating cans.

Fig. 7.1 shows a cross-sectional diagram of one design of self-heating can.

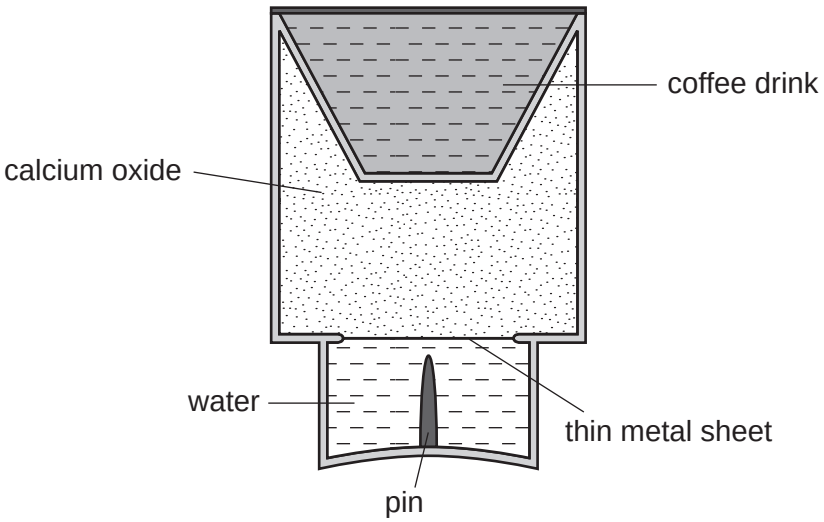


Fig. 7.1

Fig. 7.2 shows the can after it has been turned upside down and the pin p
through the thin metal sheet. This allows the water to fall into the calcium oxide.

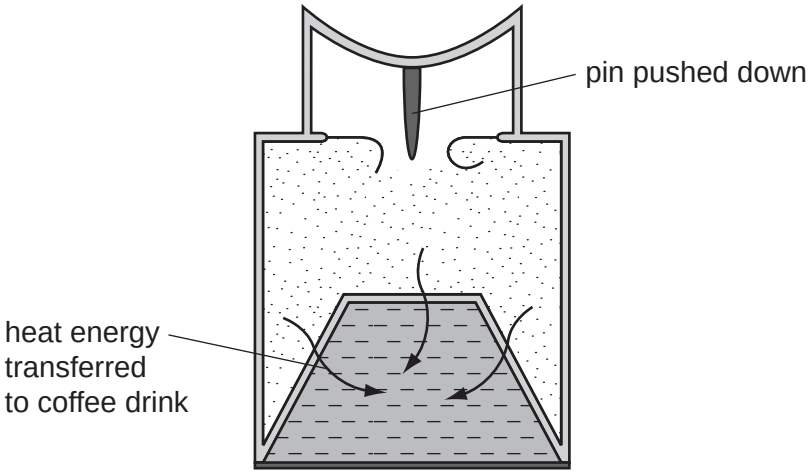


Fig. 7.2

The reaction between calcium oxide and water produces the compound calcium hydroxide, $Ca(OH)_2$.

(i) In an internet video to explain how the can works, it is stated that the water mixes with 'limestone'.

State why this information is **incorrect**.

.....

..... [1]

(ii) What can be deduced about the reaction between water and calcium oxide ?

..... [1]

(iii) A student suggests the symbolic equation below for the reaction between calcium oxide and water.

$$CaO + 2H_2O \longrightarrow Ca(OH)_2$$

Explain whether or not this is a correctly balanced equation.

.....

.....

..... [2]

(c) Calcium hydroxide forms an alkaline solution which is known as limewater.

(i) Name the compound that can be tested for using limewater, and describe th result of this test.

compound .....

result of test .....

..... [2]

(ii) Suggest a solution which could be used to neutralise a sample of limewater and name one of the products of the reaction.

solution .....

product ..... [2]

8 **(a)** Fig. 8.1 shows an electric kettle.

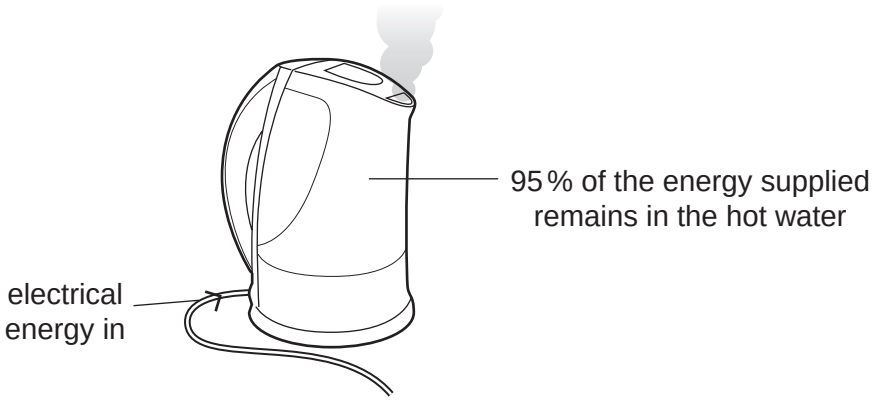


Fig. 8.1

What happens to the rest of the energy supplied?

.....

[1]

(b) The bar chart in Fig. 8.2 shows the electrical power rating of three kettles.

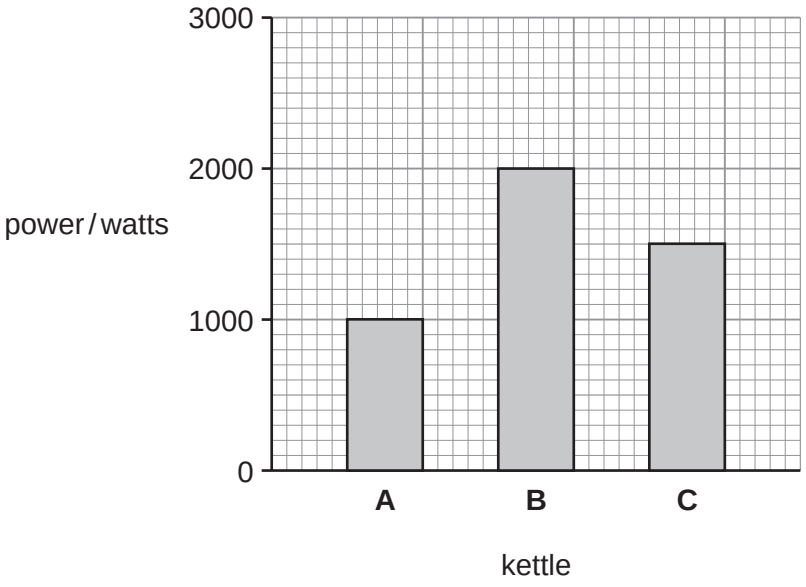


Fig. 8.2

(i) What is the power rating of kettle **C** ?

..... W [1]

(ii) Kettle **A** takes 10 minutes to boil some water.

Predict how long kettle **B** will take to boil the same mass of water.

..... minutes [1]

(c) In a kettle, the liquid water boils and turns into steam, a gas.

Fig. 8.3 shows the arrangement of particles in a solid.

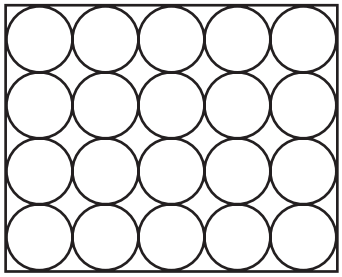
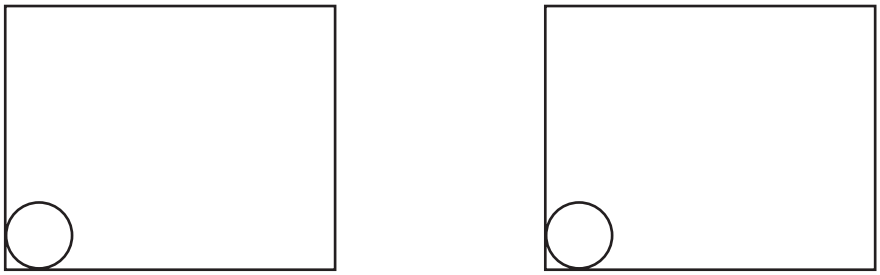


Fig. 8.3

Draw similar diagrams for a liquid and a gas.



liquid gas

[2]

(d) Kettle **A** has a label underneath it. Fig 8.4 shows some of the information on this label.

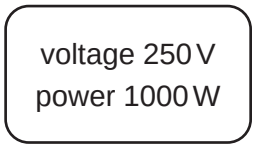


Fig. 8.4

(i) Use the formula

power = voltage x current

to show that the maximum current likely to pass through the kettle is 4 A.

[1]

(ii) A current of 4 A passes through the kettle for two minutes.

Calculate the number of coulombs of charge which pass through the kettle.

State the formula that you use and show your working.

formula used

working

..... C [2]

(iii) In another kettle, the current was 10 A when used with a 250 V supply.

Calculate the resistance of the heating element in the kettle.

State the formula that you use and show your working.

formula used

working

..... Ω [2]

(e) Use the idea of *convection* to explain why a kettle has the heating element at the bottom.

.....

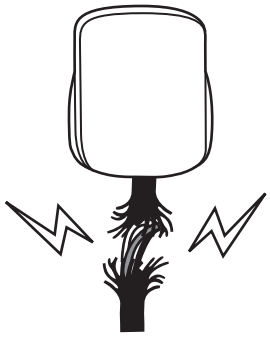
.....

..... [2]

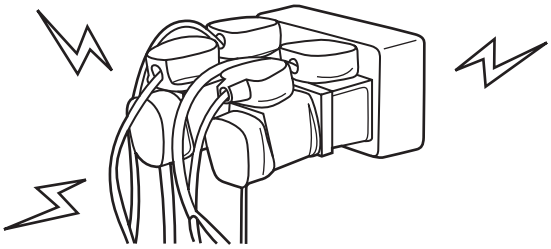
(f) The rules in Fig 8.5 are from an electrical safety manual.

ELECTRICAL SAFETY RULES

1. **Never** use electric cables which have become split or frayed.



2. **Never** overload an electrical socket.



3. **Never** operate electrical appliances with wet hands.

Fig. 8.5

Explain why each of these safety rules is important.

rule 1 .....

.....

.....

rule 2 .....

.....

.....

rule 3 .....

.....

..... [3]

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9 Cichlid fish live in lakes in east Africa. Fig. 9.1 shows a cichlid fish.

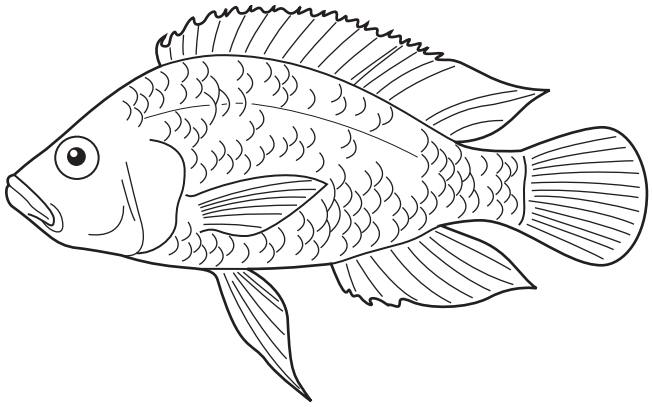


Fig. 9.1

(a) (i) State **two** features, visible on Fig. 9.1, which are characteristic of fish.

1 .....

2 ..... [2]

(ii) State **one** feature, visible on Fig. 9.1, that is shared by fish and reptiles, but not by amphibians and mammals.

..... [1]

(b) Fish reproduce sexually. The female fish lays eggs into the water. The male fish releases sperm onto them. Fertilisation takes place in the water.

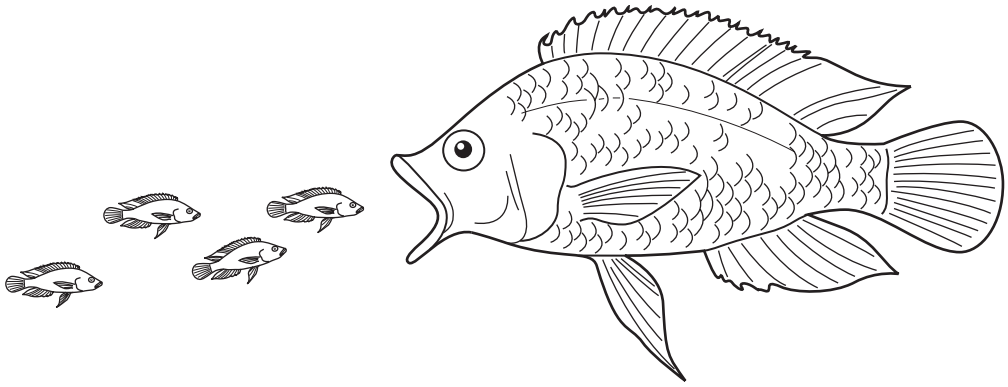
Explain what is meant by *fertilisation*.

.....

.....

..... [2]

(c) When the young hatch from the eggs, the mother cichlid fish takes them into her mouth whenever danger threatens.



Cichlid fish mothers that have been bred and kept in captivity do not do this. The breeders have to take the young away from the mothers, because the mothers eat their young.

Researchers measured the levels of testosterone in two groups of cichlid fish mothers. One group had been bred in captivity, and the other group had recently been caught in the wild.

Fig. 9.2 shows the results.

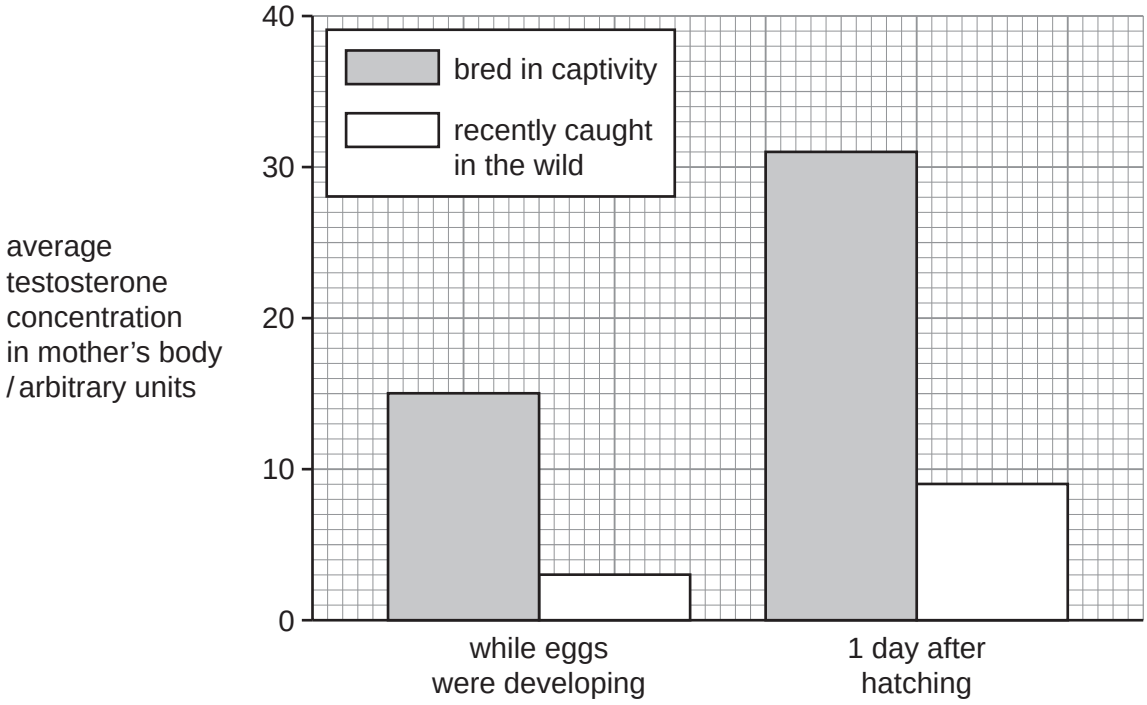


Fig. 9.2

(i) Describe how the testosterone concentrations in the fish bred in captivity d
from the fish caught in the wild.

.....

.....

..... [2]

(ii) These results do **not** prove that high testosterone levels in the mothers bred in captivity caused them to eat their young.

Explain why this statement is correct.

.....

.....

..... [1]

(d) In humans, testosterone is produced in much larger quantities in men than in women.

Name the organ that produces testosterone in men.

..... [1]

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	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 Radius 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.).