



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE
NAME

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COMBINED SCIENCE

5129/21

Paper 2

May/June 2013

2 hours 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.

You may use a soft pencil for any diagrams, graphs or rough working.

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

DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.

You may lose marks if you do not show your working or if you do not use appropriate units.

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

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.

This document consists of **20** printed pages.



- 1 Fig. 1.1 shows a vernier scale and a micrometer scale.

For
Examiner's
Use

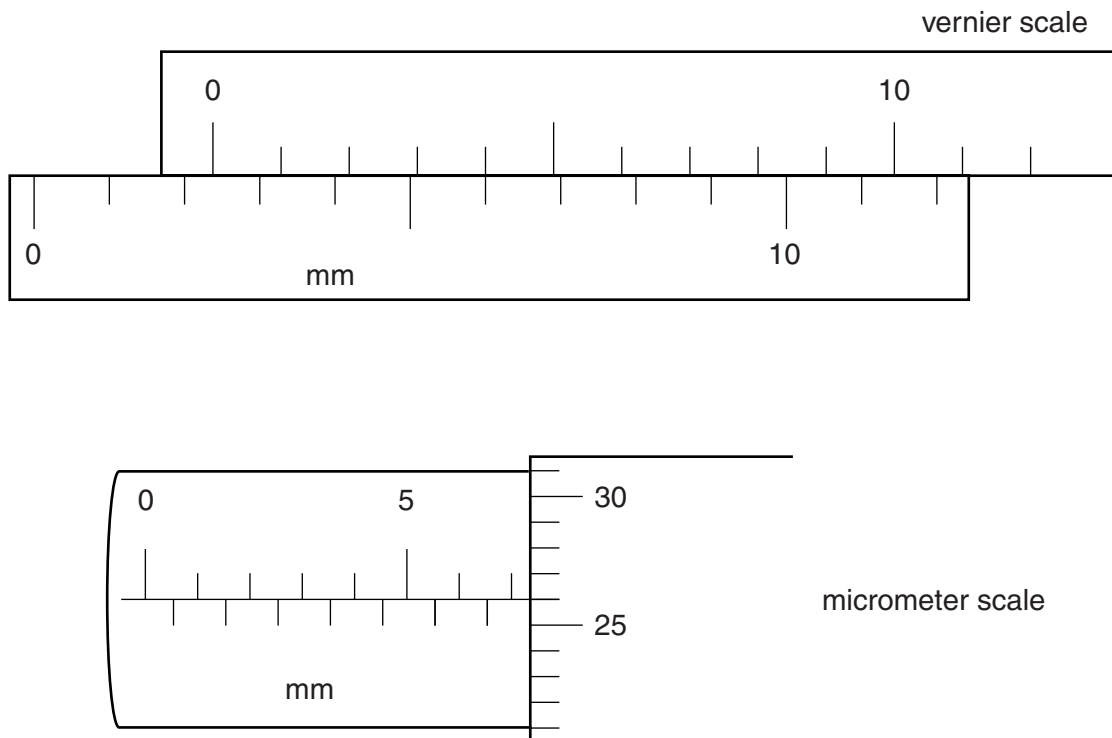


Fig. 1.1

- (a) The reading on the vernier scale ismm. [1]
- (b) The reading on the micrometer scale ismm. [1]

2 Fig. 2.1 shows a section through the eye.

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Use

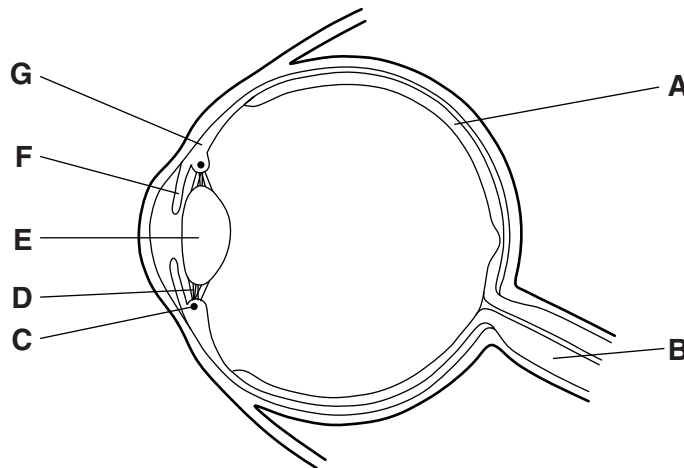


Fig. 2.1

(a) (i) Use letters from Fig. 2.1 to identify

1. the iris,
2. the optic nerve,
3. the suspensory ligaments.

[3]

(ii) State **one** function for each of the following structures.

lens

.....

ciliary muscles

.....

retina

.....

[3]

(b) Fig. 2.2 shows a student's eye in normal conditions.

Fig. 2.3 shows the eye after a particular event.

For
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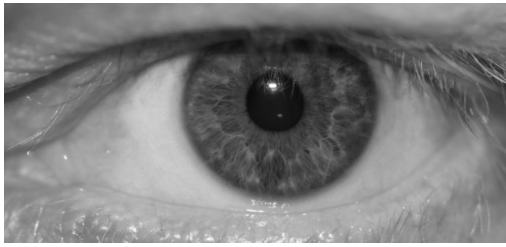


Fig. 2.2

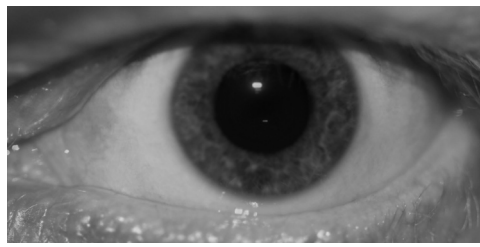


Fig. 2.3

(i) Describe the difference in the appearance of the eye.

.....
 [1]

(ii) Suggest what may cause the change shown between Fig. 2.2 and Fig. 2.3.

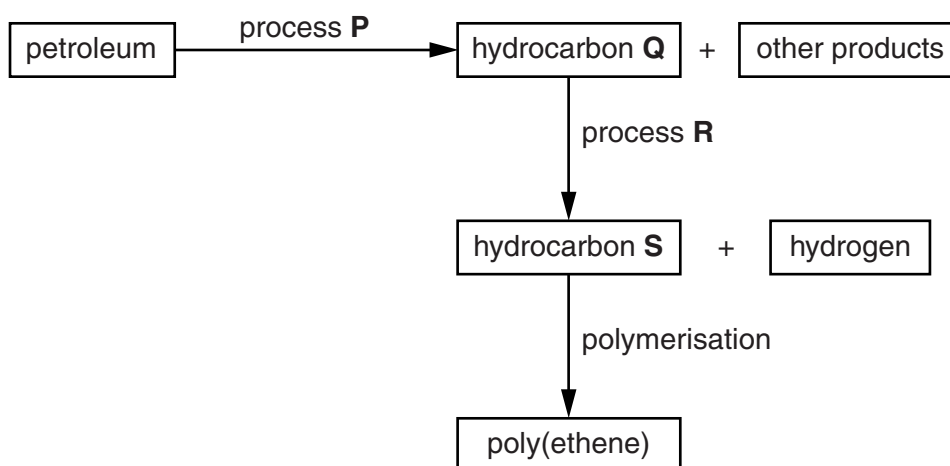
.....
 [1]

(iii) For this change to take place, state which muscles

1. contract,

2. relax.
 [2]

- 3 Fig. 3.1 shows the processes used to manufacture poly(ethene) from petroleum.



For
Examiner's
Use

Fig. 3.1

- (a) (i) Identify processes **P** and **R**.

process **P**

process **R**

[2]

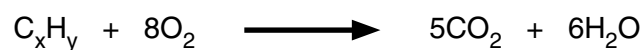
- (ii) Identify the types of hydrocarbon **Q** and **S**.

hydrocarbon **Q**

hydrocarbon **S**

[2]

- (b) The following is a balanced equation for the complete combustion of a hydrocarbon.



Calculate the values of x and y in the formula C_xH_y .

$x =$

$y =$

[2]

- 4 A metre rule is balanced horizontally on a pivot.

A wooden cube is then placed so that its centre is 0.45 m from the pivot.

A stretched spring is attached to the rule at a distance of 0.20 m from the pivot, as shown in Fig. 4.1.

For
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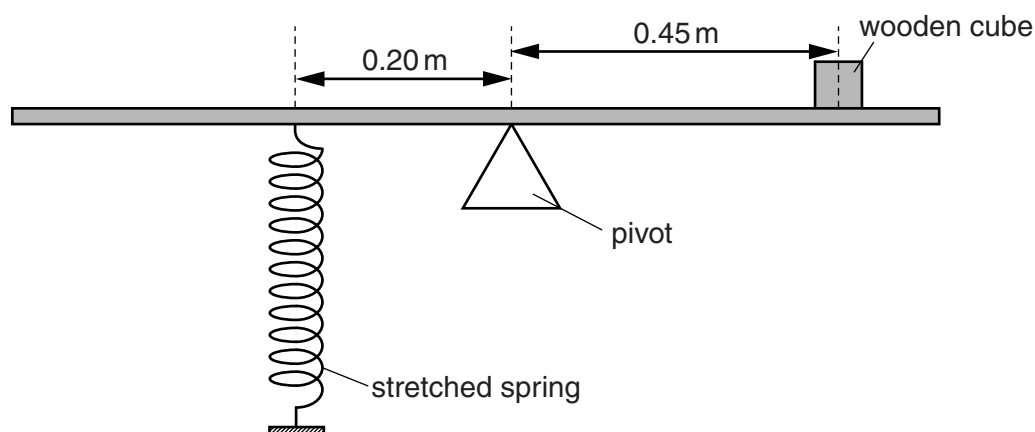


Fig. 4.1

The spring exerts a downward force of 4.5 N on the metre rule to keep it balanced horizontally.

- (a) Calculate the anticlockwise moment of the 4.5 N force about the pivot.

moment = Nm [1]

- (b) Calculate the weight of the wooden cube.

weight = N [2]

- (c) On Earth, the gravitational field strength g is 10 N/kg.

Calculate the mass of the wooden cube.

mass = kg [1]

(d) The extension-load graph for the spring is shown in Fig. 4.2.

For
Examiner's
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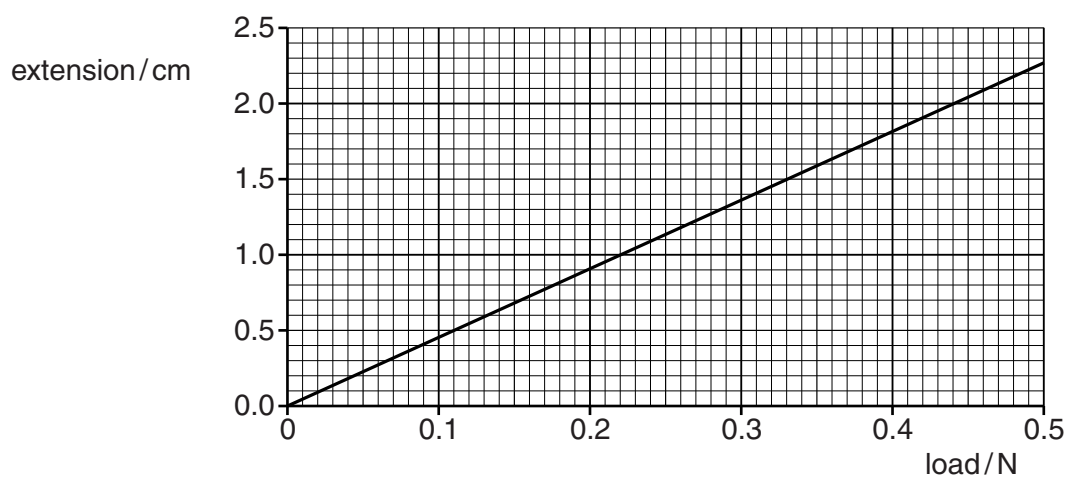


Fig. 4.2

(i) Use Fig. 4.2 to determine the extension of the spring for a load of 0.44N.

extension = cm [1]

(ii) When the load on the spring is zero, the length of the spring is 10.0cm.

Calculate the length of the spring for the load of 0.44N.

length = cm [1]

5 Fig. 5.1 shows the structure of an **ion** of element Z.

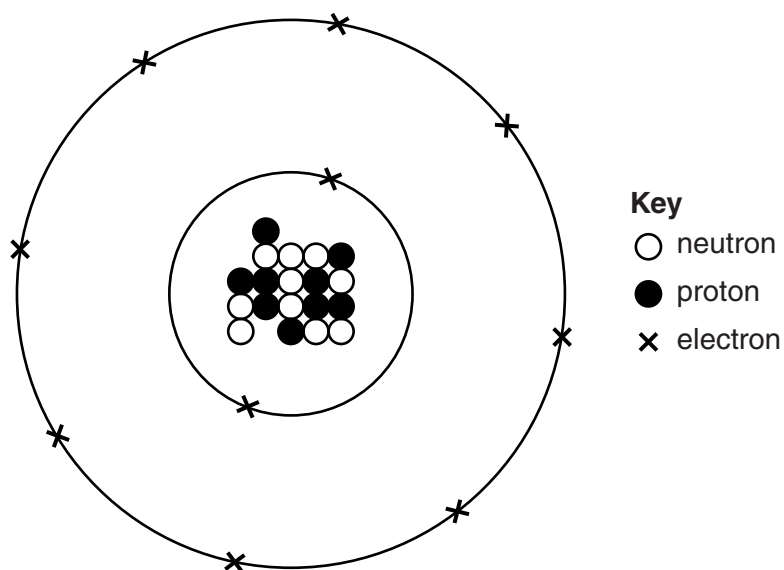


Fig. 5.1

(a) For this ion, state

(i) the nucleon number,

(ii) the proton number.

[2]

(b) (i) State in which group of the Periodic Table element Z is found.

.....

(ii) State the charge on the ion in Fig 5.1.

[2]

For
Examiner's
Use

- 6 In an experiment, a solution of sodium chloride is made by adding dilute hydrochloric acid to aqueous sodium hydroxide.

For
Examiner's
Use

- (a) Complete the following sentences which describe this experiment.

An exact volume of aqueous sodium hydroxide is added to a flask using a

.....

Universal Indicator is added to the solution and the solution turns a

..... colour.

The hydrochloric acid is added to the solution using a

until the solution turns a colour and the volume of the acid

used is noted.

[4]

- (b) The experiment is repeated using exactly the same volumes but without the indicator.

The solution obtained is evaporated to produce solid sodium chloride.

Suggest why the experiment is repeated without the indicator.

.....

..... [1]

- 7 Table 7.1 shows the average number of chloroplasts found in four different types of cell in a leaf.

For
Examiner's
Use

Table 7.1

cell type	average number of chloroplasts per cell
guard cell	4
palisade mesophyll cell	28
spongy mesophyll cell	16
upper epidermal cell	0

- (a) (i) On the axes of Fig. 7.1, draw a bar chart to show the data in Table 7.1.

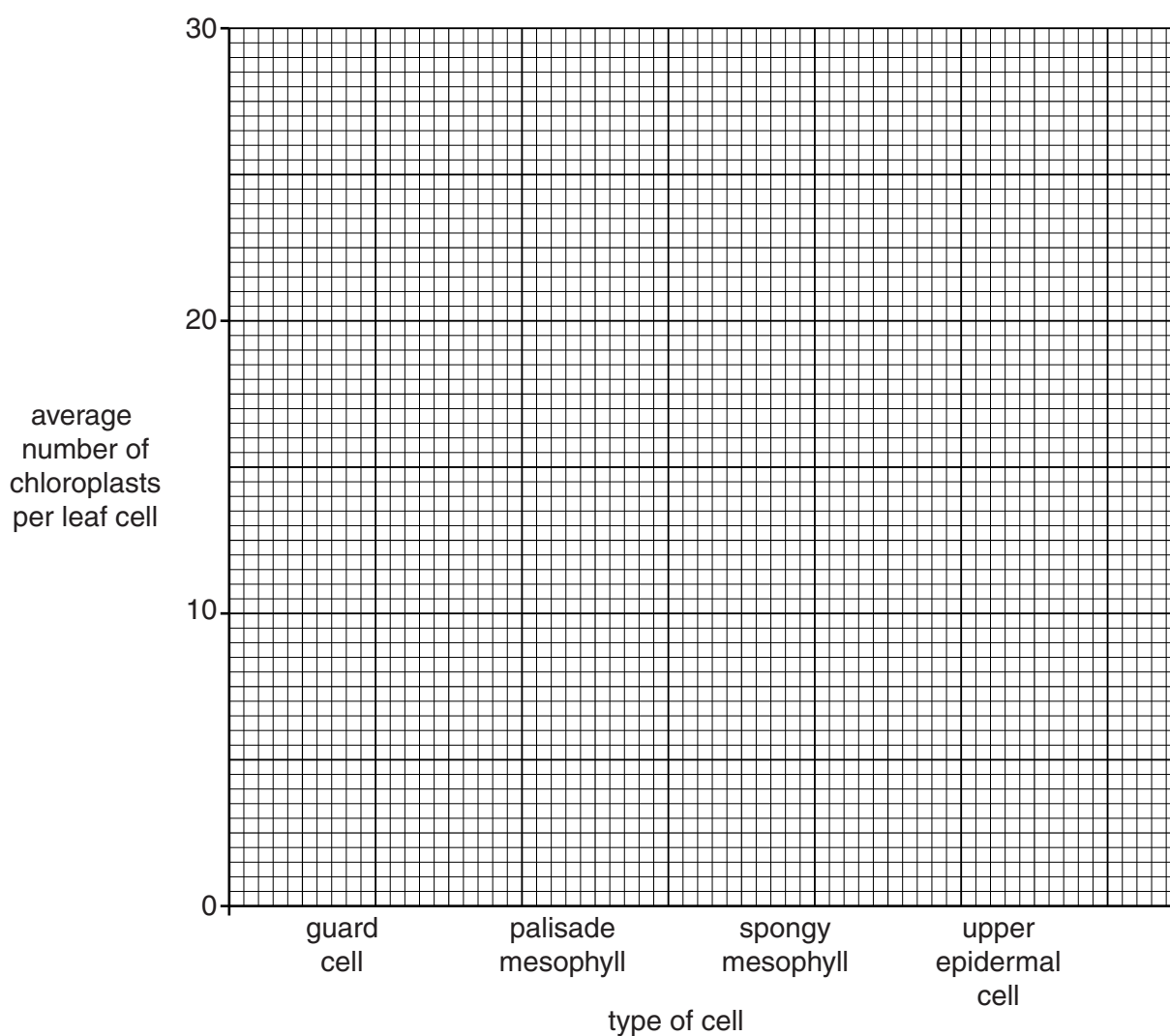


Fig. 7.1

[3]

- (ii) Calculate the number of chloroplasts in a spongy mesophyll cell as a percentage of the number in a palisade mesophyll cell.

For
Examiner's
Use

percentage = [1]

- (b) State and explain which type of cell shown in Table 7.1 forms the most glucose.

type of cell

explanation

.....

.....

.....

[2]

- (c) State and explain why it is important for a young plant to obtain nitrogen-containing ions from the soil.

.....

.....

.....

..... [2]

- 8 An electrical heater is used to warm water in a metal can, as shown in Fig. 8.1.
The heater is placed at the bottom of the can.

For
Examiner's
Use

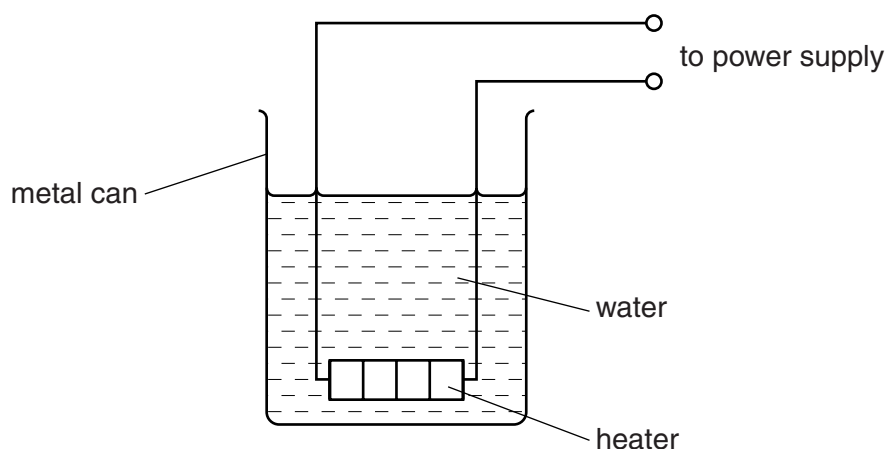


Fig. 8.1

- (a) The 6.5V heater has a power of 13W.

Calculate the current in the heater.

current = A [2]

- (b) The water at the bottom of the can is warmed directly by the heater.

Explain, in detail, how the rest of the water is heated by convection.

.....

 [3]

- (c) State how thermal energy is transferred through the metal of the can.

..... [1]

- (d) When the heater is switched off, the water cools.

The can has a white surface.

Explain why the water cools more quickly if the outside of the can is black.

.....
 [1]

- 9 Fig. 9.1 shows a pin in front of a plane mirror and a ray of light from the pin that is incident on the surface of the mirror.

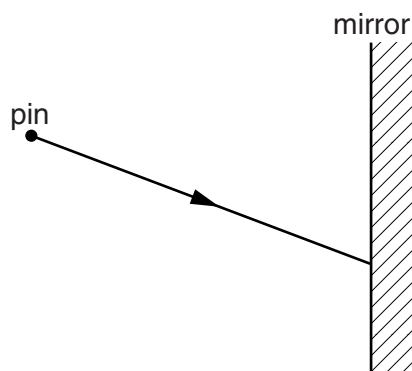


Fig. 9.1

- (a) On Fig. 9.1 draw,
- (i) the normal where the ray is incident on the surface of the mirror, [1]
 - (ii) the reflected ray of light. [1]
- (b) On Fig. 9.1, mark with the letter **X** the position of the image of the pin. [2]

- 10** Ammonia is manufactured by reacting nitrogen and hydrogen together in the presence of a catalyst.

For
Examiner's
Use

- (a) (i)** Name the catalyst and explain why this catalyst is used.

catalyst

explanation

..... [2]

- (ii)** State values for the temperature and the pressure used in this process.

temperature °C

pressure atm [2]

- (b)** State the source of the hydrogen used in the manufacture of ammonia.

..... [1]

- (c)** State one use of ammonia.

..... [1]

- (d)** Ammonia dissolves in water to produce ammonium hydroxide which is an alkaline solution.

Name the ion present in the solution responsible for it being an alkali.

..... [1]

- 11** Use words from the list to complete the sentences below.

cervix

cotyledon

egg cell

ovary

prostate gland

scrotum

seed

testes

uterus

vagina

zygote

Each word may be used once, more than once or not at all.

Sperm are produced in the of the male.

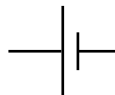
During sexual intercourse sperm are released into the of the female.

At fertilisation the sperm fuses with the and this results in a being formed. [4]

12 A student connects a cell, a resistor, an ammeter and a lamp in series.

He adds a voltmeter to measure the potential difference across the lamp.

(a) In the space below, complete the circuit diagram for the circuit that the student uses.



For
Examiner's
Use

[4]

(b) The ammeter reads 0.30A and the voltmeter reads 1.5V.

(i) Calculate the resistance of the lamp.

resistance = unit [3]

(ii) State the current in the resistor.

.....A [1]

- 13 Calcium carbonate reacts with dilute hydrochloric acid to produce calcium chloride, carbon dioxide and water.

For
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Use

The equation for the reaction is



The relative molecular mass, M_r , of calcium carbonate is 100.

[A_r : Ca, 40; Cl, 35.5; O, 16; C, 12; H, 1]

- (a) Complete the following sentences.

100 g of calcium carbonate producesg of calcium chloride andg of carbon dioxide.

10 g of calcium carbonate producesg of calcium chloride andg of carbon dioxide.

2.5 g of calcium carbonate producesg of calcium chloride. [4]

- (b) State the test for carbon dioxide.

test

result.....

..... [2]

- 14 (a) State two differences in **structure** between arteries and veins

1.

.....

2.

.....

[2]

- (b) State two differences in **function** between arteries and veins.

1.

.....

2.

.....

[2]

15 One isotope of carbon is carbon-14 ($^{14}_6\text{C}$).

(a) State the number of neutrons in a nucleus of carbon-14. [1]

(b) The isotope $^{14}_6\text{C}$ is radioactive and emits beta-particles.

(i) What is a beta-particle? [1]

(ii) State the changes that occur to the number of protons and to the number of neutrons in a nucleus when a beta-particle is emitted.

.....

 [2]

(c) The half-life of a sample of carbon-14 is 5700 years.

A sample of carbon-14 initially emits 10 000 beta-particles per second.

Complete Table 15.1 for this sample of carbon-14.

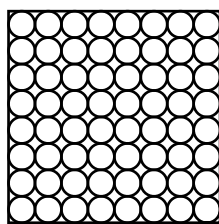
Table 15.1

time / years	number of beta-particles emitted per second
0	10 000
5700	
	2500
17 100	

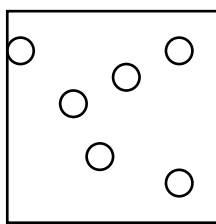
[3]

16 Fig. 16.1 shows representations of elements, compounds and mixtures.

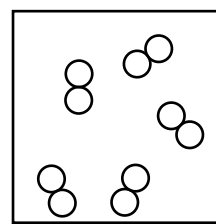
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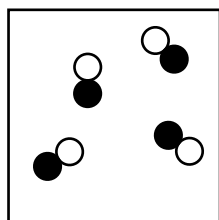
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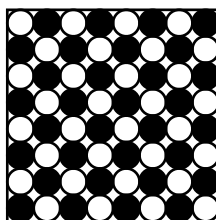
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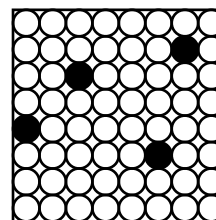
R



S



T



U

Fig. 16.1

In questions (a) to (e), each letter can be used once, more than once, or not at all.

Choose the letter which represents

- (a) an alloy,
- (b) an ionic compound,
- (c) a diatomic element,
- (d) an inert gas,
- (e) a mixture.

[5]

17 Famines occur in some parts of the world.

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(a) Explain what is meant by *famine*.

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

(b) State three problems which contribute to famine.

For each problem, explain how it produces famine conditions.

problem 1

explanation

.....

problem 2

explanation

.....

problem 3

explanation

.....

[6]

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Group													
I	II							III	IV	V	VI	VII	0
		1HHydrogen1											4HeHelium2
7LiLithium3	9BeBeryllium4							11BBoron5	12CCarbon6	14NNitrogen7	16OOxygen8	19FFluorine9	20NeNeon10
23NaSodium11	24MgMagnesium12							27AlAluminium13	28SiSilicon14	31PPhosphorus15	32SSulfur16	35.5ClChlorine17	40ArArgon18
39KPotassium19	40CaCalcium20							70GaGallium31	73GeGermanium32	75AsArsenic33	79SeSelenium34	80BrBromine35	84KrKrypton36
85RbRubidium37	88SrStrontium38	91ZrZirconium40	89YYttrium39	93NbNiobium41	96MoMolybdenum42	98TcTechnetium43	101RuRuthenium44	106PdPalladium46	108AgSilver47	112CdCadmium48	122SbAntimony51	127IIodine53	131XeXenon54
133CsCaesium55	137BaBarium56	178HfHafnium72	139LaLanthanum57	181TaTantalum73	184WTungsten74	186ReRhenium75	190OsOsmium76	195PtPlatinum78	197AuGold79	201HgMercury80	209BiBismuth83	210PoPolonium84	222RnRadon86
223FrFrancium87	226RaRadium88	227AcActinium89											
* 58–71 Lanthanoid series † 90–103 Actinoid series												173YbYtterbium70	175LuLutetium71
												169TmThulium69	260LrLawrencium103
												167ErErbium68	259NoNobelium102
												165HoHolmium67	280LrLawrencium103
												162DyDysprosium66	260LrLawrencium103
												159TbTerbium65	260LrLawrencium103
												157GdGadolinium64	260LrLawrencium103
												152EuEuropium63	260LrLawrencium103
												150SmSamarium62	260LrLawrencium103
												147PmPromethium61	260LrLawrencium103
												144NdNeodymium60	260LrLawrencium103
												141PrPraseodymium59	260LrLawrencium103
												140CeCerium58	260LrLawrencium103
												232ThThorium90	260LrLawrencium103
												231PaProtactinium91	260LrLawrencium103

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