Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

CO-ORDINATED SCIENCES **0654/22**

Paper 2 (Core) **May/June 2016**

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 an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, 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 32.

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 **30** printed pages and **2** blank pages.

CAMBRIDGE International Examinations

1 A student adds dilute hydrochloric acid to four solids.

Fig. 1.1 shows the four experiments **A**, **B**, **C** and **D**.

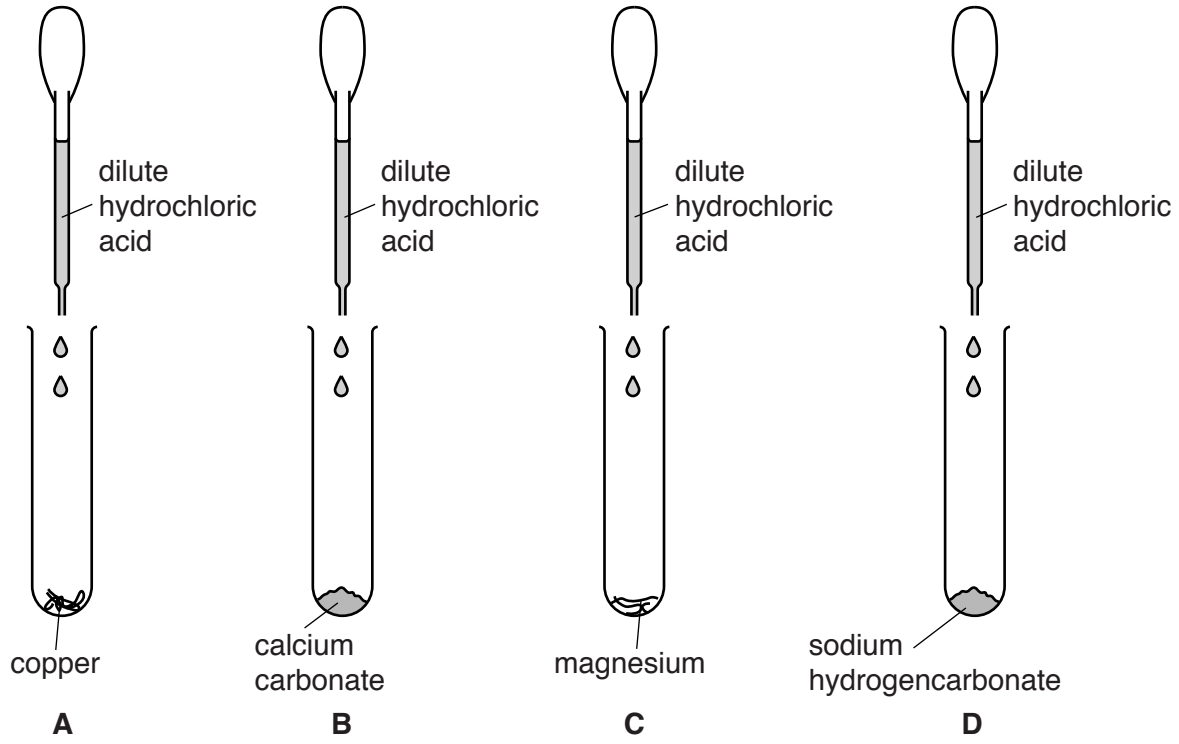


Fig. 1.1

(a) (i) In experiments **B** and **D** the same gas is released.

Name this gas and describe a test for it.

name of gas .....

test .....

.....

[2]

(ii) Name both products of the reaction in experiment **C**.

1 .....

2 .....

[2]

(b) Table 1.1 shows temperature measurements the student makes during his investigation.

Table 1.1

experiment	temperature of substances before mixing / °C	temperature of the mixture after one minute / °C
A	22	22
B	22	24
C	22	45
D	22	15

(i) Give the letter of the experiment that involves an exothermic reaction.

Explain your answer.

reaction .....

explanation .....

.....
[1]

(ii) Explain the results for experiment **A**.

.....

.....

.....[2]

(c) Nitrogen combines with oxygen to form nitrous oxide, N_2O.

Nitrogen combines with magnesium to form magnesium nitride, Mg_3N_2.

Predict the type of chemical bonding in nitrous oxide and magnesium nitride.

In each case give a reason for your answer.

bonding in nitrous oxide .....

reason .....

bonding in magnesium nitride .....

reason .....
[4]

2 **(a)** Plants lose water by evaporation.

(i) Name the part of the plant from which most of this evaporation occurs.

.....[1]

(ii) State the term for the loss of water from a plant by evaporation.

.....[1]

(b) Fig. 2.1 shows the rate of water loss and the rate of water uptake for a plant over a period of one day.

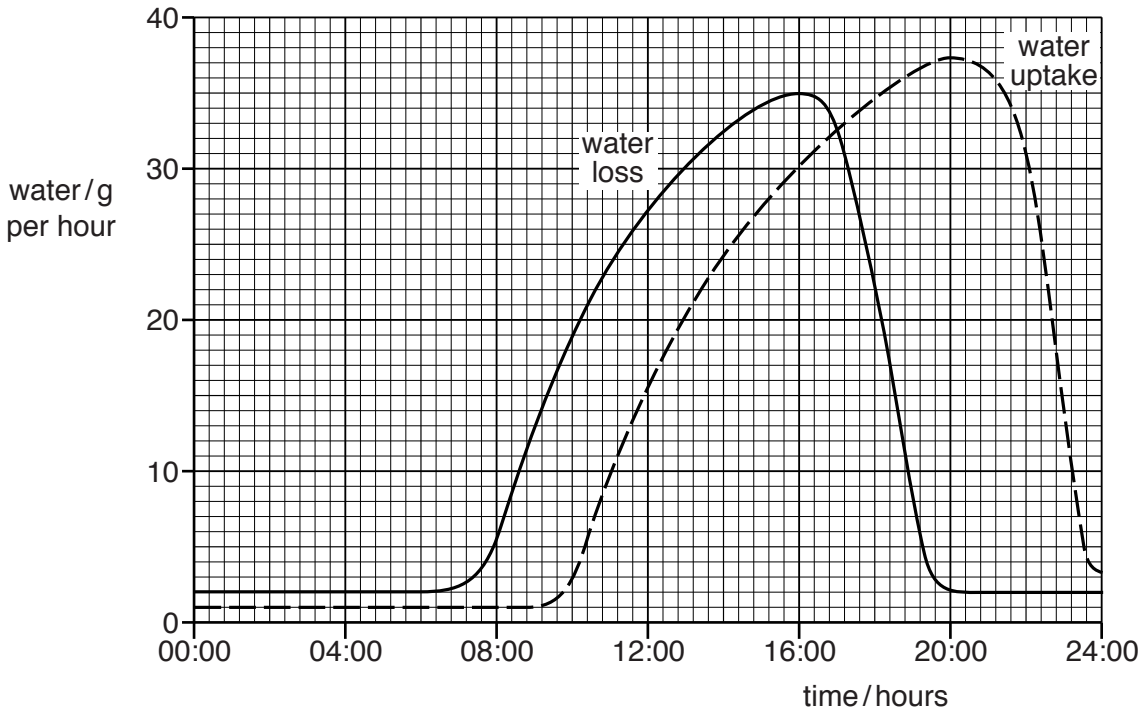


Fig. 2.1

(i) For this day, state

the time at which the rate of water loss is greatest,

.....

a time when the rate of water loss is the same as the rate of water uptake.

.....

[2]

(ii) Describe the relationship between water loss and water uptake that is shown in Fig. 2.1.

.....

.....

.....[2]

(c) State **one** way in which plants use water in

(i) palisade mesophyll cells,

.....[1]

(ii) xylem vessels.

.....[1]

3 Fig. 3.1 shows an aircraft moving with constant acceleration from rest along a runway.

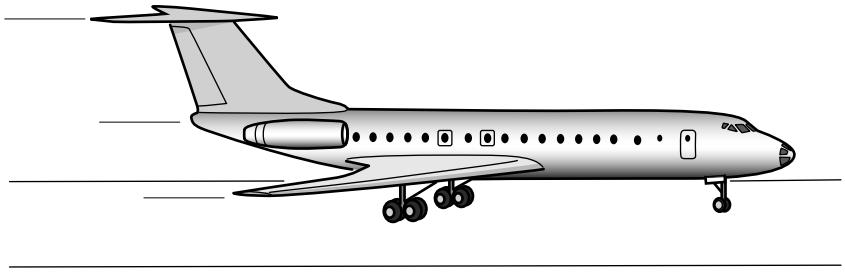
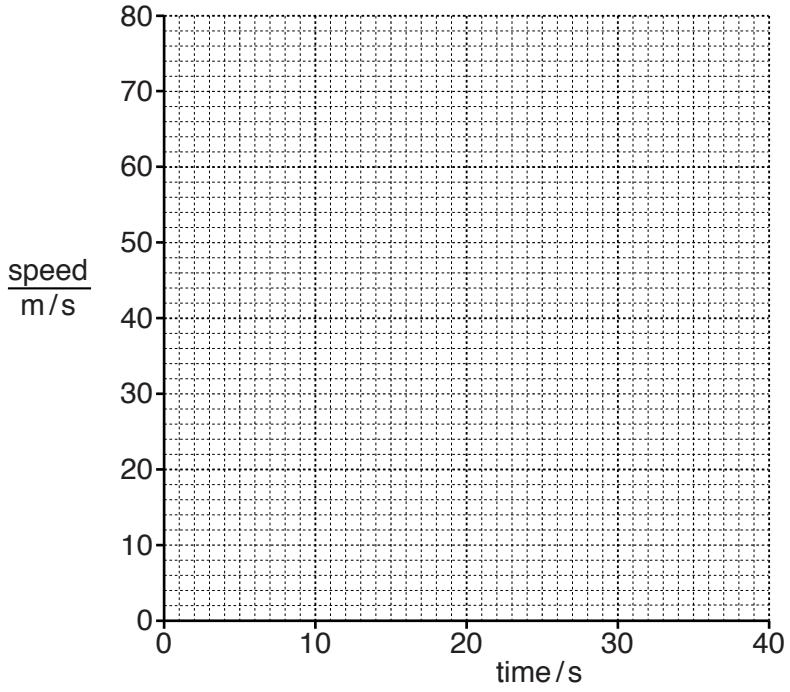


Fig. 3.1

(a) After 30 seconds the aircraft reaches a speed of 60 m/s.

On the grid below draw a speed/time graph to show the motion of the aircraft during this 30 second period.



[2]

(b) (i) Just after taking off, the aircraft continues to accelerate as it gains height.

State the term used to describe the energy gained by the aircraft.

.....[1]

(ii) State the term used to describe the energy contained in the aircraft's fuel.

.....[1]

(c) Fig. 3.2 shows a different aircraft moving at constant speed along the runway.

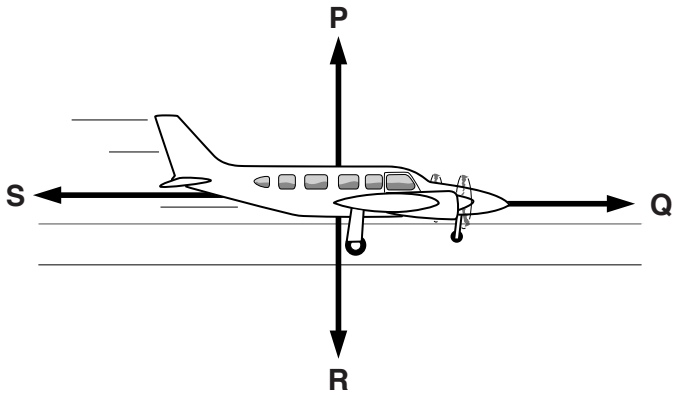


Fig. 3.2

Four forces **P**, **Q**, **R** and **S** are shown.

(i) State which force from **P**, **Q**, **R** and **S** is

the weight of the aircraft, ...

the force exerted by the thrust of the engines. ..... [2]

(ii) Compare the sizes of forces **Q** and **S**.

.....

.....[1]

(d) Fig. 3.3 shows an aircraft being refuelled through a rubber pipe.

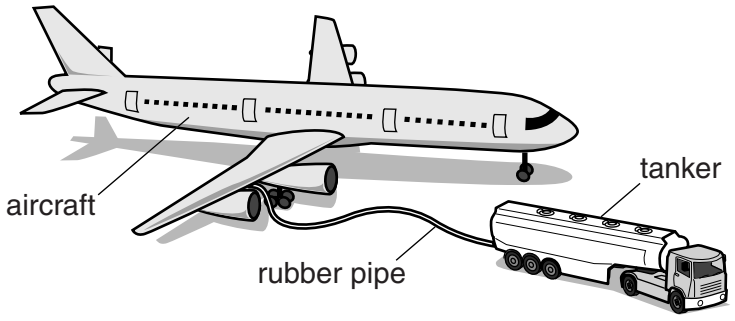


Fig. 3.3

As the fuel flows through the rubber pipe it becomes negatively charged.

Suggest, in terms of electrons, why the fuel becomes negatively charged.

.....

.....[2]

4 Fig. 4.1 shows a hot-air balloon and a helium-filled airship.

The air in the balloon is heated by burning the hydrocarbon gas propane.

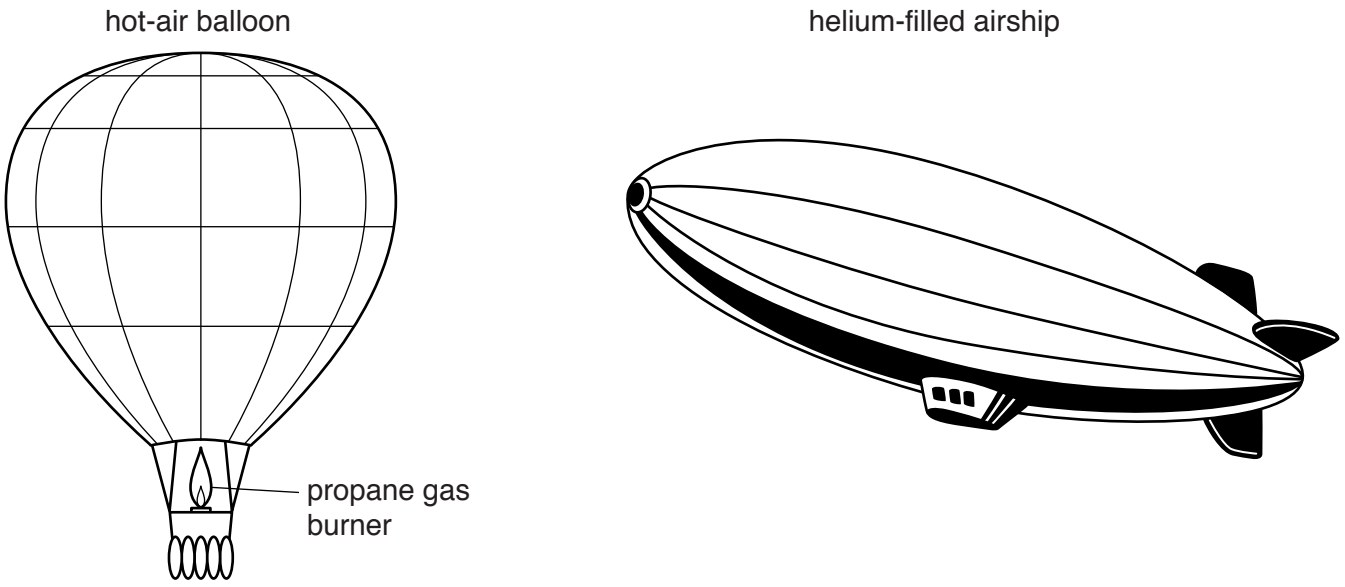


Fig. 4.1

(a) (i) State the percentages of nitrogen and oxygen in unpolluted air.

oxygen ..... %

nitrogen ..... %

[2]

(ii) The composition of the hot gas mixture inside the hot-air balloon is different from that of the air outside.

How is the air different? Explain your answer.

.....

.....

.....[2]

(b) Propane is obtained from a fossil fuel.

(i) Complete the sentences below using words or phrases chosen from the list.

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

catalytic cracking	**compound**	**fractional distillation**	**gas**
liquid	**mixture**	**polymerisation**	**solid**

Propane is obtained from petroleum by the process of

.....

Propane has a chemical formula because it is a

.....

Petroleum does **not** have a chemical formula because it is a

.....

[3]

(ii) Propane is a saturated hydrocarbon.

State the meaning of the term *saturated hydrocarbon.*

.....

.....

.....[2]

(c) Both helium and hydrogen can be used to fill airships.

Give **one** reason why helium is preferred to hydrogen for filling airships designed to transport people.

.....

.....[1]

5 Table 5.1 shows the area of deforestation in four different countries in a five year period.

Table 5.1

country	area of deforestation in five years / km^2
F	28 000
G	9500
H	1500
J	500

(a) For the four countries combined, calculate the average area of deforestation **per year** during this five year period.

average deforestation per year ..... km^2 [2]

(b) A student concluded that deforestation is more of a problem in country **F** than in country **G**. State **two** other pieces of information that are needed to make this comparison.

1 .....

2 .....
[2]

(c) **(i)** Suggest **two** reasons why people might cut down a large number of trees.

1 .....

2 .....
[2]

(ii) State **two** possible harmful effects of cutting down a large number of trees.

1 .....

2 .....
[2]

6 **(a)** Fig. 6.1 shows an incomplete diagram of the electromagnetic spectrum.

radio waves				ultraviolet		gamma radiation

Fig. 6.1

(i) Visible light is part of the electromagnetic spectrum.

On Fig. 6.1 write **visible light** in the correct position. [1]

(ii) State the part of the electromagnetic spectrum shown in Fig. 6.1 which has the highest frequency.

.....[1]

(b) Gamma radiation is emitted from some unstable nuclei. Gamma radiation is ionising.

(i) State what is meant by the term *ionising radiation*.

.....

.....[1]

(ii) State **one** risk to humans of exposure to ionising radiation.

.....[1]

(iii) Alpha radiation is also emitted from some unstable nuclei.

State **two** differences between gamma radiation and alpha radiation.

1 .....

.....

2 .....

.....
[2]

(c) Fig. 6.2 represents a wave.

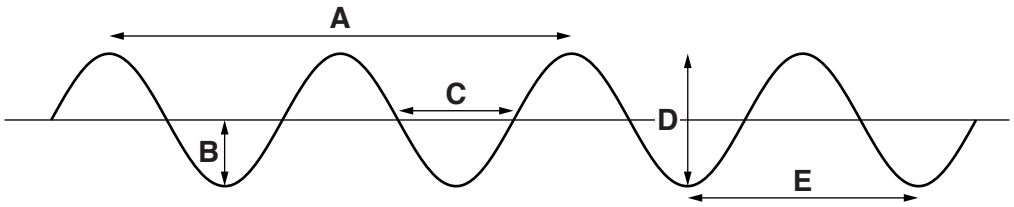


Fig. 6.2

State which measurement **A**, **B**, **C**, **D** or **E** is

(i) the amplitude of the wave, ... [1]

(ii) the wavelength of the wave. ..... [1]

(d) Visible light is able to pass through an optical fibre by total internal reflection.

Fig. 6.3 shows a student's diagram of total internal reflection along an optical fibre. The diagram contains some errors.

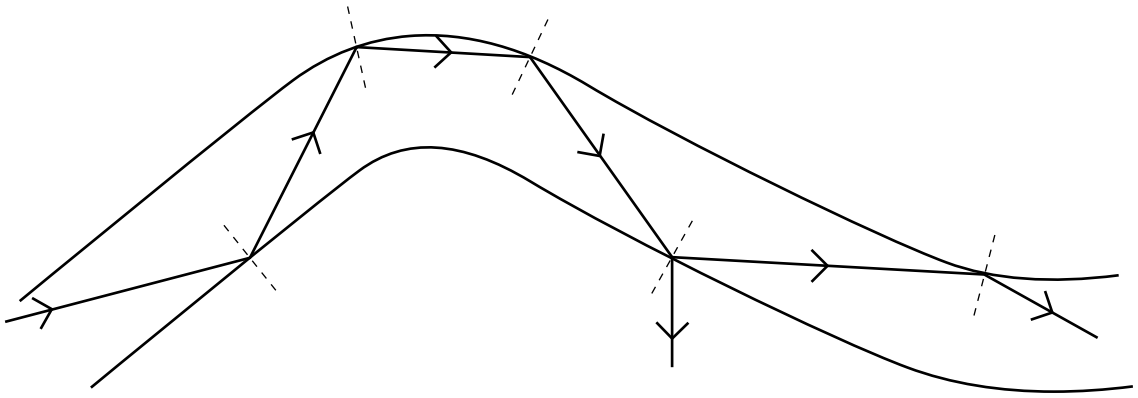


Fig. 6.3

On Fig. 6.3, circle **one** error the student has made in their diagram.

Describe the error you have identified.

.....

.....

.....
[2]

(e) A converging lens is used to produce an image of a candle.

Fig. 6.4 shows the rays of light from the top of the candle passing through the lens and being focussed on the screen.

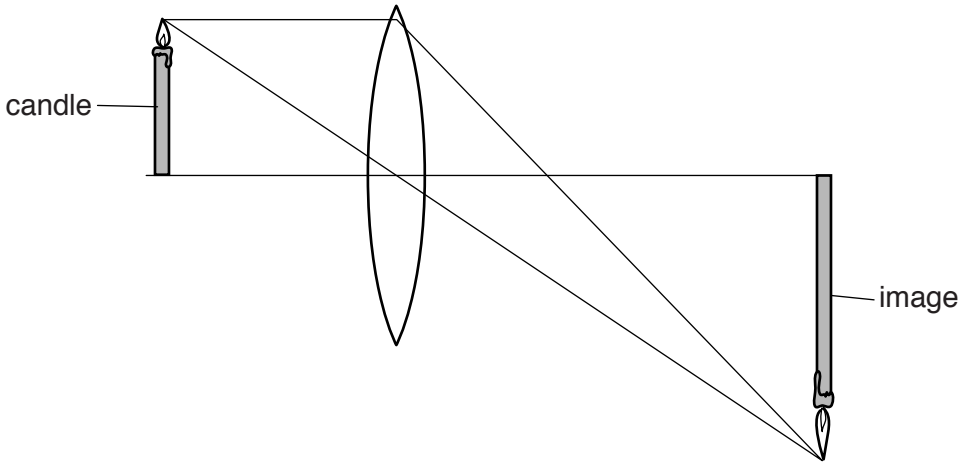


Fig. 6.4 (not to scale)

(i) On Fig. 6.4, label with an **F**, the principal focus of the lens. [1]

(ii) On Fig. 6.4, use a double headed arrow (◄——►) to show the focal length of the lens. [1]

7 **(a)** Define the term *homeostasis*.

.....

.....

.....[2]

(b) Fig. 7.1 shows a cross-section of the skin.

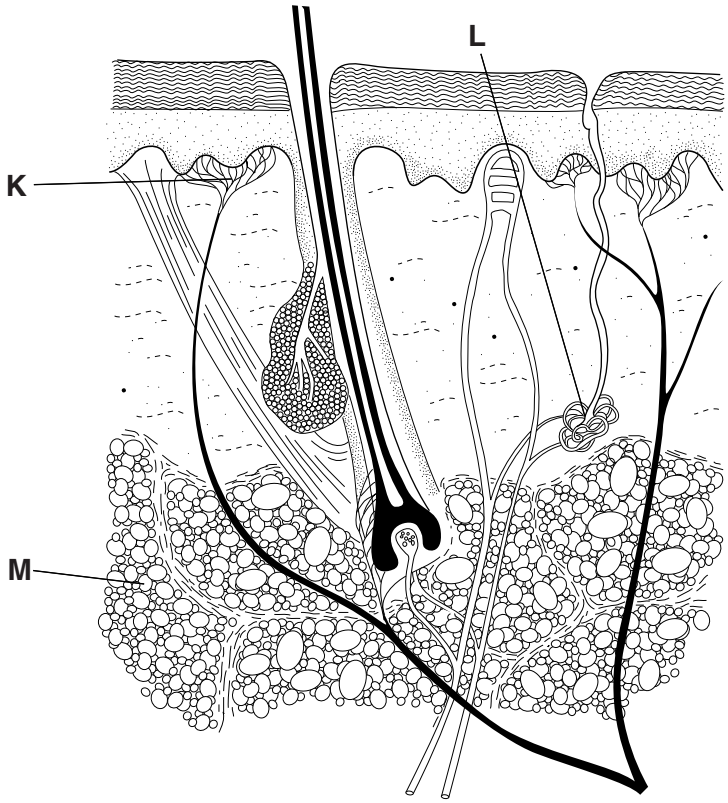


Fig. 7.1

(i) Name the structures labelled **K** and **L**.

K .....

L .....

[2]

(ii) State what type of tissue is found at **M**.

.....[1]

(iii) Use the words in the list to complete the sentences about temperature control.

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

arterioles **capillaries** **insulation** **muscles**

vasoconstriction **vasodilation** **veins**

When a person is too cold, the ..... near the surface of their skin contract. This is called ..... , and it results in reduced blood flow through the ..... near the surface of the skin.

[3]

8 Fig. 8.1 shows a car.

Fig. 8.1

(a) The car travels 70 km in 1.2 hours.

Calculate the average speed of the car in km/h.

State the formula you use and show your working.

formula

working

speed = ... km/h [2]

(b) The car is left outside on a hot, sunny day.

(i) State the method of energy transfer by which energy travels from the Sun to the Earth.

.....[1]

(ii) The air in the tyres of the car also gets hot.

Explain, in terms of particles, why the pressure of the air in the tyres increases as the air gets hot.

.....

.....

.....[2]

(c) On a very cold morning there is ice on the windscreen of the car. The ice disappears as the air temperature increases above the melting point of the ice.

State what is meant by the term *melting point*.

.....

.....[2]

(d) The wheels of some cars are made from an alloy of aluminium. Steel can also be used to make the wheels.

Suggest a simple way for the owner to test whether a wheel from the car is made from aluminium or steel. Explain your answer.

.....

.....[1]

(e) The engine in the car is noisy.

The driver can hear the sound from the engine because the frequency of the sound is within the human audible frequency range.

(i) State the audible frequency range for a normal adult human.

from ..... Hz to ..... Hz [2]

(ii) The driver notices that the sound from the engine is very loud and has a high pitch.

Describe the frequency of this sound. .....

.....[1]

9 **(a)** **(i)** Explain the meaning of the following statements about the element lead.

The proton number of lead is 82.

.....

.....

The nucleon number of a lead atom is 207.

.....

.....
[2]

(ii) Another atom of lead has a nucleon number of 208.

State the term used for atoms of an element that have different nucleon numbers.

..... [1]

(b) Fig. 9.1 shows the apparatus and materials a teacher assembles for the electrolysis of lead bromide.

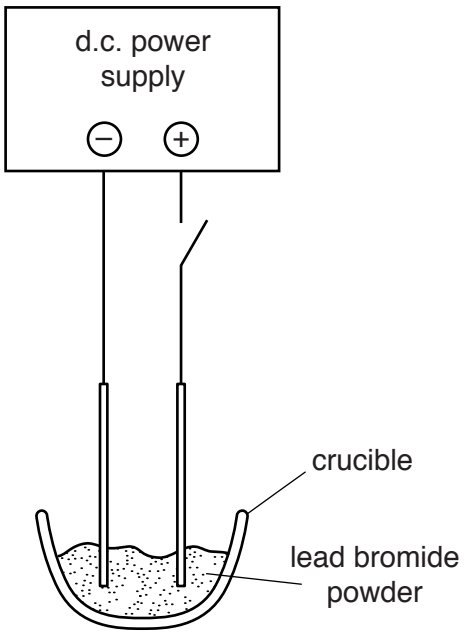


Fig. 9.1

(i) On Fig. 9.1, label the cathode. [1]

(ii) When the teacher closes the switch in his circuit, electrolysis does **not** occur.

Describe what the teacher must do so that the electrolysis does occur.

.....[1]

(iii) Name the gas that would be produced during this electrolysis and state the colour of this gas.

name of gas .....

colour of gas .....

[2]

(c) Fig. 9.2 shows the apparatus and materials used to investigate the reaction between lithium and water.

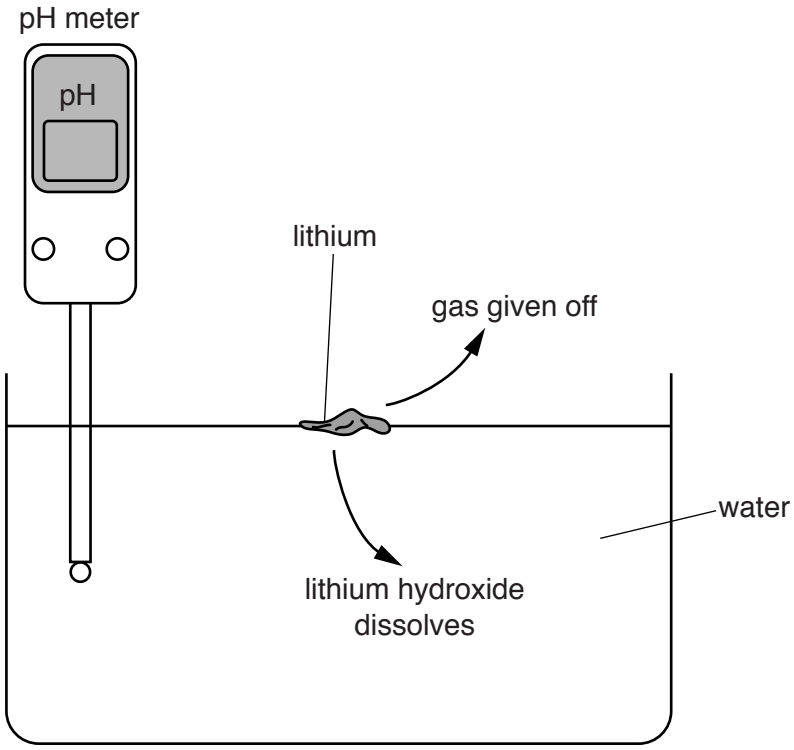


Fig. 9.2

The reaction between lithium and water produces a gas and a solution of lithium hydroxide, LiOH.

(i) Suggest and explain the reading of the pH meter at the end of the reaction.

pH reading .....

explanation .....

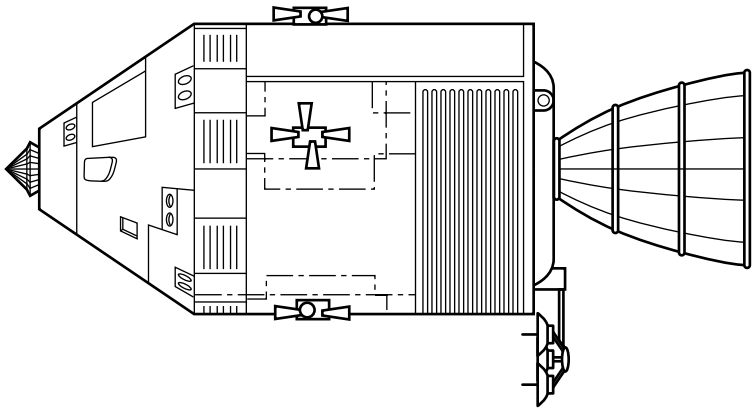
.....

[2]

(ii) Name the gas that is given off during the reaction.

.....[1]

(iii) Lithium hydroxide is used in space vehicles to remove the carbon dioxide produced by the astronauts.



Gaseous carbon dioxide reacts with lithium hydroxide to produce lithium carbonate. Water is also produced in the reaction.

Construct the word equation for this reaction.

..... + ... ⟶ ..... + ...

[1]

Please turn over for Question 10.

10 Cystic fibrosis (CF) is a genetic disorder caused by a recessive allele.

(a) State what is meant by the term *recessive allele*.

.....

.....

.....[2]

(b) Fig. 10.1 shows the inheritance of cystic fibrosis in a family.

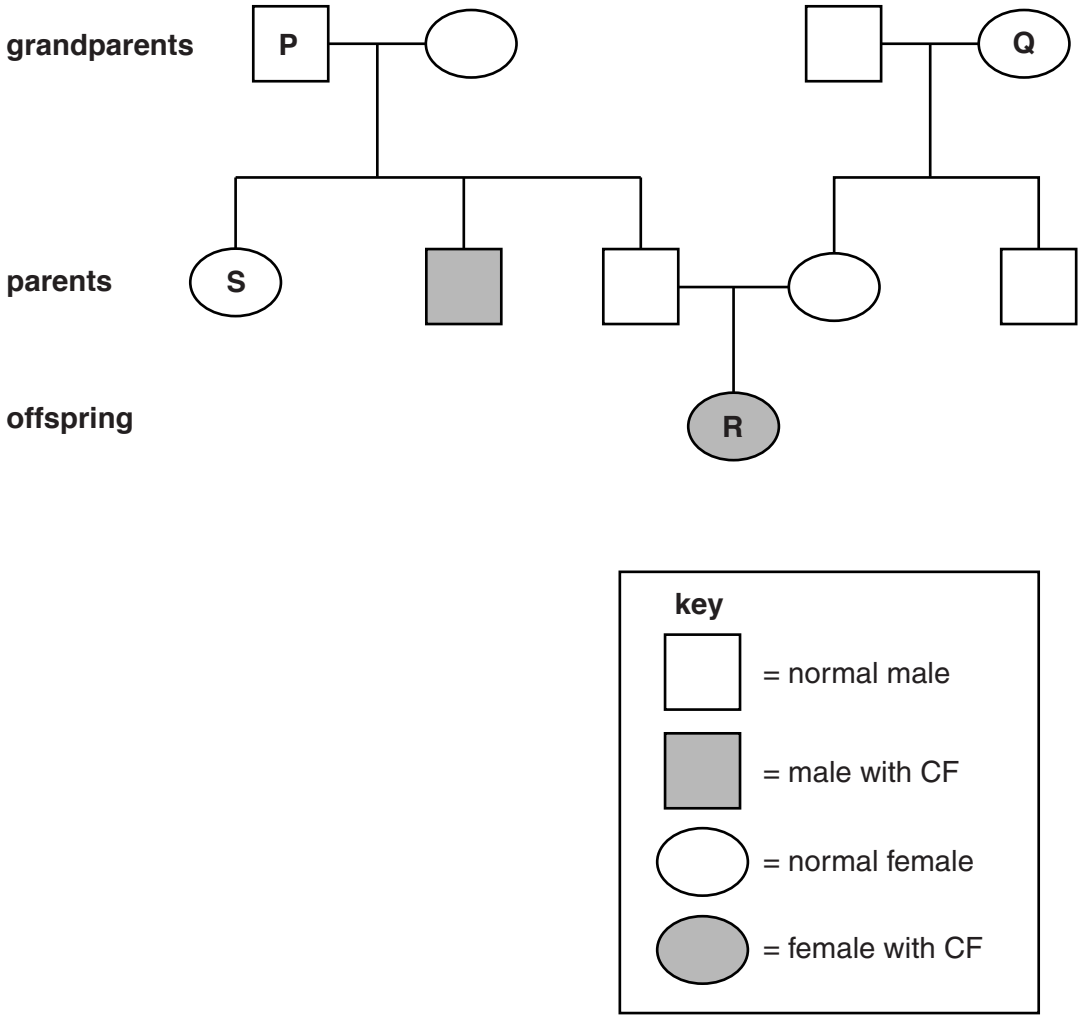


Fig. 10.1

Using the symbols **N** (allele for normal) and **n** (allele for CF), state **all** the possible genotypes of the people labelled **P**, **Q** and **R**.

P .....

Q .....

R .....

[4]

(c) The person labelled **S** has a normal phenotype.

(i) State what is meant by the term *phenotype*.

.....

.....[1]

(ii) Person **S** is heterozygous. Explain what this means.

.....[1]

11 Sulfur is a yellow, crystalline solid that is often found uncombined in the Earth's crust.

(a) Fig. 11.1 shows the arrangement of atoms in sulfur crystals.

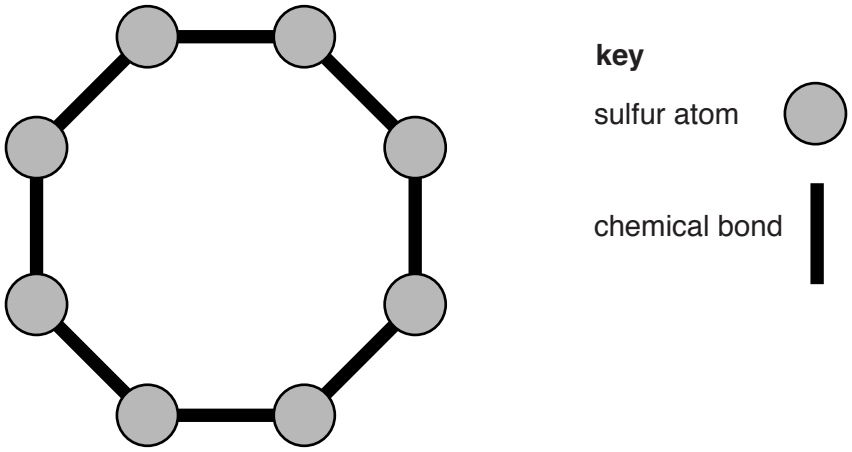


Fig. 11.1

(i) State the word used for a small group of atoms that are chemically bonded.

.....[1]

(ii) State the chemical formula of the structure shown in Fig. 11.1.

.....[1]

(b) Fig. 11.2 shows the apparatus and materials used by a teacher to demonstrate the formation of sulfur dioxide by burning sulfur in air.

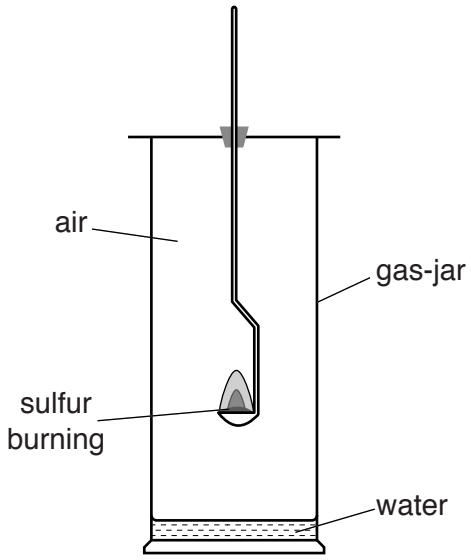


Fig. 11.2

(i) When sulfur burns it is oxidised.

Explain why sulfur is said to be *oxidised* in this reaction.

.....

.....[1]

(ii) Some sulfur dioxide dissolves and reacts with the water in the bottom of the gas-jar to form an aqueous solution.

Predict and explain the colour of full-range indicator (Universal Indicator) when added to this aqueous solution.

colour .....

explanation .....

.....
[2]

(iii) Sulfur compounds occur naturally in petroleum.
These are removed before petroleum products, such as gasoline, are used as fuel.

State and explain, in terms of the effects on the environment, why sulfur compounds are removed from petroleum.

.....

.....

.....

.....

.....[3]

12 A torch contains four cells, a filament lamp and a switch connected in series.

(a) (i) Draw a circuit diagram for the torch using electrical circuit symbols.

[3]

(ii) A voltmeter is used to check the potential difference (voltage) across the lamp.

The symbol for the voltmeter is —(V)—

Using the symbol for a voltmeter, draw the voltmeter connected in the correct position in the circuit you have drawn in **(a)(i)**. [1]

(b) The current in the filament lamp and the potential difference (voltage) across the lamp are measured.

Fig. 12.1 shows the current / potential difference graph for the lamp.

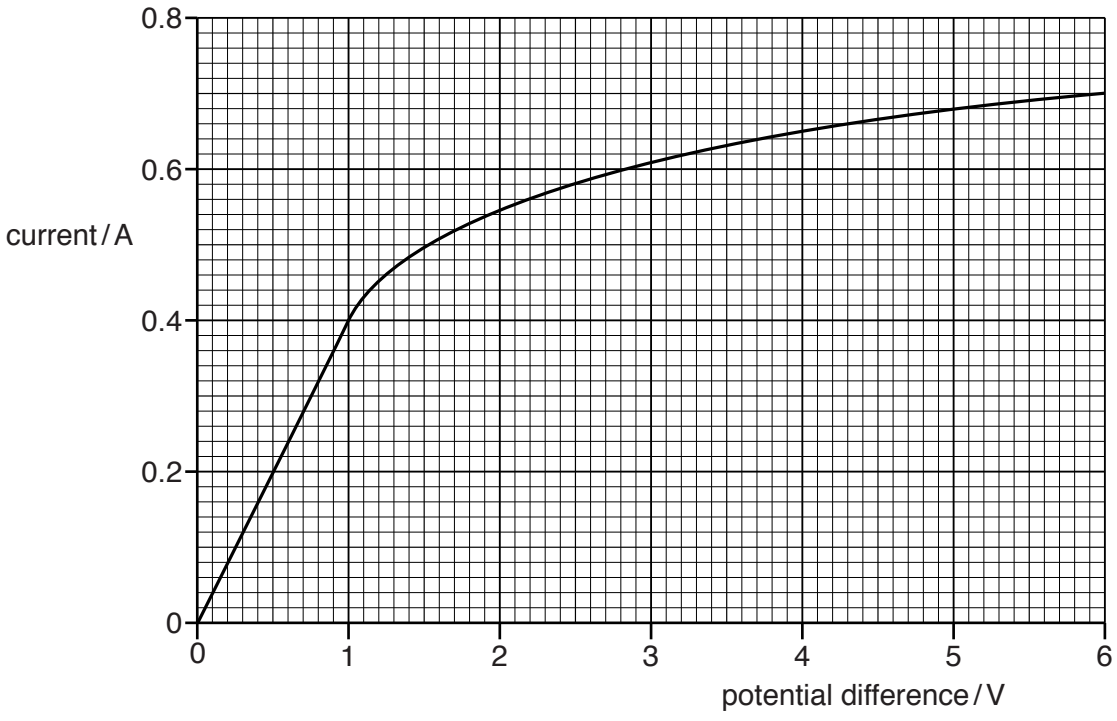


Fig. 12.1

(i) State how the graph in Fig. 12.1 shows that current in the lamp is **not** proportional to the potential difference across the lamp.

.....

.....[1]

(ii) Use the graph in Fig. 12.1 to find the current through the lamp when the potential difference across the lamp is 6 V.

current = ... A [1]

(c) Two lamps, one of resistance 4 Ω and one of resistance 12 Ω, are connected in series.

Calculate the total resistance of these two lamps in series.

State the formula you use and show your working.

formula

working

resistance = ... Ω [2]

13 **(a)** A piece of tissue from a plant root is tested for reducing sugar.

Outline how this test is done and state the result of the test if reducing sugar is present.

.....

.....

.....[3]

(b) Fig. 13.1 shows a root cell from a piece of tissue.

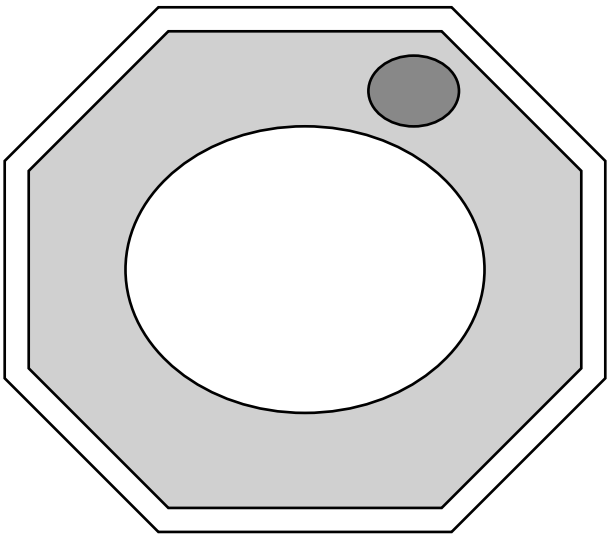


Fig. 13.1

(i) For this root cell, name

a structure that contains chromosomes,

.....

a structure that would **not** be present in an animal cell,

.....

a structure that is **not** present, but which **would** be present in a palisade cell.

.....
[3]

(ii) An animal eats this root. State which structure in the plant cell contributes fibre to the animal's diet.

.....[1]

(iii) State how fibre is important in the diet of the animal.

.....

.....[1]

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The Periodic Table of Elements

Key

atomic number
atomic symbol
name
relative atomic mass

Group																	
I	II											III	IV	V	VI	VII	VIII
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

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