Centre Number	Candidate Number	Candidate Name

NAMIBIA SENIOR SECONDARY CERTIFICATE

PHYSICAL SCIENCE ORDINARY LEVEL

4323/3

PAPER 3

1 hour 30 minutes

Marks 60

2020

Additional materials: Non-programmable calculator
Ruler

INSTRUCTIONS AND INFORMATION TO CANDIDATES

- Candidates answer on the Question Paper in the spaces provided.
- Write your Centre Number, Candidate Number and Name in the spaces at the top of this page.
- Write in dark blue or black pen.
- You may use a soft pencil for any diagrams, graphs or rough working.
- Do not use correction fluid.
- Do not write in the margin *For Examiner's Use*.

- Answer **all** questions.

- The number of marks is given in brackets [ ] at the end of each question or part question.
- You may use a non-programmable calculator.

- Take the weight of 1 kg to be 10 N (i.e. acceleration of free fall g = 10 m/s^2).
- The Periodic Table is printed on page 15.
- Chemistry practical notes are printed on page 16.

For Examiner's Use	
1	
2	
3	
4	
5	
TOTAL	
Marker	
Checker	

This document consists of **16** printed pages.

Republic of Namibia

MINISTRY OF EDUCATION, ARTS AND CULTURE

1 Students carried out two experiments.

(a) In experiment **1**, they investigated the factors which affect the speed at which a ball falls through the air. They used three balls with different sizes as shown in Fig. 1.1.

Fig. 1.1

They set up the experiment as shown in Fig. 1.2.

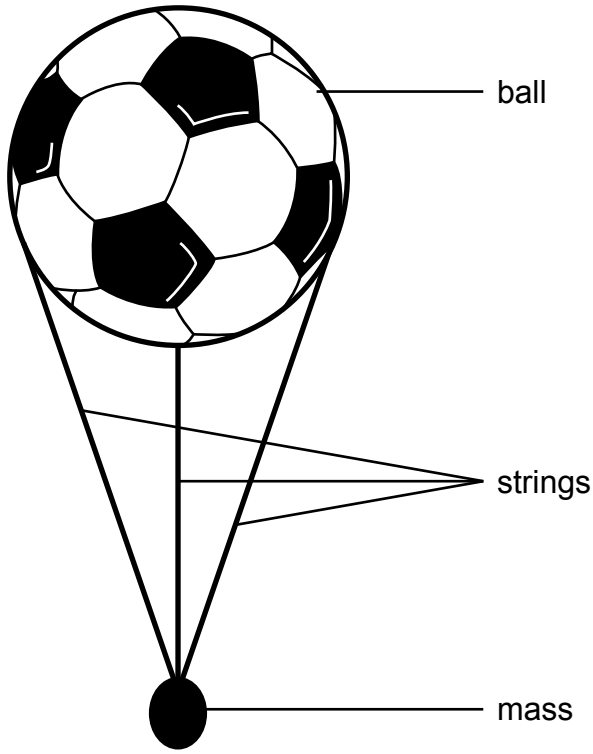


Fig. 1.2

They measured the time taken for each ball to reach the ground when dropped and recorded them in Table 1.1. They dropped the balls from heights of 3 m, 5 m and 7 m.

Table 1.1

height of drop / m	time for size 3 ball / s	time for size 4 ball / s	time for size 5 ball / s
3	1.5	9.0	16.0
5	3.0	8.0	32.0
7			

(i) The times, in seconds, for the 7 m drops are shown on the stop clocks in Fig. 1.3.

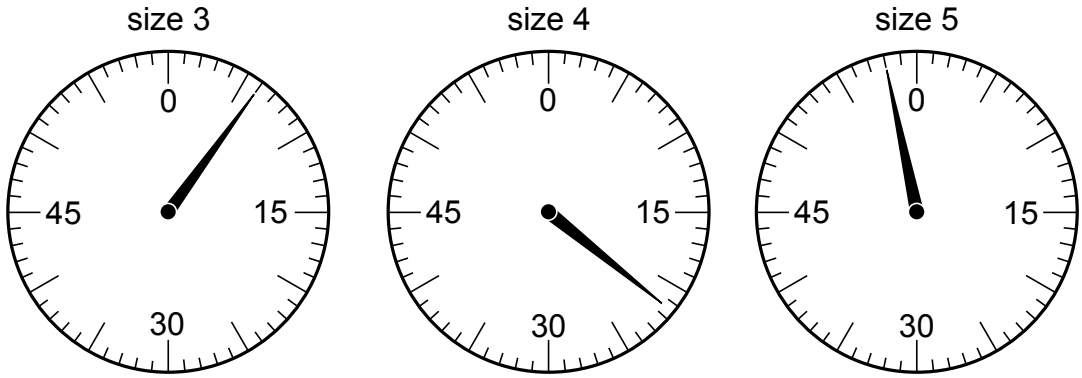


Fig. 1.3

Record the stop clock readings in Table 1.1. [3]

(ii) The students think that they may have recorded one of their results wrongly.

Which result is wrong?

..... [1]

(iii) Using the results in Table 1.1, state how the size of the ball affects the time it takes to reach the ground.

.....

..... [1]

(iv) Calculate the average speed of the size 3 ball when it is dropped from 5 m. State the unit.

Speed = ...unit ..... [2]

(v) Suggest how the students could improve the accuracy of their results.

.....

..... [1]

(b) In experiment **2**, students want to find out how high they can kick a size 4 ball.

While student **A** kicks the ball as high as he can into the air, student **B** uses a stop clock. He starts the stop clock when the ball is kicked and stops it when the ball hits the ground, t, seconds later. Student **B** then kicks the ball and student **A** uses the stop clock.

They recorded time, t, for each student in Table 1.2.

Table 1.2

student	**A**	**B**
Time t/s	5.0	6.0
Time, $\frac{t}{2}$ to fall from maximum height to the ground/s		

Complete Table 1.2. [1]

(c) Fig. 1.4 shows how the speed of the ball changes as it falls from the maximum height to the ground.

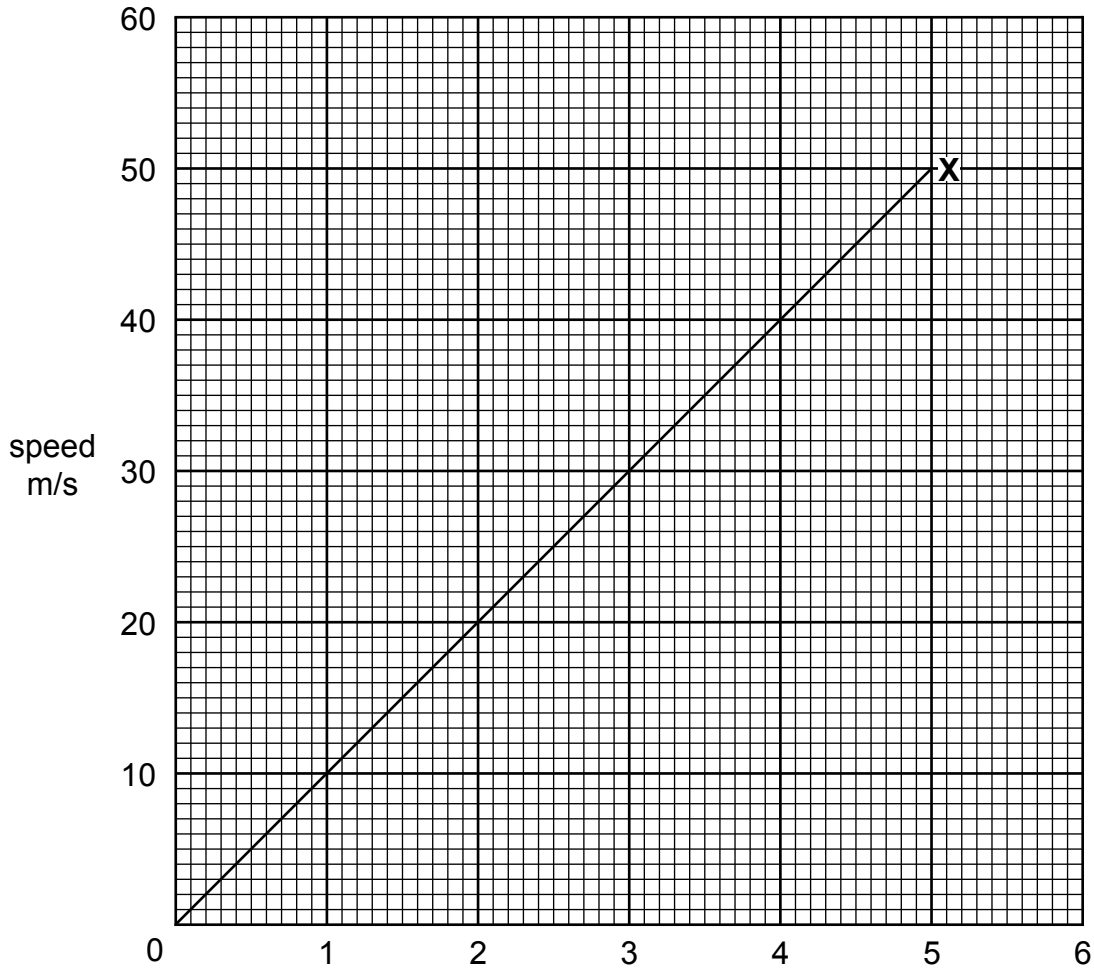


Fig. 1.4

(i) On Fig. 1.4, draw a vertical line for the time of fall of student **A**'s ball so that it meets the line **0X**. [1]

(ii) Find the distance travelled by student **A**'s ball by calculating the area enclosed under the graph.

This is equal to the maximum height of student **A**'s ball.

maximum height of student **A**'s ball = ... m [2]

(iii) Use Fig. 1.4 to determine the value for acceleration due gravity, g. State the unit.

g = ……..... unit …… [2]

[14]

2 A student investigates the reaction of four metal powders with 100 cm^3 dilute hydrochloric acid. The student measures the time taken to collect 100 cm^3 of hydrogen for each metal.

Table 2.1 shows the results of her investigation.

Table 2.1

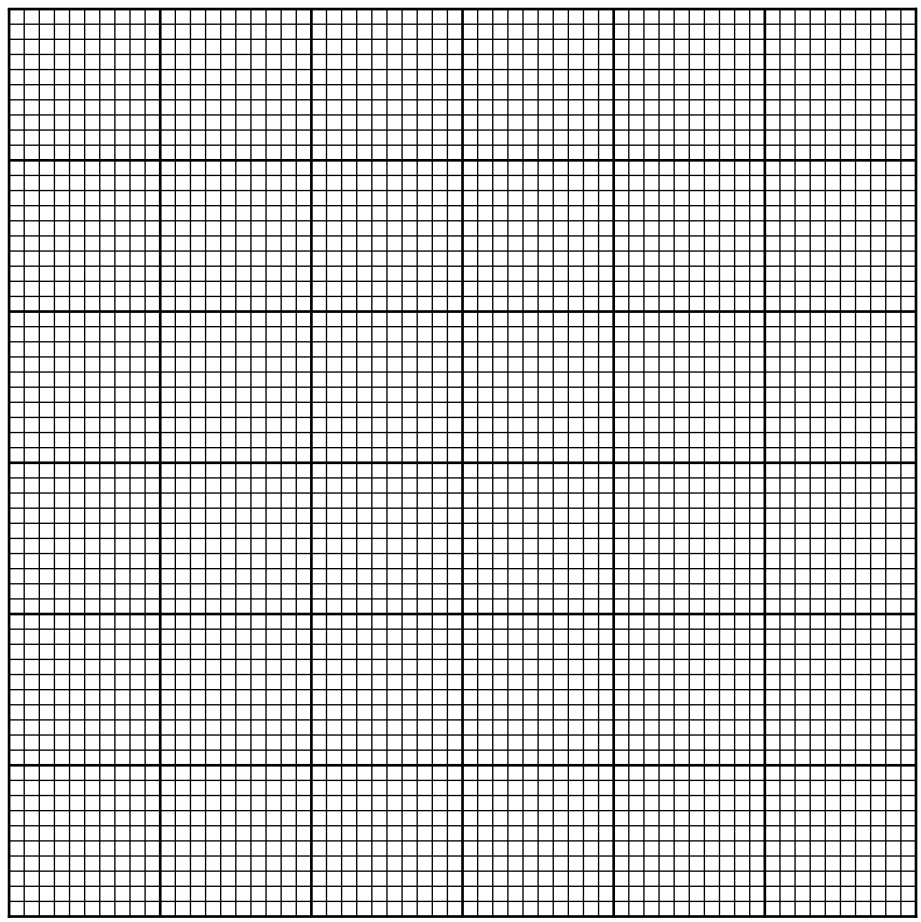
	metal powder			
	magnesium	**iron**	**calcium**	**zinc**
Time to collect 100 cm^3 of hydrogen in seconds	12		7	

The times taken to collect 100 cm^3 of hydrogen for iron and zinc are shown in Fig. 2.1.

Fig. 2.1

(a) (i) Record the times for iron and zinc in Table 2.1. [2]

(ii) Plot a bar graph on Fig. 2.2 of the time taken to collect 100 cm^3 of hydrogen for each metal.



[3]

Fig. 2.2

(iii) Place the four metals in order of reactivity, from the least reactive to the most reactive.

Least reactive.....

.....

.....

Most reactive..... [2]

(iv) The student repeats the experiment using copper powder.

Predict what the student will observe.

.....

..... [1]

(v) The student then does the experiment with magnesium ribbon instead of magnesium powder. The same mass of magnesium is used.

Predict what the student will observe.

.....

..... [1]

(b) Draw a labelled diagram of suitable apparatus to collect 100 cm^3 of hydrogen gas.

[3]

[12]

3 The solubility of a substance is the maximum mass that will dissolve in 100 g of water, forming a saturated solution. Solubility depends upon temperature.

Fig. 3.1 contains a solubility curve of substance **X**. This shows how the solubility of substance **X** changes with temperature.

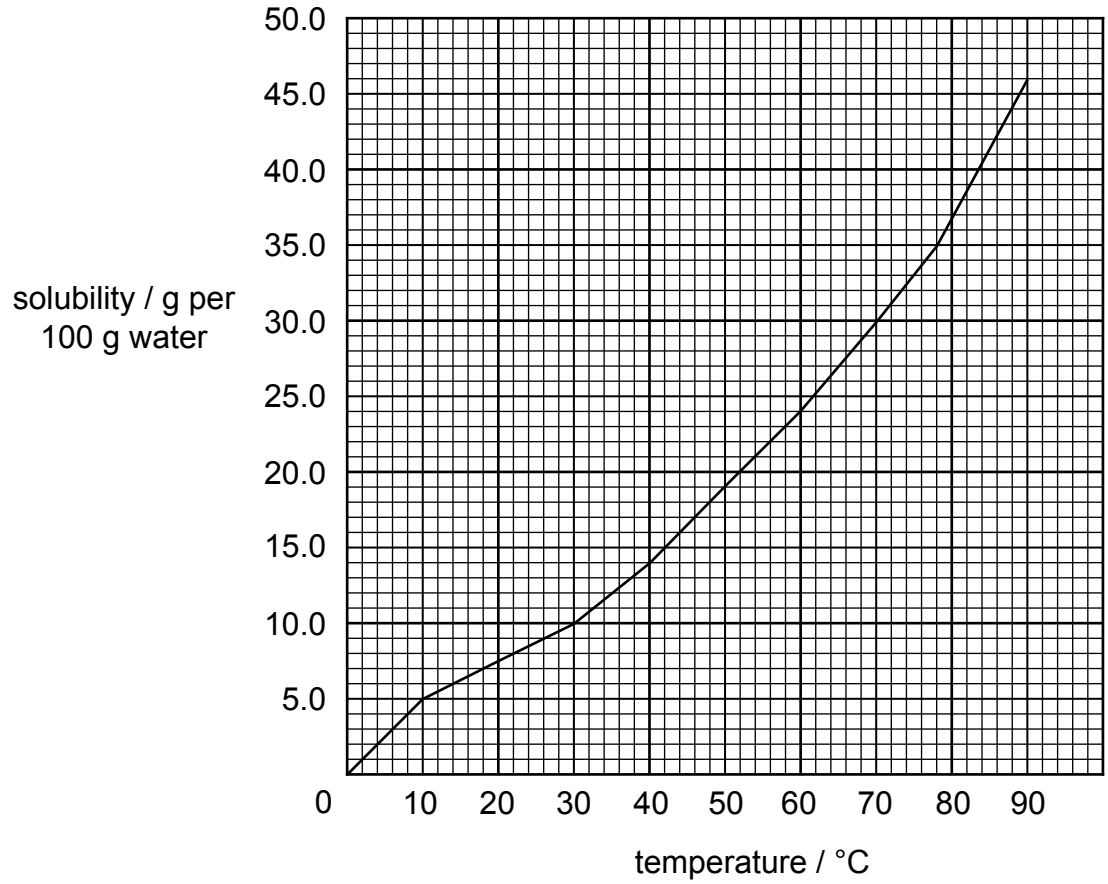


Fig. 3.1

(a) Table 3.1 shows the solubility of substance **Y** at various temperatures.

Table 3.1

solubility of Y/g per 100 g of water	34.0	34.8	35.6	36.0	37.9	38.4	40.9	42.1
temperature / °C	0	10	20	30	50	60	80	90

(i) Plot on Fig. 3.1 a solubility curve for substance **Y**. [2]

(ii) At what temperature are the solubilities of substances **X** and **Y** the same?

..... [1]

(iii) Use your graph to find the temperature at which substance **Y** has a solubility of 37 g per 100 g of water.

..... [1]

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(b) Equal volumes of saturated solutions of **X** and **Y** are cooled from 80°C to 40°C.

State whether solution **Y** will deposit a **larger**, **equal** or **smaller** mass of crystals than solution **X**. Give a reason for your answer.

.....

..... [2]

[6]

4 A student wishes to investigate how the resistance of a nichrome wire varies with the length of the wire.

Fig. 4.1 shows a set of apparatus he would need to use for his investigation.

Switch

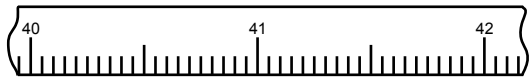
Nichrome wire

Cells

Connectors

Ammeter

Voltmeter



Metre ruler

Fig. 4.1

- He sets up the apparatus for the investigation.
- He writes down the readings of the ammeter and voltmeter in Table 4.1.
- He increases the length of the wire and then reads the ammeter and the voltmeter again, repeating this several times.

Table 4.1

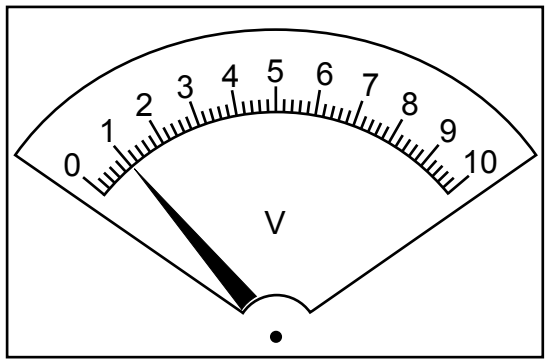
length/cm	voltage/V	current/A	resistance/Ω
10	0.5	0.20	2.5
20			
30	1.5	0.23	6.5
40			
50	2.5	0.22	11.4
60	3.0	0.21	14.3
70			
80	4.0	0.23	17.4
90	4.5	0.23	19.6

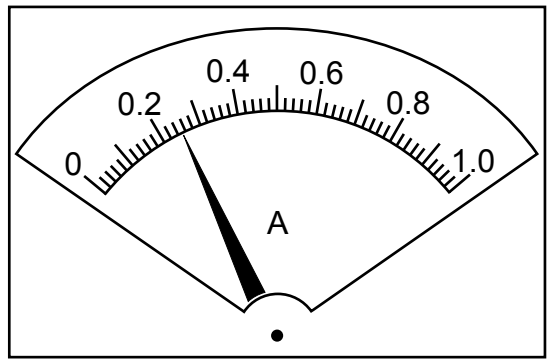
(a) In the space below, draw a circuit diagram using standard circuit symbols to demonstrate how he carried out the investigation.

[5]

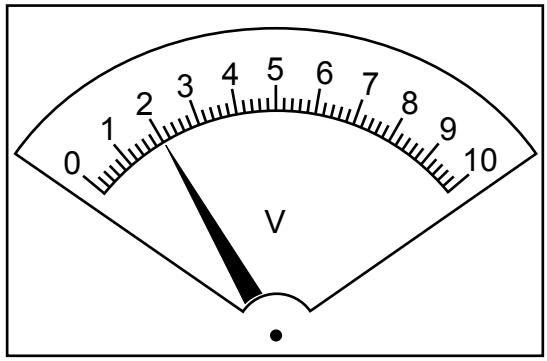
(b) Fig. 4.2 shows the voltmeter and ammeter for the 20 cm, 40 cm and 70 cm lengths.

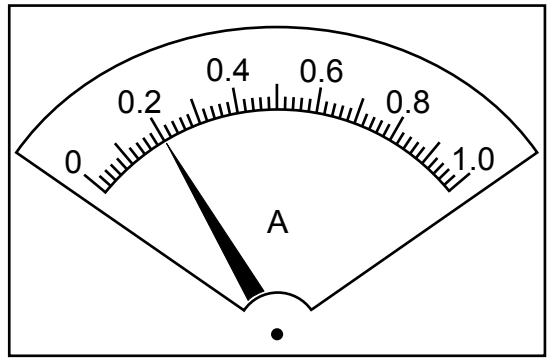
(i) Read the voltmeters and ammeters and complete Table 4.1. [3]



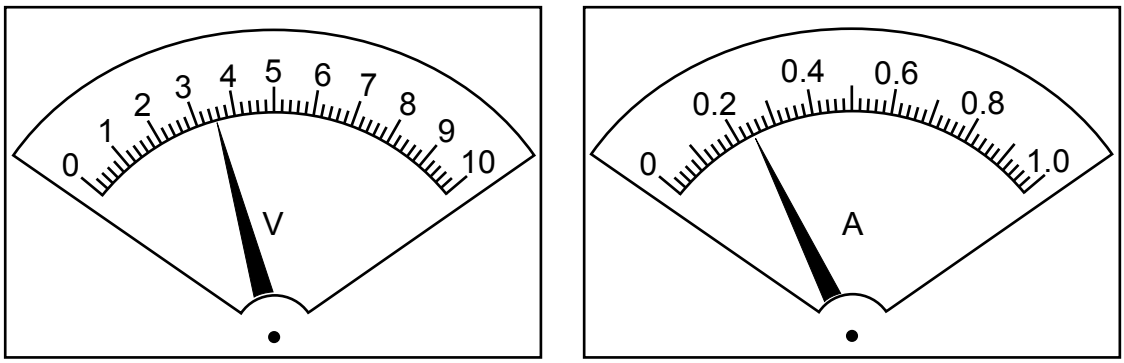


20 cm





40 cm



70 cm

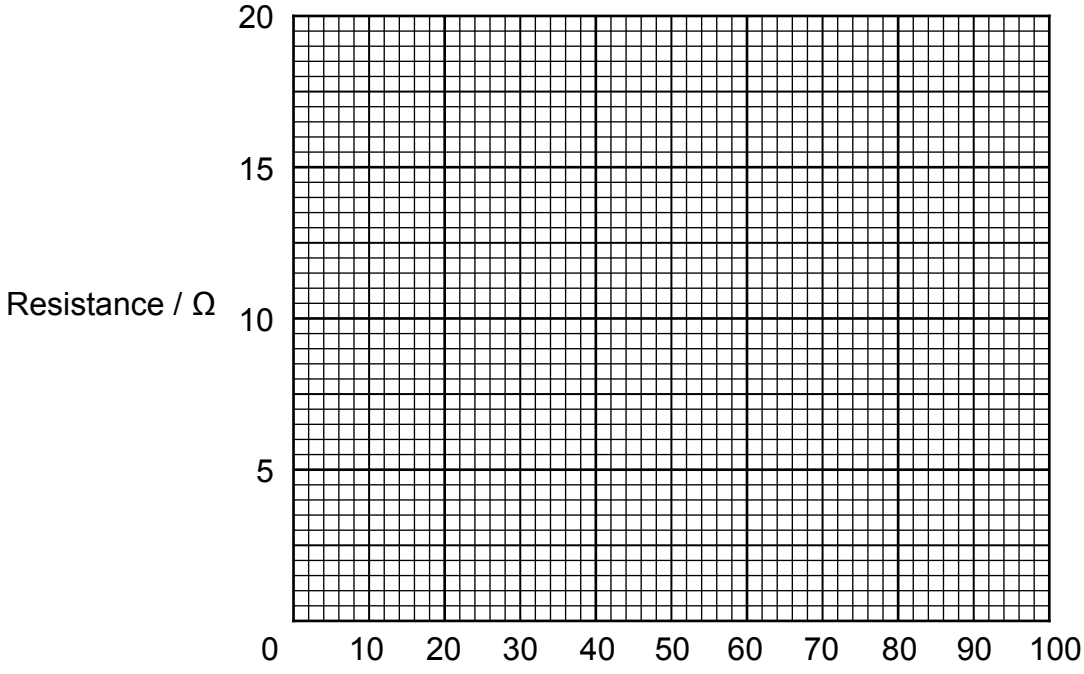
Fig. 4.2

(ii) Complete Table 4.1 by calculating the missing resistance.

State the formula used.

[1]

(c) On the grid provided on Fig. 4.3, plot a graph of the resistance against the length. Draw the line of best fit.



[3]

Fig. 4.3

(d) State the relationship between the length of a nichrome wire and its resistance.

.....

[1]

(e) The investigation is repeated with a nichrome wire of twice the cross-sectional area at the same lengths. On the grid in Fig. 4.3, sketch a graph of the results that you would expect. [2]

[15]

5 A student was given substance **K** which is a mixture of three sodium salts.
The student carried out an experiment to identify the three salts.
Table 5.1 shows tests, observations and conclusions the student made.

Complete Table 5.1 by giving the missing information.

Table 5.1

test	observation	conclusion
(a) Water is added to substance **K**.	A colourless solution is formed.	
(b) (i) A portion of colourless solution from **(a)** is warmed with sodium hydroxide solution and ....[1]	A colourless gas was produced.	
(ii) The colourless gas from **(b) (i)** is bubbled into a red litmus solution.	....[1]	Ammonia gas is produced.
(c) (i) Dilute hydrochloric acid is added to a portion of colourless solution from **(a)**.	A colourless solution and a colourless gas are produced.	
(ii) The colourless solution from **(c) (i)** is acidified with ...., then .....[2]	A white precipitate is formed.	Chloride ions present.
(iii) The colourless gas from **(c) (i)** is bubbled through clear lime water.	Clear lime water turned milky (white precipitate).	....[1]

(d) (i) Give the identity of the white precipitates formed in **(c) (ii)** and **(c) (iii)** respectively.

(c)(ii) .....

(c)(iii) ..... [2]

(ii) The formation of white precipitate in **(c) (ii)** shows the possible presence of chloride ions.

Explain why this does not prove that chloride ions are present in substance **K**.

.....

.....

..... [2]

(e) Which **two** sodium salts must be present in substance **K**?

1 .....

2 ..... [2]

(f) Write a chemical equation to represent the reaction in **(c)(i)**.

.....

..... [2]

[13]

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** 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** Radium 88	227 **Ac** Actinium 89 †															

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

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

Key

a
X
b

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.).

CHEMISTRY PRACTICAL NOTES

Test for anions

anion	*test*	*test result*
carbonate (CO_3^{2-})	add dilute acid	effervescence, carbon dioxide produced
chloride (Cl^-) [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	white ppt.
iodide (I^-) [in solution]	acidify with dilute nitric acid, then add aqueous lead (II) nitrate	yellow ppt.
nitrate (NO_3^-) [in solution]	add aqueous sodium hydroxide, then aluminium foil, warm carefully	ammonia produced
sulfate (SO_4^{2-}) [in solution]	acidify with dilute nitric acid, then add aqueous barium nitrate	white ppt.

Tests for aqueous cations

cation	*effect of aqueous sodium hydroxide*	*effect of aqueous ammonia*
aluminium (Al^{3+})	white ppt., soluble in excess, giving a colourless solution	white ppt., insoluble in excess
ammonium (NH_4^+)	ammonia produced on warming	–
calcium (Ca^{2+})	white ppt., insoluble in excess	no ppt., or very slight white ppt.
copper(II) (Cu^{2+})	light blue ppt., insoluble in excess	light blue ppt., soluble in excess, giving a dark blue solution
iron(II) (Fe^{2+})	green ppt., insoluble in excess	green ppt., insoluble in excess
iron(III) (Fe^{3+})	red-brown ppt., insoluble in excess	red-brown ppt., insoluble in excess
zinc (Zn^{2+})	white ppt., soluble in excess, giving a colourless solution	white ppt., soluble in excess, giving a colourless solution

Test for gases

gas	*test and test result*
ammonia (NH_3)	turns damp red litmus paper blue
carbon dioxide (CO_2)	turns limewater milky
chlorine (Cl_2)	bleaches damp litmus paper
hydrogen (H_2)	‘pops’ with a lighted splint
oxygen (O_2)	relights a glowing splint