BOTSWANA EXAMINATIONS COUNCIL
Botswana General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

2795428313

SCIENCE : DOUBLE AWARD **0569/04**

Paper 4 **October/November 2016**

1 hour 30 minutes

Candidates answer on the Question Paper.

Additional Materials: 300 mm ruler.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name in the spaces provided 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 staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Write your answers in the spaces provided on the question paper.
The number of marks is given in brackets [ ] at the end of each question or part question.
You may use a calculator.

A copy of the Periodic Table is printed on page 16.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
Total	

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

1 Fig. 1.1 shows the set-up for an experiment used to determine the mass *m* of a metre rule.

P is the scale reading position of the mass and Q is the scale reading position of the pivot when the rule is balanced.

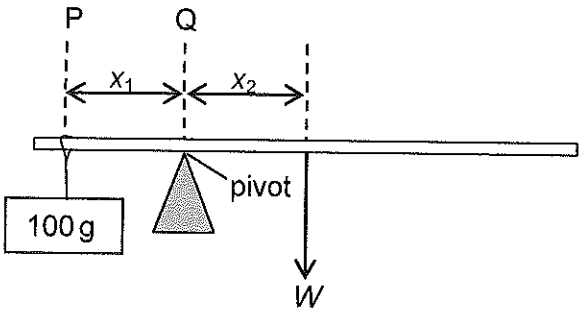


Fig. 1.1

Fig. 1.2 (a) and Fig. 1.2 (b) show the positions of the string, P, holding the 100 g mass and the line of the pivot position, Q, on the rule.

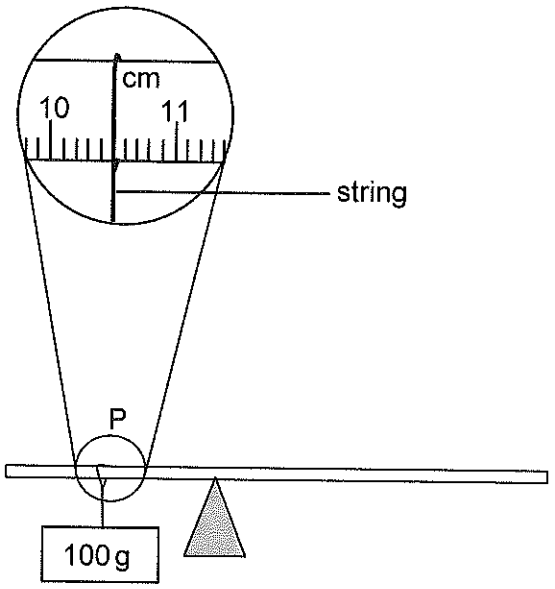


Fig. 1.2 (a)

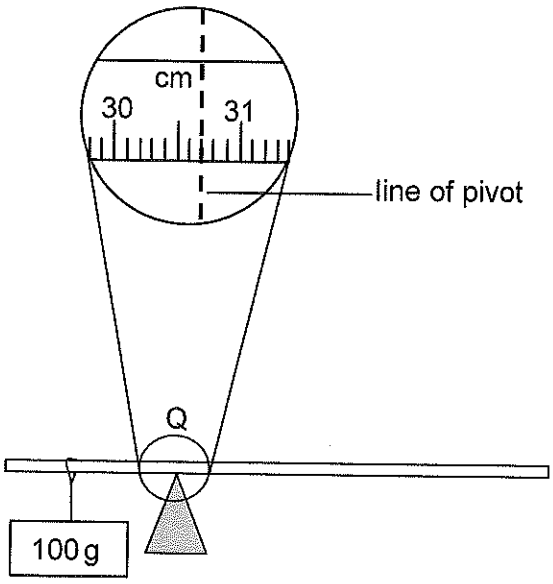


Fig. 1.2 (b)

(a) Record the scale reading positions of P and Q, for the mass and the pivot.

P = ...

Q = ...

[2]

(b) W is the weight of the metre rule.
W acts at the 50 cm position on the scale as shown in Fig. 1.1.

Determine the lengths x_1 and x_2.

x_1 = ...

x_2 = ...
[1]

(c) Calculate the mass m of the rule. Use the equation

$$m = \frac{k x_1}{x_2} \quad \text{where } k = 100\,\text{g}.$$

m = ... [2]

(d) The experiment is repeated by placing the pivot at the 20 cm mark.
The string holding the 100 g mass is moved until another balanced position is found.

(i) Explain why it is important to repeat the experiment.

.....

..... [1]

(ii) State how this will affect the mass of the metre rule.

.....

..... [1]

(e) State **one** source of inaccuracy when measuring length using a metre rule.

.....

..... [1]

Question 2 starts on page 5.

2 **(a)** Describe how you would carry out an experiment to determine how load affects the extension of a spring. You are provided with a ruler, a spring, slotted masses and a mass hanger. You may draw a diagram.

.....

.....

.....

.....

.....

..... [3]

(b) An electromagnet is used to investigate the effect of the strength of the electromagnet on the extension of a spring. The spring is attached to soft iron, a magnetic material, as shown in Fig. 2.1. The current through the electromagnet and the extension of the spring are measured.

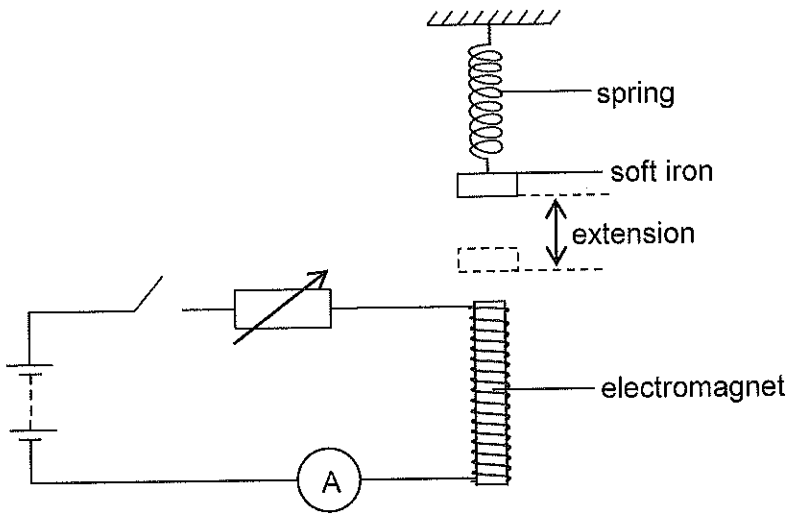


Fig. 2.1

Some of the results of the experiment are shown in Table 2.1.

Table 2.1

current / A	extension / cm
0.00	0.0
0.20	0.5
0.44	1.0
	1.6
0.80	2.0
1.00	2.5

(i) Fig. 2.2 shows the ammeter reading when the extension was 1.6 cm.

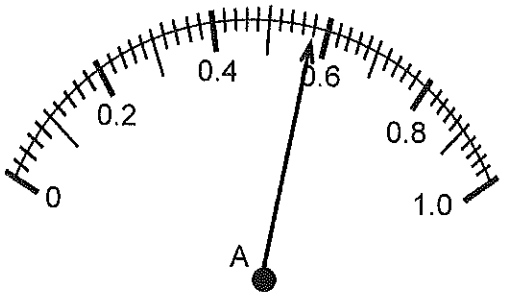
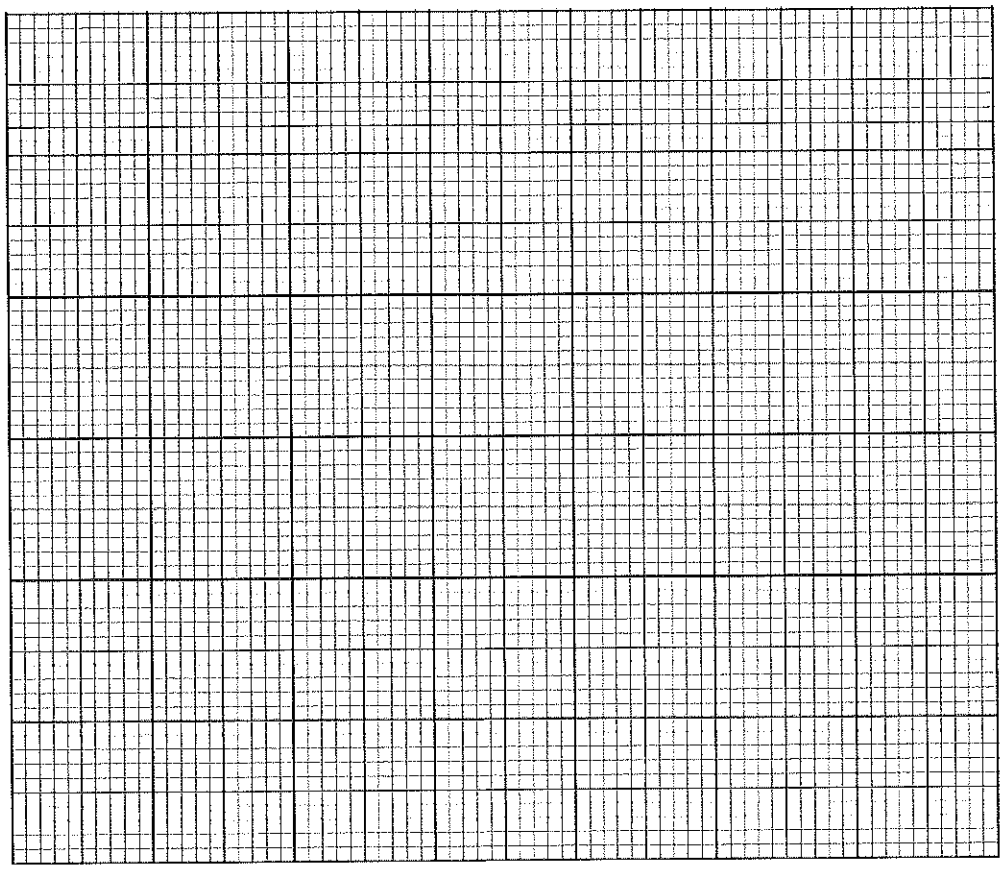


Fig. 2.2

Complete Table 2.1 by filling in the value of the current for the extension at 1.6 cm. [1]

(ii) Plot a graph of extension / cm (y-axis) against current / A (x-axis). [4]



(iii) Determine the gradient G of the graph.
Show clearly on your graph how you obtained the necessary information.

G = ... [2]

(iv) What is the conclusion that can be made from the experiment?

.....

..... [1]

(v) The current is switched on for only a short time when making each reading.
Suggest why.

.....

..... [1]

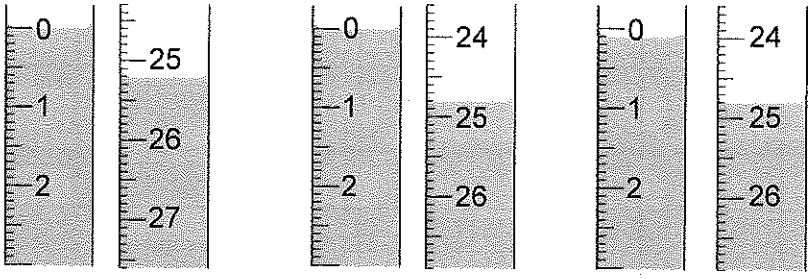
3 A student determines the concentration of dilute sulphuric acid (H_2SO_4) by titrating the acid against 25.0 cm^3 portions of 0.1 mol / dm^3 sodium hydroxide (NaOH) solution.
Methyl orange indicator was used.

(a) What is the colour of methyl orange in sodium hydroxide solution?

..... [1]

(b) The diagrams show burettes at the start and at the end of three titrations.

diagram 1 **diagram 2** **diagram 3**



(i) Complete Table 3.1 to show the volume of sulphuric acid.

Table 3.1

titration number	1	2	3
final reading / cm^3			
initial reading / cm^3			
volume of acid used / cm^3			
tick the best results			

[6]

(ii) Using the ticked values, calculate the average volume V_{av} of the acid used.

V_{av} =.....cm^3 [1]

(iii) Using the equation given, calculate the concentration of sulphuric acid.

$$\text{concentration of acid} = \frac{(0.10 \times 25)}{2\,V_{av}}$$

concentration of acid = ...mol / dm^3 [1]

(c) State any **two** sources of inaccuracy when doing the experiment.

1.....

2.....

[2]

(d) The experiment was repeated without adding the indicator, mixing 25.0 cm^3 of 0.1 mol/dm^3 NaOH with the average volume of H_2SO_4 acid found in **(b)(ii)**. One of the products is sodium sulphate (Na_2SO_4).

Suggest how crystals of Na_2SO_4 are obtained from the mixture.

.....

.....

.....

..... [2]

4 Some tests are conducted on solid X.
The table shows observations and conclusions of the test.

Complete the table.

test	observation	conclusion
(a) Solid X is placed into a test-tube and distilled water is added. The solution is divided into three (3) portions.	colourless solution is formed	
(b) **(i)** To the first portion, a few drops of sodium hydroxide solution are added **(ii)** and then excess sodium hydroxide solution is added.	....[2] ....[1]	X contains either Al^{3+} or Zn^{2+}
(c) **(i)** To the second portion, a few drops of ammonia solution are added **(ii)** and then excess ammonia solution is added.	....[1] precipitate soluble in excess	....[1]
(d) To the third portion, silver nitrate solution is added until no further change.	....[1]	X contains Cl^-

(e) Write the name or formula of solid X.

..... [1]

Question 5 starts on page 12.

[Turn over

5 Fig. 5.1 (a) shows a photograph of a cross-section of a garlic bulb.

Fig. 5.1 (b) shows a photograph of a cross-section of an onion bulb.

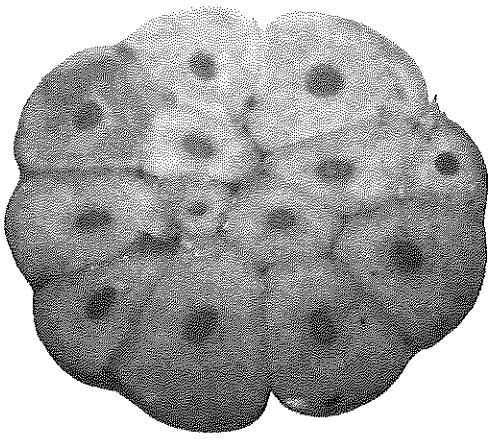


Fig. 5.1 (a)

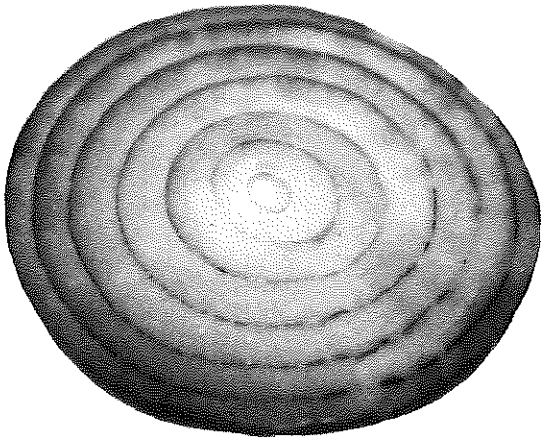


Fig. 5.1 (b)

(a) (i) Draw a large diagram of the garlic bulb shown in Fig. 5.1 (a) in the space provided.

[5]

(ii) Measure the diameter of your garlic bulb drawing.

diameter of drawing = ... [1]

(iii) The diameter of the actual garlic bulb is 64 mm.

Calculate the magnification of your drawing. Use the equation:

$$\text{magnification} = \frac{\text{diameter of drawing}}{\text{diameter of actual garlic bulb}} .$$

magnification = ... [1]

(b) (i) State **one** visible difference between Fig. 5.1(a) and Fig. 5.1(b).

.....

..... [1]

(ii) State **one** visible similarity between Fig. 5.1(a) and Fig. 5.1(b).

.....

..... [1]

(c) A student wanted to compare the amount of reducing sugar in garlic and onion.

Describe how the student would safely carry out this test.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

6 Fig. 6.1 shows a potometer used to measure the rate of transpiration of a plant.

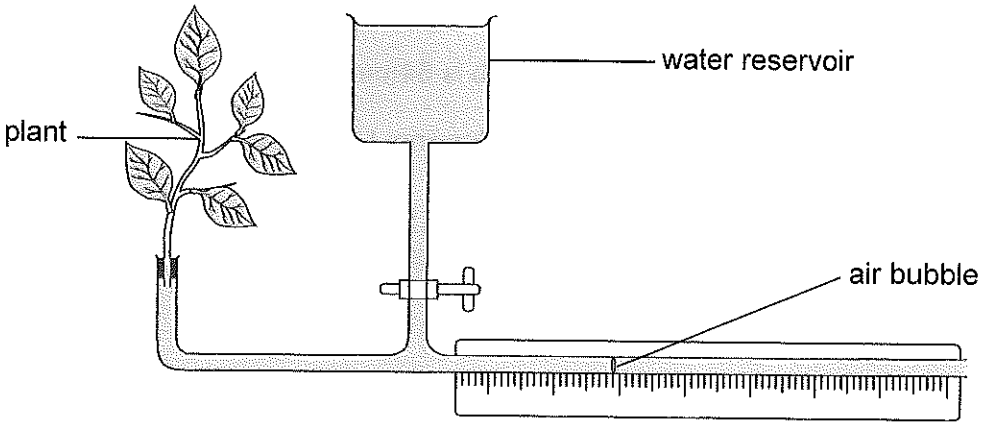


Fig. 6.1

The experiment is carried out at the same temperature.
The first set of results is for still air and the second set of results is for moving air.

At the start of each experiment, the bubble is at position 0 cm.
Readings of the bubble position are taken for 50 minutes at 10 minutes intervals.

Some of the results are recorded in Table 6.1.

Table 6.1

time of reading / minutes	distance moved in 10 minutes by air bubble / cm	
	still air	moving air
10	2.0	
20	2.2	4.9
30	1.9	4.9
40	2.2	4.8
50	2.1	5.0
average rate of bubble movement in cm / min	0.208	

Fig 6.2 shows the potometer readings for moving air at 10 minutes.

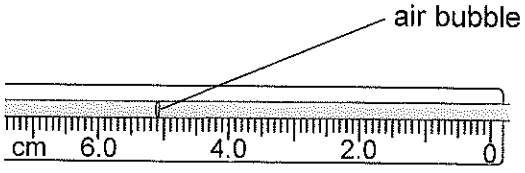


Fig. 6.2

(a) Complete Table 6.1 by recording the reading for moving air as shown in Fig. 6.2. [1]

(b) Calculate the average rate of bubble movement for moving air and record it in Table 6.1. Use the equation

$$\text{average rate} = \frac{\text{total distance moved}}{\text{total time taken}} .$$

Show your working.

average rate =..... [2]

(c) Suggest how the moving air condition can be created in the laboratory.

..... [1]

(d) Suggest **one** factor that should be kept the same in this experiment.
Give a reason for your answer.

factor .....

reason .....

.....
[2]

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 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 = 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.).