3.5 CHEMISTRY (233)

Chemistry is examined using three papers. Two papers, 233/1 and 233/2 test theory. Each of the two papers is taken in 2 hours and is marked out of 80 marks. Paper 233/3 tests the practical part of the syllabus. It is taken in 2¼ hours and is marked out of 40 marks. The three papers are thus marked out of a total of 200 marks.

Table 12: Performance of Chemistry in the Years 2009, 2010, 2011 and 2012.

Year	Paper	Candidature	Maximum Score	Mean Score	Standard Deviation
2009	1	**329,730**	80	12.49	9.50
	2		80	14.93	12.04
	3		40	10.86	4.55
	Overall		**200**	**38.23**	**24.53**
2010	1	**347,364**	80	18.78	14.48
	2		80	16.19	13.25
	3		40	14.87	5.60
	Overall		**200**	**49.79**	**31.57**
2011	1	**403,070**	80	18.43	14.86
	2		80	16.99	13.95
	3		40	11.91	6.30
	Overall		**200**	**47.31**	**33.51**
2012	1	427,190	80	22.36	14.17
	2	427,212	80	17.18	14.50
	3	427,167	40	16.34	6.73
	Overall	427,386	**200**	**55.86**	**34.10**

From the table it can be observed that:

(i) The candidature went up from 403,070 in 2011 to 427,386 in 2012. An increment of 6%.

(ii) Performance in all the three papers went up. 233/2 increased marginally by 0.19.

(iii) The means for 233/1 and 233/3 went up by 3.93 and 4.43 respectively.

(iv) Overall performance in chemistry 233 went up from a mean of 47.31 in 2011 to 55.85 in 2012.

The increase in performance is attributed to a change in marking style. Examiners were able to award marks where candidates gave partially correct responses. In the past these partially correct responses were awarded zero marks.

THE QUESTIONS WHICH WERE PERFORMED POORLY ARE BRIEFLY DISCUSSED BELOW

3.5.1 Chemistry Paper 1 (233/1)

Questions 11

The empirical formula of A is CH_2Br. Given that 0.470g of A occupies a volume of $56cm^3$ at 546K and 1 atmospheric pressure, determine its molecular formula.
(H = 1.0, C = 12.0, Br = 80.0, molar gas volume at STP = 22.4 dm^3). (3 marks)

In this question, candidates were required to study the information given and find the molecular mass of the compound whose empirical formula is given then determine the molecular formula of the compound.

Weaknesses

Candidates were not able to calculate correctly the molecular mass of the compound hence they could not determine the correct molecular formula. This weakness could have been caused by lack of enough practice on questions dealing with Gay-Lussac's Law and the molar gas volume. Candidates should be thoroughly drilled on all topics of syllabus. During teaching, different types of questions should be set on these topics. Once the candidates attempt the questions they should be discussed thoroughly. Teachers should arrange for remedial teaching and re-drilling to candidates of low ability so that they are brought to the same level with the average and above average candidates.

Expected Responses

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}$ $(\frac{1}{2})$

$P_2 = 1$ litre
$V_2 = ?$
$T_2 = 273K$

$P_1 = 1$ atm
$V_1 = 56cm^3$
$T_1 = 546K$

$\frac{1 \times V_1}{273} = \frac{56 \times 1}{546}$

$V_1 = \frac{56 \times 1 \times 273}{546}$

$V1 = 28cm^3$ $(\frac{1}{2})$

0.47g of A occupies $28cm^3$ at STP
? $22400cm^3$

$\frac{0.47 \times 22400}{28} = 376$ $(\frac{1}{2})$

$CH_2Br = 12 + 2 + 80 = 94$ $(\frac{1}{2})$

$94n = 376$
$n = 376/94$
$n = 4$ $(\frac{1}{2})$

$(CH_2Br)_4 = C_4H_8Br_4$ $(\frac{1}{2})$

Question 13

A dynamic equilibrium is established when hydrogen and carbon (IV) oxide react as shown below:

$$H_2(g) + CO_2(g) \rightleftharpoons H_2O(g) + CO(g)$$

What is the effect of adding powdered iron catalyst on the position of the equilibrium?
Give a reason. (2 marks)

In this question the candidates were expected to state the effect of a catalyst on the position of equilibrium.

Weaknesses

Some candidates stated that the position of equilibrium shifts to the right. Others wrote, it shifts to the left. Yet others left the question unanswered. These kind of weaknesses show that the topic equilibria and effects of catalysts on position of equilibrium is not well understood.

Candidates were supposed to realize that catalysts do not take part in reactions. They only change the speed at which reactants react in a chemical reaction. If the reaction comes to an equilibrium, they only change the rate at which the equilibrium is attained. Thus they have no effect on either forward or backward reactions.

Teachers should ensure that concepts on each topic are thoroughly understood and where possible use the practical approach method to demonstrate effect of a catalyst.

Expected Responses

The catalyst has no effect on the position of equilibrium. (1)
The catalyst will increase the rate of forward and backward reactions to the same extent. (1)

Question 14

Distinguish between ionisation energy and electron affinity of an element. (2 marks)

In this question candidates were expected to show the difference between ionization energy and electron affinity.

Weaknesses

Some candidates had an idea what ionization energy is but the majority had no idea what electron affinity is. In the past, candidates have been tested on ionization energy but not on electron affinity. It should be known that **all** topics can be tested any time and thus they should be thoroughly covered and proper revision made.

Electron affinity is associated with gaining of electrons while ionization energy is associated with electron loss.

Expected Responses

Ionisation energy

This is the energy required to remove an electron from an atom in its gaseous state. (1)

Electron affinity:

This is the energy change that results in the formation of an ion when an atom gains an electron. (1)

Question 23

Describe how the percentage by mass of copper in copper carbonate can be determined.

(3 marks)

In this question candidates were expected to describe in detail the experimental method which could be used to determine the % by mass of copper in copper (II) carbonate.

Weaknesses

Majority of the candidates did not give the experimental details required. Others just left the question unanswered. Candidates should have realized that copper (II) carbonate can be changed to copper (II) oxide by heating it strongly. The copper(II) oxide can be reduced to copper metal by reduction. The weakness stated could be caused by lack of experimental exposure. Teachers are advised to use the practical approach method in teaching of chemistry. Theoretical teaching should be discouraged. Schools should ensure that enough funds are allocated for purchase of chemicals and equipment if performance is to be improved. The weakness stated could also have been cuased by students not taking enough time to read, understand the demands of the question and interpret it correctly.

It is important for candidates to understand the question before they begin to write answers.
Composure, avoiding nervousness gives candidates confidence and this leads to alertness and unblocks the mind. This improves performance.

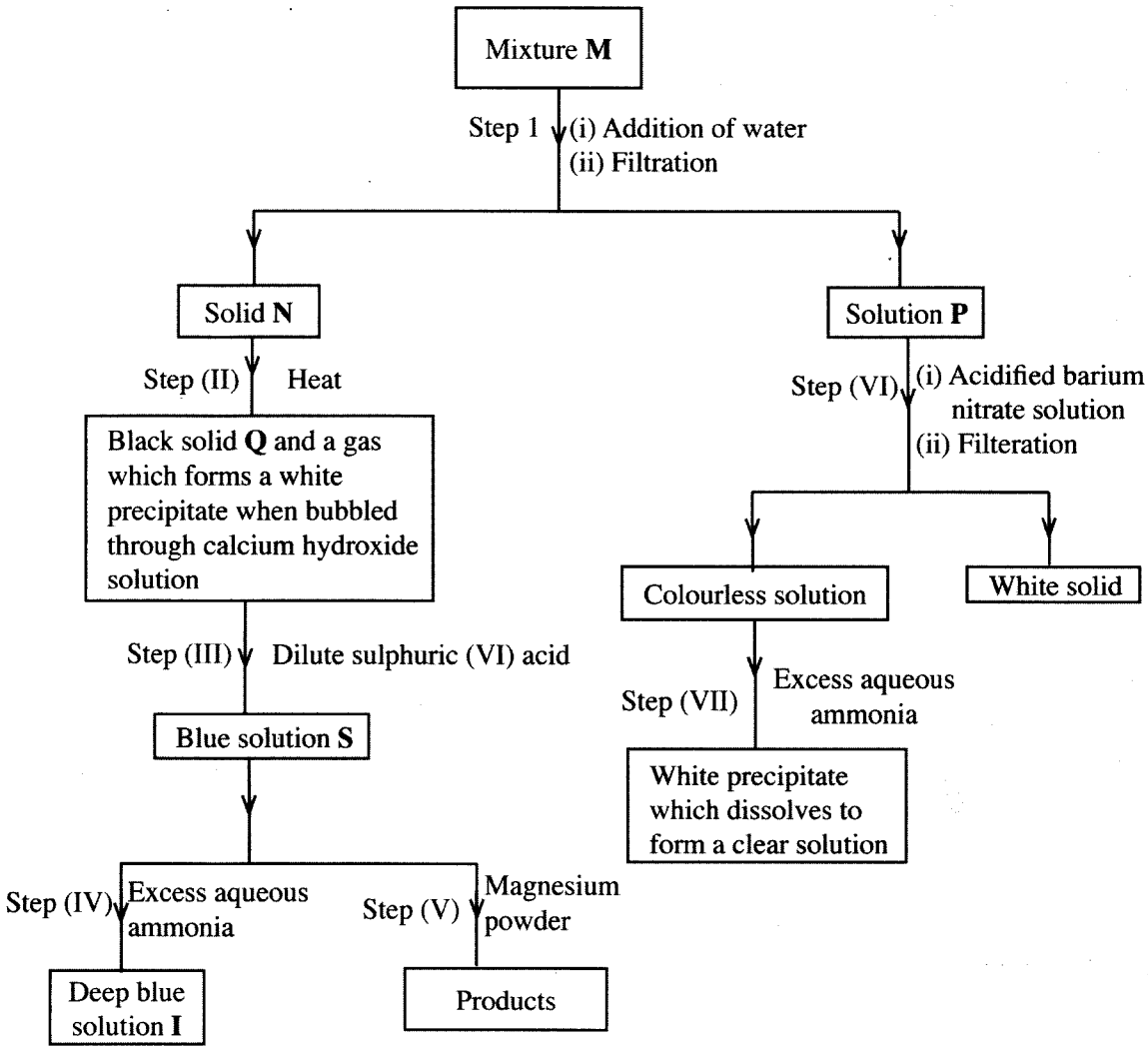
Expected Responses

- Weigh copper carbonate ($\frac{1}{2}$)
- Heat $CuCO_3$ to constant mass in a combustion tube (1)
- Reduce CuO using dry H_2/NH_3 or CO ($\frac{1}{2}$)
- Allow to cool and reweigh to get mass of copper ($\frac{1}{2}$)
- $\% = \frac{Mass\ of\ Cu}{Mass\ of\ CuCO_3} x\ 100$ ($\frac{1}{2}$)

3.5.2 Chemistry Paper 2 (233/2)

Question 6

The flow chart below shows a sequence of reactions involving a mixture of two salts, mixture **M**. Study it and answer the questions that follow.



(a) Write the formula of the following:

(i) anion in solid **Q** (1 mark)

(ii) the two salts present in mixture **M**. (2 marks)

(b) Write an ionic equation for the reaction in step (VI). (1 mark)

(c) State and explain the observations made in step (V). (3 marks)

(d) (i) Starting with Lead (II) oxide, describe how a pure solid sample of lead sulphate can be prepared in the laboratory. (2 marks)

(ii) How can one determine whether the lead sulphate prepared is pure? (2 marks)

In the question, candidates were required to:

1. Read a detailed flow chart on simple experimental processes;
2. Identify anions and cations present in a mixture of two salts.
3. Name the two salts in the mixture;
4. Write ionic equations;
5. Explain some of the observations;
6. Describe how to prepare a salt;
7. State methods of determining purity of a substance.

Weaknesses

Candidates showed weaknesses in:

1. Identifying the anions present in the two salts;
2. naming the salts;
3. writing equations;
4. giving scientific description of some of the observations;
5. describing logically a method of preparing leadsulphate.

This showed serious lack of exposure to experimental processes; students should be exposed to experimental processes. They need to carry out experiments themselves in groups and where it is not possible due to large numbers, class demonstrations should be carried out so that they can see, smell touch and therefore make conclusions.

All practical results should be analysed, discussed thoroughly and logical conclusions made.
Equations should be balanced and have the correct state symbols. Where substances are to be prepared, it is important for candidates to plan first. Decide on how the processes should follow one another starting with the first, second, third etc in a **logical** manner. Remember if the first process is wrong then everything else is wrong.

Expected Responses

(a) (i) Cu^{2+} √1

(ii) $CuCO_3$ √1 / $ZnSO_4$ √1

(b) $Ba^{2+}_{(aq)} + SO_4^{2-}{}_{(aq)} \longrightarrow BaSO_{4(s)}$ √1

(c) The solution changes from blue to colourless √1 and a brown solid is formed. √1
The magnesium which is above copper in the reactivity series displaces the copper ions √1 from the solution. Apparatus become warm. The reaction is exothermic.

(d) (i) Add nitric (V) acid to √½ lead oxide, filter√½, add a soluble sulphate/ sulphuric acid to the filtrate √½. Filter √½, and wash residue with distilled water √½ to remove traces of the filterate, then dry residue between √½ filter papers /oven.

(ii) Determine the melting √1 point, if it is pure the melting point will be constant. √1

3.5.3 Chemistry Paper 3 (233/3)

Question 2

You are provided with solid **E**. Carry out the experiments below. Write your observations and inferences in the spaces provided.

(a) Place all of solid **E** in a boiling tube. Add about 20 cm^3 of distilled water and shake until all the solid dissolves, label the solution as solution **E**. Use solution **E** for experiments (i) and (ii).

(i) To 2 cm^3 of solution **E**, in a test - tube in each of experiments I, II, III and IV, add:

I. two drops of aqueous sodium sulphate;

Observations	**Inferences**
(1 mark)	(1 mark)

II. five drops of aqueous sodium chloride;

Observations	**Inferences**
(1 mark)	(1 mark)

III. two drops of barium nitrate;

Observations	**Inferences**
(1 mark)	(1 mark)

IV. two drops of lead (II) nitrate;

Observations	**Inferences**
(1 mark)	(1 mark)

(ii) To 2 cm^3 of solution **E**, in a test - tube, add 5 drops of aqueous sodium hydroxide. Add the piece of aluminium foil provided to the mixture and shake. Warm the mixture and test any gas produced with both blue and red litmus papers.

Observations	**Inferences**
(2 marks)	(1 mark)

The question was on qualitative analysis. Candidates were expected to carry out experiments on an unknown compound. Write observations and then draw conclusions.

Weaknesses

- Candidates failed to write correct observations.
- They also failed to use acceptable scientific language in describing the observations.
- Due to lack of correct observations, they could not give the correct conclusions.

Candidates should be encouraged to plan on how to carry out the experiments successfully. They should use **clean** apparatus, use the correct chemicals, distilled water etc. They should write the observations as soon as these are made.

Teachers should give many experiments on qualitative analysis, assist the candidates to write accurate observations and draw conclusions. Candidates can use symbols and where a candidate is not sure of the correct formula or symbol, they can write in words.

Expected Responses

Observation

(a) (i)	(I)	A white precipitate (1)	Presence of Pb^{2+}, Ba^{2+} or Ca^{2+} (1) *1 mark for all the 3 ions* *½ mark for 2 correct ions* *0 mark for one or none*
	(II)	No white precipitate (1)	Absence of Pb^{2+} (1)
	(III)	No white precipitate (1)	SO_4^{2-}, SO_3^{2-}, CO_3^{2-} ions absent (1) *1 mark all the 3* *½ mark for 2 ions correct* *0 mark for one or none*
	(IV)	No white precipitate (1)	Cl^- ions absent (1)
(ii)		Effervescence ½/Bubbles/Fizzing Colourless gas produced ½ Turns red litmus blue ½ Blue litmus remained blue ½ (2 marks)	NO^-_3 present (1)
			(Total 11 marks)

3.7.4 Conclusion

Knowledge in chemistry is mainly used in industrial production of goods e.g. fertilizers, medicines etc. It is important that during teaching that the many benefits of the knowledge is made known to students so that they can build an interest in a chemistry related career in future eg. chemical engineers.