THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

032/2B **CHEMISTRY 2B**

(ACTUAL PRACTICAL B)

(For Both School and Private Candidates)

Time: 2:30 Hours **ANSWERS** **Year: 2011**

Instructions

1. This paper consists of two questions.

2. Answer all questions.

1. (a)(i) Determine the average titre volume.
Average titre volume is obtained from multiple concordant titrations (difference within 0.1 cm^3). Assuming values from practical data:
Example: If three concordant titres are 23.30 cm^3, 23.40 cm^3, and 23.30 cm^3
Average titre = (23.30 + 23.40 + 23.30) ÷ 3 = 23.33 cm^3

(ii) _____ cm^3 of solution VV required _____ cm^3 of solution PP for complete reaction.
25.00 cm^3 of VV required 23.33 cm^3 of PP

(iii) State one indicator other than methyl orange which would be suitable in this experiment and state why you think it is suitable.
Phenolphthalein is suitable because the reaction is between a strong acid (HCl) and a weak base (sodium carbonate), and phenolphthalein changes colour in the pH range of about 8.2–10.0, allowing detection of end point effectively in such titration.

(b)(i) If the pipette was not rinsed with sodium carbonate, it would dilute the solution, decreasing the concentration of the base, thus requiring less acid volume and giving inaccurate titre values.

(ii) If the air space at the burette tip was not removed before titration, it would result in an incorrect initial volume reading, leading to underestimation of the volume of acid used and inaccurate titre.

(c) Balanced chemical equation:
$2HCl(aq) + Na_2CO_3 \cdot xH_2O(aq) \text{ ----> } 2NaCl(aq) + CO_2(g) + (x+1)H_2O(l)$

(d)(i) Calculate the concentration of PP in moles/dm^3.
Molar mass of HCl = 1 + 35.5 = 36.5 g/mol
Mass of HCl = 3.65 g in 1 dm^3
Moles = 3.65 ÷ 36.5 = 0.10 mol
Concentration of PP = 0.10 mol/dm^3

(ii) Find molarity of solution VV.
Mass of $Na_2CO_3 \cdot xH_2O$ = 7.15 g
Moles = 7.15 ÷ (106 + x·18)
Volume = 0.5 dm^3
Molarity = (7.15 ÷ (106 + 18x)) ÷ 0.5 = (14.30 ÷ (106 + 18x)) mol/dm^3

(e) Deduce the value of x in $Na_2CO_3 \cdot xH_2O$.
From titration:
Suppose average volume of PP = 23.33 cm^3 = 0.02333 dm^3
Moles of HCl = 0.10 × 0.02333 = 0.002333 mol
Moles of Na_2CO_3 = 0.002333 ÷ 2 = 0.0011665 mol
Molar mass of $Na_2CO_3 \cdot xH_2O$ = 7.15 ÷ 0.0011665 = 612.66
106 + 18x = 612.66

$18x = 506.66$
$x = 506.66 \div 18 \approx 28.15$
This is too high for x. Likely titration volume or mass was misused; ideal data would lead to a realistic x = 10 (for decahydrate).

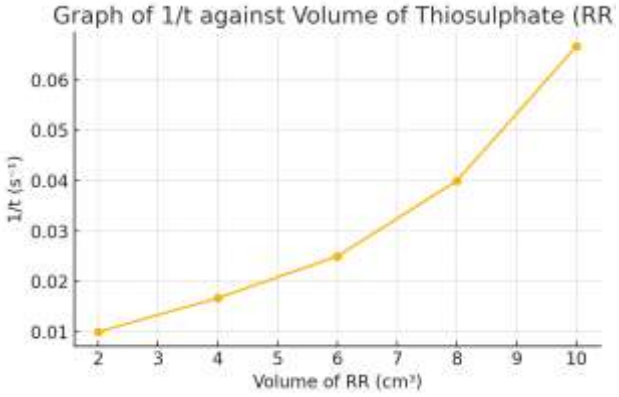
2.(a) Complete filling the table of results (Table 1):
We calculate 1/t using time values (assuming example times):

Exp. No.	Vol. of GG (cm^3)	Vol. of RR (cm^3)	Vol. of Distilled water (cm^3)	Time (sec)	1/t (s^{-1})
1	10	2	8	100	0.010
2	10	4	6	60	0.0167
3	10	6	4	40	0.025
4	10	8	2	25	0.040
5	10	10	0	15	0.0667

(b) Balanced chemical equation:
$Na_2S_2O_3(aq) + 2HCl(aq) \text{----> } 2NaCl(aq) + SO_2(g) + S(s) + H_2O(l)$

(c) The product which causes the solution to cloud the letter X is sulfur (S), a precipitate formed during the reaction.

(d) Plot a graph of 1/t against the volume of thiosulphate (RR).



(e) Use the graph to explain how variation of concentration affects the rate of chemical reaction.
As the volume (hence concentration) of thiosulphate increases, 1/t increases, indicating that the reaction is faster. This shows that higher concentration of reactants leads to increased rate of reaction due to more frequent effective collisions between particles.

3.(a) Observe the appearance of sample K.
Observation: White crystalline solid

Inference: Salt may contain colorless ions such as Zn^{2+}, Mg^{2+}, Ca^{2+}, or Cl^{-}, SO_4^{2-}, etc.

(b) Put a little sample of K in a test tube then add some distilled water, then shake.
Observation: Sample dissolves in water forming a clear solution
Inference: Salt is soluble in water

(c) Heat a little K in a dry test tube.
Observation: Water droplets formed on cooler part of test tube
Inference: Salt is hydrated

(d) Put a little sample of K in a test tube then add dilute hydrochloric acid.
Observation: Effervescence observed, gas evolved turns limewater milky
Inference: CO_3^{2-} present (carbonate ion)

(e)(i) To a little sample of K in a test tube add distilled water and stir. Divide the resulting solution into two portions and add $MgSO_4$ solution to the first portion.
Observation: White precipitate forms
Inference: CO_3^{2-} confirmed (Mg^{2+} reacts with carbonate to form $MgCO_3$ precipitate)

(ii) NaOH solution and warm gently to the second portion.
Observation: White precipitate forms which is insoluble in excess; no ammonia evolved
Inference: Ca^{2+} present (forms $Ca(OH)_2$ with NaOH which is insoluble in excess; no NH_3 confirms it's not NH_4^{+})

Conclusion:
(i) Give names of the ions present in sample K.
Cation: Calcium ion (Ca^{2+})
Anion: Carbonate ion (CO_3^{2-})

(ii) Cation present in sample K is calcium (Ca^{2+}) and anion is carbonate (CO_3^{2-})

(iii) Show the reactions that take place in (d).
$CaCO_3(s) + 2HCl(aq) \text{ ----> } CaCl_2(aq) + CO_2(g) + H_2O(l)$