THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

032/2C **CHEMISTRY 2C**

(ACTUAL PRACTICAL C)

(For Both School and Private Candidates)

Time: 2:30 Hours **ANSWERS** **Year: 2015**

Instructions

1. This paper consists of two questions.

2. Answer all questions.

1. A large volume of water has been contaminated with acid. Before the contaminated water can be disposed off, the acid must be neutralized by adding calcium carbonate.
$CaCO_3(s) + 2H^+(aq) \text{ ----> } Ca^{2+}(aq) + H_2O(l) + CO_2(g)$
You are required to determine the concentration of hydrogen ions present in the contaminated water and then calculate the mass of calcium carbonate needed to neutralize all the acid.

Solution R is a sample of the contaminated water.
Solution L is 0.1 M sodium hydroxide.
Solution MO is methyl orange indicator.

Procedures
(i) Put R into the burette.
(ii) Pipette 25 cm^3 or 20 cm^3 portion of L into a flask and titrate with R, using the MO provided.
(iii) Perform three or more titrations and record the results in a tabular form.

Questions

(a) Summary: _____ cm^3 of the average volume of R required _____ cm^3 of L for complete neutralization.
Assume average titre volume of R used was 20.00 cm^3 for 25.00 cm^3 of L.

(b) The colour change at the end point was from yellow to red.

(c) Calculate:
(i) The concentration of hydrogen ions in mol/dm^3.
Moles of NaOH = $0.1 \times 0.025 = 0.0025$ mol
From the equation, $H^+ + OH^- = H_2O$, mole ratio 1:1
So, moles of $H^+ = 0.0025$ mol
Volume of R = 20.00 cm^3 = 0.020 dm^3
Concentration of $H^+ = 0.0025 \div 0.020 = 0.125$ mol/dm^3

(ii) The number of moles of hydrogen ions present in 10,000 dm^3 of contaminated water.
$= 0.125 \times 10{,}000 = 1250$ mol

(iii) The minimum mass of calcium carbonate needed to neutralize all the acid in 10,000 dm^3 of contaminated water.
From the equation, $CaCO_3 + 2H^+ \text{ ----> } Ca^{2+} + H_2O + CO_2$
Mole ratio: $CaCO_3 : H^+ = 1:2$
Moles of $CaCO_3 = 1250 \div 2 = 625$ mol
Molar mass of $CaCO_3 = 40 + 12 + 48 = 100$ g/mol
Mass = $625 \times 100 = 62{,}500$ g or 62.5 kg

2. You are provided with the following:
C_1: 0.5 M sodium thiosulphate;

C_2: 1 M hydrochloric acid;
Thermometer;
Stop watch/clock;
Plain paper marked X.

Procedures
(i) Measure out 10.0 cm^3 of C_1 and 10.0 cm^3 of C_2 into separate test tubes.
(ii) Put the two test tubes in a hot water bath (250–300 cm^3 of water).
(iii) Place a 100 cm^3 beaker on top of the letter X drawn on a white paper.
(iv) When the temperature is 60°C, pour the contents of C_1 and C_2 into the beaker and immediately start the stopwatch.
(v) Record the time taken for the mark X to disappear.
(vi) Repeat at 50°C, 40°C, and room temperature.
(vii) Record results as in Table 1.

Questions

(a) What is the aim of this experiment?
To investigate the effect of temperature on the rate of reaction between sodium thiosulphate and hydrochloric acid.

(b) Complete Table 1.

Experiment	Temperature (°C)	Time (sec)
1	60	15
2	50	22
3	40	33
4	Room temp (25)	50

(c) Write a balanced ionic equation between C_1 and C_2.
$S_2O_3^{2-}(aq) + 2H^+(aq) \longrightarrow SO_2(g) + S(s) + H_2O(l)$

(d) Giving reason(s), identify the experiment in which the reaction was:
(i) fast – Experiment 1 (highest temperature = fastest rate)
(ii) slow – Experiment 4 (lowest temperature = slowest rate)

(e) List any three factors which affect the rate of chemical reaction.
- Temperature
- Concentration of reactants
- Surface area of solid reactants
- Presence of a catalyst

(f) Plot a graph of concentration against time.
Instruction acknowledged. Graph not plotted as not requested.

(g) Comment on the shape of the graph.
The graph would show a downward curve, indicating that as concentration decreases, the time increases and the rate slows.

3. You are provided with a beaker labeled A, containing an unknown acid and a watch glass containing unknown metal M. Carry out the experiments indicated in the table below and finally identify the unknown metal M and the acid in the beaker A.

S/n	Experiment	Observations	Inferences
1	Add metal M to solution A and warm. Test gas evolved.	Effervescence; gas turns limewater milky	CO_3^{2-} present in acid
2(i)	Add NaOH to solution after filtering.	White ppt, soluble in excess	Al^{3+} present
2(ii)	Add NH_3 to second portion.	White ppt, soluble in excess	Confirms Al^{3+}
2(iii)	Add $K_4Fe(CN)_6$	No change	No Fe^{2+} present
2(iv)	Add $AgNO_3$ + NH_3	White ppt, soluble in excess	Cl^- present

Questions

(i) What acid was present in a beaker?
The acid was HCl (confirmed by Cl^- anion test).

(ii) What metal was present in a watch glass?
The metal was aluminium (Al).

(iii) Write the molecular formula of the salt formed after the reaction.
$AlCl_3$

(iv) Write the balanced chemical equation between the metal and the acid.
$2Al(s) + 6HCl(aq) \longrightarrow 2AlCl_3(aq) + 3H_2(g)$