**233/3**

**Chemistry**

**(Practical) Paper 3**

**NOV/DEC 2021**

**Kenya Certificate of Secondary Education**

**Chemistry practical 233/3**

 **MARKING SCHEME**

**1*.* You are provided with;**

Aqueous hydrochloric acid, solution **W**9 in a burette.

Solution sodium **W**11 containing 6.3g of a dibasic acid H2CO4**.**2H2O per litre

Aqueous sodium hydroxide, solution **W**12.

Phenolphthalein indicator

Metal M

**You are required to;**

 Standardize the sodium hydroxide solution **W**12

 Use the standardized solution **W**12 to determine the concentration of **W** React the hydrochloric acid solution **W**9 with metal **M** and determine the mass per unit length of metal **M**.

**Procedure**

**I** Fill a burette with solution **W**11, pipette 25.0cm3 of solution **W**12 into a conical flask. Titrate using phenolphthalein indicator. Record your results in Table A below;

**Table A.**

|  |  |  |  |
| --- | --- | --- | --- |
|  | 1st | 2nd | 3rd |
| Final Burette Reading | 20.0 | 20.0 | 20.0 |
| Initial Burette Reading | 0.0 | 0.0 | 0.0 |
| Volume of W11 used (cm3) | 20.0 | 20.0 | 20.0 |

CT--- 1mk

DP--- 1mk

A ----- ½ Mk PA------ ½ Mk FA-----1MK

**School value.**

|  |  |  |
| --- | --- | --- |
| **Shift 1** | **Shift 2** | **Shift 3** |
| **17.4/17.7** | **18.5/18.7** | **18.5/18.7** |

(3 marks)

iv) Average volume of solution **W**11 used (1 mark)

=20.0cm3

v) Calculate the concentration of the dibasic solution W11 in mol-1 (*C*=12, *H*=1, *O*=16) (1 mark) H2C2O4**.**2H2O = (1 X2) + (12 X2) + (16 X 4) + 2(18) =126

= 0.05M

vi) Calculate the concentration of the sodium hydroxide solution **W**12 in mol*l-1*

(2 marks)

Moles of acid = =0.001moles, moles of NaOH = 0.001 X 2=0.002

0.002…………….25cm3 =0.08 M

?.............................1000cm3

**II.** Using a 100cm3 measuring cylinder measure 90cm3 of distilled water and place it into a 250cm3 beaker then add 10cm3 of solution **W**9 (**W**9 is supplied in a burette). Mix the solution well and label it **W**10. Fill a burette with solution W10, pipette 25.0cm3 of solution W12 into a conical flask. Titrate using phenolphthalein indicator. Record your results in Table B below.

**Table B.**

**School value.**

|  |  |  |  |
| --- | --- | --- | --- |
|  | 1st | 2nd | 3rd |
| Final Burette Reading | 20.0 | 20.0 | 20.0 |
| Initial Burette Reading | 0.0 | 0.0 | 0.0 |
| Titre (cm3) | 20.0 | 20.0 | 20.0 |

CT--- 1mk

DP--- 1mk

A ----- ½ Mk PA------ ½ Mk FA-----1MK



|  |  |  |
| --- | --- | --- |
| **Shift 1** | **Shift 2** | **Shift 3** |
| **15.5/15.7** | **16.5/16.7** | **16.5/16.7** |

(3 marks)

i). Average volume of solution W10 used. (1 mark)

=20.0cm3

ii). Calculate the concentration of the diluted hydrochloric acid solution W10 in mol *l-*

(2 marks

Moles of HCl=moles of NaOH = = 0.002

0.002………………………..20cm3 = 0.1M

?.................................................1000cm3

iii). Determine the concentration of the original hydrochloric acid solution W9 in mol

*l-1* (1 mark) M1V1 = M2V2 = M1 X 10 =0.1X 100

= 1.0M

Conditions and penalties for table 1

Titration **Table II…………………………………..4mks**

**The marks are distributed as follows**

a) Complete table....... 1mk

**Conditions**

 Complete table with 3 titration done........ 1mk

 Incomplete table with 2 titrations done..... 1/2 mk  Incomplete table with only 1 titration done.... 0 mk **Penalties**

 Wrong arithmetic/subtraction

 Inverted table

 Burette reading beyond 50cm3 unless explained

 Unrealistic titre(s) i.e. to small (below 1.0cm3 or too high (100s)

 NB: Penalise 1/2mk for each to a max. Penalty of 1/2mk (i.e. Penalise 1/2mk ONCE)

b) Use of decimals......1 Mk

(Tied to 1st and 2nd rows each)

**Conditions**

 Accept either 1 or 2 d.p used consistently otherwise Penalise fully.

 If 2 d.p are used the 2 dp must be a “0” or “5” otherwise penalize fully.

 Accept inconsistency of zero as initial burette reading i.e. 0.0

c) **ACCURACY.......** 1/2mk **MK**

Compare the candidate titre values with the S.V tick the chosen value where it earns a mark NB: The S.V is the

teacher „Average Titre”.

If at least One value is within + 0.2cm3 of s.V ..... 1 Mk

If no value is within + 0.2cm3 for at least ONE is written +.0 of the SV.....1/2mk

If no value is within + 0.2cm3 of the SV.... O mk

d) **Principle of Averaging........ 1 mk**

**Conditions**

 If 3 consistent values are averaged....... 1mk

 If 3 titrations are done but only 2 are consistent and averaged........ 1 Mk

 If only 2 titrations are done are consistent and are averaged.... 1mk

 If 3 are possible but only 2 are averaged ....0 Mk

 If 3 titrations are done are in consistent and averaged..... 0 Mk

**Penalties**

 Penalise 1/2mk for wrong arithmetic if the errors is outside +2 units in the 2nd d.p

 Penalise 1/2mk if no working is shown but the answer is correct.  If no working is shown but answer given is wrong, penalise fully.

 Accept rounding off of answer to 2 d.p otherwise penalize 1/2mk for rounding off to 1 dp or whole number.

**NOTE:**

 Accept “Answering it works out exactly to 1 d.p or to a whole number.

 Section (i) Must be marked for the „mark‟ for averaging is awarded in table 1.

e) ***FINAL ACCURACY........*** 1/2mk ***MK***

Compare the candidate’s CORRECT average titre with the SV.

If within + 0.2cm3 of the SV..... 1/2mk Mk

If beyond + 0.2cm3 of the SV....0 Mk

**NOTE:**

 In case there was wrong arithmetic/subtraction in the table, use the correct values in averaging for the final answer.

 Where there are two possible average titres use the value which gives the candidate max. Credit

 If wrong values are averaged, pick the correct values (if any) following the principles of averaging, a average and award accordingly.

**III**. . From the burette containing **W**9 measure 10cm3 of **W**9 into a boiling tube. Wrap the boiling tube with tissue paper. Measure the temperature of this solution and record it in **Table C** below. Place one of the 2cm piece of metal **M** into the hydrochloric solution **W9** in the boiling tube and measure the temperature. Record the highest temperature in table C below. Repeat this procedure using the other two, 2cm, pieces of M.

**Table C. school values**

(5 marks)

|  |  |  |  |
| --- | --- | --- | --- |
|  | 1st shift | 2nd shift | 3rd shift |
| Piece of metal M |  |  |  |
| Highest temperature | 21 | 22 | 23 |
| Initial temperature | 13 | 15 | 16 |
| Change in temperature, ∆T | 8 | 8 | 8 |

Ct 1mk

Dp 1mk

A ----- ½ Mk

T------ ½ Mk

i). Average change in temperature ∆T. =80C (1 mark) ii). Calculate the heat of the reaction between metal **M** and hydrochloric acid using the expression below; heat of reaction (1 mark)

∆H=MC∆T = =-0.336

iii). Given that the heat of the reaction is 440Kj per mole of **M**. Calculate the number of moles of **M** used in this reaction. (2 marks)

Moles = = 0.00076

iv). Calculate the mass per unit length of metal M (M=24). (2 marks)

0.76 =0.00912g/cm penalize ½mk for units

Conditions and penalties for table 1 and 2

**1. PROCEDURE**

**TABLE 1 (4 Marks) Award a total of 4 marks distributed as follows**

i). Complete table (1mark)

ii). Table with 3 readings (1mark)

**a). Penalties**

*i). Penalize ½ km once for any space not filled subject to at least 4 readings being given otherwise penalize fully*

*ii). Penalize ½ mark for unrealistic temperature reading (below 10 and above 40OC) for the whole table*

*once.*

***b). Use of decimals*** *(1 mark)*

*i). accept temperature readings and award 1 mark only. If consistency given either as whole numbers a to 1*

*decimal place otherwise penalize fully*

***c). Accuracy***

*Compare the S.V. to the candidate’s temperature reading and award 1 mark if the reading is within +2.0 0C*

*of the S.V. otherwise award zero mark*

***Note***

S.V refers to the teacher’s initial temperature readings at

|  |  |  |
| --- | --- | --- |
| **d).** | **Trends**  | **(1 mark)** |
| i). | The reaction is exothermic a hence temperature must rise if not penalize ½ |  |

2. You are provide with solid E which is suspected to be calcium nitrate. Using the reagents below, describe how you can confirm its presence

 Aqueous NaOH

 Dilute sulphuric (V) acid

 Aluminium foil

Bunsen burner

Red and blue litmus papers

|  |  |
| --- | --- |
| Test 1 | Expected observations |
| **Dissolve solid E in distilled water ,To a portion of solution of E add aqueous sodium hydroxide till in****Excess** | **White ppt insoluble in excess** |
| Test 2 | Expected observations |
| **To a portion of solution of E add aqueous****sulphuric (VI) acid** | **white precipitate** |
| Test 3 | Expected observations |
| ***To a portion of solution of E add sodium******hydroxide ,followed by aluminium foil warm and test the gases produced with a red and blue litmus paper*** | ***Effervescence of a colorless gas with a******pungent smell that turns red litmus paper blue and no effect on blue litmus*** |

Carry out the test above

|  |  |
| --- | --- |
| Test 1 |  |
| Observations | Inference |
| **White ppt insoluble in excess** | **Mg2+,Ca2+ present** |
| Test 2 |  |
| Observations | Inference |
| **No white precipitate** | **Ca2+ absent** |
| Test 3 |  |
| Observations | Inference |
| **Effervescence of a colourless gas with a****pungent smell that turns red litmus paper blue and no effect on blue litmus** | *NO - present**3* |

**3.** You are provided with solid F. carry out the following tests. Write your inferences and observations in the spaces provided.

d) Place all of solid F in a boiling tube. Add about 20cm of distilled water and shake until all the solid dissolves.

Label the solution F. Add about half of the solid hydrogen carbonate provided to 2 cm3 of solution

e) i). Add about 10 cm3 of dilute hydrochloric acid to the rest of solution F in the boiling tube. Filter the mixture.

**Observations Inference**

½ mark

No effervescence

Compound/solution F *not acidic* H+ or H3O+

 Ignore R-COOH absent. ½ mark

Wash the residue with about 2 cm of distilled water. Dry the residue

Between filter paper. Place about one third of the dry residue n metallic spatula and burn t on a Bunsen burner flame.

|  |  |
| --- | --- |
| **Observations** | **Inference** |
|  Burns with a sooty/smoky/luminous/yellow flame½ mark |  Unsaturated compound orLong chain hydrocarbon or**, -C ≡C- present** ½ mark |

ii). Place all the remaining residue in to a boiling tube. Add about 10 cm3 of distilled water and shake thoroughly. **Retain the mixture for the test in**

|  |  |
| --- | --- |
| **Observations** | **Inference** |
|  Some white suspension/solid remains un dissolved **NB reject** white precipitate formed1 mark |  Compound slightly/partially soluble in water 1 mark |

f) Divide the mixture in to two portions:

iii. To the first portion add the rest of the solid sodium hydrogen carbonate.





|  |  |
| --- | --- |
| **Observations** | **Inference** |
| Effervescence, Colourless gas produced1 mark |  Mixture is acidic H+ or H3O+ RCOOH present**Rejec**t F is acidic, accept substance is acidic1 mark |

iv. Describe a test show that the mixture above is unsaturated

|  |  |
| --- | --- |
| **Test** | **Expected observations** |
| **Add few drops of bromine water to the****mixture 1mk** | **Yellow bromine water decolourised 1mk** |

|  |  |
| --- | --- |
| Test 1 |  |
| Observations | Inference |
| Yellow bromine water not decolourised(1mk) | **=c=c, -C ≡C- absent**Accept mixture is not unsaturated(1mk) |