# MECS FORM 4 END OF TERM 2 EXAM CHEMISTRY

Paper 3
December2021
## MARKING SCHEME

A. PROCEDURE I
Table I

| Exp. number | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Time taken (sec) | 12 | 18 | 22 | 32 | 96 |
| $^1$/time (sec$^{-1}$) | 0.0830 | 0.0560 | 0.0450 | 0.0313 | 0.0104 |

a)  Table
   Marking areas
   *i)*  Complete table - **3 marks**

   Penalties /conditions
-  Penalise *½mk* for each space not filled.
-  Reject fractions for 1/Time and award a max of 1½ mks for the table.
-  if fractions appear followed by an extra column of decimals ignore the fractions and award accordingly.
-  penalise *½mk* each for wrong arithmetic in the values of 1/Time not within an error of ± 2 units in the 3rd decimal place unless it divides exactly.
-  Accept reciprocals given to at least 3 decimal places. otherwise penalise *½mk* each for rounding off to the 2nd decimal place to a max of 1mark, unless it divides exactly.
-  penalise *½mk* for every reading <5 and >240 seconds in the time row.
-  penalise *½mk* for each entry not in seconds.

ii)  Use of decimals - 1 mk
   (Tied to the 4th row only)
-  Accept whole numbers or decimals upto the 2nd decimal place only used consistently, otherwise penalise fully.

iii)  Accuracy - 1 mark
   (Tied to 4th row only)
-  Compare the candidates 1st reading to the school's value and if within ±2sec, award 1 mark. Otherwise penalise fully.

iv)  Trend - 1 mark
   (Tied to 4th row only)
-  Award 1mk if time is continuously increasing otherwise penalise fully

b)  Graph - 3marks

   marking areas.
*i)*  Labelling of both axes - *½mk*

   Conditions and penalties.
-  Penalise *½mk* for wrong units used in any of the axis.
-  Penalise *½mk* for inverted axes.
-  Accept if units not shown, otherwise if shown must be correct.
-  Both axes must be labelled.

ii)  Scale - ½ mark
-  are covered by the actual plots including the origin should be ¾ or more of the squares provided in both axes.
-  The scale interval should be consistent.

iii)  Plotting - 1 mark
-  award 1mk if all plots are correctly plotted.
-  award *½mk* if 4 plots correct
-  award 0mk if less than 4 plots correctly plotted.
-  accept plots even if the axes are inverted.
-  accept rounding off the values of 1/Time to the 3rd decimal place when plotting.

iv)  Line - 1 mark
-  Accept a straight line passing through at least 2 points.
   Correctly plotted and through the origin (0,0) for 1 mk.
   OR
   if <u>extrapolated</u> can pass through the origin. (0,0)

c)  Showing 1/T on the graph - ½ mk
-  Stating the correct reading of 1/T at 36cm³ - *½mk*
-  applying the expression that
   $$Time = \frac{1}{correct\ reading}\ \textit{½mk}$$
-  correct answer *½mk*

d)  Rate increases with increase in concentration of hydrochloric acid or vice versa - 1mark

   OR

   Rate of reaction is directly proportion to the concentration.

   Conditions.
-  tied to the correct graph or trend in the table
-  If volume is used instead of concentration award full mark.

## B. PROCEDURE II.
Table II

|  | I | II | III |
|---|---|---|---|
| Final burette reading (cm³) |  |  |  |
| Initial burette reading (cm³) |  |  |  |
| Volume of solution P used (cm³) |  |  |  |

*Use your school value*

Marking areas
I.   Complete table -      1 mark

Conditions
-   award 1mk for complete table with 3 titrations done.
-   award *½mk* for incomplete table with 2 titrations done.
-   Award 0 mark for 1 titration done.

Penalties
-   wrong arithmetic.
-   inverted table.
-   burette readings beyond 50cm³ unless explained.
-   unrealistic titre values i.e. below 1.0cm³ or hundreds.
NB- Penalise *½mk* each. For a maximum of *½mk* penalise once.

II.   use of decimals - 1 mark
      (Tied to 1st and 2nd rows only)
-   Accept either 1 or 2 decimal places used consistently.
-   Accept 2 decimals places only if the 2nd decimal place is 0 or 5.
      NB: Penalise <u>fully</u> is any of the conditions is not net.

III.   Accuracy - 1 mark
       (Tied to the school's value (S.V)

Conditions
-   If any of the titre values is within ± 0.1 of the S.V award 1mark.
-   If any of the 3 titre values is within ± 0.2 of the S.V award *½mk*
      NB: If there is wrong arithmetic compare the S.V with the <u>worked out correct</u> value and award accordingly.

IV.   Principles of averaging - 1 mark
      <u>I + II + III</u> = correct answer
          3

Conditions and penalties.
-   The values to be averaged MUST be within ±0.2 of each other (i.e. consistent)
-   If 3 titrations are done and all are consistent, they must all be averaged.
-   If 3 titrations are done and only 2 are consistent and averaged, award 1mk

-   If 2 titrations are done and are consistent and averaged award 1mark.
-   If the answer is correct but no working is shown award. *½mk*

V.   Final answer - 1 mark
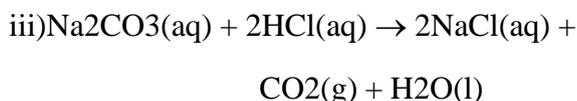     (Tied to the S.V. and to the correct average titre)

Conditions.
-   If within ±0.1 of the S.V - 1 mark
-   If within ± 0.2 of the S.V - ½ mark
-   If wrong values are averaged pick for the candidates correct values. If any and average then for the candidate and award accordingly.

NB: A total of 5 marks

*ii)*   Moles of $Na_2CO_3$ = $\dfrac{0.5M \times 25}{1000}$ *½mk*

                  = correct ans *½mk*

iii) $Na_2CO_3(aq) + 2HCl(aq) \rightarrow 2NaCl(aq) +$

                  $CO_2(g) + H_2O(l)$

Moles of HCl
   = $2 \times$ ans in (ii) above *½mk*
   = correct answer *½s*

iv) Moles of HCl in solution P
   = $\dfrac{100cm^3 \times \text{ans in b(iii) above}}{\text{Average volume}}$ *½mk*
   = Correct answer *½*

v) Moles of HCl in 60cm³ of solution W.
   = $\dfrac{60 \times 2}{1000}$ *½mk*

   = 0.12 moles *½mk*

vi) Moles of HCl reacted with magnesium ribbon.
= Ans in (V) - Ans in (iv) *½mk*
= correct ans *½mk*

vii)  Mass of magnesium present in 2cm ribbon

$Mg(S) + 2HCl(aq) \rightarrow MgCl_2 + H_2(g)$ *½mk*

$L = \frac{1}{2}$

$S = \frac{1}{2}$

$P = 1$

$L = 1$

$\overline{03}$

Y-axis: $\frac{1}{t}$ $s^{-1}$ $\times 10^{-2}$

X-axis: Volume of Hydrochloric acid
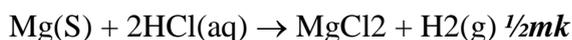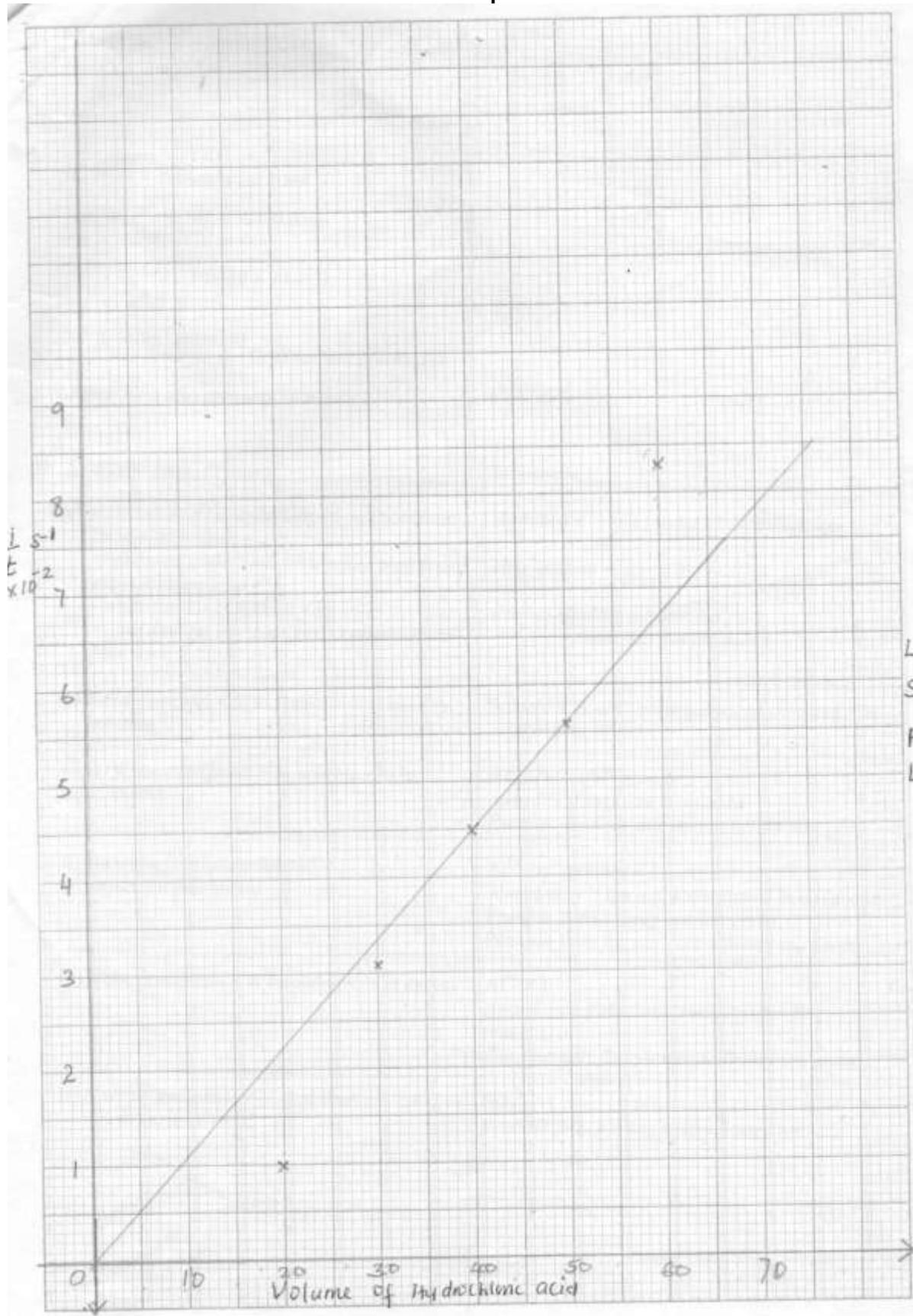
Moles of = ½ × ans b(vi) above **½mk**

   = intermediate answer.

Mass of Mg = Intermediate × 24 **½mk** answer

       = Final answer **½**


Conditions / penalties
penalise **½mk** in the final answer if units are wrong or missing.

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**2.**

| OBSERVATION | INFERENCE |
|---|---|
| a) - colourless ✓½ liquid formed on the colour parts of test tube<br>- red litmus paper turns blue while blue litmus paper remains blue ✓½<br>- white residue is formed ✓½<br>*Award 1mk for any two correct observations Max. 1mk* | Hydrated ✓½ salt / water of crystallisation<br><br>$NH_4^+$ present ✓½<br><br>*Reject: Alkaline gas present<br>    - Ammonia gas produced* |
| b) Solid dissolves ✓½ to form a colourless✓½ solution | Soluble ✓½ salt /  coloured ✓½ionsAbsent |
| c) i) White precipitate ✓½  soluble ✓½ in excess | $Al^{3+}$, $Zn^{3+}$, $Pb^{2+}$ present<br>*Award ½ if only one mentioned<br>Penalise ½mk for any contradictory ion* |
| ii) No white precipitate formed ✓1<br>   Reject: no precipitate | $Al^{3+}$ $Zn^{2+}$ present ✓1<br>Award only if the ion is mentioned in c(i) above<br>Penalise ½mk if only one ion given<br>Penalise fully for any contradictory ion given |
| iii)White precipitate ✓½ insoluble ✓ in excess | $Al^{3+}$ ✓<br>*Award only if the ion is mentioned in c(i)<br>and c(ii) above<br>Penalise fully for any contradictory ion given* |
| iv) A white precipitate ✓½  that does not dissolve ✓½ in nitric (V) acid | $SO_4^{2-}$ ✓1<br>*penalise fully for any contradictory ion* |

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**3.**

| Observations | Inferences |
|---|---|
| a) Burns with a yellow ✓½ / sooty ✓½ / smoky flame | $\diagdown C = C \diagup$ or $-C \equiv C-$ ✓1<br><br>*Accept: unsaturated organic compound for ½mk*<br>*Reject: unsaturated hydrocarbon*<br>  *- alkenes or alkynes written in words* |
| b) i) Effervescence / fizzing / bubbles ✓½ | RCOOH ✓½ or $H^+$ present<br>*- award fully if only RCOOH mentioned*<br>*- penalise fully (deny ½mk) it only $H^+$ mentioned* |
| ii) Potassium manganate (VII) is decolourised ✓1<br>Or<br>Purple potassium manganate (VII) solutions turns colourless<br>Reject: solution is decolourised | $\diagdown C = C \diagup$ ✓½ $-C = C-$ or ROH ✓½ |
| iii) Bromine water ✓1 is decolourised or yellow bromine water turns colourless<br>*Reject: orange / red colour*<br>*- colour changes to colourless*<br>*- solution is decolourised* | $\diagdown C = C \diagup$ or $-C \equiv C-$ ✓1<br><br>*Award fully if only one functional group mentioned*<br>*Penalise fully for any contradictory functional group* |