

Q1. PROCEDURE I

a) Table 1

Award a total of 3 mks distributed as follows:

A Complete table ----- 1 MK

Award 1 mk for complete table with 10 temperature readings.

Penalties / Conditions

- (i) Penalize $\frac{1}{2}$ MK ONCE for any space not filled subject to atleast 5 readings given, otherwise Penalize FULLY, i.e award 0 MK.
- (ii) Penalize $\frac{1}{2}$ MK ONCE for unrealistic temperature readings of less than 10°C and /or greater than 40°C for $t=0$ to $t=1\frac{1}{2}$ minutes and /or temperature reading(s) of greater than 50°C for readings $t=2\frac{1}{2}$ to $t=5$ minutes.
- (iii) Penalise $\frac{1}{2}$ MK if ALL temperature readings are constant.
- (iv) Penalize $\frac{1}{2}$ MK ONCE if temperature reading at $t=2\frac{1}{2}$ minutes is below or equal to the initial temperature reading at $t=1\frac{1}{2}$ minutes.
- (v) If two or more rows of temperature readings are given, Penalize $\frac{1}{2}$ MK on Complete table. However, for use of decimal, accuracy and trend to be credited, the two or more sets of rows MUST meet the criteria provided for each case.

NOTE: Any reading after $t=2\frac{1}{2}$ minutes falls below room temperature ($t=1\frac{1}{2}$ mins) Penalize $\frac{1}{2}$ MK.

B Use of decimals ----- $\frac{1}{2}$ MK

Subject to atleast 2 temperature readings.

- (i) All temperature readings MUST be recorded consistently either as a whole number, to 1 d.p or to 2 d.p's, otherwise Penalize FULLY.
- (ii) If readings are recorded to 1 d.p, then it should be either $\cdot 0$ or $\cdot 5$, otherwise Penalise FULLY.
- (iii) If readings are recorded to 2 d.p's, then it should be $\cdot 00$, $\cdot 25$, $\cdot 50$, $\cdot 75$, otherwise Penalize FULLY.

C. ACCURACY ----- $\frac{1}{2}$ MK

Compare the candidate's value at $t = 1\frac{1}{2}$ mins with the S.V

- (i) If within $\pm 2.0^\circ\text{C}$ of S.V award $\frac{1}{2}$ MK, otherwise award 0 MK for accuracy.

NOTE: If the candidate's value earns the mark, tick (✓) the reading on the table.

- (ii) If no school value is given by the teacher or where the S.V given is unrealistic, sample and average the candidates' values at $t = 1\frac{1}{2}$ mins per session that are close.

However, if candidates' values are too varied, then use KNEC value of 22.5°C as the S.V. (at $t = 1\frac{1}{2}$ mins).

D. Trend ----- (1 MK)

Conditions

- (i) Award the first $\frac{1}{2}$ MK if temperature readings from $t = \frac{1}{2}$ min to $t = 1\frac{1}{2}$ mins are constant

- (ii) Award the second $\frac{1}{2}$ MK for either:

- a) a continuous rise to a maximum followed by a constant at maximum and then a continuous drop.

OR

- b) a continuous rise up to a maximum followed by a continuous drop

OR

- c) a ~~continuous~~ constant at the maximum followed by a continuous drop

OR

- d) a sudden rise followed by a continuous drop.

$\frac{1}{2}$
 $\frac{1}{2}$

3

b) GRAPH - - - - - 3 mks

Award a total of 3 mks distributed as follows.

A. Labelling of axes - - - - - $\frac{1}{2}$ mk

Award $\frac{1}{2}$ mk only if BOTH axes are correctly labelled.

Penalties

(i) Penalize FULLY for ^{inverted} axes.

(ii) Units may or may not be used but if ~~is~~ given MUST be correct, otherwise Penalize FULLY for wrong units.

NOTE: Both axes MUST be marked accordingly before Posting the mark for labelling axes.

B. Scale - - - - - $\frac{1}{2}$ mk

(i) Area covered by the actual plots must be at least half the grid provided, i.e. 7 big squares vertically and 9 big squares horizontally.

(ii) Scale intervals MUST be consistent ON EACH of the axes.

(iii) Scale chosen MUST be able to accommodate all the readings whether plotted or not.

(iv) If the scale is such that it leaves no room for extrapolation, the scale is credited 0 mk.

NOTE

(i) Award for correct scale even if the axes are inverted.

(ii) Penalize FULLY if any of the above conditions is not met.

C. Plotting - - - - - 1mk

Conditions

(i) If 10 or 9 are correctly plotted, award 1mk.

(ii) If only 8 to 5 are correctly plotted, award $\frac{1}{2}$ mk.

(iii) If less than 5 are correctly plotted award 0 mk.

NOTE

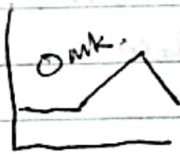
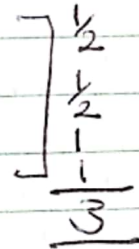
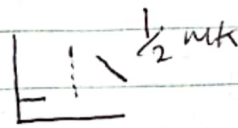
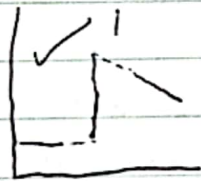
(i) Accept correct plots even if axes are inverted and award accordingly

(ii) If any scale intervals are inconsistent, mark the pts. If any within the first correct interval and treat all the other plots as wrong and award accordingly.

(iii) Mark all the pts on the graph with either a tick (✓) or a cross (X).

D. Shape / Lines ----- (1mk)

- (i) Accept 2 straight lines correctly extrapolated up to $t = 2$ minutes with the initial line being horizontal and the other line a dropping one for 1mk.
- (ii) Accept 2 lines not extrapolated and not joined with the initial line being horizontal and the other a dropping one for $\frac{1}{2}$ mk.
- (iii) Each of the two lines MUST pass through at least 2 correctly plotted points, otherwise award 0mk.



C) Temperature change, ΔT . ----- (1mk)
Conditions

- (i) Accept the correct value of ΔT from the correct graph with or without showing on the graph even if the axes are inverted for 1mk.
- (ii) If shown on the graph correctly but ΔT is either missing or wrong award $\frac{1}{2}$ mk for correct showing on the graph.
- (iii) If not shown on the correct graph, award $\frac{1}{2}$ mk for correct working and another $\frac{1}{2}$ mk for correct ΔT

NOTE:

- (i) Reject reading and showing from a wrong graph (ie a graph that has score 0mk for shape / lines).
- (ii) The units may or may not be shown but if shown MUST be correct, otherwise penalize $\frac{1}{2}$ mk for wrong unit.

d(i) No. of moles of solid A used = $\frac{5.3}{106} = 0.05$ moles

Conditions / Penalties

- (i) If the expression is NOT shown, but answer is correct, award only 1/2 mk.
- (ii) The units may or may not be shown, but if shown MUST be correct, otherwise Penalize 1/2 mk for wrong units used.
- (iii) The 5.3 and 106 MUST be transferred intact, otherwise Penalize FULLY.

d(ii) $\Delta H = 30 \times 4.2 \times \text{Ans (c) above} = \text{correct answer.}$

\therefore Molar enthalpy of solution = $\frac{\text{Correct answer}}{\text{Ans. d(i) above}} = \text{Final correct answer}$
(J mol⁻¹)

OR

$\Delta H = \frac{30 \times 4.2 \times \text{Ans (c) above}}{1000} = \text{correct answer.}$

\therefore Molar enthalpy of solution = $\frac{\text{Correct answer}}{\text{Ans. d(i) above}} = \text{Final correct answer}$
(kJ mol⁻¹)

OR

Molar enthalpy of solution = $\frac{30 \times 4.2 \times \text{Ans. (c) above}}{\text{Ans. d(i) above}} = \text{Final correct answer}$
(J mol⁻¹)

OR

Molar enthalpy of solution = $\frac{30 \times 4.2 \times \text{Ans. (c) above}}{1000 \times \text{Ans. d(i) above}} = \text{Final correct answer}$
(kJ mol⁻¹)

Conditions / Penalties

- (i) Accept correct transfer of ans (c) and d(i) even if rejected in (c) and d(i) above.
- (ii) Penalize 1/2 mk for wrong transfer of either ans. (c) or ans. d(i) or BOTH otherwise Penalize FULLY

for strange figures used.

- (iii) Penalize $\frac{1}{2}$ mk on final correct answer if the negative sign and/or the unit is or are wrong or missing.
- (iv) penalize $\frac{1}{2}$ mk for wrong answer if arithmetic error is outside ± 2 units in the 3rd digit.
- (v) Penalize FULLY for unrealistic final answer if outside the range of $-12.6 \text{ kJ mol}^{-1}$ to $-28.1 \text{ kJ mol}^{-1}$.

PROCEDURE II

e(i) Table 2 ----- 4 MKS
Award 4 distributed as follows:

A. Complete table ----- 1mk

Conditions

- (i) Complete table with BOTH titrations done, award 1mk.
- (ii) Incomplete titration table with ONLY ONE titration done, award $\frac{1}{2}$ mk.

Penalize

- Wrong arithmetic
- Inverted table
- unrealistic titration(s) i.e. titre(s) below 10 cm^3 or in hundreds.
- burette reading(s) beyond 50.0 cm^3 , unless explained.

NOTE

- (i) Penalize $\frac{1}{2}$ mk for each of the above mistakes to a maximum of $\frac{1}{2}$ mk (i.e. Penalize $\frac{1}{2}$ mk ONCE)
- (ii) If NO TITRATION is done, award 0 mk

for complete table as well as for EACH of the other Marking Points.

B. Use of decimals (tied to 1st and 2nd rows only).
----- 1/2 MK

Conditions

- (i) Accept either 1 or 2 d.p.s used consistently otherwise Penalize FULLY.
- (ii) If ~~two~~ ³ d.p.s are used the second d.p should be a "0" or "5" otherwise Penalize FULLY.
- (iii) Accept inconsistency in the use of zeros as INITIAL burette reading(s) i.e 0, 0.0, 0.00

C. Accuracy ----- 1 MK

Compare the candidates correct titre values with the S.V

Conditions

- (i) If at least one titre is within $\pm 0.10\text{cm}^3$ of the S.V, but ~~at least one is within~~ award 1mk.
- (ii) If no titre is within $\pm 0.10\text{cm}^3$ of the S.V but at least one is within $\pm 0.20\text{cm}^3$ ^{of the S.V} award 1/2 MK.
- (iii) If no titre is within $\pm 0.20\text{cm}^3$ of the S.V award 0 MK.

NOTE:

- (i) If there was wrong arithmetic / subtraction in the table, compare the S.V with the worked OUT CORRECT titre(s) and award accordingly.
- (ii) If no S.V is given by the teacher or S.V cannot be worked out from the teacher's titres according to the Principles of averaging, then,
 - (a) Write down all the candidate's' average titres Per Session and sample those that are close and average them to get the S.V.

b) If the candidate's' average titres are too varied then use the KNEC value of 16.5 cm^3 as the s.v.

(iii) Tick (✓) the Candidate's chosen titre on the table, if it earns a mark before posting the mark.

D. Principles of averaging ----- $\frac{1}{2}$ mk. Conditions

- (i) If both titrations are done, are consistent and are averaged correctly, award $\frac{1}{2}$ mk
- (ii) If both titrations are done, are inconsistent and yet averaged, award 0 mk for both Principles of averaging and final accuracy.
- (iii) If only one titration is done, award 0 mk for both PA and FA.

NOTE

- (i) Answer should be expressed to at least 2 d.p.s unless it works out exactly to 1 d.p or whole number otherwise Penalize FULLY.
- (ii) If no working is shown but answer given is correct, credit FULLY.
- (iii) The working under principles of averaging MUST be marked before Posting the Mark.

Penalties

- (i) Penalize FULLY for wrong arithmetic if error is outside ± 2 units in the 2nd d.p.
- (ii) Penalize FULLY if no working is shown and answer given is wrong.

E. Final accuracy _____ 1mk

(Tied to correct average titre)

Compare the candidate's correct average titre with the S.V

Conditions

- (i) If average titre is within $\pm 0.1 \text{ cm}^3$ of S.V award 1mk
- (ii) If the average titre is not within $\pm 0.1 \text{ cm}^3$ of S.V but within $\pm 0.2 \text{ cm}^3$ of S.V award $\frac{1}{2}$ mk.
- (iii) If the average titre is beyond $\pm 0.2 \text{ cm}^3$ of the S.V, award 0mk.

	1
	$\frac{1}{2}$
	1
	$\frac{1}{2}$
	1
	4

Table 3

- (ii) Mark as per table 2. However if the KNEC value is to be used as the S.V, then it is 16.45 cm^3 .

	1
	$\frac{1}{2}$
	1
	$\frac{1}{2}$
	1
	4

NIB Table 2 & 3 check on school value

if realistic / unrealistic

If school value of table 3 is almost double of table 2, it is unrealistic hence sample out candidates' values.

Table 2 and 3 titre values should be more or less the same.

Calculations

$$\begin{aligned} \text{F(i) Molarity of soln A} &= \frac{\text{Ans. d(i) above} \times 1000}{250} \\ &= \frac{\text{Correct ans.} \times 1000}{250} \times \frac{1}{2} \quad \text{I} \end{aligned}$$

OR

$$\text{Conc. of Solution A} = \frac{1000 \times 5.3}{250} = 21.2 \text{ g/dm}^3$$

$$\text{Molarity of Solution A} = \frac{21.2}{106} = 0.2 \text{ M}$$

NOTE

If there is arithmetic error in the intermediate answer of 21.2 g/dm^3 , then award $\frac{1}{2}$ mark for the correct expression and penalize FULLY for the final answer.

OR

$$\text{Molarity of Solution A} = \frac{1000 \times 5.3}{250 \times 106} = 0.2 \text{ M}$$

f(ii) Moles of Na_2CO_3 in 25cm^3 of solution A

$$= \frac{\text{Ans. f(i) above} \times 25}{1000} = \text{correct Ans}$$

OR

$$\frac{5.3 \times 25}{250 \times 106} = 0.05 \text{ moles}$$

OR

$$\frac{\text{Ans. f(i) above} \times 25}{250} = \text{corr. ans.}$$

(iii) Moles of HCl solution B in $V_1 + V_2$

$$= \text{Ans. f(ii) above} \times 2 = \text{correct ans}$$

(iv) Molarity of HCl = $\frac{\text{Ans. f(iii)} \times 1000}{V_1 + V_2} = \text{correct Ans.}$

OR

$$M_{\text{HCl}} = \frac{\text{Ans. f(i)} \times 25 \times 2}{V_1 + V_2} = \text{Correct Ans.}$$

Conditions / Penalties

- (i) Answer d(i) and f(i) to f(iii) MUST be transferred INTACT, otherwise Penalize $\frac{1}{2}$ mk for wrong transfer in each case. However Penalize FULLY for strange figure in each case.
- (ii) Answer f(i) and f(iv) should be expressed to at least 3 d.p.s, unless they work out exactly to 2 d.p.s or 1 d.p. Otherwise Penalize $\frac{1}{2}$ mk for round off in each case.
- (iii) In answer f(i) to f(iv) units may or may not be given but if given MUST be correct, otherwise Penalize $\frac{1}{2}$ mk in each case for wrong units used.
- (iv) Ans. f(iv) should be in the range of 0.1M to 0.5M otherwise Penalize FULLY for unrealistic answer.

22

2. a) Observ.

White ppt $\frac{1}{2}$ formed which is insoluble $\frac{1}{2}$ in excess alkali

NOTE - White ppt in excess (full credit)

- i) Accept white solid / white suspension in place of white ppt
- ii) Reject
 - White solution
 - White substance
 - White particles

Inferences.

Ca^{2+} , Mg^{2+} or Ba^{2+}

NOTE:

- i) Credit 1mk where any 2 of the ions are given
- ii) If only one of the ions is given credit only $\frac{1}{2}$ mk
- iii) Penalize $\frac{1}{2}$ mk for each contradictory ion to a max. of 1mk.
- iv) Ignore mention of Al^{3+} , Zn^{2+} , and Pb^{2+} ions as absent

b) White ppt formed $\frac{1}{1}$

NOTE

- i) Accept white solid / suspension in place of white ppt
 - ii) Ignore mention of 'insoluble in excess' but penalize fully if "Soluble" in excess
- REJECT
- White solution
 - ppt on its own or ppt with a contradictory ~~color~~ colour.

Ca^{2+} / Ba^{2+} Present $\frac{1}{1}$

NOTE:

- i) Credit 1mk for either of the two ions given on its own
- ii) Correct inference tied to Ca^{2+} / Ba^{2+} having been correctly inferred in 2(a) above.
- iii) Penalize fully for any contradictory ion given
- iv) In the absence of Ca^{2+} / Ba^{2+} , credit $\frac{1}{2}$ mk for Mg^{2+} absent subject to having been correctly inferred in 2(a) above as present.

2

2(c)

Observ:

Inferences

No white ppt formed ✓ 1

NOTE:

ACCEPT

- No ppt
- Colourless solution retained
- No observable change for 1/2 mk but accept correct inference and credit accordingly

REJECT

- Colourless solution formed
- No change
- No colour change
- No white substance
- No reaction
- No observation
- No white solution

SO_4^{2-} , SO_3^{2-} , CO_3^{2-}

absent.

- All 3 ions given -- 2mks
- Only 2 ions given -- 1mk
- only 1 ion given ---- 1/2mk

NOTE

Where there's a contradictory ion, mark out 1/2mks and penalize 1/2mk for each contradictory ion to a Max. of 1 1/2mks.

3

d) A white ppt is formed which dissolves on heating.

NOTE:

REJECT

- White solution
- White substance

GENERAL NOTE

Accept ions written in words for only 1/2mk each.

Cl^- / Br^- present

NOTE:

- Credit 1mk for either of the ions given on its own
- Correct inference tied to the white ppt dissolving on heating.
- Penalize FULLY for any contradictory ion given

2

3. a. White ^{1/2} crystalline solid / White ^{1/2} crystals I

NOTE

- i) Accept white solid / white powder for only 1/2 mk.
- ii) Reject solid on its own.
- iii) Colourless crystals (Reject)
- iv) Reject white ppt or white solution.

b (i) Observations

Solid melts and burns with a yellow ^{1/2} luminous and sooty ^{1/2} smoky flame

Inferences



Present

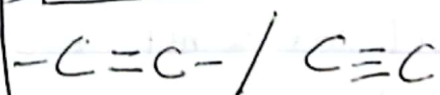
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NOTE

i) Accept either of the following statements given in words in place of the above structures for full credit.

- Unsaturated organic cpd
- Organic cpd with a high C:H ratio
- Aromatic organic cpd
- A long chain organic cpd
- Carbon-carbon double (triple bond) present

ii) Reject



iii) Ignore alkenes/alkynes
Present

- Ignore long chain hydrocarbons

2(ii)

Observations

Inferences

The solid dissolves to form a colourless solution.

NOTE

- i) Reject - Colourless liquid used in place of a colourless solution
- ii) Credit Fully for Colourless solution without the mention of the word dissolving.

- Acidic compound.
- RCOOH Present

2

NOTE:

- i) Accept Carboxylic / alkanolic acid Present for full credit
- ii) Correct inference is tied to solid dissolving
- iii) Ignore H^+ / H_3O^+ Present

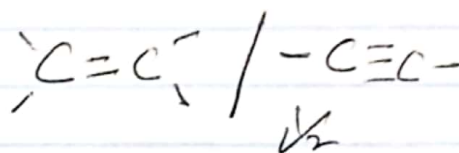
2(iii) - Acidified $KMnO_4$ solution not decolourised

OR

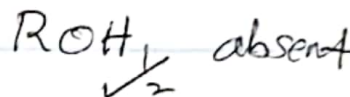
- Purple colour of Acidified $KMnO_4$ solution does not change to colourless.
- OR
- Purple colour of Acidified $KMnO_4$ solution persists / retained / remains

REJECT

- Solution remains purple
- Solution is not decolourised
- Purple colour persists on its own.
- colour of $KMnO_4$ remains / persists / retained.



and



2

NOTES:

In the absence of the above structures, accept the correct inference given in words for full credit. Written as:

- Unsaturated organic compound absent
- Alkanol / Alcohol absent

b(iv)

Observations

Effervescence / bubbles of a
colourless gas / Fizzing

NOTE

REJECT - Hissing
- Fizzling
- Zizzling
- Colourless gas

-COOH

$\begin{matrix} \text{O} \\ \parallel \\ \text{R}-\text{C} \\ | \\ \text{OH} \end{matrix}$
Inferences

R-COOH Present
✓ 1

2

NOTE:

Accept either of the following
if given in place of the
above structure for $\frac{1}{2}$ mk

- i) Carboxylic / alkanoic acid
Present
- ii) Solution is acidic
- iii) H_3O^+ / H^+ Present.

General Note:

- i) Credit fully for inference in b(i) and
b(ii) even if the observation has scored
only $\frac{1}{2}$ mk.
- ii) Penalize Fully for any contradictory functional
group in the inferences in each case.

09