2024 ANDSS 6092 Prelim Paper 3 - Mark Scheme

1 (a) Read all the instructions carefully before starting the experiments in Question 1.

You are provided with salt solution **W** in a boiling tube. You will carry out tests on **W** to deduce its identity.

You should test and identify any gases evolved. Record all your observations in the table.

The volumes given below are approximate and should be estimated rather than measured, unless instructed otherwise.

test	observations
Test 1 Put about 1 cm depth of solution **W** in a clean test-tube. Add 1 cm depth of aqueous sodium hydroxide. Gently warm the mixture.	- no ppt / no visible change / no apparent change - pungent gas turns damp red litmus blue [1] - ammonia / NH_3 is produced [1]
Test 2 Put about 1 cm depth of solution **W** in a clean test-tube. Add an equal depth of dilute nitric acid and then add a few drops of aqueous barium nitrate.	- white ppt [1]
Test 3 Put about 1 cm depth of solution **W** in a clean test-tube. Add an equal depth of dilute nitric acid and then add a few drops of aqueous silver nitrate.	- no ppt / no white ppt / no visible change / no apparent change / solution remains colourless [1]

[4]

(b) Deduce the identity of salt **W**.

ammonium [1] **sulfate** [1] [2]
OR **$(NH_4)_2SO_4$** [2]

2 (a) (i)

shift	titration 1	titration 2	average volume used for accuracy mark [SS results]
01	29.80	29.70	29.75
02	30.00	29.80	29.90
03	29.80	29.80	29.80
04	29.80	29.80	29.80

[5]

Marking Points

format	Record initial burette readings, final burette readings and volume added with correct headings and units in a titration table.	**[1]**
decimal places	**All** burette readings for all accurate titres in titration table are recorded to nearest 0.05 cm^3.	**[1]**
accuracy	**Supervisor's result** 1. For the **average** titre (of consistent readings) within ±0.20 cm^3 of supervisor's average value scores **2 marks.** 2. For the **average** titre (of consistent readings) within ±0.30 cm^3 of supervisor's average value scores **1 mark**.	**[2]**
concordance	At least two titre values are within 0.20 cm^3.	**[1]**

(ii) 1m awarded only when **working for average volume** is shown, correct to **2 decimal places** (reject 3 sf) 1

(b) No. of moles of KOH

$= 0.100 \times \frac{25.0}{1000}$

$= 0.00250$ mol / 2.5×10^{-3} mol 1

(c) ratio of KOH : $H_2C_4H_4O_5$ = 2 : 1

no. of moles of malic acid = 0.00250 ÷ 2 = 0.00125 mol 1

(d) concentration of P 1

= 0.00125 ÷ [(ave. vol. of P) ÷ 1000)]

Note: allow ecf from (c)

2 **(e)** average concentration of malic acid in apple juice 2

= 4.50 ÷ [2(1) + 4(12) + 4(1) + 5(16)]
= 4.50 ÷ 134 } either step shown as working [1]
= 0.03358208955 (at least 5 sf)
≈ 0.0336 mol/dm^3 [1]

(f) Method 1: 2

average volume of apple juice

= [(d) x $\frac{200}{1000}$)] ÷ (e) (at least 5 sf in working) [1]

(final answer to 3sf) dm^3 [1]

Method 2:

average volume of apple juice

= [(d) x $\frac{200}{1000}$) x 134] ÷ 4.50 (at least 5 sf in working) [1]

(final answer to 3sf) dm^3 [1]

(g) There are other acids (besides malic acid) in apple juice / acidic impurities / other acidic substances 1

rejected: other compounds in apple juice

[* Note: overall minus 1 mark for sig. fig. of final answers for (c) – (f)]

3 **(a)** **result for masses** 1

clear unambiguous headings in table with correct units **OR**
clear statements with correct units

mass of container with solid T / g	
mass of container with residual solid T / g	
mass of solid T used (or added) / g	

result for temperature readings

✓ **all** thermometer readings to _**.0 or** _**.5** 1

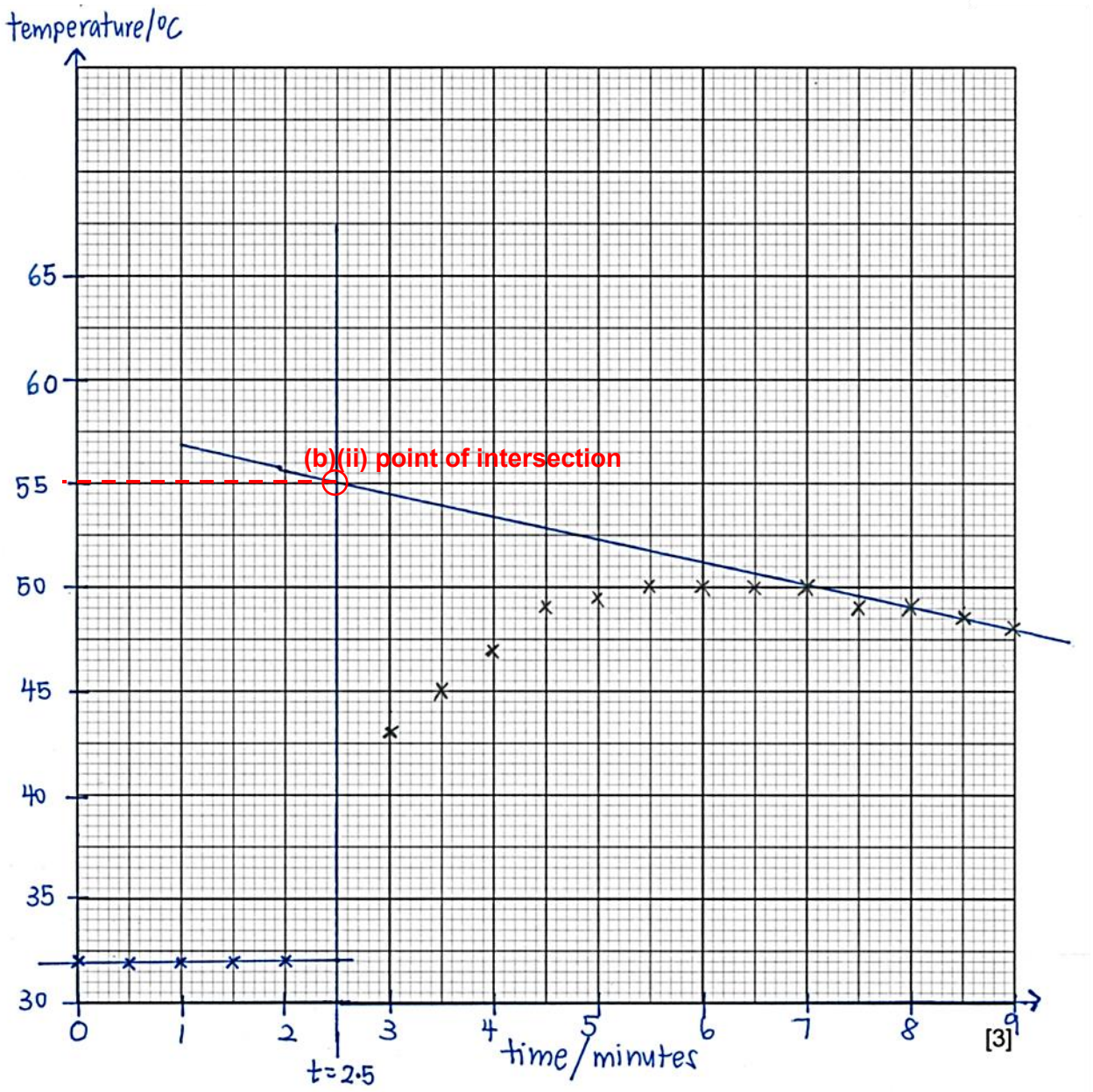
✓ **correct trends** in thermometer readings: 1

O constant / almost constant temperature from 0 to 2 min

O sharp increase in temperature from 3 to about 6 min

O gradual decrease in temperature **OR** temperature remains constant till end of experiment (9 min)

(b)(i) example of sample graph



(b)(i) – axes correctly labelled **AND**
appropriate scales chosen; graph covers at least half the grid **[1]**

– **all** points are correctly plotted **[1]**

– **2 lines of best fit drawn [1]**
(one line before adding T and one line for the cooling of the mixture / constant temperature at second portion)

– **solid vertical line at t = 2.5 min [1]**
(no mark if it is dotted vertical line)

3 **(b)** **(ii)** ✓correct highest temperature from the intersect at 2.5 min on student's graph

✓ correct subtraction to determine theoretical rise

theoretical rise in temperature = **55.0 – 32.0 = 23.0**°C [refer to graph] 1

[reject if student chose a temperature that shows that it is still rising, not following instructions in question]

(c) **(i)** No. of moles of $CuSO_4$

= 0.800 x (30.0 ÷ 1000)

= 0.0240 mol 1

(ii) No. of moles of zinc added 2

= (mass of solid T) ÷ 65 [1]

ratio of **Cu^{2+} : Zn = 1: 1**

no. of moles of zinc is more than the number of moles of $CuSO_4$ (or Cu^{2+}), hence zinc is in excess (OWTTE) [1]

(d) heat energy = 30 x 4.18 x **(b)(ii)** [allow ecf form (b)(ii)]

(**final answer to 3sf) J** (stated in question) 1

(e) 2

$$\Delta H = -\left(\frac{\textbf{non-rounded numbers from (d)}}{0.0240 \times 1000}\right)$$ [1]

– **final answer to 3sf** (stated in question) kJ / mol [1]

Note: award **max of 1 mark** if student used rounded off number for working

(f) displacement / redox / exothermic 1

reject : oxidation alone / reduction alone

(g) Any **one** of the following: [1] 1

- red-brown / brown solid on zinc / red-brown deposit / red-brown ppt
- blue solution becomes pale blue / lighter blue / colourless / fades in colour

4 **key marking points:** max 4

- method stated or implied clearly: chromatography / paper chromatography
- draw a pencil baseline / pencil start line (reject: pencil solvent front)
- use the pointed end of a toothpick to apply a small spot of orange colouring from drink onto the pencil start line of the paper/ chromatogram / paper chromatogram
- as well as samples of both E110 and E129
- depth of solvent (state water or ethanol) in beaker is below base line/ start line / spots on chromatogram
- allow the solvent to travel up the paper for about 10 minutes (suitable time period) so as to separate the components of the samples
- use a ruler to measure the distance / heights of spots from pencil start line of E-colours against orange drink
- **conclusion** based on height of spots from start line / comparison to known R_f values [orange drink will **not** have spots on the same horizontal height as E110 and E129 / different R_f values] [OWTTE]

descriptors	marks awarded
o all 8 points mentioned in proper sequence	4
o 6 points mentioned in proper sequence	3
o 4 points mentioned in proper sequence	2
o 2 points mentioned	1

Note: if clearly-labelled diagram is drawn instead, relevant marks that correspond to the descriptors above can also be awarded