Victoria School
Secondary 4 Preliminary Examination 2024
Suggested Answer to Chemistry Paper 3

<table>
<tr><th>Qn</th><th>Skill</th><th>Answer</th><th>Mark</th></tr>
<tr><td>1(a)</td><td>PDO

MMO</td><td>
Results table:
<table>
<tr><th>experiment</th><th>volume of P /cm^3</th><th>volume of Q /cm^3</th><th>initial temperature of P /°C</th><th>highest temperature of mixture /°C</th><th>temperature rise /°C</th></tr>
<tr><td>1</td><td>40.00</td><td>10</td><td>31.5</td><td>34.0</td><td>2.5 - 3</td></tr>
<tr><td>2</td><td>35.00</td><td>15</td><td>31.5</td><td>35.5</td><td>3.5 - 4.5</td></tr>
<tr><td>3</td><td>30.00</td><td>20</td><td>31.5</td><td>37.0</td><td>5.5 - 6.5</td></tr>
<tr><td>4</td><td>25.00</td><td>25</td><td>31.5</td><td>39.0</td><td>7 – 8</td></tr>
<tr><td>5</td><td>20.00</td><td>30</td><td>31.5</td><td>38.0</td><td>5.5 - 6</td></tr>
<tr><td>6</td><td>15.00</td><td>35</td><td>31.0</td><td>37.0</td><td>4.5 – 5.5</td></tr>
<tr><td>7</td><td>10.00</td><td>40</td><td>31.0</td><td>35.0</td><td>3 - 4</td></tr>
</table>
Results:

Temperature readings to be recorded to nearest 0.5 °C
Ignore if student wrote °C or ‘+’ in the table
Reject if student writes ‘-‘

All temperature rise calculated correctly

All temperature readings within range of teacher’s value.

All results display the correct trend (increase from 1-4, decrease from 5-7, with 5 no more than 4)
</td><td>1

1

1

1</td></tr>
<tr><td>1(b)</td><td>PDO</td><td>
Scale chosen is appropriate and is not accurate (uniform scale chosen to use more than half of each axis); no awkward scale

2 Lines of best fit (equal points on both sides of the graph and any anomalous points ignored) BOD if best fit lines do not cross above highest point *first line must pass through origin. Only 1 anomalous point allowed.

Axes (include labels with units)

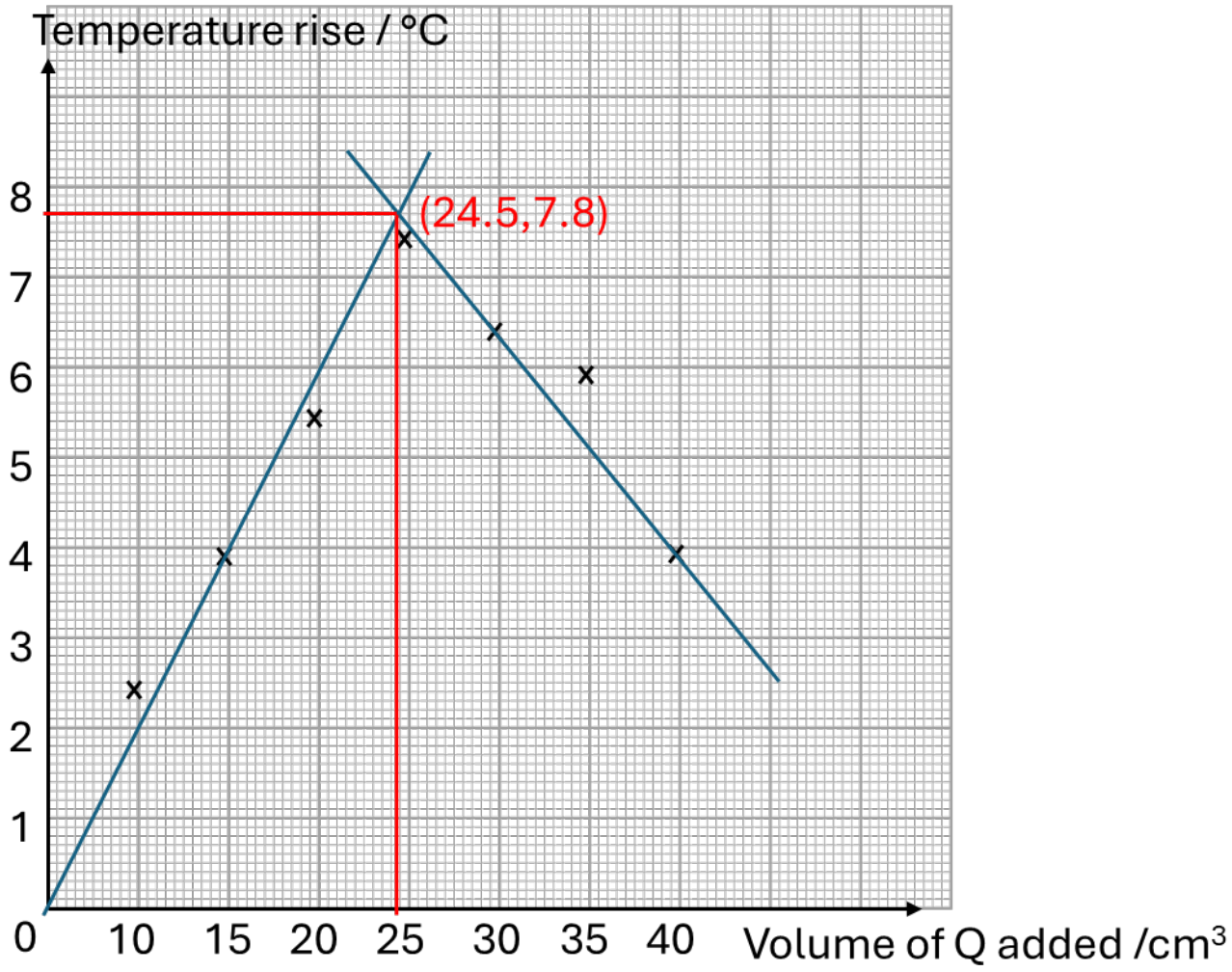
All points plotted correctly (allow error to ½ a square)
</td><td>1

1

1

1</td></tr>
</table>

1(c)	ACE	Correct volume of **Q** read from graph with units shown (24.5 cm^3 ± 0.50). Correct temperature rise read from graph with units shown (7.8 ± 0.10) Working on the graph (Penalize if working is missing)	1 1
1(d)(i)	ACE	$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$	1
1(d)(ii)	ACE	No of mol of NaOH = 24.5/1000 x 1.23 = 0.03014 mol = 0.0301 mol 2 mol NaOH ≡ 1 mol H_2SO_4 No of mol of acid in P = 0.03014/2 mol = 0.01507 mol = **0.0151 mol** UNDERLINED VALUES TO BE TAKEN FROM STUDENT'S GRAPH	 1
1(d)(iii)	ACE	Volume of sulfuric acid = 50 – 24.5 = **25.5 cm^3**	1
1(d)(iv)	ACE PDO	Concentration of sulfuric acid = 0.01507 / (25.5)/1000 = **0.591 mol/dm^3** appropriate units in final answers in **((d)(iii)** (cm^3), **(d)(iv)** (mol/dm^3)	1 1
1(e)	ACE PDO	ΔH = 50 x 1.05 x 4.2 x 7.8 = -1719.9 J Correct sign (-) and appropriate significant figures (1 d.p.) in final answers in **(e)**	1 1
1(f)	ACE	I agree with student A but disagree with student B. (must state but no marks) Both a weak acid and a monobasic acid would result in a lower concentration of H^+ ions and hence a lower maximum temperature. However, the (final) volume of a weak dibasic acid would be the same as that of the sulfuric acid.	 1 1


Temperature rise / °C
8
7
6
5
4
3
2
1
0
10
15
20
25
30
35
40
Volume of Q added /cm3
(24.5,7.8)

<table>
<tr><th>Qn</th><th>Skill</th><th>Answer</th><th>Mark</th></tr>
<tr><td>2a</td><td>PDO

MMO</td><td>Results table:

record initial mass, mass after 2 minutes and final mass, with correct headings and units in a table

<table>
<tr><th>initial mass of conical flask and acid / g</th><th>mass of conical flask and contents after 2 minutes / g</th></tr>
<tr><td>180.06</td><td>181.82</td></tr>
</table>
REJECT: WEIGHT

Results:

Mass record to 2 d.p. or 3 d.p. (Depending on Lab)</td><td>1

1</td></tr>
<tr><td>2b</td><td>MMO</td><td>
<table>
<tr><th>test</th><th>observations</th></tr>
<tr><td>To 1 cm depth of P in a test tube, add aqueous ammonia until no further change occurs.</td><td>Light blue ppt formed 

Blue ppt dissolves in excess (aqueous ammonia) to form a dark blue solution  </td></tr>
<tr><td>To 2 cm depth of P in a test tube, add aqueous sodium hydroxide until no further change is observed.

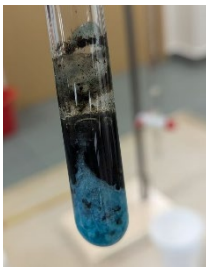
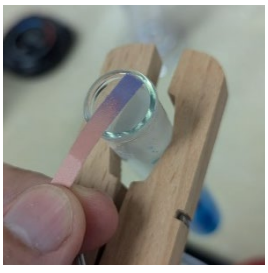
Heat and test any gas evolved.</td><td>Light blue ppt formed 

Light blue ppt insoluble in excess (sodium hydroxide)

Light blue ppt turns black 
BOD: Black solid formed.</td></tr>
</table>
</td><td>1

1

1</td></tr>
</table>

				(Colourless gas evolved) (Gas is pungent) Gas turns <u>moist blue litmus paper red</u> Gas is <u>ammonia</u> *(Marks awarded in Test 2 OR Test 4)* 	1
			To 1 cm depth of **P** in a test tube, add aqueous silver chloride.	No observable changes *(1 mark for Test 3 AND Test 5)* 	1
			To 2 cm depth of **Q** in a test tube, add aqueous sodium hydroxide until no further change is observed. Add a piece of aluminum foil. Heat and test any gas evolved.	Blue/pale blue ppt formed Blue ppt insoluble in excess sodium hydroxide *(Marks awarded in Test 2 OR Test 4)*  Blue ppt turns black / Black solid formed [BOD] *(Marks awarded in Test 2 OR Test 4)*  (Effervescence of Colourless gas) (Gas is pungent) Gas turns <u>moist blue litmus paper red</u> Gas is <u>ammonia</u> *(Marks awarded in Test 2 OR Test 4)* 	

<table>
<tr><td></td><td></td><td><table>
<tr><td>To 1 cm depth of Q in a test tube, add aqueous barium nitrate.</td><td>No observable changes

(1 mark for Test 3 AND Test 5)</td></tr>
<tr><td>To a 1 cm depth of Q, add aqueous potassium iodide until no further change is observed.</td><td>white/cream/yellowish-brown/brown ppt formed
OR
blue solution turned brown
  </td></tr>
<tr><td>Leave the mixture to stand.</td><td>white ppt settles to the bottom
  </td></tr>
</table></td><td>1</td></tr>
<tr><td>2(c)(i)</td><td>ACE</td><td>Tick: Copper(II)</td><td>1</td></tr>
<tr><td>2(c)(ii)</td><td>ACE</td><td>Cation: ammonium/NH_4^+

Moist red litmus paper turns blue, ammonia gas produced.
BOD: Test 2/ Produced ammonia gas after heating with aqueous sodium hydroxide

Anion: Nitrate/NO_3^-

Moist red litmus paper turns blue, ammonia gas produced.
BOD: Test 4/ Produced ammonia gas after heating with aluminum and aqueous sodium hydroxide</td><td>1

1</td></tr>
<tr><td>2(d)(i)</td><td>ACE</td><td>Mass lost = 180.06+2 – 181.82 = 0.24 g</td><td>1</td></tr>
</table>

2(d)(ii)	ACE	$CuCO_3 + 2HNO_3 \rightarrow Cu(NO_3)_2 + CO_2 + H_2O$ No of mol of CO_2 = 0.24 / 44 = **0.005455 mol** 1 mol CO_2 ≡ 1 mol $CuCO_3$ 0.005455 mol CO_2 ≡ 0.005455 mol $CuCO_3$ Mass of $CuCO_3$ = 0.005455 x 124 = 0.6764 g Percentage Purity = 0.6764 / 2 x 100% = **33.8 %** (to 3sf)	 1 1
2(e)	MMO	All mass lost is due to carbon dioxide	1
2(f)	MMO	Plug the mouth of the conical flask with cotton wool. OR Keep weighing the flask until a constant mass is achieved.	1
2(g)	ACE	To remove any carbonate ions (that may give a false positive/interfere with the reaction.)	1
			Total: 17

3	P	1. Measure a fixed volume e.g 20 cm^3, using a measuring cylinder, of 1.0 mol/dm^3 of acidified sodium iodate and transfer into a conical flask/beaker. 2. Add a few drops of starch solution indicator. 3. Measure a fixed volume e.g 20 cm^3, using a measuring cylinder, of 1.0 mol/dm^3 of aqueous potassium iodide and add it to the conical flask/beaker. 4. Start the stopwatch and measure the time taken to the nearest second for blue-black colour to appear. 5. Repeat step 1 to 4 using same volume and concentration of acidified sodium iodate and same volume but varying concentrations e.g. 2.0 mol/dm^3 ,0.5 mol/dm^3 of aqueous potassium iodide. 6. The highest concentration would give the colour change first, while the lowest concentration would give the colour change last. Q1: Constant quantities of KI and $NaIO_3$ and constant concentration of $NaIO_3$ Q2: Varying concentrations of KI A: Suitably sized container, stopwatch, measuring cylinder/burette/pipette M: Take the time using the stopwatch, describe how time is related to concentration.	 1 1 1 1
			Total: 4

Skill	Marks
PDO	10
MMO	12
ACE	14
P	4