Zhonghua Sec
Practical #1 (2025) Ans

Answers for 2025 Prelim Practical

Chemicals: *P: zinc Carbonate Q: iron(II) chloride*

<table>
<tr><th>Qn</th><th>Ans</th><th>Marks</th></tr>
<tr><td>1(a)</td><td>

Refer to class students results.

<table>
<tr><td>mass of vial + calcium carbonate/g</td><td>6,15</td></tr>
<tr><td>mass of empty vial/g</td><td>4.90</td></tr>
<tr><td>mass of calcium carbonate/g</td><td>6.15 – 4.90
= 1.25</td></tr>
</table>

Marking points

1. Header with units -1m
2. Precision (2 d.p) -1m
3. Complete set of readings. -1m
4. Correct calculation of dry mass (2 d.p) -1m

</td><td>4</td></tr>
<tr><td>(b)</td><td>

<table>
<tr><th><u>key sources of error</u></th><th><u>Effect on results</u></th></tr>
<tr><td>- calcium carbonate may not be completely dry</td><td>- mass of calcium carbonate obtained will be greater than expected</td></tr>
<tr><td>- loss of some calcium carbonate during filtration / during transfer into vial</td><td>- mass of calcium carbonate obtained will be lower than expected</td></tr>
</table>

Source of error 1m
Correct effect 1m

</td><td>2</td></tr>
<tr><td>(c)(i)</td><td>

2 $NaHCO_3$ (s) + $CaCl_2$ (aq) → $CaCO_3$ (s) + 2 NaCl (aq) + H_2O (l) + CO_2 (g)

<u>$NaHCO_3$</u>
Mass = 2g
M = 1.0 mol/dm^3
V = 15/1000 dm^3
= 0.015 dm^3

Mr $NaHCO_3$ =23+1+12+(16X3)
= 84

<table>
<tr><th>$NaHCO_3$</th><th>$CaCl_2$</th></tr>
<tr><td>No of mol of $NaHCO_3$ =2/84
=0.0238 mol</td><td>No of moles of $CaCl_2$ = M X V
= 1.0 X 0.015
= 0.015 mol</td></tr>
</table>

According to equation
1 mol of $CaCl_2$: 2 mol of $NaHCO_3$
0.015 mol of $CaCl_2$: 2X 0.015 mol of $NaHCO_3$
= <u>0.03 mol of $NaHCO_3$</u>
Limiting reactant is $NaHCO_3$

</td><td>1
1
1</td></tr>
<tr><td>(ii)</td><td>

2 mol of $NaHCO_3$ reacts to form 1 mole of $CaCO_3$
0.0238 mol of $NaHCO_3$ reacts to form 0.0238/2 mol of $CaCO_3$

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

<table>
<tr><td></td><td>Mass of $CaCO_3$ (theoretical mass) = 0.0238/2 X Mr $CaCO_3$
= 0.0119 X100
= 1.19 g</td><td>1
1</td></tr>
<tr><td>(iii)</td><td>Percentage yield = Student's Actual yield (table) / theoretical yield X100%
= 1.25 g / 1.19 g X100
= 104.63 %

= 105% (3sf – follow instructions)</td><td>1
1

1</td></tr>
<tr><td>(d)</td><td>
<table>
<tr><th>solution</th><th>initial temperature / °C</th><th>lowest temperature reached / °C</th><th>change of temperature/°C</th></tr>
<tr><td>X</td><td>30.0</td><td>22.5</td><td>7.5</td></tr>
<tr><td>Y</td><td>30.0</td><td>14.0</td><td>16.0</td></tr>
</table>
X: ethanoic acid Y: citric acid

Headers with units -1m
Precision (0.5 °C) -1m
Correct calculation of change of temperature -1m
Identities of X and Y -1m
(Y should show a larger change in temperature as the reaction is more endothermic)</td><td>4</td></tr>
<tr><td>(e)</td><td>Use a lid
To prevent convection/ heat transfer / gain or lost from the surrounding</td><td>1
1</td></tr>
<tr><td>2</td><td>Test 1
Gas</td><td></td></tr>
</table>

	- White ppt formed when gas bubbled through limewater (carbon dioxide is formed) Residue - yellow when hot - white when cold	1 1 1
	Test 2 Effervescence / CO_2 produced White ppt formed when gas bubbled through limewater (carbon dioxide) White ppt formed, soluble in excess aqueous ammonia (zinc ions)	 1 1 1
	Test 3 Green ppt formed, insoluble in excess sodium hydroxide	 1
	Test 4 green ppt turns reddish-brown gas evolved relights glowing splint.	 1 1
	Test 5 white ppt formed (chloride ions)	1
(b)	$ZnCO_3$	1
(c)	Iron(II) chloride	1
(d)	Oxidising agent Green iron (II) ions are oxidised to reddish-brown brown iron(III) ions	1 1

3a

Approach
Decomposition of hydrogen peroxide produces oxygen.

5

The effectiveness of the catalyst, thus the rate of reaction, can be determined by either

1. measuring the time take for a fixed volume of oxygen to be collected via water displacement,
2. measuring mass of gas loss

Variables

- change the type of catalyst

Constants

- same volume and concentration of hydrogen peroxide
- same mass of catalysts.

Marking points (5 out of 7 points)

1. Measure the time taken to collect a fixed volume of gas (approach) using copper(II) oxide/ manganese(IV) oxide.

2. Variable to be fixed: same concentration and volume of H_2O_2.

3. Variable to be fixed: same mass of catalysts.

4. Apparatus:

   Either: Collection of gas
   Gas syringe and stopwatch/ water displacement apparatus (measuring cylinder/ burette) and stopwatch

or

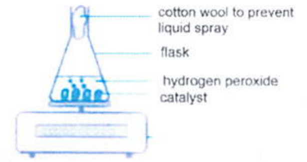
   Alternative method: Mass of gas lost
   electronic balance and stopwatch

5. Repeat with the use of another catalyst, Copper (II) oxide /manganese(IV) oxide

6. Wash, dry and weigh the catalyst. Mass of catalyst remains unchanged.

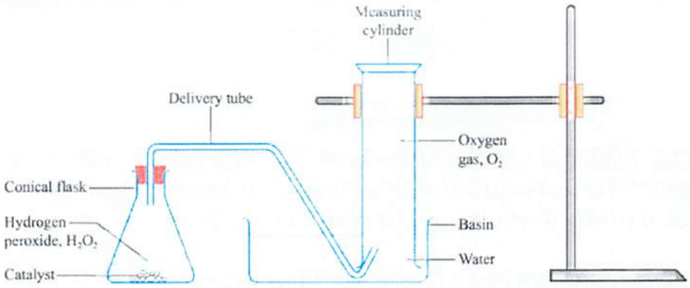
7. Data processing
   Collection of gas: The shorter the time taken, the more effective the catalyst.

==

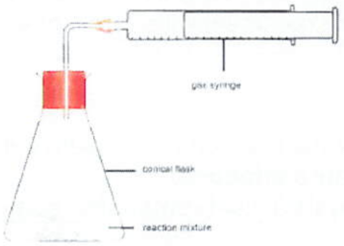
	Method 2 - measuring mass of gas loss  Experimental setup for measuring loss in mass 1. Using 1.00 g of copper(II) oxide as the catalyst and 100.0 cm^3 of 1.0 mol/dm^3 H_2O_2, **record the time taken for the reaction to complete where no further change in mass is observed.** 2. Once experiment had completed, **filter** the reaction mixture. The residue is copper(II) oxide. 3. **Wash** the copper(II) oxide with deionized water and **dry** between filter paper. **Weigh** the dry copper(II) oxide on electronic balance to find the mass. Repeat the experiment with 1.00 g of lead(IV) oxide as the catalyst instead. Conclusion: - The time taken for the reaction to complete will be **shorter for the catalyst that is more effective.** - The mass of catalysts should **remain the same** at 1.00 g.	
b	Either Keep in a cool place / in the refrigerator Or Keep in a dark container	1

Method 1 - measuring the time take for a fixed volume of oxygen to be collected via water displacement,

Water displacement setup



Alternative method - to collect volume of gas using a **gas syringe** is acceptable



Record:

1. Using 1.00 g of copper(II) oxide as the catalyst and 100.0 cm^3 of 1.0 mol/dm^3 H_2O_2. **record the time taken for 50 cm^3 of oxygen gas to be collected in the measuring cylinder/ gas syringe**

2. Once experiment had completed, **filter** the reaction mixture. The residue is copper(II) oxide.

3. **Wash** the copper(II) oxide with deionized water and **dry** between filter paper. **Weigh** the dry copper(II) oxide on electronic balance to find the mass. Repeat the experiment with 1.00 g of lead(IV) oxide as the catalyst instead.

Conclusion:

- The time taken for a 50 cm^3 of oxygen gas will be **shorter for the catalyst that is more effective**
- The mass of catalysts should **remain the same** at 1.00 g.

Marking Scheme Xinmin Sec

Chemistry Preliminary Examination 2025 Practical #2 (2025) Ans

Mark scheme will use these abbreviations

/	alternatives
+	statements on both sides of the + are needed for that mark
R	reject
A	accept (for answers correctly cued by the question)
Ig	ignore as irrelevant
ref	with reference to
ecf	error carried forward
AW	alternative wording (where responses vary more than usual)
AVP	alternative valid point
ORA	or reverse argument
OWTTE	or words to that effect
<u>underline</u>	actual word given must be used by candidate (grammatical variants excepted)
( )	the word / phrase in brackets is not required but sets the context

Paper 3

Qn	Marking Scheme	Marks	Marker's Report
1a	1. 1m – correct volumes of P and water for experiments 3 to 5 2. 1m – record time to nearest second 3. 1m – increasing trend for time taken	max 3	R: Time is not nearest second.

experiment	volume of **Q** / cm^3	volume of **P** / cm^3	volume of water / cm^3	time taken for blue-black colour to appear / s
1	10	25	0	10-16
2	10	20	5	17-24
3	10	15	10	25-35
4	10	10	15	40-65
5	10	5	20	about 200

1b	1. appropriate scale (1) 2. labelled axes (with units) (1) 3. curved line of best fit (1) 4. 5 data points (1) penalize 1 if axes are reversed penalize if students write **vol. amt. temp.**	4	Minus MP4 as long as one point is off.
1c	1. As the volume of P decreases, there are fewer number of reacting particles of P per unit volume 2. Less frequency of effective collisions between P and Q, hence time taken increases. ORA	2	
1d	Use a burette instead of measuring cylinder to measure out solution P / starch solution / water / all solutions.	1	A: using pipette only if the volume is specified and need to state multiple pipettes. R: data logger
1e	(Aim: To determine which catalyst is effective in speeding up the rate of reaction between P and Q.) MP1: steps (a) (i) and (ii). Students must ensure that catalyst is added before they start the stopwatch. MP2: fixed or known mass/volume of catalyst MP3: repeat with remaining catalysts MP4: analysis & conclusion of the results Example: a) Measure out 10 cm^3 of Q using a measuring cylinder and transfer it into a beaker. b) To the beaker, add 2 cm^3 of starch solution using a 10 cm^3 measuring cylinder. (Place the flask and its contents on a white tile.) c) Add 1.0 g of Pb^{4+} catalyst into the beaker. d) Measure 25 cm^3 of P as accurately as possible, using a 25 cm^3 measuring cylinder. e) Pour P into Q and immediately start the stopwatch and swirl the flask. f) When the mixture first turns blue-black, stop the stopwatch and record the time taken. g) Repeat steps a) to f) using 1.0 g of Fe^{3+} and Mn^{4+} catalysts. h) Analysis of results: The catalyst that recorded the shortest time taken is the most effective catalyst. **Alternative response:** MP1: 1. Carry out step (a) (i) of experiment 1.	 1 1 1 1	

	2. Using an electronic balance, weigh and transfer 1g of Pb^{4+} catalyst into the conical flask (Accept if students measure out a known volume of solution with correct apparatus as the state of the catalyst is not known). MP2: 3. Carry out step (a) (ii) in experiment 1 and start the stopwatch. 4. When the mixture turns blue-black, stop the stopwatch and record the time taken. MP3: 5. Repeat steps 1 – 4 using same mass or volume of the Fe^{3+} and Mn^{4+} catalysts. MP4: 6. The catalyst that recorded the shortest time/smallest value is the most effective catalyst. A: the catalyst that allows KI to change colour the fastest is the most effective catalyst.		

<table>
<tr><th>Qn</th><th>Marking Scheme</th><th>Marks</th><th>Marker's Report</th></tr>
<tr><td>2a)</td><td>
<table>
<tr><th>test</th><th>observations for R</th><th>observations for S</th></tr>
<tr><td>Add about 1cm depth of R into a test tube.
Add dilute nitric acid, then aqueous silver nitrate.
Repeat with S.
OWTTE</td><td>No observable change</td><td>No observable change</td></tr>
<tr><td>Add about 1cm depth of R into a test tube.
Add dilute nitric acid, then aqueous barium nitrate
Repeat with S.
OWTTE</td><td>No observable change</td><td>White ppt.</td></tr>
<tr><td>Add about 1cm depth of R in a clean boiling tube.
Add 2 cm depth of aqueous sodium hydroxide, shake the contents and then add a piece of aluminium foil. Heat the contents carefully.
Repeat the test using S.</td><td>(Pungent gas,) turns <u>moist red litmus paper blue</u>. Gas is <u>ammonia</u></td><td>No observable change
Accept:
Moist red litmus paper remained red</td></tr>
</table>
Accept: no visible change/observation/reaction.
Reject: all others e.g. no change seen. Penalize once only, ecf the rest.
</td><td>4
Every 2 correct boxes – 1 m</td><td></td></tr>
<tr><td>2b</td><td>R: HNO_3
S: H_2SO_4</td><td>1</td><td></td></tr>
<tr><td>2ci</td><td>Temperature readings to 1d.p and no units
Correct calculation of temperature change with '+' sign.</td><td>1
1</td><td>Teachers' reading = +6 °C</td></tr>
</table>

2cii	Correct calculation of enthalpy change using the formula. Final answer to 3.s.f **AND correct units**	1 1	Teachers' value = -50.4kJ/mol Second MP not awarded if value is inaccurate or missing the negative sign
2ciii	As the reaction is done in a beaker, there could be heat loss to the surroundings, which causes the temperature measured to be lower than expected. This would result in a less negative calculated enthalpy change. A: lower enthalpy change A: energy loss **AVP**: In order to determine the maximum temperature rise, varying volumes of KOH should be added to varying volumes of acid S. Then a graph should be plotted and the highest temperature rise determined by finding the point of intersection between the 2 lines of best fit.	1 1 1 1	402: Generally, students were able to identify that there will be heat/energy loss to surroundings but could not state the effect on calculated enthalpy change

<table>
<tr><th>Qn</th><th>Marking Scheme</th><th>Marks</th><th>Marker's Report</th></tr>
<tr><td>3ai</td><td><table>
<tr><td></td><td>1</td><td>2</td><td>3</td></tr>
<tr><td>final reading /cm^3</td><td>23.40</td><td>49.20</td><td>33.60</td></tr>
<tr><td>initial reading / cm^3</td><td>0.00</td><td>24.80</td><td>10.00</td></tr>
<tr><td>volume used / cm^3</td><td>23.40</td><td>24.40</td><td>23.60</td></tr>
<tr><td>best titration result</td><td>✓</td><td></td><td>✓</td></tr>
</table></td><td>3</td><td>1 – correct table headings
1 – correct readings from burette to 2dp
1 – correct selection of best titration results

R: vol.</td></tr>
<tr><td>3aii</td><td>23.50cm^3
average volume correctly calculated AND to 2 d.p</td><td>1</td><td></td></tr>
<tr><td>3bi</td><td>No of mol of B = [average volume of B / 1000] x 0.15
[0.00353]</td><td>1</td><td>For all calculation,
- Answers must match working
- credit is award if answer is correct without working
- answers written on the ……… will be the final answer
M1: ECF from (a)(i)
M2: ECF from previous step</td></tr>
<tr><td>3bii</td><td>No of mol of A (in 25 cm^3) = ans / 2
[0.00177 or 0.00176]</td><td>1</td><td></td></tr>
<tr><td>3biii</td><td>No of mol of A (in 1 dm^3) = [answer in (b)(ii)] x 40
[0.0704/0.0705/0.0706/0.0708]</td><td>1</td><td></td></tr>
<tr><td>3biv</td><td>Mass of A = [answer in (b)(iii)] x 90
[6.34/6.35/6.37]</td><td>1</td><td></td></tr>
</table>

3bv	Mass of water = 8.9 – [answer in **(b)(iv)**] [answer in previous step] / 18 3 s.f for all answers in 1(b)(i),(ii),(iii),(iv),(v) [0.142]	1 1 1	
3bvi	[answer in 3**(b)(v)**] / [answer in 3**(b)(iii)**] **AND** whole number [2]	1	
3ci	no effect **AND** number of moles / amount of A is the same	1	
3cii	Add the indicator immediately. If the indicator records a colour that is before the end-point of the titration, the student may continue the titration. / If the indicator records a colour that has overshot the end-point, he may record the reading down and repeat the titration again. Accept: other tests that checks for the presence of acid (e.g., moist red/blue litmus paper/ adding metal or carbonate) as at end-point of reaction, pH will be slightly alkaline. Reject: universal indicator, as not single colour change.	1 1	

Presbyterian high school
Practical #3 (2025) Ans.

2025 CHEMISTRY PRELIM PAPER 3 MARKING SCHEME

1. You are to determine by titration, the volume of dilute hydrochloric acid, **P**, neededto neutralize a volume of **Q**, using methyl orange as an indicator, and thencalculate the concentration of sodium hydroxide present.

Q is mixture containing 0.0150 mol/dm^3 of sodium carbonate.
P is 0.100 mol/dm^3 aqueous hydrochloric acid.

(a) **(i)** Put **P** into the burette.

Pipette a 25.0 cm^3 portion of **Q** into a conical flask. Add **P** from the burette using the indicator provided.
Record your titration results in the space provided, repeating the titration as many times as you consider necessary to achieve consistent results.

[5]

Results

Titration number	1	2	3
Final burette reading / cm^3	26.40	26.40	
Initial burette reading / cm^3	0.00	0.00	
Volume of solution **P** used / cm^3	26.40	26.40	
Best titration results	√	√	

Results table:

- *Record initial burette readings, final burette readings and volume added with correct headings and units in the titration table. [1]*
- *All burette readings for all accurate titres in titration table are recorded to nearest 0.05 cm^3. [1]*

Titration results:

- *Accuracy*
  - *Average titre (of consistent readings) within 0.20 cm^3 of supervisor's average value [2]*
  - *Average titre (of consistent readings) within 0.30 cm^3 of supervisor's average value [1]*
- *Concordance*
  - *At least two titre values are within 0.20 cm^3 [1]*

Comments on errors made:

1. Some still gave their burette readings in 1 d.p

2. Average reading was rounded to 3 s.f.

3. Initial reading came first before final reading.

4. Initial/final volume was stated instead.

- **(a)** **(ii)** From your titration results, obtain an average volume of **P** to be usedin your calculations.

Show clearly how you obtained this volume.

Calculation to 2 decimal places

average volume of **P** ....[1]

(b) **P** is 0.100 mol/dm^3 hydrochloric acid, HCl.

Using your results, calculate the number of moles of hydrochloric acid present.

Assuming titration reading of 26.40 cm^3

Moles of hydrochloric acid present in average volume of **P**
= (26.40 x 0.1) / 1000

= **0.00264 mol**

moles of hydrochloric acid: .... mol[2]

(c) The concentration of sodium carbonate, Na2CO3, in the mixture **Q** is 0.0150mol/dm^3.

Calculate the number of moles of sodium carbonate present in the volumeof **Q**.

Assuming titration reading of 21.70 cm^3

Moles of sodium carbonate in **Q**
= (25.0 x 0.0150) / 1000
= **0.000375 mol**

moles of sodium carbonate: .... mol [2]

(d) Using your answers to **(c)**, deduce the number of moles of hydrochloric acidwhich react with the sodium carbonate present in your volume of **Q**.

Moles of hydrochloric acid reacting with sodium carbonate
= 2 x 0.000375
= **0.000750 mol**

number of moles of hydrochloric acid: .... mol
[2]

1. **(e)** Using your answers to **(b)** and **(d)**, calculate the number of moles of hydrochloric acid which react with the sodium hydroxide in your volume of **Q**.

Moles of hydrochloric acid reacting with sodium hydroxide
= **0.00264** (from part b) – **0.000750** (from part d)
= **0.00189 mol**

[2]

number of moles of hydrochloric acid: .... mol

(f) Using your answer to **(e)**, calculate the concentration of sodium hydroxide in
Q.

Concentration of sodium hydroxide in **Q**
= (**0.00189** x 1000) / 25.0
= **0.0756 mol/dm^3**

[2]

concentration of sodium hydroxide in ....mol/dm^3

(g) A student repeated the experiment and accidentally used a 20.0 cm^3 pipetteto measure solution **Q** into the flask in each titration and did not realise it.
Describe and explain the effect this would have in his results.

Titre value lower than expected [1]

Students calculated concentration of NaOH would be lower than actual value. [1]

[2]

[Total: 18]

- A mixture of two solid compounds **D** and **E** was analysed. [11]

Solid **D** was a salt which is soluble in water. Solid **E** was an insoluble metal carbonate. The tests on the mixture and some of the observations are in the following table.

Complete the observations in the table.

	tests	**observations**
(a)	Add one flat spatula of solid **D** andsolid **E** each in a boiling tube. The mixture was warmed gently.	Green solid / Green Mixture formed after gentle heating. [1]
(b)	Distilled water was added to the resulting mixture of solids **D** and **E** from part **(a)** to at least one-third of the boiling tube.	Green solid formed **insoluble** in the mixture. [1]
	The contents of the tube were filtered.	Colourless **solution** collected as the filtrate. [1]
	Keep the residue for part **(c)** and the filtrate for part **(e)**.	Green **solid** collected as the residue.[1]
(c)	Test on residue: Using spatula, transfer the residue from the filter paper into a test- tube. To this test tube, add about 3 cm^3 of dilute sulfuric acid was added.	Light blue solution [1] formed after adding sulfuric acid. Effervescence seen and white ppt formed in the limewater. [1]
(d)	**(i)** Place 1 cm^3 of the solution from **(c)** to a clean dry test tube. To this test tube, add dilute sodium hydroxide dropwise with shaking, until no further change is observed.	Light blue ppt formed insoluble in excess aq NaOH. [1]
	(ii) Place another 1 cm^3 of the solution from **(c)** to a clean dry test tube. To this test tube, add aqueous ammonia dropwise with shaking, until no further change is observed.	Light blue ppt formed soluble inexcess aq NH3 to give a dark blue **solution** [1]

(e)	Test on filtrate: The filtrate from **(b)** was divided into three approximately equal portions.	
	(i) To the first portion, add drops of aqueous sodium hydroxide, untilno further change.	White ppt formed soluble in excess aq NaOH to form a colourless solution. [1]
	(ii) To the second portion, addexcess aqueous ammonia, until no further change.	White ppt formed soluble in excess aq NH3 to form a colourless solution. [1]
	(iii) To the third portion, add fewdrops of dilute hydrochloric acid and aqueous barium chloride.	White ppt formed upon adding barium chloride. [1]

(f) What conclusions can you draw about the identity of solid **D**? [2]

Provide evidences to explain your

answer. Solid is zinc sulfate.

In part e(i) and (ii), when aq NaOH and aq NH3 was added, white ppt formed soluble in excess aq NaOH and aq NH3 respectively which tells zinc ion is present. [1]

In e(iii), white ppt formed when acidified barium chloride is added, whichtells sulfate ion is present. [1]

(g) What conclusions can you draw about the identity of the cation in solid **E**? Provide **two** evidences to explain your answer. [3]

Cation present in solid E is copper(II). [1]

In part d, blue ppt is formed insoluble in excess aq NaOH. [1] and blue ppt is formed soluble in excess aq NH3. [1]

Note: students must state the test / part of the questions in their evidence.

[Total: 16]

Comments on errors made:

1. Many overly heated the given mixture (despite the question mentioned heat gently- bunsen flame should not be a strong one) as a result they obtained the black solid.

2. When describing the residue and filtrate, the physical state should be stated. For example, green solid and colourless solution and not green residue and colourless/white/clear filtrate.

3. In describing the observation of Cu^{2+} with aqueous ammonia, the student must state that light blue ppt is formed initially, before mentioning it dissolves in excess to produce a dark blue solution, instead of dark blue precipitate.

4. In explaining (f), students should explain which observation corresponds to the deduction of what cation or anion is present, and not simply putting down the observations only.

5. In (g), student needs to be careful in stating "cation is copper" and not copper is present. In fact, stating copper(II) or Cu^{2+} is the more straightforward way.

6. The standard tests for the presence of Cu^{2+} are using aqueous NaOH and aqueous NH_3. As such, students should not use "forming a blue solution when an acid is added to the solid as evidence (since there could be other cations that may give rise to a blue solution-example vanadyl ion, VO^{2+} forms a blue solution in acid).

3. Washing soda are crystals of hydrated sodium carbonate, $Na_2CO_3.10H_2O$.

When exposed to the air, some of the water is lost from the crystals and a new substance is formed.

This process occurs faster in hotter climates. Plan an experiment to determine the percentage of water by mass present in the new substance.

You are provided with common laboratory apparatus.

[6]

Heating to dryness method max [6]:

M1 weigh (any) sample of washing soda to obtain mass of crystals using electronic balance
M2 heat (to remove water of crystallisation)
M3 in named container (must be: evaporating dish)
M4 reweigh & repeat heating
M5 to constant mass
M6 appropriate calculation suggested for the percentage of water mass of water

Comments on errors made:

1. Not stating the use of an electronic balance or simply mentioning weighing scale.
2. Instead of measuring the "mass" of students, they mentioned "weight".
3. Use a crucible/boiling/test-tube/beaker instead of an evaporating dish.
4. Did not mention reweighing and repeat heating to ensure constant mass.
5. Some thought the new substance formed was metal oxide, and carbon dioxide was given off.
6. Instead of taking the loss in mass of the solid over the mass of the solid, students stated over the mass of the "new" substance formed.

[Total: 6]

Chung Cheng High School (Main)
Practical #4 (2025) Ans.

2025 Sec 4 Prelim Chemistry P3 Mark Scheme

Question	Skill	Indicative material	Mark	Total
1(a)	PDO	*Results table:*		**[4]**
		records 7 sets of readings	1	
		record temperature to the nearest 0.5 °C	1	
		correct calculation of temperature change	1	
		correct trend in highest temperature rise	1	
1(b)	PDO	*Plotting of Graph:*		**[4]**
		Plot a graph of highest temperature rise (y-axis) against volume of Q (x-axis)	1	
		Axes labelled with correct units, appropriate scale	1	
		All points plotted correctly.	1	
		Draw two best fit straight line with 1 line passing through origin, intersection of two lines has to be the highest point in the graph	1	
(c)	MMO	Correct determination of volume of Q from intersection of two straight lines. (27.50 cm^3) 2 d.p.	1	**[1]**
(d)	ACE	No, of moles of NaOH = 27.5/1000 x 1.2 = 0.0330 mol	1	**[1]**
(e)	ACE	Volume of P = 50 – 27.5 = 22.5 cm^3	1	**[1]**
(f)	ACE	No. of moles of HA in P = 0.033 mol (e.c.f from (d)) *Award if seen in concentration formula*	1	**[2]**
		Concentration of HA = 0.033/0.0225 = 1.47 mol/dm^3 max 1m if volume is wrong	1	
(g)	ACE	No. of moles of HA in 250 cm^3 = 0.2357 mol	1	**[3]**
		Molar mass = mass/mol (award for correct working) = 20 /0.2357 = 84.9 g/mol	1	
		Correct unit and 3 sig. fig.	1	
(h)	P	- Use a burette to measure volume of Q.	1	**[1]**

		- Repeat each experiment and take the average temperature rise. - (feasible method to reduce heat loss)		

Total: 17

Question	Skill	Indicative material	Mark	Total
2(a)	MMO	Gas evolved produce white ppt with limewater Gas is CO_2. Solid turns yellow on heating /white when cooled.	1 1 1	**[3]**
2(b)	MMO	Gas evolved turns damp blue litmus paper red and then white/bleached OR gas evolved turns damp red litmus paper white/bleached OR Gas bleaches damp litmus paper If student gave positive test for H_2, do not award mark for Cl_2 test Gas is Cl_2	1 1	**[2]**
2(c)	MMO	Solid dissolves to form colourless solution. Ignore effervescence	1	**[1]**
	MMO	White precipitate produced, soluble in excess NaOH (aq) Gas evolved. Damp blue litmus paper remains red/no observable changes to litmus paper Reject: No observable change, no reference to litmus paper	1 1	**[2]**
2(d)	MMO	White precipitate produced, soluble in excess NH_3 (aq)	1	**[1]**
2(e)	MMO	White precipitate	1	**[1]**
2(f)	MMO	No observable changes/no precipitate	1	**[1]**
2(h)	ACE	**R** – $ZnCO_3$ Zn^{2+} present as **X** gives white precipitate that is soluble in excess NH_3(aq) reject: white ppt, soluble in NaOH (aq), **R** gives white ppt (aq NH_3 added to **X**, not **R**) CO_3^{2-} present as CO_2 evolved when **R** is heated. **S** – HC*l* Cl^- ions present as **X** forms white ppt with $AgNO_3$ (aq)	1 1 1 1 1	**[5]**
2(g)	ACE	reducing agent (no mark), reduces NaC*l*O to Cl_2 / decreases oxidation state of C*l* from +1 in NaC*l*O to 0 inCl_2 Reject: S is reducing agent as it is oxidised.	1	**[1]**

Total: 17

Question	Skill	Indicative material	Mark	Total
3	P	Apparatus: weighing/electronic balance	1	**[6]**
		Assumption: no other ions precipitated	1	
		Procedure: 1) Add excess aqueous silver nitrate into seawater (or any idea of excess)	1	
		2) Filter, wash and dry the residue	1	
		3) Measure mass of the residue	1	
		Reject: • Add equal volume of aqueous silver nitrate (no evidence of excess) • Crystallisation [no mark for steps 2 and 3]		
		Allow: use different volume of seawater but note calculation of concentration		
		Calculation (mark independently): No. of moles of AgCl = mass / 143.5, (no. of moles of Cl^- = no. of moles of AgCl) Concentration = (mass/143.5)/0.1	1	
				Total: 6
				Question paper total: [40]

Practical #5 (2025) Ans

TANJONG KATONG GIRLS' SCHOOL
PRELIMINARY EXAMINATION
SECONDARY FOUR EXPRESS

CANDIDATE NAME: ANSWERS

CLASS	4			INDEX NUMBER		

CHEMISTRY

6092/03

Paper 3 Practical Test

5 August 2025

1 hour 50 minutes

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on all the work you hand in.
Write in dark blue or black pen.
You may use a HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Answer all questions in the spaces provided on the Question Paper.

The use of an approved scientific calculator is expected, where appropriate. You may lose marks if you do not show your working or if you do not use appropriate units.

Qualitative Analysis Notes are printed on page **13**.

The number of marks is given in brackets [ ] at the end of each question or part question.

Shift
Laboratory

For Examiner's Use	
1	
2	
3	
Total	

This document consists of **13** printed pages and **1** blank page.

1 You are going to investigate the reaction between aqueous copper(II) nitrate and aqueous sodium carbonate.

Step 1: Label the test-tubes 1, 2, 3, 4 and 5 and place them in order in the test-tube rack.

Step 2: Use the measuring cylinder to pour 5.0 cm^3 of the 1 mol/dm^3 of aqueous copper(II) nitrate into each of the five test-tubes.

Step 3: Using another measuring cylinder, add 1.0 cm^3 of 1 mol/dm^3 of aqueous sodium carbonate to test-tube 1. Using the glass rod, carefully stir the contents of the test-tube. **Repeat for steps 4 to 7**. Rinse the glass rod with distilled water before stirring it in each test-tube.

Step 4: Add 2.0 cm^3 of 1 mol/dm^3 of aqueous sodium carbonate to test-tube 2.

Step 5: Add 3.0 cm^3 of 1 mol/dm^3 of aqueous sodium carbonate to test-tube 3.

Step 6: Add 4.0 cm^3 of 1 mol/dm^3 of aqueous sodium carbonate to test-tube 4.

Step 7: Add 5.0 cm^3 of 1 mol/dm^3 of aqueous sodium carbonate to test-tube 5.

Leave the contents of the test-tubes to stand for 15 minutes.

You should start Question 2 while you are waiting for the solid formed in the test-tubes to settle.

(a) After 15 minutes, use a ruler to measure the height of the solid formed in each test-tube. In Table 1, record the volume of 1 mol/dm^3 of aqueous sodium carbonate added, and the height (in cm) of the solid formed in each test-tube. Include appropriate headings in Table 1.

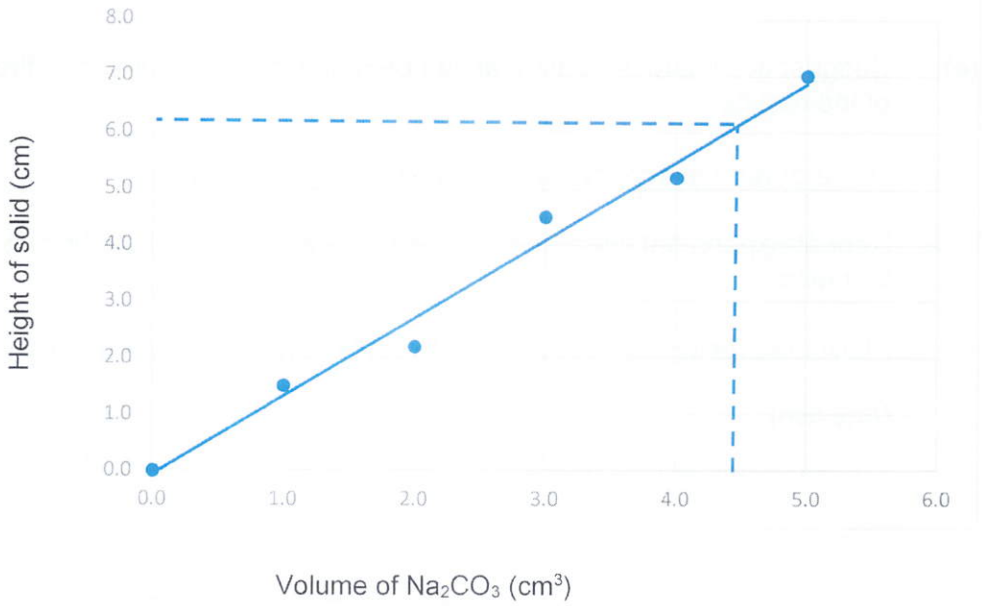
Table 1

test-tube number	Volume of Na_2CO_3 (aq) / cm^3	Height of solid / cm
1	**1.0**	**1.5**
2	**2.0**	**2.2**
3	**3.0**	**4.5**
4	**4.0**	**5.2**
5	**5.0**	**7.0**

[4]

Volume of Na_2CO_3 (aq) in cm^3 measured to 1 d.p	[1]
Height of solid in cm measured to 1 d.p. (allow mm measurement to nearest whole number)	[1]
Appropriate heading and correct units	[1]
Full set of data shows • correct volumes of Na_2CO_3 (aq), according to question • height increasing with test-tube number	[1]

(b) On the grid provided, plot a graph of height of solid against volume of aqueous sodium carbonate added.



Axis labels and correct units (based on table of values)	[1]
Appropriate axis and scale must include (0,0) origin (vertical: height of solid / cm; horizontal: volume of aqueous Na_2CO_3 added / cm^3).	[1]
All points plotted correctly from table of values	[1]
Best fit line that **uses all/most points** and starts from origin Line can be straight or curved, whichever is **more suitable** (ECF if already penalised for axis not including origin)	[1]

[4]

(c) Describe the trend in the height of the solids formed in test-tubes 1 to 5.

The height of the precipitate generally increases as the volume of aqueous sodium carbonate added increases [1].

....[1]

(d) From the graph, deduce the height of the solid formed when 0.0045 moles of aqueous sodium carbonate is added to 0.005 moles of copper(II) nitrate.

Value from graph with unit (indicated with dotted line) when 4.5 cm^3 of aqueous sodium carbonate is added to 5 cm^3 of copper(II) nitrate.

....[1]

(e) Suggest two improvements that can be made in order to improve the accuracy of the results.

Use a burette to add the copper(II) nitrate to the test tubes.

Repeat experiment twice and calculate average height of precipitate for each test tube.

Allow the precipitate a longer time to settle to the bottom of the test-tube.

[Any two]

....[2]

[Total: 12]

2 Water of crystallisation refers to the water molecules bonded to the lattice structure of ionic compounds.

You are going to investigate the enthalpy change, ΔH_{hyd}, when anhydrous sodium carbonate, Na_2CO_3, converts to hydrated sodium carbonate, $Na_2CO_3.10H_2O$.

One way to determine the enthalpy change is to measure the changes in temperature when samples of anhydrous sodium carbonate and hydrated sodium carbonate are added separately to excess hydrochloric acid.

Read all the instructions carefully before starting the experiments in Question 2.

Instructions

You are going to carry out two experiments.

X is 2.2 g of anhydrous sodium carbonate, Na_2CO_3.

Y is 5.5 g of hydrated sodium carbonate, $Na_2CO_3.10H_2O$

Z is 1.50 mol/dm^3 hydrochloric acid, HCl.

(a) Experiment 1

Place a Styrofoam cup into a 250 cm^3 beaker.

Transfer 25.0 cm^3 of **Z** into the cup using the 25 cm^3 measuring cylinder. Measure the temperature of **Z** and record the value in the table.

Pour all of **X** into the acid in the cup. Stir, using the thermometer, and measure the highest or lowest temperature reached. Record this temperature in the table.

Experiment 2

Repeat *Experiment* 1 using the Styrofoam cup, but use **Y** in place of **X**.

Complete Table 2 and calculate the temperature change for each experiment.

Table 2

experiment	initial temperature of Z /°C	highest or lowest temperature of Z /°C	temperature change /°C
1	**30.0**	**38.5**	+ **8.5**
2	**30.0**	**21.0**	**-9.0**

All four thermometer readings recorded to .0 °C or .5 °C.

ΔT calculated correctly using $T_{final} - T_{initial}$ with negative sign for Experiment 2. Experiment 1 temperature increase AND experiment 2 temperature decrease

Full set of data

2 correct answers= 1mk

[3]

(b) **(i)** The amount of heat transferred in the experiments can be calculated using the expression shown.

Heat transferred (J) = mass of solution (g) x maximum temperature change (°C) x 4.2

Use this expression to calculate, in J, the amount of heat transferred in each experiment.

Assume that 1.0 cm^3 of solution has a mass of 1.0 g.

Heat transferred in Experiment 1 = 25 x 4.2 x 8.5 = 892.5 J **[1]**

Heat transferred in Experiment 2 = 25 x 4.2 x 9.0 = 945 J **[1]**

Allow ECF from incorrect ΔT

Answers to be in 2-3 sf

Experiment 1 with X: heat transferred = ...J

Experiment 2 with Y: heat transferred = ...J [2]

(vii) A student carrying out the experiment with an anhydrous sodium carbonate, **X**, could not find 1.50 mol/dm^3 hydrochloric acid. The student used the same volume of 0.750 mol/dm^3 sulfuric acid instead.

Predict the effect on the change in temperature obtained by the student. Assume the same mass of **X** was used.

There will be no change or no effect on the temperature change [1]

Since sulfuric acid is a dibasic acid, it will have the same mole/concentration of H^+ ions as the 1.50 mol/dm^3 of HC*l*. [1]

....[2]

[Total: 15]

3 **Read all the instructions carefully before starting the experiments in Question 3.**

You are provided with a mixture of two solids, **J** and **K**, which are both salts. **J** is soluble and **K** is insoluble in water.

Carry out the following tests and record your observation. You should test and name any gas evolved. If no change is observed for a test, write 'no observable change'.

Instructions

(a) Add 3 spatulas of the mixture to a boiling tube. Add a 6 cm depth of distilled water to the mixture. Stopper the boiling tube with a rubber bung and shake the mixture for a minute.

Filter the mixture and keep the residue for tests later.

Tests on filtrate

Divide the solution into two equal portions in two test-tubes.

test	observations
Test 1 To the first portion of the solution, add about 1 cm depth of aqueous sodium hydroxide and shake the contents.	No observable change.
Heat the contents carefully and test any gas evolved with damp litmus paper.	Pungent gas evolved turns **moist red litmus blue**. Gas is **ammonia / NH_3.** [both answers=1 mk]
Test 2 To the second portion of the solution, add a 1cm depth of dilute nitric acid into a test-tube. Add a few drops of aqueous silver nitrate.	White ppt formed. **[1]**

Test on residue

test	observations
Test 3 Use a spatula to transfer some of the residue into a test-tube.	
Add dilute hydrochloric acid to a depth of approximately 3 cm.	**Effervescence.** Gas forms white ppt in limewater. Gas is CO_2 [1]
To the solution formed, add about 1 cm depth of dilute sulfuric acid	White ppt formed [1]

[4]

(b) Deduce the formulae of the cation and anion present in solid **J**.

cation: **NH_4^+**

anion: **Cl^-**

[2]

(c) Using your knowledge on solubility rules, suggest the identity of solid **K**. Use your observations to explain how you reached the conclusion.

solid **K** barium / calcium / lead carbonate **[1]**

When hydrochloric acid is added to the residue, effervescence is formed indicating the anion is a carbonate. White ppt formed when sulfuric acid is added indicating the cation can be either Ba^{2+}, Ca^{2+} or Pb^{2+}. **[1]**

.... [2]

(d) A farmer would like to fertilise his soil with the fertiliser ammonium sulfate, $(NH_4)_2SO_4$.
He took a sample of the soil from his farmland and would like to find out the amount of ammonium sulfate fertiliser already present in the soil.

You are **not** to use precipitation method to answer.

With the help of a chemical equation, outline a method to determine the mass of sulfate ions present in the soil.

- **Dissolve** a known mass (e.g 5.0 g) of the soil sample in **water**.
- **Filter** the mixture and **collect ammonium sulfate** solution as **the filtrate**.
- Add **excess NaOH** to the filtrate and warm. **Use a gas syringe** to collect the **volume of ammonia gas** produced.

$$(NH_4)_2SO_4\,(aq) + 2NaOH\,(aq) \rightarrow Na_2SO_4\,(aq) + 2NH_3\,(g) + 2H_2O(l)$$

- Find the **number of moles of ammonia gas and ammonium/sodium sulfate:**

Moles of ammonia gas = $\frac{\text{Volume of ammonia gas}}{24000}$

Number of moles of sodium sulfate = $\frac{\text{Number of moles of ammonia gas}}{2}$

- Number of moles of sodium sulfate = Number of moles of sulfate (SO_4^{2-})
- Calculate mass of sulfate (SO_4^{2-}): **Number of moles X molar mass**

....[5]

[A] Approach (correct concept) Ammonium salt reacts with alkali to form salt, NH_3 gas and water Reject: Precipitation method	[1]
[P] Procedure • Dissolve a known mass of soil in water and filter • Add excess NaOH and measure NH_3 gas using a gas syringe	[1] [1]
[DP] Data Processing • Chemical equation (correct reactants and products with proper balancing) • Show correctly how the number of moles of ammonia and the mass of sulfate are formed	[1] [1]

[Total: 13]

Common mistakes:

- Did not dissolve soil in water and filter, add NaOH (aq) immediately instead
- React ammonium sulfate with acid (HC*l*) to form ammonia/hydrogen gas instead of alkali
- Use precipitation method instead (did not read the question carefully)
- Heat the ammonium sulfate solution to get sulfate ions and calculate the mass
- Incorrect or unbalanced chemical equation for the reaction between ammonium sulfate and alkali.