

AS Level Chemistry Paper 3

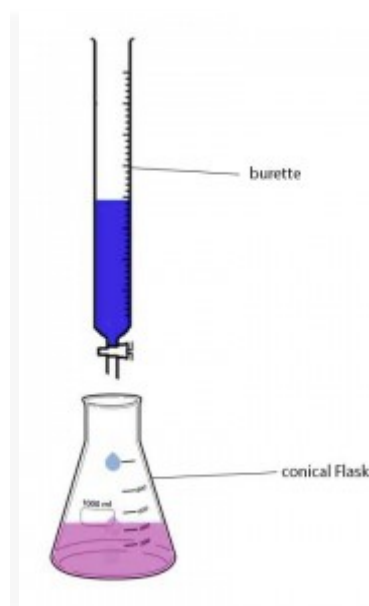
Titration:

Burette can be started from any point. The first titre must be from about 26 cm^3 because we don't know how much volume will be needed. but rest of them can be started from any value which allows you to measure the volume. Let's say that rough titre was 23 cm^3 you can start the next titration from 15 cm^3 because you know $15+23=38$ which is inside the 50 cm^3 range of burette. But if the rough titre is 38 cm^3 and you start from 15 cm^3 then you will be in trouble.

The two best titre must be consecutive as well as within 0.1 cm^3 . If first titre was 23.40 , second was 23.10 and third was 23.50 then first and second can not be best titres. the reason is obvious. the second titre was more accurate than first and third.

If first two titres are within 0.1 cm^3 then there is no need for third titration. If you think that any reading is not correct because it is out of pattern or too far away from line of graph circle that point on graph, again take that reading on the same table but on new row, and then plot new point.

All readings on table must be consistent. All your burette readings must be given to the nearest 0.05 cm^3 . For example if your volume comes out to be 24.1 cm^3 , then don't write it as 24.1 cm^3 rather write it as 24.10 cm^3 .



Always beware of endpoints. Whenever you know the end point is near, add the solution in burette drop by drop and close tap when the end point is reached without



overly-titrating. An example of good titration (#1) and over-titration (#2) (*bad titration*) is shown on the left.

All readings should be in a single organized table. **1 MARK** would be deducted otherwise. An example of a good table for recording readings while performing titrations is given below (you may memorize this table!):

	1	2
Initial Burette Reading / cm^3		
Final Burette Reading / cm^3		
Titre / cm^3		
Best Results (✓)		

In the table, the headings and their units have separate marks. Write Temperature/C or temperature (C) but T/C or temperature C are not allowed. Full name of quantity must be used. Writing V for volume might be acceptable but 'T' is not acceptable as it may have been used for temperature or for time.

Measuring Mass:

Using the Electronic Balance:

- Before measuring any mass, press the **"tare"** button to make sure that the initial reading is zero.
- Make sure that the electronic balance is clean with no residues on it. Blow lightly if you feel there are any.
- The precision of the electronic balance is up to 2 decimal places e.g. 13.45 g.
- **Units:** Electronic balance measure in grams, so always write units ("g", "/g", or "grams") beside every reading.
- All recordings should be made in a single table. Otherwise your **1 Mark** will be on stake.
- As already stated, the headings and their units have separate marks. Write **mass/g** or **mass (g)** but **m/g** or **mass g** are not allowed. Full name of quantity must be used.

Below is a table that may be used for recording Masses:

	Exp. 1	Exp. 2
Mass of empty test-tube / g		
Mass of empty test-tube + Sample X / g		
Mass of test-tube + residual Sample X / g		
Mass of sample X used / g		

Measuring Temperature:

There're only a few tips relating to this measurement. First, always stir the mixture before recording the temperature. Second, when measuring temperature, make sure that the thermometer is not taken out from the solution.

Calculations:

This is an easier yet trickier part of the paper. Mostly, it will involve calculations regarding moles, enthalpy changes etc.

In this part of the the paper, keep the following things in mind:

- **3 significant figures:** Calculation should be done to 3 significant figures. Remember that there's a difference between 3 significant figures and 4 significant figures. 25.6 is 3 significant figures and 25.60 is 4 significant figures & 2 decimal places. 25.659 is 25.7 when read to 3 significant figures. **(1 Mark)**
- **Working:** Show your working in calculations, and the key steps in your reasoning.
- **Calculations involving enthalpy:** In calculations involving enthalpy, never forget to put a negative sign (-) before exothermic, and positive sign (+) before endothermic reactions.

Errors & Improvements (Enthalpy experiments):

Sr. No.	Errors	Improvements
1	Heat loss to surrounding	• Lid – prevents convection or evaporation • Insulation – prevents conduction • Use plastic beaker – provides insulation
2	Thermometer does not have good precision	Use thermometer at 0.5°C or better, gives smaller % error
3	Use of glass beaker	Polystyrene cup – lower heat capacity
4	Small temperature fall	Use larger quantities of reacting substances. e.g. Larger mass of NH_4Cl or smaller water volume. Gives greater temperature change

* Please note that these are not the only possible errors & improvements. There may be more as well depending upon the nature of the experiment.

Graphs:

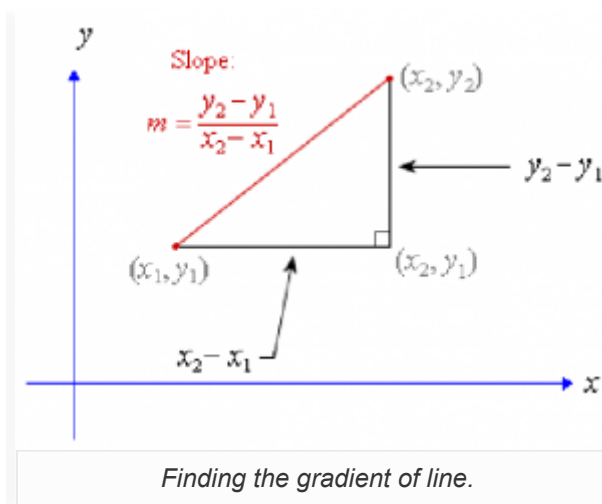
Layout:

The best fit line has to be drawn, which means that line must an average of all the values. The scattering of point must be uniform: number of points above and below the line must be same. The axes must be labelled with the quantity and it's units. Values on axes must be written. While plotting, odd scales such as using 10 blocks to represent 3 units is not acceptable. All of the points must be plotted. However, if you suspect one of them is wrong (anomalous point), plot it and then you **MUST** circle it, otherwise you will lose a mark if you do not circle it.

Your graph should cover more than half of the provided graph paper along both axes. For example if the graph paper provided has 12 big squares along y-axis and 12 along x-axis, then your graph should cover **ATLEAST** 6 boxes along x-axis and 6 boxes along y-axis.

Gradient:

When calculating gradient for a line, always remember to draw a large triangle on the graph paper (**1 Mark**). The triangle should be drawn next to the points where the gradient has to be calculated as shown on the right.



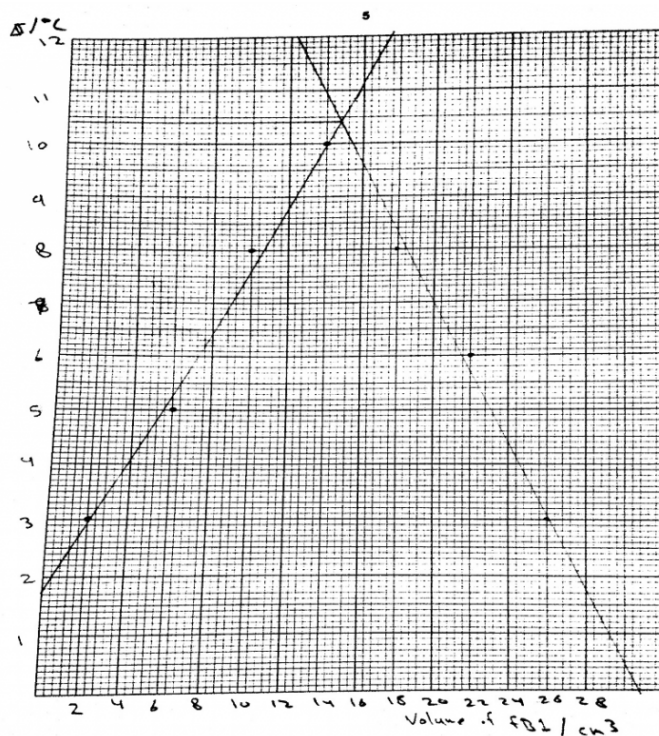
Extrapolating graphs:

There are some practicals where you are required to take maximum temperature change. The change in temperature increase and then fall. By drawing two lines and extrapolating them you need to find the maximum temperature change and where it occurs. In others you need to extrapolate the line where the value is constant after certain readings and you need to extrapolate the two lines and find where they intersect.

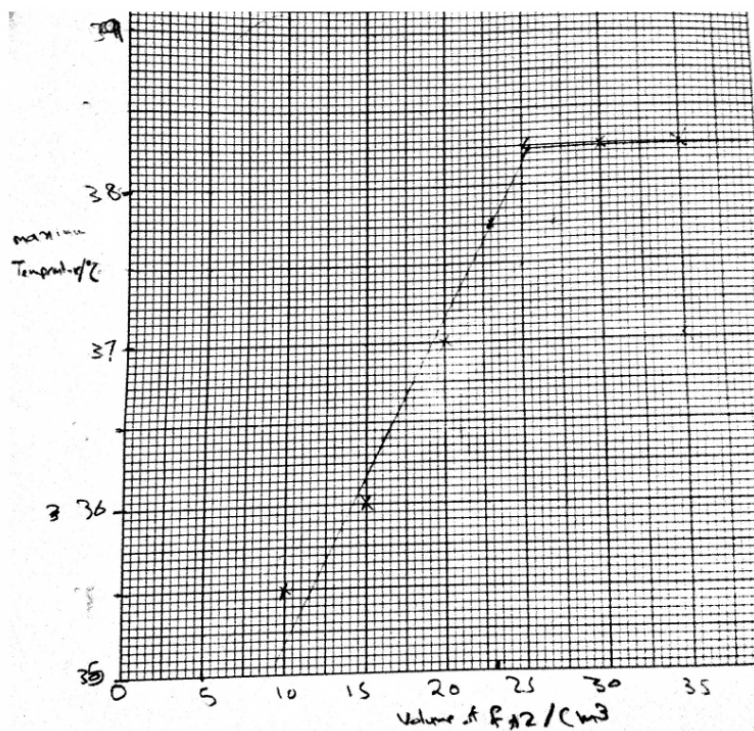
Markscheme:

- 1 *Layout:* axes labeled with quantities + units.
- 2 *Layout:* line is best fit + intersects + plotted close to 1 mm of the value from table
3. *Quality:* close to 1 degree of the max temp of supervisor

Marks of these can vary depending on question and its demand. From the samples given below, you can see example of drawing best-fit as well as extrapolating.



Extrapolating Example 1



Extrapolating Example 2

Salt Analysis:

Always write observations by looking at observations mentioned in the salt analysis data given at the back of the question paper. Find a close match to your observations from the sheet, and copy the same wordings of the observations given in the data sheet. There'll be rare cases when you'll be unable to find a match. In that case, write down whatever you see.

Moreover, always write proper bench reagents when you are asked to state certain reagents. Never write like H^{+1} or $\text{Cr}_2\text{O}_7^{-2}$, rather write names of proper bench reagents like $\text{HCl}_{(\text{aq})}$ or $\text{HNO}_{3(\text{aq})}$ or $\text{K}_2\text{Cr}_2\text{O}_7$ etc.

When you stir the boiling tube, don't let the stirrer touch or strike the bottom of the tube. Whenever heating let the tube give time to heat. First heat gently then strongly. Keep the tube oblique. This way your tube will never break. It's what my experience had taught me. When adding NaOH or NH_3 for ion testing, add a few drops first (**DO NOT ADD A DROPPER FULL OF REAGENT AT ONCE**). Your eye must be close to the top level of the reagent in test tube. When a precipitate is observed, add the reagent in excess to almost $\frac{2}{3}$ of the test tube. Don't use more than 1 cm^3 of the reagent because it will have more precipitate which will take more NaOH or NH_3 to dissolve; this can confuse you into thinking that ppt is insoluble.

Distinguishing between Pb^{+2} / Al^{+3} :

- NaOH / NH_3 reagents when used for identification of these ions give similar results (observations).
- PbCl_2 , PbI_2 , PbSO_4 , PbCr_2O_7 or PbCrO_4 , is insoluble. Use the following reagents; HCl , KI , $\text{K}_2\text{Cr}_2\text{O}_7$ or any other reagent that contains the ions mentioned above. The insolubility of the afore-mentioned lead compounds can help us distinguish between the Pb^{+2} and Al^{+3} ions.
- Also, take care about other possible precipitates that might confuse your results. For example, BaCl_2 (aq) contains Cl^{-1} and can be used to test for Pb^{+2} ions but the presence of Ba^{+2} ions makes precipitates of its own, so always use reagents which have Na^{+1} , K^{+1} , or H^{+1} ions which always make soluble compounds, reducing the possibility of any other precipitates, except for the precipitates formed by Pb^{+2} .

Distinguishing between Ba^{+2} / NH_4^{+1} :

- Both give no precipitate with NaOH or NH_3 except that NH_3 is produced on warming NH_4^{+1} with NaOH . Ba^{+2} can be identified by H_2SO_4 , it will give white precipitate.

Test for Manganese Mn^{+2}

- Mn^{+2} can be identified with NH_3 / NaOH . With these reagents, it has a white / pale brown ppt which turns brown when in contact with air and is insoluble in excess of the reagent. There would be brown residues floating on the top surface, and on the sides of the test tube, and white ppt/light brown ppt at the bottom.

Tests for Cu^{+2}

- *With NaOH :* pale blue ppt insoluble in excess.
- *With NH_3 :* Blue ppt which dissolves and forms a dark blue solution in excess. It will be hard to dissolve the precipitate if too much Cu^{+2} are present in the test tube, so use very small quantity of Cu^{+2} (less than 1 cm^3) or use a lot of NH_3 (fill the entire test tube) and shake vigorously to dissolve this precipitate.

Problems with Al^{+3} ions test with NaOH :

- The precipitate formed by Al^{+3} is very soluble and disappears very quickly.

Students can easily make the mistake of not noticing any precipitate, and writing down that no change occurred. Use a very tiny quantity of NaOH at first, just a few drops (put one drop, shake it lightly, then put another and so on), and a small white ppt will form floating on the surface of the solution, which would dissolve very quickly if a very small amount of NaOH is added.

The identification of the other cations and anions is easy. For them just refer to the salt analysis notes given at the end of the paper.

Identification of gases:

Whenever a gas evolves, there is some sort of effervescence (bubbles form) that occurs in the solution. Whenever you notice such a thing, just put your thumb on the top of the test-tube. If the pressure builds up, there'll be definitely some sort of gas evolving.

Now the thing is that, **how to identify them?**

CO_3^{2-} : If an acid is added, or is present in the test-tube and you see vigorous effervescence, then definitely it's CO_2 that's evolving. If you have time, just to counter check, test it with lime water, it will definitely turn milky. Effervescence produced is similar to gas bubbles in coke. Generally produced when metal carbonates react with acids.

NO_2^{-1} : Whenever an acid is added, put your thumb top of the tube, and allow pressure to build up. The tube will turn pale brown and when you release your thumb and allow gas to escape, then a pale brown gas will release. If it occurs then definitely NO_2^{-1} is present in the solution. This pale brown gas is also very visible if seen in front of a white background. The gas is especially very visible when the reactants are thrown in the white sink and you will notice brown vapors in the sink easily.

SO_3^{2-} : Another gas that is produced on addition of dilute acids is SO_2 which indicates the presence of SO_3^{2-} ions. SO_2 gas is colorless and acidic and is produced when dilute acid is added to sulfite SO_3^{2-} ions. If a damp blue litmus paper is placed at the mouth of the tube, then it will turn red. Damp litmus paper must not touch the test tube itself as it might contain an acid. Note, that damp blue litmus paper will turn red when NO_2 gas is produced but NO_2 is pale brown and can be distinguished from SO_2 . Another test for SO_2 gas is that it smells of rotten eggs or burnt matches. It can also be distinguished by dipping a paper in $\text{K}_2\text{Cr}_2\text{O}_7$ and then placing it at the mouth of the test tube. This paper will turn from orange to green.

NO_3^{-1} , NO_2^{-1} : To test for these ions, NaOH is added followed by the addition of Al foil and heated. When bubbles start to form (vigorous bubbling), put a damp red litmus paper near the mouth of the test-tube. NH_3 is liberated if these ions are present, and it turns damp red litmus paper blue.

Always use damp red litmus paper, by making the litmus paper wet. Nothing happens if the litmus is not damp! And make sure that the litmus paper never touches the test tube, because the test tube might contain an alkali which will turn the litmus paper blue. A lot of students make the mistake of allowing the litmus paper to touch the top of the test tube, and in many cases an alkali is present in the test tube which makes the litmus paper blue. So, keep the litmus paper a fair distance (1 cm) away from the test tube.

Students should be able to distinguish between a red litmus paper from a blue litmus paper. Red litmus paper is pale pink, and blue litmus paper is pale blue. Some

students also make the mistake of using the cover paper of the litmus paper stack which is also pink (Avoid silly mistakes)

Identification for hydrogen (H_2) gas:



Use the above equation to detect the hydrogen gas.

If you are adding metal, and a gas is produced, then you don't necessarily need to test for Hydrogen gas, if you see effervescence, then it is obviously hydrogen.

Just for confirming if you have time, test it. Hydrogen gas produces pop sound when burnt with a lighted splint. The only way it produces a pop sound when enough pressure is built up in the test tube. Put your thumb on top of the test tube and allow pressure to build up and only then light it.

Organic Chemistry:

Testing for Carbonyl compounds: ketones and aldehydes..

- **Tollens Reagent:** Tollens reagent is made by mixing $AgNO_3$ and NH_3 . It gives a black precipitate with Aldehyde which has a silvery mirror floating on top. The observation should be that silver mirror is obtained with Tollens Reagent. Most of the time this silver mirror will not be visible, so black precipitate is enough to test for the presence of aldehyde.
- **Fehling Solution:** Fehling solution also tests for the presence of Aldehyde. Aldehyde is added to Fehling Solution and heated lightly. A red/brown precipitate is obtained
- **2,4 DNPH:** This is an orange colored solution, which has a strong acid in it. Be careful when using this. 2,4 DNPH has forms a yellow or orange precipitate with carbonyl compounds (both ketones and aldehydes). Remember that anything when it is added to 2,4 DNPH will turn yellow because it has a yellow color. So you should be looking for yellow precipitates and ignore the color of the solution.

Carboxylic Acid Test: If you add Na_2CO_3 and vigorous effervescence is observed, then the compound present is carboxylic acid.

Potassium Di Chromate: It will turn from orange to green with alcohols and aldehydes but the mixture has to be gently heated otherwise the color change wouldn't be visible. If it is strongly heated then aldehyde and alcohols will evaporate. You should also not add Potassium di chromate in excess, as a lot of it will not get reduced and you will get a mixture of green and orange which would be very hard to distinguish.

Potassium Manganate (VII): If it is added to a solution, and the solution then warmed in a water bath; if the purple color of the solution disappears then in the solution either an aldehyde or alcohol is present.