Practical 1+2 revision

Starter: Similarities and differences between these two practicals?

1	Making up a volumetric solution and carrying out a titration
2	Measurement of an enthalpy change

	Practical	Topic
1	Making up a volumetric solution and carrying out a titration	2.5, Balanced equations an related calculations
2	Measurement of an enthalpy change	4.3, Measuring enthalpy changes 4.4, Hess's law
3	Investigation of how the rate of a reaction changes with temperature	5.2, The Maxwell-Boltzmann distribution
4	Carrying out test-tube reactions to identify cations and anions in aqueous solutions	9.1, The alkaline earth elements
5	Distillation of a product from a reaction	15.2, Ethanol production
6	Tests for alcohol, aldehyde, alkene, and carboxylic acid	15.3, The reaction of alcohols

Practical		Topic
1	Making up a volumetric solution and carrying out a titration	2.5, Balanced equations an related calculations
2	Measurement of an enthalpy change	4.3, Measuring enthalpy changes 4.4, Hess's law

For each one:
Labelled diagram
Detailed method
Explanation for choice of each piece of equipment / technique used
List of relevant equations
Brief summary of relevant theory

Read the following instructions that describe how to make up a standard solution of a solid in a volumetric flask.
Answer the questions which follow.

'Take a clean 250 cm^3 volumetric flask. Use the balance provided and a clean, dry container, to weigh out the amount of solid required. Tip the solid into a clean, dry 250 cm^3 beaker and add about 100 cm^3 of distilled water. Use a stirring rod to help the solid dissolve, carefully breaking up any lumps of solid with the rod. When the solid has dissolved, pour the solution into the flask using a filter funnel. Add water to the flask until the level rises to the graduation mark.'

(a) Suggest **three** further instructions that would improve the overall technique in this account.

Any **three** from:

A method of weighing by difference / wash the solid from its weighing container into the beaker

If the nature of any washing is imprecise penalise once only.

Wash the (wet) rod into the flask / beaker after use

Do not allow a method where the solution is made up directly in the flask.

Wash the (wet) beaker into the flask after transfer

Ignore any instructions that refer to rinsing equipment (before use) or use of deionised water.

Wash the filter funnel (after transfer) into the flask

Use a teat pipette to make up to the mark on the volumetric flask

Ensure the bottom of the (liquid) meniscus is on the graduation mark

Mix / shake the final solution in the flask / invert flask

Max 3

In a series of titrations using the solution made up in part (a), a student obtained the following titres (all in cm^3).

Rough	1	2
25.7	25.20	25.35

State what this student must do in order to obtain an accurate average titre in this experiment.

Do (a) further titration(s)

Mark these points independently.

To obtain concordant results

Allow results with ± 0.1

In a titration, it is important to wash the inside of the titration flask with distilled or deionised water as you approach the end-point.

(a) Suggest **one** reason why it is important to wash the inside of the flask.

(1)

(b) Washing with water decreases the concentration of the reagents in the titration flask.

Suggest why washing with water does **not** affect the titre value.

(1)

(Total 2 marks)

(a) To make sure all the solutions (from both the burette and pipette) react with each other / are in the flask

Penalise 'solid' or 'residue'.

Do not allow any suggestion of removal of species.

1

(b) Water does not change the number of moles of either reagent / reactants

Water is not a reagent / does not react with either reactant.

Do not allow 'water is not involved in the reaction'.

Apply list principle.

1

The correct technique can improve the accuracy of a titration.

(a) State why it is important to fill the space below the tap in the burette with solution **A** before beginning an accurate titration.

....

....

(1)

(b) Suggest **one** reason why a 250 cm^3 conical flask is preferred to a 250 cm^3 beaker for a titration.

....

....

(1)

(c) During a titration, a chemist rinsed the inside of the conical flask with deionised water. The water used for rinsing remained in the conical flask.

(i) Give **one** reason why this rinsing can improve the accuracy of the end-point.

(a) Space will fill during titration / titres or volumes added are too high

Do not allow 'to improve accuracy' without qualification.

Do not allow 'incorrect end-point' without qualification.

Do not allow 'titres or volumes added are too low'.

Ignore 'titres or volumes added are different'.

1

(b) Less chance of losing liquid on swirling / liquid doesn't splash on swirling

Do not accept 'easier to swirl' on its own.

1

(c) (i) Returns reagent on the sides of the flask to the reaction mixture (to ensure that all of the acid / alkali reacts)

Do not allow 'to improve accuracy' without qualification.

Ignore reference to cleaning.

1

A student weighed out 1.00 g of anhydrous calcium chloride. Using a pipette, 25.0 cm^3 of water were measured out and transferred to a plastic cup. The cup was placed in a beaker to provide insulation. A thermometer was mounted in the cup using a clamp and stand. The bulb of the thermometer was fully immersed in the water.

The student recorded the temperature of the water in the cup every minute, stirring the water before reading the temperature. At the fourth minute the anhydrous calcium chloride was added, but the temperature was not recorded. The mixture was stirred, then the temperature was recorded at the fifth minute. The student continued stirring and recording the temperature at minute intervals for seven more minutes.

The student's results are shown in the table below.

Time / minutes	0	1	2	3	4
Temperature / °C	19.6	19.5	19.5	19.5	

Time / minutes	4	5	6	7	8	9	10	11	12
Temperature / °C		24.6	25.0	25.2	24.7	24.6	23.9	23.4	23.0

Plot a graph of temperature (*y*-axis) against time on the grid below.
Draw a line of best fit for the points before the fourth minute.
Draw a second line of best fit for the appropriate points after the fourth minute.
Extrapolate both lines to the fourth minute.

(a) Temperature on y-axis

If axes unlabelled use data to decide that temperature is on y-axis.

1

Uses sensible scales

*Lose this mark if the **plotted points** do not cover half of the paper.*

Lose this mark if the temperature axis starts at 0 °C.

1

Plots **all** of the points correctly ± one square

Lose this mark if the graph plot goes off the squared paper.

1

Draws two best-fit lines

*Candidate must draw **two** correct lines.*

Lose this mark if the candidate's line is doubled or kinked.

1

Both extrapolations are correct to the 4th minute

(b) Use your graph to determine an accurate value for the temperature of the water at the fourth minute (**before** mixing).

Temperature before mixing ....

(1)

(c) Use your graph to determine an accurate value for the temperature of the reaction mixture at the fourth minute (**after** mixing).

Temperature after mixing ....

(1)

(d) Use your answers from parts (b) and (c) to determine an accurate value for the temperature rise at the fourth minute.
Give your answer to the appropriate precision.

Temperature rise ....

(1)

(e) Use your answer from part (d) to calculate the heat given out during this experiment.
Assume that the water has a density of 1.00 g cm^{-3} and a specific heat capacity of 4.18 JK^{-1} g^{-1}. Assume that all of the heat given out is used to heat the water.
Show your working.

(b) 19.5 (°C)

Accept this answer only.

1

(c) 26.5 ± 0.2 (°C)

Do not penalise precision.

1

(d) (c) – (b)

*Only award this mark if temperature rise is recorded to **1 d.p.***

1

(e) Uses $mc\Delta T$ equation

Allow use of this equation with symbols or values for M1 even if the mass is wrong.

1

Correct value using 25 × 4.18 × (d)

7.0 gives 732 J.

Correct answer with no working scores one mark only.

Do not penalise precision.

Allow answer in J or kJ.

(f) Calculate the amount, in moles, of $CaCl_2$ in 1.00 g of anhydrous calcium chloride (M_r = 111.0).

....

(1)

(g) Use your answers from parts (e) and (f) to calculate a value for the enthalpy change, in kJ mol^{-1}, for the reaction that occurs when anhydrous calcium chloride dissolves in water.

$$CaCl_2(s) + aq \longrightarrow CaCl_2(aq)$$

....

....

....

....

(2)

(h) Explain why it is important that the reaction mixture is stirred before recording each temperature.

(f) $9.0(1) \times 10^{-3}$

Do not allow 0.01

Allow 9×10^{-3} or 0.009 in this case.

1

(g) If answer to (e) in J, then (e) / (1000 × (f))

or

If answer to (e) in kJ, then (e) / (f)

7.0 and 9.01×10^{-3} gives 81.2 kJ mol^{-1}

If answer to (e) is in J must convert to kJ mol^{-1} correctly to score mark.

1

Enthalpy change has negative sign

Award this mark independently, whatever the calculated value of the enthalpy change.

(h) The idea that this ensures that all of the solution is at the same temperature

Do not allow 'to get an accurate reading' without qualification.