Sample Pearson Set Assignment Brief

Single Part Assessment

Unit 2 – Principles and Applications of Chemistry I

For use with:

Pearson International BTEC Level 3 Qualifications in Applied Science

Certificate / Subsidiary Diploma / Foundation Diploma / Diploma / Extended Diploma

Advised supervised hours	22 hours

For completion by the centre

Qualification (select as appropriate)	Certificate / Subsidiary Diploma / Foundation Diploma / Diploma / Extended Diploma
Assessment date	

Instructions to Teachers/Tutors and/or Invigilators

The Pearson Set Assignment should be undertaken in conditions that assure the authenticity of outcome. This may require supervision.

We advise that the Pearson Set Assignment be completed in sessions that come to a total of 22 hours. The Pearson Set Assignment should not be shared with learners prior to the start of the assessment period. Teachers/tutors are responsible for security of the Pearson Set Assignment and materials.

Outcomes for Submission

Learners may submit handwritten or word-processed evidence plus labelled biological drawings where appropriate.

Learners must submit their own, independent work as detailed in the set assignment, together with notes prepared. Each learner must complete an authentication sheet.

Instructions to Learners

You will be asked to carry out specific activities using the information provided. You will be given a specific time period to complete the assignment. Read the Set Assignment Brief carefully.

Your notes should:

- be individually and independently prepared by you
- use short, bullet-point style information, and cannot contain long narrative pieces of text.

At all times you must work independently and must not share your work with other learners. You must complete an authentication sheet and submit this along with your work. This document contains the information you need to prepare for the set assignment.

Set Assignment

You must complete ALL activities.

ACTIVITY 1
Your laboratory has just employed two new science technicians, who have varying knowledge of chemistry. As part of your role, you have been tasked to prepare support materials for them that describe and explain the atomic and electronic structure of elements, including chlorine. The support materials are to be given out to the new employees as an introduction to elements that the company makes use of (see Activity 1). a) Find the elements magnesium, chlorine, argon and copper in the Periodic Table, and note the position of the four elements and other information shown. Describe what the position and information for the four elements in the Periodic Table informs you about their atomic and electronic structure. b) Write the electronic configurations of magnesium, chlorine, argon and copper atoms using s,p,d notation and electron-in-boxes diagrams. Explain these representations using the three main rules to fill an atom with electrons and how the element copper does not entirely follow the rules. Explain why magnesium forms +2 ions, chlorine forms -1 ions and copper forms +1 and +2 ions using your representations. c) (i) Chlorine has a relative atomic mass of 35.5. A natural sample of chlorine contains two isotopes, 75.5% of chlorine-35 and 24.5% of chlorine-37. Prove by calculation that this will give a relative atomic mass of 35.5. (ii) Calculate the relative atomic mass if a different sample of chlorine contained 65% of chlorine-35 and 35% chlorine-37. (iii) Copper has the relative atomic mass of 63.6 and is made up of two isotopes – copper-63 and copper-65. Calculate the percentage abundance of both isotopes. (iv) Magnesium has three isotopes ^{24}Mg, ^{25}Mg and ^{26}Mg. Using the mass spectrum for magnesium shown in Figure 1: • determine the percentage abundance for each isotope • calculate the relative atomic mass for magnesium to 2 decimal places.

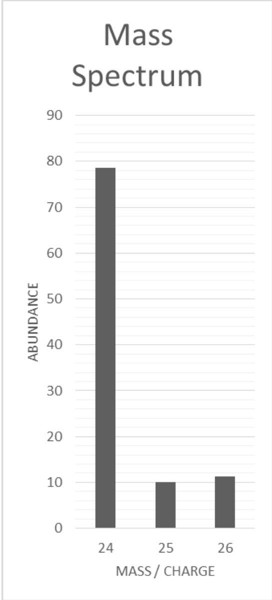


Figure 1

d) Explain the trend in atomic and ionic radius down Group 2 using **Graphs 1** and **2** on **Physical Data Sheet A**. Comment upon any similarities or differences between the two graphs.

e) Explain the trend in atomic and ionic radius across Period 3 using the graphs presented in **Graphs 3** and **4** on **Physical Data Sheet B**. Comment upon any similarities or differences between the two graphs.

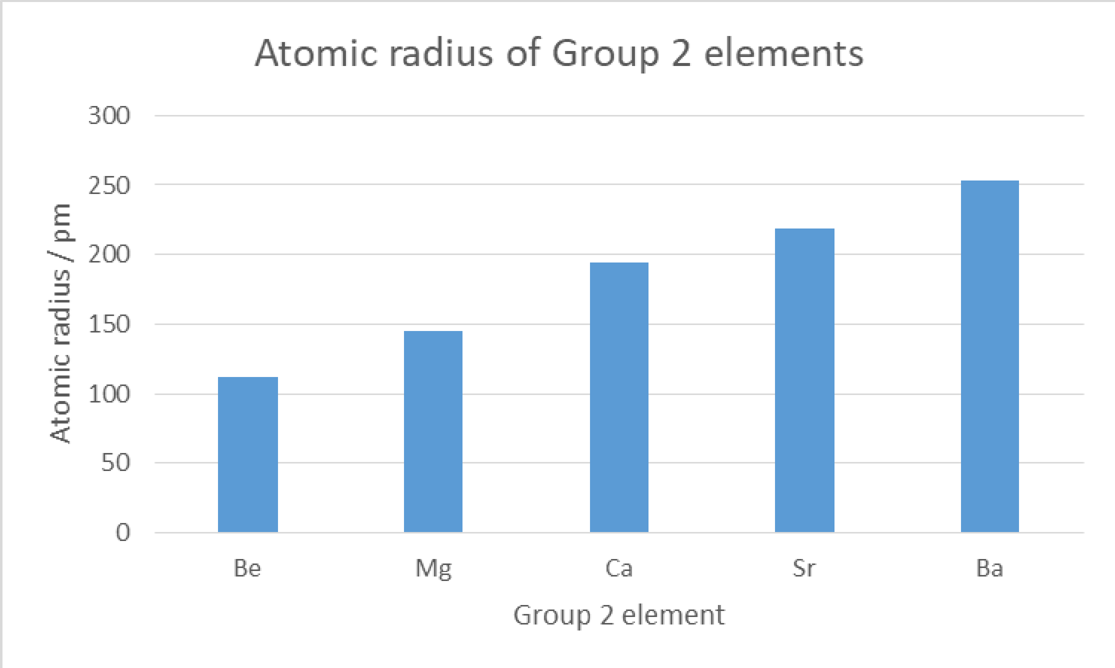
f) Analyse the first ionisation energy data for Group 2 elements shown in **Table 1** on **Physical Data Sheet C** by plotting a graph of ionisation energy against the element and then explaining the trend. Compare this against the atomic and ionic radius graphs for Group 2 (Figures 2 and 3) and explain how they are related.

Analyse the first ionisation energy data for the following consecutive elements shown in **Table 2** on **Physical Data Sheet C** by plotting a graph of ionisation energy against atomic number. Explain the variation in ionisation energy with reference to electron configurations.

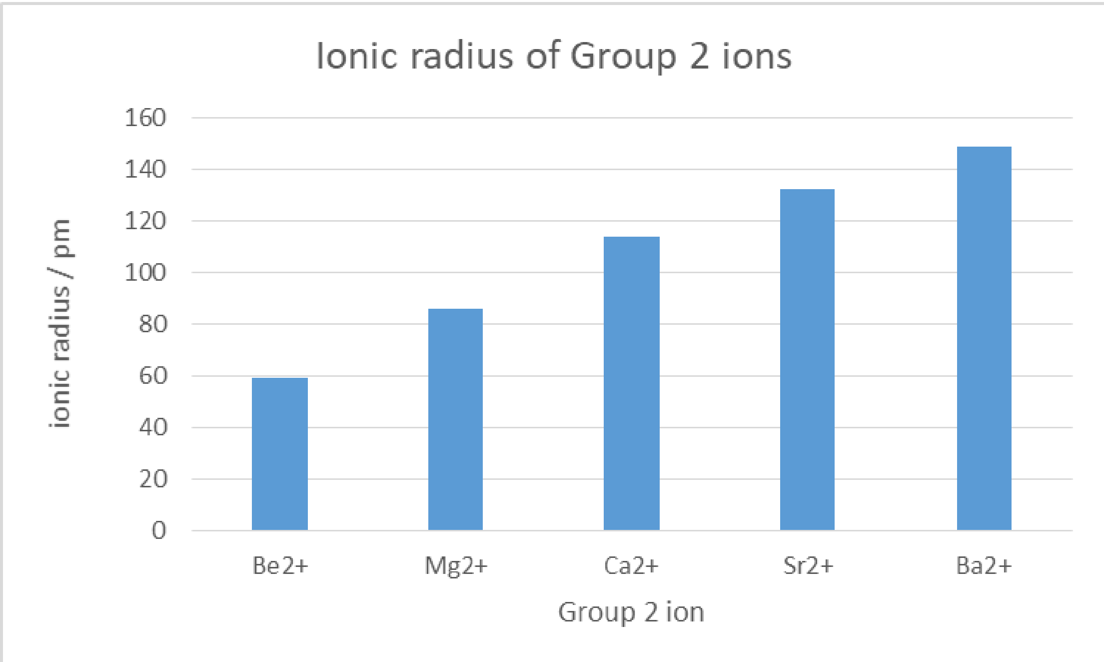
This activity covers learning aim A:
A.P1, A.P2, A.P3, A.M1, A.D1

Learners may word process their evidence and use software packages to plot graphs.

Physical Data Sheet A

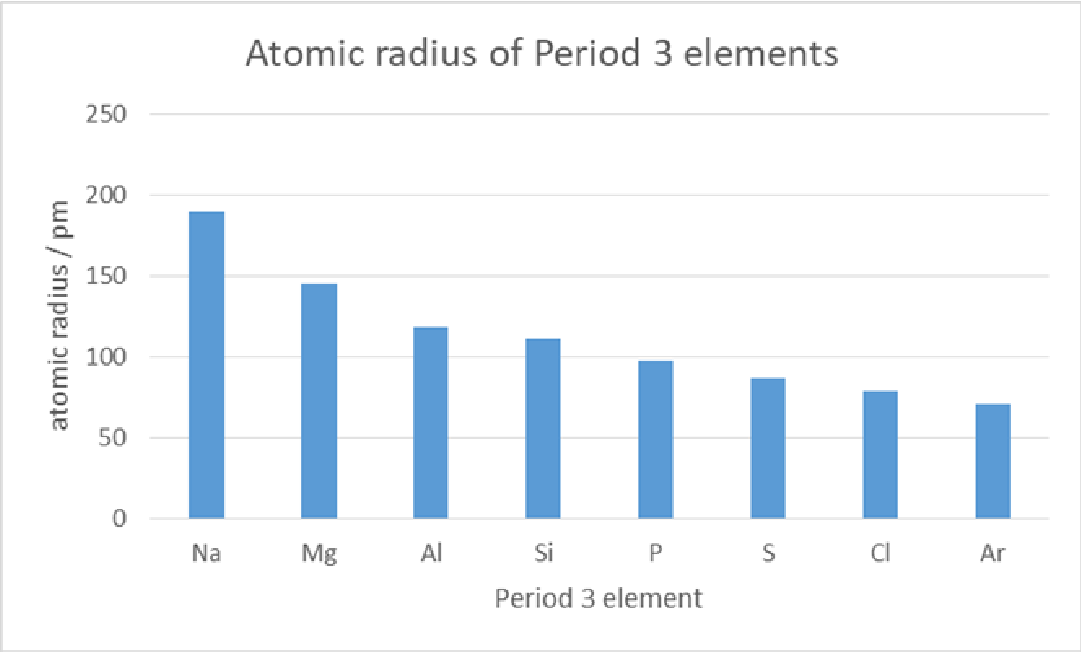


Graph 1

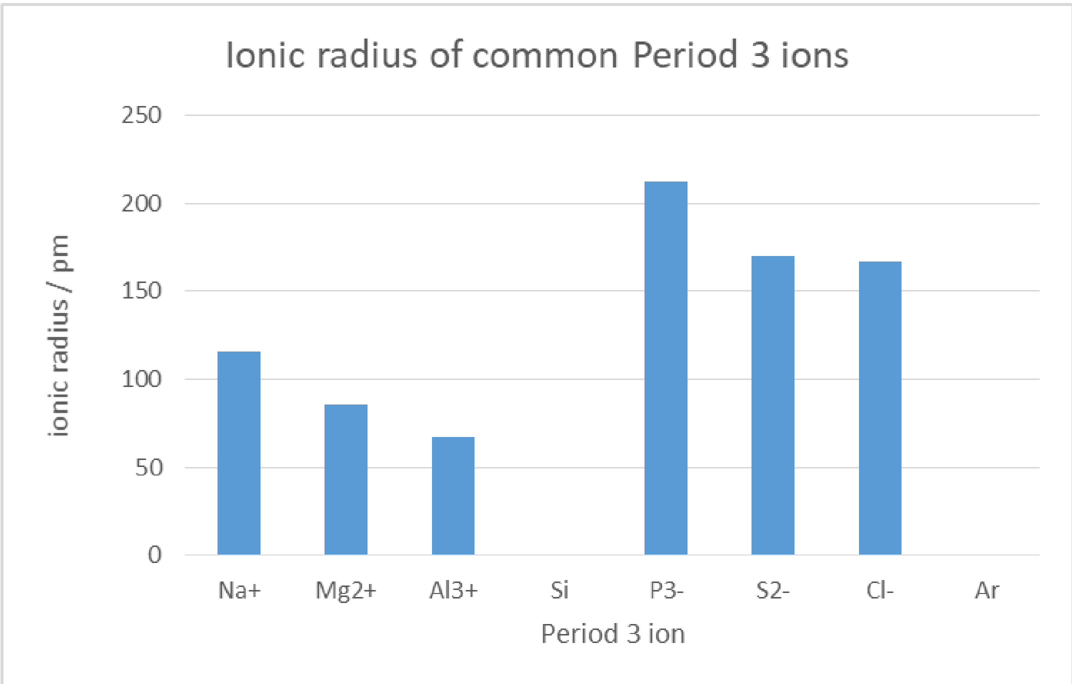


Graph 2

Physical Data Sheet B



Graph 3



Graph 4

Physical Data Sheet C

Element	Ionisation energy / kJ mol^{-1}
Be	900
Mg	736
Ca	590
Sr	548
Ba	502

Table 1

Atomic number	Ionisation energy / kJ mol^{-1}
10	2080
11	494
12	736
13	577
14	786
15	1060
16	1000
17	1260
18	1520
19	418

Table 2

Number of the electron removed	Log (ionisation energy / kJ mol^{-1})
1st	2.87
2nd	3.16
3rd	3.89
4th	4.02
5th	4.13
6th	4.26
7th	4.64
8th	4.71
9th	4.76
10th	4.80
11th	4.86
12th	4.89

Table 3

ACTIVITY 2

The laboratory has a basic website which advertises and promotes their range of chloride compounds, which the laboratory manager would like you to update. The manager has provided you with technical information on some of the substances that you synthesise and would like a collection of short web page articles explaining the bonding and structure of these substances and of the elements that they are made of. Additionally, the manager is particularly keen that your articles are accompanied by diagrams of bonding and structure, and graphs to highlight differences and similarities (see Activity 2).

a) Describe the main types of bonding (metallic, ionic, covalent, coordinate and intermolecular forces) and structure (giant and simple) in the elements:
- magnesium
- chlorine
- carbon
- oxygen

and their compounds:
- magnesium chloride ($MgCl_2$)
- carbon tetrachloride (CCl_4)
- carbon dioxide (CO_2)
- carbon monoxide (CO)
- water (H_2O)

You should include appropriate diagrams to support your description, such as dot-and-cross diagrams, stick diagrams, 2D and 3D lattices.

Table 4 on **Physical Data Sheet D** shows the physical properties of some common elements and compounds Explain the physical properties in terms of bonding and structure for the following four substances:
- magnesium
- carbon (diamond)
- $MgCl_2$
- CCl_4

b) **Figure 1** shows the electronegativities for elements in the first three periods of the periodic table.

			H			
			2.1			
Li	Be	B	C	N	O	F
1.0	1.5	2.0	2.5	3.0	3.5	4.0
Na	Mg	Al	Si	P	S	Cl
0.9	1.2	1.5	1.8	2.1	2.5	3.0

Figure 1

- Using the electronegativity information in **Figure 1**, predict the extent of covalent / ionic character in the following bonds between the following pairs of elements:
  - Magnesium and chlorine
  - Carbon and chlorine
  - Aluminium and chlorine
  - Chlorine and chlorine (ie Cl_2)

- Assess whether your predictions for the extent of covalent / ionic character fully account for the physical properties shown in **Table 4** on **Physical Data Sheet D** for substances with these bonds (ie $MgCl_2$, CCl_4, $AlCl_3$ and Cl_2).

- For the compounds LiCl and NCl_3, determine the difference in electronegativity between the elements in each compound and suggest physical properties of the compounds based upon the covalent / ionic character.

c) Using electron pair repulsion theory, draw your prediction for the 3-dimensional shape (with bond angles) for the following molecules:
- $AlCl_3$
- $SiCl_4$
- PCl_3
- OCl_2
- $BeCl_2$
- SCl_2
- PCl_5

Using the electronegativity values in **Figure 2**, assign dipoles to the molecules and predict whether they are polar or non-polar.

d) Analyse the melting point data for Group 2 elements shown in **Table 5** on **Physical Data Sheet E** by plotting a graph of melting point against the element and then explaining the trend. Explain the variation in melting point with reference to the bonding and structure in the elements.

e) Analyse the melting point data for the following consecutive elements shown in **Table 6** on **Physical Data Sheet E** by plotting a graph of ionisation energy against atomic number. Explain the variation in ionisation energy with reference to the bonding and structure in the elements.

f) Analyse the boiling point data for Group 7 hydrides shown in **Table 7** on **Physical Data Sheet E** by plotting a graph of boiling point against the group 7 hydride and then explaining the trends and anomalies. Explain the variation in boiling point with reference to the bonding, electronegativity differences, polarity and intermolecular forces for the molecules.

g) Analyse the boiling point data for the consecutive chlorides of Period 3 shown in **Table 8** on **Physical Data Sheet E** by plotting a graph of boiling point against the period 3 chloride. Explain the variation in boiling point with reference to the bonding type, electronegativity differences, and where simple molecules are involved, the polarity, molecular size and intermolecular forces.

This activity covers learning aim B:
B.P4, B.P5, B.M2, B.M3, B.D2

Learners may word process their evidence and use software packages to plot graphs.

Physical Data Sheet D

	Magnesium	Carbon (diamond)	$MgCl_2$	CCl_4	$AlCl_3$	Cl_2
Melting point/°C	650	Sublimes at 3825	714	-23	Sublimes at 180	-102
Boiling point/°C	1080		1412	77		-34
Electrical conductivity	Conducts	Non-conductor	Non-conductor when solid, conducts when molten or in solution only	Non-conductor	Non-conductor when solid or molten, conducts when in solution	Non-conductor
Malleability/ brittleness/ hardness	Malleable	Hard	Brittle	Not applicable	Brittle	Not applicable
Solubility in water	Reacts	Insoluble	High	Insoluble	Reacts	Reacts

Table 4

Physical Data Sheet E

Element	Melting point / °C
Ca	850
Sr	768
Ba	714
Ra	700

Table 5

Formula of element	Melting point / °C
Ne	-249
Na	98
Mg	650
Al	660
Si	1410
P_4	44
S_8	113
Cl_2	-102
Ar	-189
K	64

Table 6

Group 7 hydride	Boiling point / °C
HF	20
HCl	-85
HBr	-67
HI	-35

Table 7

Chloride	Boiling point / °C
NaCl	1467
$MgCl_2$	1412
$AlCl_3$	180 (sublimes)
$SiCl_4$	58
PCl_3	76
SCl_2	59
Cl_2	-35

Table 8

ACTIVITY 3

You will now prepare a report for the company directors which will:

- explain and compare the properties of the metals with magnesium
- explain and compare the properties of the non-metals with chlorine
- assess different methods of manufacturing magnesium and chlorine

g) You will be provided with a sample of the s-block element magnesium.
  - Describe the appearance of magnesium, give any inferences that you can make about its physical properties (relative melting and boiling point, electrical conductivity, density, etc) and compare to a group 1 s-block element.
  - Carry out the following test tube reactions by adding magnesium to:
    - water
    - hydrochloric acid
    - sodium chloride solution
    - copper(II) sulfate solution
  - Place a solution of magnesium chloride in a test tube and add:
    - a piece of copper
    - a few drops of sodium hydroxide solution
  - You will need to record all observations which may include changes of colour, release or absorption of heat, precipitates formed or gases released.
  - Predict how the elements beryllium, barium and a group 1 element would appear and react in the same experiments by comparison to magnesium
  - Write balanced equations for all reactions that occur (or that you have predicted) for magnesium, beryllium and barium. You must:
    - identify reactions that involve reduction and oxidation (redox)
    - identify the oxidation numbers for any elements in the equations that undergo redox
    - identify the number of electrons that are being transferred
    - write appropriate half-equations for reduction and oxidation reactions that have been identified
    - where no reaction has taken place, explain why in terms of relative reducing or oxidising ability of the elements involved
  - Using your research on the transition metals copper and iron, compare their physical and chemical properties against your findings for magnesium. You must explain the reasons for similarities and differences.

h) You will be provided with a sample of the element chlorine.
This will be in a fume cupboard and you will not be able to handle the element directly.
  - Describe its appearance and give any inferences that you can make about its physical properties (relative melting and boiling point, electrical conductivity, density, etc) and make a comparison to other halogens.
  - Your assessor / lecturer will demonstrate the reaction of heated iron wool with chlorine.
  - Carry out the following test tube reactions by adding chlorine water to:
    - sodium bromide solution
    - sodium iodide solution
  - Add a few drops of sodium hydroxide solution to chlorine water in a test tube
  - Add a few drops of silver nitrate solution to a solution of sodium chloride in a test tube
  - You will need to record all observations which may include changes of colour, release or absorption of heat, precipitates formed or gases released and write

balanced equations.
• Predict how the elements fluorine and iodine would appear and react in the same experiments by comparison to chlorine and note any trends in properties.
• Write balanced equations for all reactions that occur (or that you have predicted) for chlorine, fluorine and iodine. You must:
  ○ Identify reactions that involve reduction and oxidation (redox)
  ○ Identify the oxidation numbers for any elements in the equations that undergo redox
  ○ Identify the number of electrons that are being transferred
  ○ Write appropriate half-equations for reduction and oxidation reactions that have been identified
  ○ Where no reaction has taken place, explain why in terms of relative reducing or oxidising ability of the elements involved
• Using your research on the noble gases argon and xenon, compare their physical and chemical properties against your findings for chlorine and other halogens. You must explain the reasons for similarities and differences.
 	
i) Using your research on the industrial manufacture of magnesium and chlorine from their compounds, you must assess two different methods of extraction for each element. The methods must be based upon two different chemical principles (eg electrolysis and thermal reduction or oxidation). You will assess each extraction in terms:
• the source of the compound / raw materials
• the process of extraction of the element, with key reactions
• any operating conditions and reagents used
• energy requirements
• the chemistry involved in terms of reduction and oxidation, using equations and showing changes in oxidation number
• atom economy of the equations in respect of the desired product
• by-products and their uses / problems
• produced by a batch or continuous process
• safety and environmental issues
 	
You will also assess the uses of magnesium and chlorine, justifying the use in terms of the physical and chemical properties that are being utilised.

This activity covers learning aim C: C.P6, C.P7, C.M4, C.M5, C.D3
Learners may word process their evidence and use software packages to plot graphs.

ACTIVITY 4

a) Complete the calculations on moles, mass, concentration and gas volumes on the worksheet **Quantitative Chemistry Calculation Worksheet**.

b) Complete the practical work following the instructions on the worksheet **Quantitative Chemistry Practical Instructions**.

Your practical work must be undertaken correctly and safely at all times. Before undertaking any practical work, you must produce a risk assessment for any practical task that you are going to undertake. Your techniques will need to be performed to a high degree of accuracy and precision in order to obtain reliable and valid outcomes. You will be observed performing your preparation of solutions, calibration of equipment and application of titration and gravimetric techniques.

Part 1 - Preparation of a standard solution

- You will first need to calibrate the equipment that you will use for these titrations which will include: the pipette and the weighing balance
- You will prepare a stock standard solution of Na_2CO_3 by weighing the solid, using the calibrated weighing balance, mixing and dissolving in water, and making up the solution to an accurate volume with a volumetric flask
- You will then need to prepare a diluted solution from the stock standard solution of Na_2CO_3 for use in volumetric analysis

Parts 2 and 3 – Standardisation and volumetric analysis of solutions

- You will perform different titrations to accurately and skilfully determine the concentration of a solution of sodium hydroxide.
- You will first need to calibrate the equipment that you will use for these titrations which will include: the pipette, the burette and the weighing balance
- Your practical work will involve:
  - Accurate standardisation of a given concentration of hydrochloric acid (HCl) by titration with your diluted primary standard solution of Na_2CO_3 and using the calibrated pipette and burette, with an appropriate indicator to determine the end point
  - Titration of the sodium hydroxide (NaOH) solution of unknown concentration with the standardised HCl using volumetric glassware and an appropriate indicator
  - You must produce accurate, precise and reliable results from your titrations
  - You must calculate the concentration of NaOH solution directly from your recorded results, in the titration technique using the indicator

Part 4 - Gravimetric analysis

- You will determine the formula of hydrated magnesium chloride (ie determining the value of **n** in the formula $MgCl_2.nH_2O$) by precipitation gravimetric analysis.
- Your practical work will involve:
  - calibration of the weighing balance on each separate occasion that you use it
  - accurate weighing and transference of the hydrated magnesium chloride
  - dissolving of the hydrated magnesium chloride
  - addition of excess silver nitrate solution to the magnesium chloride solution to precipitate silver chloride
  - filtration, washing and drying of silver chloride
  - accurate weighing of the dry silver chloride

• You must produce accurate, precise and reliable results from your weighings
• You must determine the moles of chloride present in the hydrated magnesium chloride and therefore the ratio $MgCl_2$:H_2O to determine the value of **n** for H_2O
 	
Produce a report of your practical work, which will:
• Provide an account of the experiments, including all risk assessments, observations, measurements, tables of results, and calculations
• Evaluate the accuracy of your results by:
  ○ comparing the molar concentration of sodium hydroxide you have determined with the actual concentration and with those of other learners
  ○ comparing the formula of $MgCl_2.nH_2O$ you have determined with the actual formula
  ○ commenting upon the significance of the differences
• Evaluate the accuracy of the equipment used by
  ○ calculating percentage errors in mass and volume recorded in each experiment
  ○ explaining how your calibration of equipment has been used
  ○ commenting upon the significance that these have upon your results
• Discuss how accuracy, precision and reliability were ensured during your experiments, and discuss any problems or issues that occurred during performance of the experiments
• Propose improvements or alternatives to the procedures and techniques, providing a strong rationale of how they will improve accuracy, precision, reliability or validity
• Discuss the hazards and risks associated with the procedures and techniques you have used, justifying the way in which certain procedures were carried out in a particular way on grounds of safety

This activity covers learning aim D: D.P8, D.P9, D.M6, D.M7, D.D4
Learners may word process their evidence.

Quantitative Chemistry Calculation Worksheet

Relative atomic masses: *Ag = 107.9, C = 12.0, Cl = 35.5, Cu = 63.5, Mg = 24.3, Na = 23.0, O = 16.0*

1 mole of any gas occupies 24.0 dm^3 at room temperature and pressure

Q1. Calculate the number of moles of AgCl in a mass of 4.77g.

Q2. Calculate the mass of 1.50 moles of $MgCl_2$.

Q3. Calculate the mass of copper produced when 2.00g of magnesium reacts with copper(II) oxide.

$$Mg + CuO \rightarrow MgO + Cu$$

Q4. Calculate the volume of 3.4 moles of argon gas at room temperature and pressure.

Q5. Calculate the number of moles of chlorine gas in a volume of 2200 cm^3 at room temperature and pressure.

Q6. Calculate the volume of 10.3 g of CO_2 gas at room temperature and pressure.

Q7. Calculate the number of moles in 50 cm^3 of hydrochloric acid of concentration of 0.4 mol dm^{-3}.

Q8. Calculate the volume in cm^3 that contains 0.05 moles of silver nitrate if it has a concentration of 0.1 mol dm^{-3}.

Q9. Calculate the concentration in mol dm^{-3} of 25.0 g of Na_2CO_3 in 100 cm^3 of solution.

Q10. 23.6 cm^3 of 0.2 mol dm^{-3} of hydrochloric acid reacts with 25.0 cm^3 of sodium hydroxide. Calculate the concentration in mol dm^{-3} of the sodium hydroxide.

$$HCl + NaOH \rightarrow NaCl + H_2O$$

Q11. 25 cm^3 of 0.1 mol dm^{-3} of sodium carbonate reacts with 17.0 cm^3 of hydrochloric acid. Calculate the concentration in mol dm^{-3} of the hydrochloric acid.

$$Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$$

Q12. Calculate the mass of magnesium chloride needed to form 1.40g of silver chloride precipitate.

$$MgCl_2\ (aq) + 2AgNO_3\ (aq) \rightarrow Mg(NO_3)_2\ (aq) + 2AgCl\ (s)$$

Quantitative Chemistry Practical Instructions

Part 1 - Preparation of a Standard Solution

- Calculate the amount of **anhydrous** sodium carbonate that you will need to produce a stock solution of 250cm^3 of approximate concentration 0.5 mol dm^{-3}.
- Calibrate the weighing balance that you will be using.
- Weigh approximately the amount of **anhydrous** sodium carbonate that you will need (ie within 1g of your calculated mass).
- Carefully transfer the sodium carbonate to a large beaker, accurately and precisely recording measurements to determine the exact mass transferred.
- Add 150cm^3 of distilled water to the beaker, stir and completely dissolve the sodium carbonate.
- Carefully and accurately transfer all of the solution to a 250cm^3 volumetric flask, and make up the solution to the 250cm^3 mark appropriately in line with the meniscus with more distilled water, ensuring that it is thoroughly mixed and that it is labelled.
- Calibrate a 25cm^3 pipette.
- Carefully and accurately transfer 25cm^3 of sodium carbonate solution using the pipette from your stock solution into another 250cm^3 volumetric flask.
- Make up the solution to the 250cm^3 mark with distilled water, ensuring that it is thoroughly mixed and that it is labelled.
- Calculate the exact concentration of the diluted sodium carbonate solution and add this to the label.

You must risk assess your experiment and have it checked by your supervisor before starting.

You will need to demonstrate and evidence your skills and techniques in calibrating equipment, transferring solids and liquids, mixing of substances and taking and recording accurate measurements.

You will need to show how you determined the mass of sodium carbonate that you were going to use for the original stock solution and accurately calculate what the actual concentration of the diluted sodium carbonate solution that you have made is.

Part 2 - Standardisation of an acid

- Calibrate the pipette that you will be using.
- Carefully and accurately transfer 25cm^3 of your sodium carbonate solution into a 250cm^3 conical flask and add a few drops of methyl orange indicator.
- Clean and fill a burette with a given solution of hydrochloric acid, which will have a concentration of approximately 0.1 mol dm^{-3}.
- Using the correct technique titrate the sodium carbonate solution with the hydrochloric acid using , until the indicator changes colour at the end point.
- Accurately and precisely record all measurements to determine the exact titre of hydrochloric acid required to reach the end point of the titration.
- You will need to decide whether the titration needs repeating and how many times.

You must risk assess your experiment and have it checked by your supervisor before starting. You will need to demonstrate and evidence your skills and techniques in calibrating equipment, using volumetric glassware, transferring and mixing liquids, and taking and recording accurate measurements.

You will need to use your results to accurately calculate the precise concentration of the hydrochloric acid.

Part 3 – Volumetric analysis of sodium hydroxide by titration with standardised hydrochloric acid

- Calibrate the pipette that you will be using.
- Carefully and accurately transfer 25cm^3 of sodium hydroxide solution (unknown concentration) into a 250cm^3 conical flask and add a few drops of phenolphthalein indicator.
- Clean and fill a burette with the standardised solution of hydrochloric acid.
- Titrate the sodium hydroxide solution with the hydrochloric acid, until the indicator changes colour at the end point.
- Accurately and precisely record all measurements to determine the exact titre of hydrochloric acid required to reach the end point of the titration.
- You will need to decide whether the titration needs repeating and how many times.

You must risk assess your experiment and have it checked by your supervisor before starting. You will need to demonstrate and evidence your skills and techniques in calibrating equipment, using volumetric glassware, transferring and mixing liquids, and taking and recording accurate measurements.

You will need to use your results to accurately calculate the precise concentration of the sodium hydroxide.

Part 4 – Gravimetric analysis of the formula of hydrated magnesium chloride by precipitation

- Calibrate the weighing balance that you will be using.
- Weigh approximately 0.3g of **hydrated** magnesium chloride (ie within 0.01g of your calculated mass).
- Carefully transfer the hydrated magnesium chloride to a beaker, accurately and precisely recording measurements to determine the exact mass transferred.
- Add about $50cm^3$ of distilled water to the beaker, stir and completely dissolve the hydrated magnesium chloride.
- Calculate the **maximum** volume of 0.1mol dm^{-3} (or concentration provided) silver nitrate solution that you will need to add to precipitate the chloride (NB assume that the sample is pure magnesium chloride, rather than hydrated, for this calculation).
- Add the calculated volume of silver nitrate solution to the dissolved magnesium chloride, and stir to ensure precipitation.
- Ensure precipitation is complete, by adding a few more cm^3 of silver nitrate solution
- Allow solution and precipitate to stand so that the silver chloride precipitate settles
- Weigh the filter paper that you will use to separate the precipitate from the solution
- Filter the precipitate from the solution using the weighed filter paper and a vacuum filter pump
- Wash the precipitate from the beaker through the filter with a little dilute nitric acid
- Allow air to pass through the filter to dry
- Carefully store the filter paper with the precipitate in an oven at 100^{o}C to dry overnight
- When dry, allow the filter paper and precipitate to cool in a desiccator before weighing to determine the combined mass
- Determine the mass of the silver chloride precipitate made
- Calculate the moles of chloride present in the precipitate, the moles of magnesium chloride originally and the ratio of $MgCl_2$:H_2O to determine a value for **n**

You must risk assess your experiment and have it checked by your supervisor before starting. You will need to demonstrate and evidence your skills and techniques in calibrating equipment, transferring solids and liquids, mixing and filtering of solutions, and taking and recording accurate measurements.

You will need to accurately determine the formula for $MgCl_2.nH_2O$ from the masses of solids weighed.