# St Dominics Sixth Form College

# Chemistry

# Transition Work 2026

**Name** ______________________________________________ **Class** ________________

This work should be **printed out** and **handwritten**.

Bring your completed transition work to your first chemistry lesson in September.

Your work will be checked by one of your Chemistry teachers.

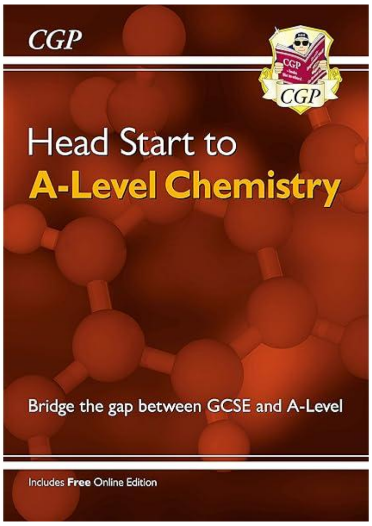
**Instructions**

Work through the tasks in this document.

The video links will provide any additional information needed to complete the questions.

**Recommended Reading**: **Head Start to A level Chemistry CGP Book**

**ISBN 9781782942801**




This book is highly recommended for students who have taken Combined Science GCSE, as there are several topics you have not covered that are required for the A level.

You can also use the Cognition revision videos linked below:

[Cognito Revision Video Playlist]

**Section 1 – Key Words and Definitions –** Add the missing key words to the table

| Definition | Word/Term |
|---|---|
| The smallest particle of an element | |
| Positive nuclei held together by delocalised electrons | |
| Different physical structures of atoms of the same element | |
| The change in concentration of a reactant or product over time | |
| Chemically combined elements in a fixed ratio | |
| Able to dissolve in a particular solvent | |
| Breaking a substance apart using an electrical current | |
| A reaction in which a substance is burned in oxygen | |
| A substance able to speed up a chemical reaction that remains unchanged after the reaction is complete | |
| A bond formed by the sharing of a pair of electrons | |
| Negatively charged particle found within atoms | |
| The loss of electrons | |
| The reaction between an acid and a base to produce water and a solution of pH 7 | |
| A bond formed by the exchange of electrons and resulting attraction between ions | |
| Positively charged particle found within atoms | |
| A type of reaction that gives out heat and causes a rise in temperature | |
| Centre of an atom, containing protons and neutrons | |
| Gain of electrons | |
| Particle with no charge found within atoms | |
| The amount of a dissolved substance in a given volume of solvent | |
| A type of reaction that takes in heat and causes a decrease in temperature | |
| A charged particle | |
| A more reactive element taking the place of a less reactive element | |

**Section 2 – Orbitals and Electron Configuration**

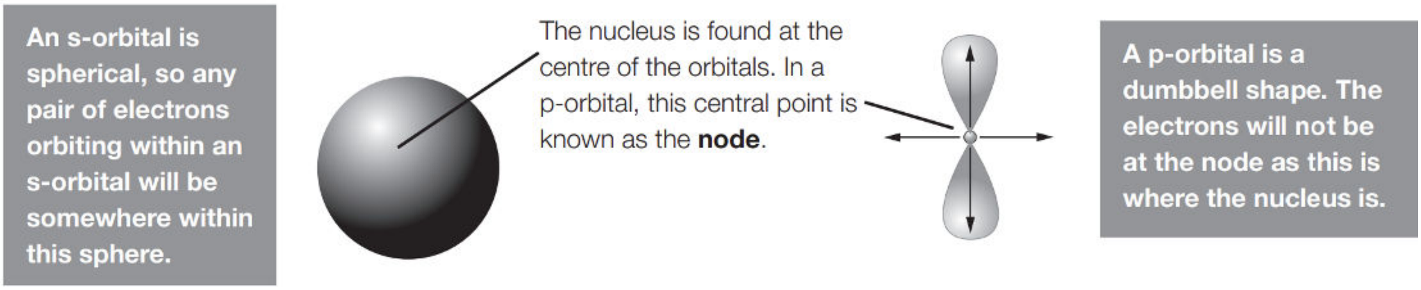
| GCSE | A level |
|---|---|
| At GSCE, you will have described electrons as orbiting the nucleus in fixed 'shells' and described how many electrons can fit in each shell. | At A level, electron 'shells' are defined as quantum energy levels which contain 'orbitals'<br>You will need to:<br>- describe and draw the shapes of various orbitals<br>- state how many electrons orbitals can hold<br>- describe what a sub-shell is |

Watch the following video link:

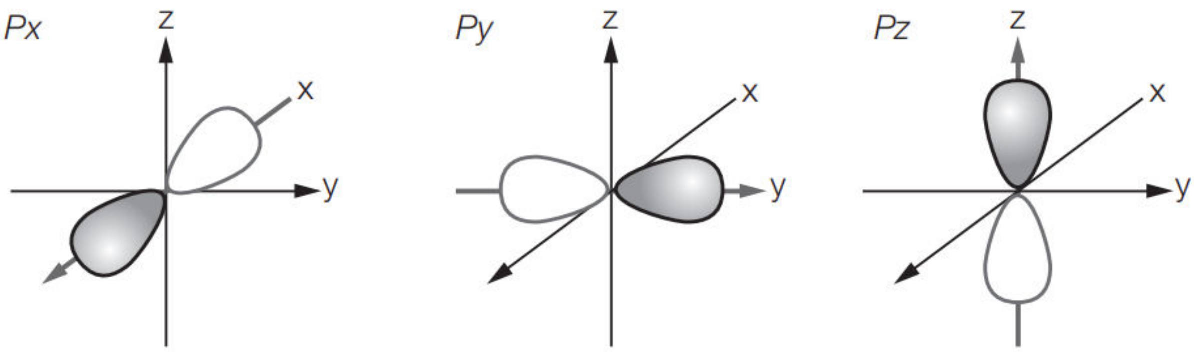
**Electron configuration, Paper 1 - AQA A Level Chemistry**

There are four different types of orbitals, and they are given letters to identify them: **s**, **p**, **d** and **f**.

s-orbitals have the lowest energy and are closest to the nucleus, then p-orbitals, then d-orbitals and then f-orbitals. Each orbital has a different shape.

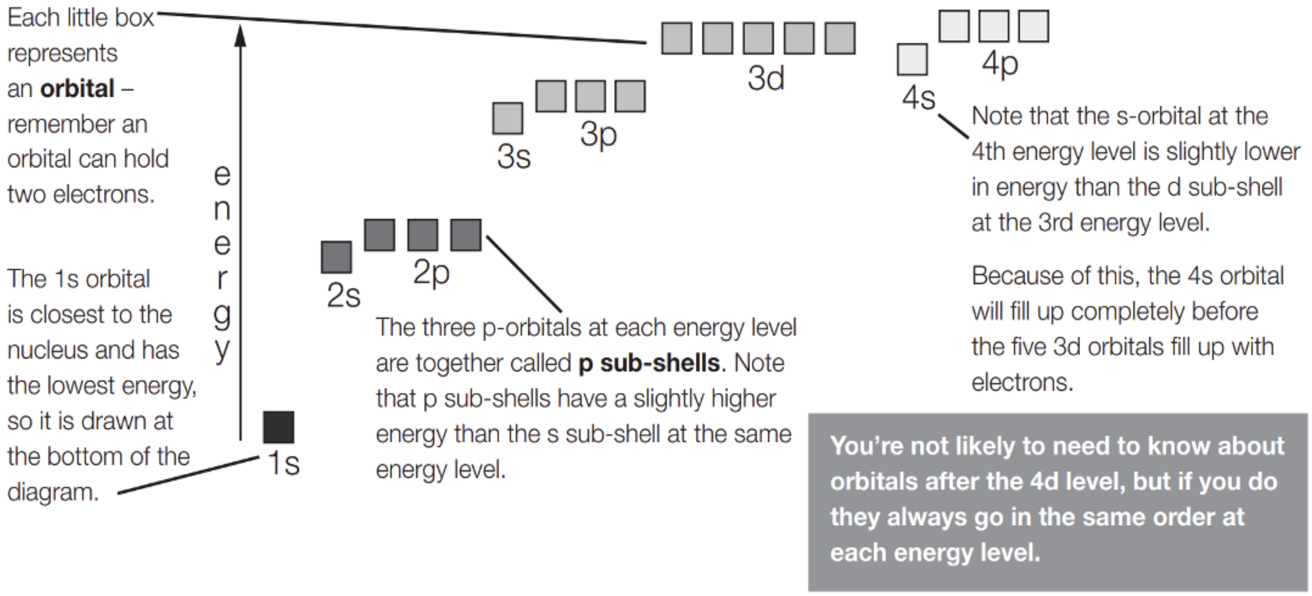



If a quantum energy level contains p-orbitals, it will always have three.

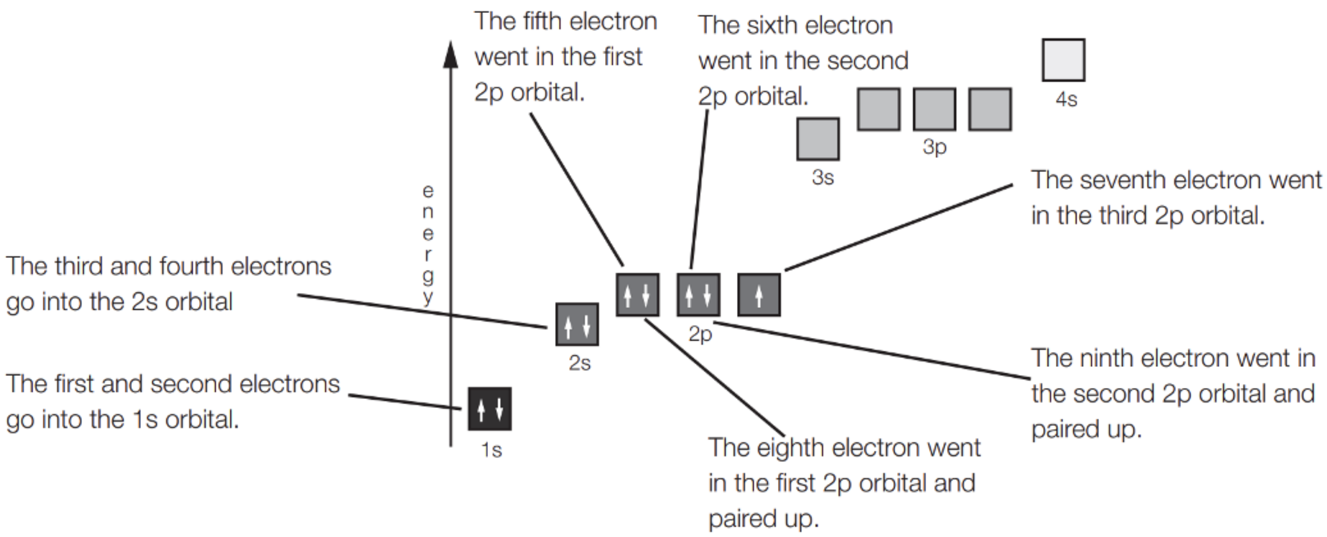



Each p orbital lies on a different plane. Imagine the y plane runs horizontally along the surface of this page, the z plane runs vertically along the surface of this page, and the x plane runs from you into the page and out the back of this page.

We can draw a diagram to represent the orbitals at each energy level:




Consider fluorine's electronic configuration for example:




**Shorthand electron configurations**

It would take a very long time to draw these diagrams every time you wanted to give an element's electronic configuration.

The shorthand for this diagram is to write a number for the energy level, then the letter for the orbital being used and then the number of electrons in it (this is written in superscript).

For fluorine this would be: **$1s^2$ $2s^2$ $2p^5$**

**Task 2a**

**1.** Draw the shape of:

(a) An s orbital:

(b) A p orbital

**2**. Give the electronic configurations of:

(a) sodium

(b) magnesium

(c) chlorine

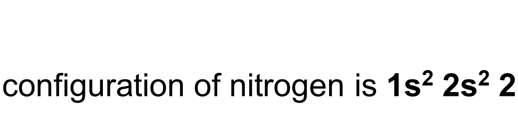
(d) helium

(e) carbon

(f) calcium

**3**. **Challenge** The electron configuration of nitrogen is $\mathbf{1s^2\ 2s^2\ 2p^3}$.

The electron configuration can be drawn in a box diagram like this:




Explain why each of the p orbitals only contains one electron

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## Section 3 – Ions, Formulae and Equations

| GCSE | A level |
|---|---|
| At GSCE, you will have<br>- used ions to write the formula of a salt.<br>- balanced equations when all the formulae in an equation are give. | At A level, you are required to construct equations for all the reactions in the specification.<br>You need to recall common ions and formulae, and use this information to write balance equations. |

Watch the video link: **A Level Chemistry - 2 - Compounds, formulae and equations**

For A level Chemistry, you need to learn the formula and charges of common ions.

Learn the formulas of the ions in the table below (you may want to make flash cards!)

| **Positive ions** | | **Simple negative ions**<br>**ions ending in -ide contain one element* | |
|---|---|---|---|
| **Group 1 ions** | **+1 charge** | **Group 7 ions** | **-1 charge** |
| lithium | $Li^+$ | fluoride | $F^-$ |
| sodium | $Na^+$ | chloride | $Cl^-$ |
| potassium | $K^+$ | bromide | $Br^-$ |
| **Group 2 ions** | **+2 charge** | iodide | $I^-$ |
| magnesium | $Mg^{2+}$ | hydride | $H^-$ |
| calcium | $Ca^{2+}$ | **Group 6 ions** | **-2 charge** |
| strontium | $Sr^{2+}$ | oxide | $O^{2-}$ |
| **Group 3 ions** | **+3 charge** | sulfide | $S^{2-}$ |
| aluminium | $Al^{3+}$ | **Group 5 ions** | **-3 charge** |
| **Other metal ions** | | nitride | $N^{3-}$ |
| zinc | $Zn^{2+}$ | **Compound negative ions**<br>**ions ending in -ate contain oxygen* | |
| silver | $Ag^+$ | | |
| **Compound ions** | | sulfate | $SO_4^{2-}$ |
| ammonium | $NH_4^+$ | nitrate | $NO_3^-$ |
| **Metals with a roman numeral** | roman numeral = charge on ion | carbonate | $CO_3^{2-}$ |
| | | hydrogen carbonate | $HCO_3^-$ |
| iron(III) | $Fe^{3+}$ | phosphate | $PO_4^{3-}$ |
| copper (II) | $Cu^{2+}$ | hydroxide | $OH^-$ |
| **Compound ions** | | | |
| ammonium | $NH_4^+$ | | |

**Working out the formula of an ionic compounds**

In the formula of an ionic compound, the charges must cancel out.

eg magnesium chloride is $MgCl_2$ **NOT** MgCl

Use brackets where more than one of a compound ion is needed in formula.

eg calcium hydroxide is $Ca(OH)_2$ **NOT** $CaOH_2$

Do not include any charges in the formula of an ionic compound.

**Task 3a**: Use the charges on the ions to work out the formulas of the ionic compounds listed in the table:

| Compound Name | Formula | Compound Name | Formula |
|---|---|---|---|
| silver bromide | | sodium sulfate | |
| sodium carbonate | | lead (II) oxide | |
| potassium oxide | | sodium phosphate | |
| Magnesium phosphate | | zinc hydrogencarbonate | |
| chromium (III) chloride | | ammonium sulphate | |
| calcium hydroxide | | iron (III) oxide | |
| aluminium nitrate | | lithium carbonate | |
| silver sulfate | | aluminium sulfate | |
| **Challenge** - use a periodic table to answer these questions: | | | |
| strontium selenide | | radium sulfate | |
| gallium hydroxide | | aluminium astatide | |

**<u>Other common formulae</u>**

**Acids:** Learn these formulae of common acids:

| Name | Formula |
|---|---|
| hydrochloric acid | $HCl$ |
| nitric acid | $HNO_3$ |
| sulfuric acid | $H_2SO_4$ |
| phosphoric acid | $H_3PO_4$ |
| ethanoic acid | $CH_3COOH$ |

**Diatomic Elements:** Most gases, as well as the group 7 halogens, exist as diatomic molecules. Chlorine exists as $Cl_2$, NOT $Cl$.

**Covalent molecules**: You can work out the formula from the **prefixes** in the name of a compound, eg sulfur **tri**oxide = $SO_3$, carbon **tetra**chloride = $CCl_4$

**Table of prefixes**:

| Prefix | Number of atoms in a formula |
|---|---|
| mono | 1 |
| di | 2 |
| tri | 3 |
| tetra | 4 |
| penta | 5 |
| hexa | 6 |

**Task 3b**: Complete the table below with the formula of each substance.

| Compound | Formula | Compound | Formula |
|---|---|---|---|
| oxygen | | water | |
| nitrogen | | hydrogen peroxide | |
| fluorine | | phosphorous pentachloride | |
| chlorine | | sulfur hexafluoride | |
| bromine | | nitrogen dioxide | |
| carbon monoxide | | carbon dioxide | |
| ammonia | | methane | |

## Writing balanced equations

When writing equations, you **must** make sure that the **formula** of each substance is correct, before you try to balance the equation!

Use the steps below to construct an equation:

Step 1: **Ions**: For any ionic compounds, recall the ions needed.

Step 2: **Formula**: Write the correct formula for each substance in the equation.

Step 3: **Equation**: Add the formulae into the equation

Step 4: **Balancing**: Now balance the equation!

Step 5: **State symbols**: Add the state symbols: (s), (l), (g), (aq).

**Example**: Write an equation for the reaction of zinc metal with nitric acid to form zinc nitrate and hydrogen.

**Ions**: Zinc = $\mathbf{Zn^{2+}}$ and nitrate = $\mathbf{NO_3^-}$

**Formula**: hydrochloric acid = $\mathbf{HNO_3}$; Zinc nitrate = $\mathbf{Zn(NO_3)_2}$, hydrogen = $\mathbf{H_2}$

**Equation**: $Zn + HNO_3 \rightarrow Zn(NO_3)_2 + H_2$

**Balancing**: $Zn + 2HNO_3 \rightarrow Zn(NO_3)_2 + H_2$

**State symbols**: $Zn_{(s)} + 2HNO_{3\,(aq)} \rightarrow Zn(NO_3)_{2\,(aq)} + H_{2\,(g)}$

**Task 3c**: Write balanced symbol equations for the following reactions:

(a) sodium + oxygen → sodium oxide

(b) chlorine + fluorine → chlorine tetrafluoride

(c) aluminium + chlorine → aluminium chloride

(d) calcium + hydrochloric acid → calcium chloride + hydrogen

(e) ammonia + sulphuric acid → ammonium sulphate

(f) magnesium oxide + nitric acid →

(g) strontium carbonate + hydrochloric acid →

(h) ammonia + phosphoric acid →

(i) Phosphine, $PH_3$, is a poisonous gas. Phosphine reacts with oxygen gas to form phosphorus(V) oxide, $P_4O_{10}$, and water.

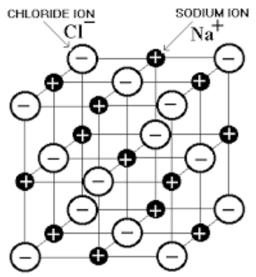
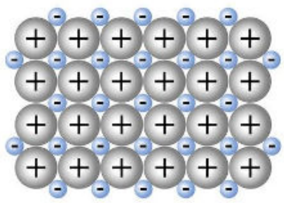
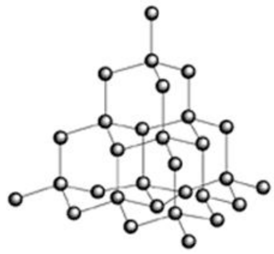
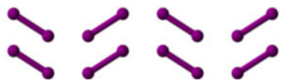
Give the equation for this reaction.

## Section 4 – Structure and Bonding

| GCSE | A level |
|---|---|
| At GSCE, you will have learnt the following types of structures:<br>- simple covalent<br>- giant covalent<br>- metallic bonding<br>- giant ionic lattice<br>In simple covalent structures, the molecules are held together by *weak intermolecular forces*. | At A level, you learn about the four types of crystal structure:<br>• **ionic**<br>• **metallic**<br>• **macromolecular** (giant covalent)<br>• **molecular** (simple covalent)<br>You will learn about the different types of intermolecular forces present in molecular structures:<br>• permanent dipole–dipole forces<br>• Van der Waals forces (aka induced dipole–dipole, dispersion, London forces)<br>• hydrogen bonding. |

### Types of crystal structure

Watch the video link: **Predicting Bonding Types | A Level Chemistry**

| | **ionic** | **metallic** | **macromolecular** (giant covalent) | **molecular** (simple covalent) |
|---|---|---|---|---|
| **Diagram** |   |  |  |  |
| **Description** | Alternating oppositely charged ions | Lattice of positive metal ions surrounded by delocalised electrons | A lattice of many covalently bonded atoms | Simple molecules containing covalent bonds |
| **What holds it together?** | strong electrostatic forces | strong electrostatic forces | strong covalent bonds | Van der Waals forces<br>Permanent dipole – dipole forces<br>Hydrogen bonding |

**Task 4a :** Complete the table to show the type of crystal structure present in each of the substances.

| Substance | Monoatomic *(single atoms only)* | Molecular | Macromolecular | Metallic | Ionic |
|---|---|---|---|---|---|
| bromine | | | | | |
| silver nitrate | | | | | |
| calcium | | | | | |
| neon | | | | | |
| ammonia | | | | | |
| hydrogen sulfide | | | | | |
| graphite | | | | | |
| ammonia | | | | | |
| water | | | | | |

**Task 4b: What are Van Der Waal's forces of attraction?**

Watch the video link **Van der Waals force of attraction**

(a) Describe how Van der Vaal's forces arise

(b) Explain, in terms of Van der Waal's forces, why chlorine has a higher boiling point than fluorine.

## Section 5 – Maths Skills

| GCSE | A level |
|---|---|
| At GSCE (double science), you will have completed calculations on reacting masses.<br><br>At GCSE (triple science) you will have completed calculations on reacting masses, solutions and gases at RTP, including titration calculations.<br><br>A mole contains $6.02 \times 10^{23}$ particles. This is Avogadro's number. | At A level, you will complete unstructured calculations on reacting masses, solutions and gases, including the ideal gas equation for gases not under standard conditions.<br><br>You will need to convert units, and confidently use standards form and logarithms. |

### Converting Units

We use prefixes as shorthand for standard form when using commonly occurring very large or very small numbers.

For example, the length 0.0000000023 m may be written as $2.3 \times 10^{-9}$ m

2.3 is the *digit number* and is kept. $10^{-9}$ is known as the *exponential number* and can be replaced with the prefix *'n'* pronounced as 'nano'.

Hence:

$$0.0000000023 \text{ m} = 2.3 \times 10^{-9} \text{ m} = 2.3 \text{ nm}$$

Watch the video to find out how units are converted when using the ***Ideal gas equation***

**AQA A level Chemistry - Amount of substance PART 2**

**Converting units (volume)**

| Number | | Exponential number | Prefix | |
|---|---|---|---|---|
| billion | 1 000 000 000 | $10^{9}$ | G | 'giga' |
| million | 1 000 000 | $10^{6}$ | M | 'mega' |
| thousand | 1000 | $10^{3}$ | k | 'kilo' |
| tenth | 0.1 | $10^{-1}$ | d | 'deci' |
| hundredth | 0.01 | $10^{-2}$ | c | 'centi' |
| thousandth | 0.001 | $10^{-3}$ | m | 'milli' |
| millionth | 0.000 000 1 | $10^{-6}$ | μ | 'micro' |
| billionth | 0.000 000 000 1 | $10^{-9}$ | n | 'nano' |

**Manipulating units**

- A number and a unit (like 3 m) is a magnitude (3) multiplied by a unit (metre).
- The rules of algebra apply not only to the numbers you are manipulating, but also to the units attached to them. For example:

$$\mathbf{3\ m \times 3\ m = 3 \times 3 \times m \times m = 9 \times m \times m = 9 \times m^2 = 9\ m^2}$$

- Units can be multiplied and divided just like a regular number. For example:

$$\frac{6\ \mathrm{m}^3}{2\ \mathrm{m}^2} = 3\frac{\mathrm{m}^3}{\mathrm{m}^2} = 3\frac{\mathrm{m}\ \times\ \mathrm{m}\ \times \mathrm{m}}{\mathrm{m}\ \times \mathrm{m}} = 3\ \frac{\mathrm{m}\ \times \cancel{\mathrm{m}}\ \times \cancel{\mathrm{m}}}{\cancel{\mathrm{m}} \times \cancel{\mathrm{m}}} = 3\ \mathrm{m}$$

- At A-level, rather than write m/s to mean metres per second, we will write $\mathrm{ms}^{-1}$.
- This makes it easier to combine units via the following rules:

$$unit^a \times unit^b = unit^{a+b}$$

$$\frac{unit^a}{unit^b} = unit^{a-b}$$

This means that: $\frac{1}{\mathrm{kg}^{-1}} = \mathrm{kg}$ or more generally $\frac{1}{a^{-n}} = a^n$

**Task 5a**. Convert the following numbers into metres:

(a) 3 km

(b) 20 cm

(c) 2.3 mm

(d) 550 nm

(e) 5.1 μm

(f) 13.7 Gm

(g) 0.0025 km

(h) 1.0001 km

**Task 5b**. Simplify the units in the table below

| | | | |
|---|---|---|---|
| (a) cm × cm | | (e) $\frac{\mathrm{cm}^3}{\mathrm{cm}}$ | |
| (b) $\mathrm{cm}^2$ × cm | | (f) $\frac{\mathrm{cm\ x\ cm}^3}{\mathrm{cm}}$ | |
| (c) $\frac{\mathrm{kg\ m}}{\mathrm{m}}$ | | (g) $\frac{\mathrm{cm}}{\mathrm{cm}^2}$ | |
| (d) $\mathrm{nm}^2 \times \mathrm{nm}^{-1}$ | | (h) $\frac{\mathrm{g\ cm}^3}{\mathrm{cm}^{-1}}$ | |

**Standard Form**

We use standard form to easily manage very large or very small numbers.

For example, the number 0.00000000000087 may be written as $8.7 \times 10^{-13}$

In this form, $8.7 \times 10^{-13}$ is the product of two numbers: 8.7 is the **digit number**, and $10^{-13}$ is the **exponential number**.

A number is in standard form when it is written as $a \times 10^n$, where $1 \leq a < 10$

Here are some further examples of numbers in standard form.

| Decimal | Standard Form |
|---|---|
| 134 000 | $1.34 \times 10^5$ |
| 0.0034 | $3.4 \times 10^{-3}$ |
| 270 | $2.7 \times 10^2$ |
| 0.000 000 000 026 | $2.6 \times 10^{-11}$ |

**Standard Form – Using your calculator**

To type a number in standard form on your calculator,

- Input the digit number followed by the multiplication sign.
- Locate the "$10^x$" symbol, and use this to insert the exponent.
- Check your equation for any needed brackets.

To check, multiply $6.1 \times 10^4$ and $2 \times 10^3$. The answer should be $1.22 \times 10^8$

**Example**

0.0125 moles of a salt were dissolved in 2.5 $dm^3$ of water.

What is the concentration of this substance in mol $dm^{-3}$?
Give your answer in **standard form**.

$c = n / v = 0.0125 / 2.5 = 0.005$ mol $dm^{-3}$ = $5 \times 10^{-3}$ mol $dm^{-3}$

**Task 5c** Convert the following numbers into standard form:

| | | | |
|---|---|---|---|
| 32000 | | 9 230 000 | |
| 0.0006 | | 0.000 040 5 | |
| 104 000 | | 0.002 019 | |
| 18 200 000 | | 30 200 | |

**Task 5d** Convert the following numbers from standard form into decimal notation:

| | | | |
|---|---|---|---|
| $3.26 \times 10^4$ | | $8 \times 10^{-6}$ | |
| $8.4 \times 10^{-3}$ | | $1.3 \times 10^8$ | |
| $7.29 \times 10^7$ | | $2.3 \times 10^{-4}$ | |
| $1.26 \times 10^2$ | | $5.001 \times 10^6$ | |

**Task 5e** Challenge Question

The data in the following table were obtained in two experiments about the rate of the reaction between substances **B** and **C** at constant temperature.

| Experiment | Initial concentration of **B** / mol $dm^{-3}$ | Initial concentration of **C** / mol $dm^{-3}$ | Initial rate / mol $dm^{-3}$ $s^{-1}$ |
|---|---|---|---|
| **1** | $4.2 \times 10^{-2}$ | $2.6 \times 10^{-2}$ | $8.4 \times 10^{-5}$ |
| **2** | $6.3 \times 10^{-2}$ | $7.8 \times 10^{-2}$ | To be calculated |

***k*** is the known as the rate constant. ***k*** is the same for both experiments.

The rate equation for this reaction is known to be:

**Rate = $k[B]^2[C]$**

Which can also be written as:

**Rate of reaction = *k* x [concentration of B]$^2$ x [concentration of C]**

(a) Use the data from Experiment **1** to calculate a value for the rate constant ***k***

Give your answer in **standard form** to **3 significant figures**

State the **units** of the rate constant

(b) Use your value of ***k*** to calculate the rate of reaction for Experiment **2**.

## Section 6 – Mole Calculations

If you have taken Combined Science GCSE, you may not have covered all of the GCSE mole calculations.

Watch the following videos to revise mole calculations:

**GCSE Chemistry The Mole**

**GCSE Chemistry Moles Concentration and Volume Calculations**

**Task 6**: Complete the calculation questions. Show all your working!

Q1

Explain what the Avogadro constant is. ..........................................................................................

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Q2

Calculate the number of molecules of water in 90.0 g of water. (Avogadro constant, $L = 6.022 \times 10^{23}\ mol^{-1}$)

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Q3

Calculate the relative formula mass ($M_r$) of the following substances.

a) $O_2$ .......................................................................................................................... (1)

b) $K_2SO_4$ ..................................................................................................................... (1)

c) $Mg(NO_3)_2$ .................................................................................................................. (1)

d) $CuSO_4.5H_2O$ .............................................................................................................. (1)

Q4

Calculate the mass of each of the following.

a) 5.00 moles of $Fe_2O_3$ ......................................................................................................

.......................................................................................................................................... (1)

b) 0.250 moles of hydrogen ....................................................................................................

.......................................................................................................................................... (1)

c) $1.50 \times 10^{-4}$ moles of aluminium iodide ...........................................................................

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## Q5

Calculate the number of moles of each of the following.

a) 23.6 g of Cu ........................................................................................................

........................................................................................................ (1)

b) 43.8 mg of fluorine ........................................................................................................

........................................................................................................ (1)

c) 1.25 tonnes of vanadium(V) oxide ........................................................................................................

........................................................................................................ (1)

## Q6

Convert these quantities into the units shown.

a) 18 mmol to mol ........................................................................................................ (1)

b) 20 MPa to Pa ........................................................................................................ (1)

c) 65 mg to g ........................................................................................................ (1)

d) 20°C to K ........................................................................................................ (1)

e) 125 pm to m ........................................................................................................ (1)

f) 50 $cm^3$ to $dm^3$ ........................................................................................................ (1)

g) 200 $cm^3$ to $m^3$ ........................................................................................................ (1)

## Q7

250 $cm^3$ of aqueous solution contains 2.0 g of dissolved sodium hydroxide. Calculate the concentration of the solution in mol $dm^{-3}$

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........................................................................................................ (2)

## Q8

What mass of oxygen reacts with 2.30 g of sodium? $4Na(s) + O_2(g) \rightarrow 2Na_2O(s)$

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Q9

Which is the limiting reagent and what mass of aluminium chloride is formed when 1.35 g of aluminium is heated with 4.26 g of chlorine?

$$2Al(s) + 3Cl_2(g) \rightarrow 2AlCl_3(s)$$

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Q10

In a titration, it was found that 25.0 $cm^3$ of 0.150 mol $dm^{-3}$ sulfuric acid reacts with 23.58 $cm^3$ of sodium hydroxide solution. Calculate the concentration of the sodium hydroxide solution in mol $dm^{-3}$.

$$H_2SO_4(aq) + 2NaOH(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(l)$$

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