DIXONS SIXTH FORM ACADEMY

SUMMER WORK

A LEVEL CHEMISTRY

2024

STUDENT NAME:

About the Summer Work

This booklet contains a number of tasks that students are expected to complete to a good standard in order to be able to be enrolled in this subject.

Please complete these tasks on A4 paper and bring them to your first lesson in September.

The work handed in should be:

- written in black or blue ink on A4 lined paper
- written in full sentences with no copying and pasting from external sources
- have all compulsory tasks completed
- have your full names on each sheet
- multiple sheets should be connected together

This booklet also contains significant additional information and a range of optional tasks. We would encourage you to complete all the tasks including the optional ones to fully prepare for Sixth Form study.

You can use revision books from GCSE and can use links to the websites give below to extract information and further reading and complete the task either on paper/ as a word document.

On the first day in the college you will do an induction test. This test will be based on the summer work which has been set for you as your homework. Remember- first impressions are important.

(WE DO NOT NEED TO SEE YOUR NOTES OR TASKS SO YOU DO NOT NEED TO PRINT OFF ANY WORK TO BRING TO US)

Key websites and text Books:

Hodder’s Chemistry Books

Welcome to Chemistry

Chemistry is the central science, with links to biology, physics, mathematics, and engineering. Chemists design and synthesise medicines, investigate climate change and energy, create our everyday products, and develop new materials. With a chemistry degree you'll be able to work in a diverse range of industries.

An excellent student in Chemistry will essentially follow these routines and continues to be better in understanding concepts by the habit of practice

1. *Review and Study Material Before Going to Class.*
2. *Seek Understanding.*
3. *Take Good Notes.*
4. *Practice Daily.*
5. *Ask your teacher if unsure.*

Careers & Higher Education

- Medicine
- Dentistry
- Chemistry BSc
- Chemistry MChem, BSc
- Chemistry and Mathematics BSc
- Chemistry and Mathematics MChem, BSc
- Medicinal Chemistry BSc
- Medicinal Chemistry MChem, BSc
- Pharmacy
- Radiology
- Optometry

In addition to Medicine and Dentistry there is a range of careers which can be taken up following the study of Chemistry

- Research Chemist
- Resin Technology Scientist
- Analytical Development Technician
- Equity Analyst
- Analytical Chemist
- Scientist
- Process Technologist
- Systems Manager
- Analyst
- Graduate Chemist
- Product Testing Analyst
- Health Care Assistant, NHS
- Drug Discovery Chemist

- Chemical Analyst
- Graduate Trainee
- Lab Technician
- Business Development Executive, Royal Society of Chemistry
- Formulation Scientist

Bradford has a range of Pharmaceuticals and Chemical process plants where there is always a need of Scientists, Chemical Engineers and Laboratory technicians

Links to key information:

https://www.dixons6a.com/uploads/files/Chemistry.pdf

https://www.aqa.org.uk/subjects/science/as-and-a-level/chemistry-7404-7405/specification-at-a-glance

Summer work tasks

SECTION A - Knowledge and Practice

1. **Bonding**
   (a) Create a mind map on different types of bonding.
   (b) What are the differences in the physical properties of the compounds formed from each type of bonding?
   (c) How can we explain properties such as the melting and boiling points, solubility and electrical conductivity for different types of compounds formed?

2. **Atomic Structure**

   (a) Describe the history of the atom – from plum Pudding model to Bohr's atomic model.
   (b) Define - Atomic number, Mass number, Relative atomic mass and Isotopes.
   (c) Find the RFM /RAM (Relative Formula Mass) of the following compounds using a periodic table

1) silver carbonate ....
2) gold ....
3) platinum (II) fluoride ....
4) nitric acid ....
5) ammonia ....
6) silicon (IV) hydride ....
7) phosphorus ....
8) diamond ....
9) vanadium (V) oxide ....
10) cobalt (II) hydroxide ....

Calculating the relative atomic mass

Isotopes have the same number of ______________ but different numbers of ______________.

The relative atomic mass is the average mass of an element. To calculate the relative atomic mass, you need to know the mass of the isotope and how much there is of each isotope (abundance).

$$RAM = \frac{(\text{mass number} \times \text{percentage})\text{of isotope 1} + (\text{mass number} \times \text{percentage})\text{ of isotope 2}}{100}$$

1. The table shows information about the isotopes of an element.

	Mass number	Percentage (%) abundance
Isotope 1	10	20
Isotope 2	11	80

Calculate the relative atomic mass (A_r) of the element. Give your answer to 1 decimal place.

$$RAM = \frac{(10 \times \_\_\_\_\_\_\_) + (11 \times \_\_\_\_\_\_\_)}{100} = \frac{\_\_\_\_\_\_ + \_\_\_\_\_\_}{100} =$$

2. Calculate the relative atomic mass of bromine. Give your answer to 1 decimal place.

	Mass number	Percentage (%) abundance
^{79}Br	79	50.7
^{81}Br	81	49.3

$$\text{RAM Bromine} = \frac{(79 \times \_\_\_\_\_\_\_) + (81 \times \_\_\_\_\_\_\_)}{100} = \frac{\_\_\_\_\_\_ + \_\_\_\_\_\_}{100} =$$

3. Calculate the relative atomic mass of gallium. Give your answer to 1 decimal place.

	Mass number	Percentage (%) abundance
^{69}Ga	69	60.1
^{71}Ga	71	39.9

$$\text{RAM Gallium} = \frac{(69 \times \_\_\_\_\_\_\_) + (71 \times \_\_\_\_\_\_\_)}{100} = \frac{\_\_\_\_\_\_ + \_\_\_\_\_\_}{100} =$$

3. <u>Ionic formulae</u>

Use the chart below to write the formulae of the ionic compounds listed as Tasks 1-3.

Elements

Monatomic	Simple molecular	Ionic	Metallic	Giant covalent
helium neon argon krypton xenon radon	hydrogen nitrogen oxygen fluorine chlorine bromine iodine phosphorus sulfur	There are no ionic elements!!	The formula is just the symbol, e.g. magnesium iron sodium nickel	The formula is just the symbol diamond graphite silicon

Compounds

Monatomic	Simple molecular	Ionic	Metallic	Giant covalent
There are no monatomic compounds!!	Some common molecular compounds: carbon dioxide carbon monoxide nitrogen monoxide nitrogen dioxide sulfur dioxide sulfur trioxide ammonia methane hydrogen sulfide	These have to be worked out using ion charges – you have to know these at AS/A level! LEARN them ASAP. Note these acids: hydrochloric acid sulfuric acid nitric acid phosphoric acid	There are no metallic compounds!!	silicon dioxide

Positive ions		Negative ions	
Group 1 ions: lithium sodium potassium Group 2 ions: magnesium calcium barium	Group 3 ions: aluminium Other common ions silver zinc ammonium hydrogen	Group 7 ions: fluoride chloride bromide iodide Group 6 ions: oxide sulfide	Other common ions nitrate sulfate carbonate hydrogencarbonate hydroxide hydride phosphate

TASK 1 – WRITING FORMULAS OF IONIC COMPOUNDS

1)	silver bromide	....	9)	lead (II) oxide	....
2)	sodium carbonate	....	10)	sodium phosphate	....
3)	potassium oxide	....	11)	zinc hydrogencarbonate	....
4)	iron (III) oxide	....	12)	ammonium sulphate	....
5)	chromium (III) chloride	....	13)	gallium hydroxide	....
6)	calcium hydroxide	....	14)	strontium selenide	....
7)	aluminium nitrate	....	15)	radium sulfate	....
8)	sodium sulfate	....	16)	sodium nitride	....

TASK 2 – WRITING FORMULAS 1

1)	lead (IV) oxide	....	11)	barium hydroxide	....
2)	copper	....	12)	tin (IV) chloride	....
3)	sodium	....	13)	silver nitrate	....
4)	ammonium chloride	....	14)	iodine	....
5)	ammonia	....	15)	nickel	....
6)	sulfur	....	16)	hydrogen sulfide	....
7)	sulfuric acid	....	17)	titanium (IV) oxide	....
8)	neon	....	18)	lead	....
9)	silica	....	19)	strontium sulfate	....
10)	silicon	....	20)	lithium	....

TASK 3 – WRITING FORMULAS 2

1)	silver carbonate	....	11)	barium hydroxide	....
2)	gold	....	12)	ammonia	....
3)	platinum (II) fluoride	....	13)	hydrochloric acid	....
4)	nitric acid	....	14)	fluorine	....
5)	ammonia	....	15)	silicon	....
6)	silicon (IV) hydride	....	16)	calcium phosphate	....
7)	phosphorus	....	17)	rubidium	....
8)	diamond	....	18)	germanium (IV) oxide	....
9)	vanadium (V) oxide	....	19)	magnesium astatide	....
10)	cobalt (II) hydroxide	....	20)	nitrogen monoxide	....

3. **Equations**

Chemical equations form the most important part for understanding Chemistry. Read the examples in the table given below and complete Tasks 4 and 5.

From an early age you should have been able to balance chemical equations. However, at A level, you will often need to:

- work out the formulas yourselves
- work out what is made (so you need to know some basic general equations)
- for reactions involving ions in solution, write ionic equations

Some general reactions you should know:

General Reaction	Examples
substance + oxygen → oxides	$2\,Mg + O_2 \rightarrow 2\,MgO$ $2\,H_2S + 3\,O_2 \rightarrow 2\,H_2O + 2\,SO_2$ $C_3H_8 + 5\,O_2 \rightarrow 3\,CO_2 + 4\,H_2O$
metal + water → metal hydroxide + hydrogen	$2\,Na + 2\,H_2O \rightarrow 2\,NaOH + H_2$
metal + acid → salt + hydrogen	$Mg + 2\,HCl \rightarrow MgCl_2 + H_2$
oxide + acid → salt + water	$MgO + 2\,HNO_3 \rightarrow Mg(NO_3)_2 + H_2O$
hydroxide + acid → salt + water	$2\,NaOH + H_2SO_4 \rightarrow Na_2SO_4 + H_2O$
carbonate + acid → salt + water + carbon dioxide	$CuCO_3 + 2\,HCl \rightarrow CuCl_2 + H_2O + CO_2$
hydrogencarbonate + acid → salt + water + carbon dioxide	$KHCO_3 + HCl \rightarrow KCl + H_2O + CO_2$
ammonia + acid → ammonium salt	$NH_3 + HCl \rightarrow NH_4Cl$
metal carbonate → metal oxide + carbon dioxide (on heating)	$CaCO_3 \rightarrow CaO + CO_2$

TASK 4 – WRITING BALANCED EQUATIONS

1) Balance the following equations.

a) $Mg + HNO_3 \rightarrow Mg(NO_3)_2 + H_2$

b) $CuCl_2 + NaOH \rightarrow Cu(OH)_2 + NaCl$

c) $SO_2 + O_2 \rightarrow SO_3$

d) $C_4H_{10} + O_2 \rightarrow CO_2 + H_2O$

2) Give balanced equations for the following reactions.

a) sodium + oxygen → sodium oxide

b) aluminium + chlorine → aluminium chloride

c) calcium + hydrochloric acid → calcium chloride + hydrogen

d) ammonia + sulphuric acid → ammonium sulphate

TASK 5 – WRITING BALANCED EQUATIONS 2

Write balance equations for the following reactions:

1) burning aluminium
2) burning hexane (C_6H_{14})
3) burning ethanethiol (CH_3CH_2SH)
4) reaction of lithium with water
5) reaction of calcium carbonate with nitric acid
6) thermal decomposition of lithium carbonate
7) reaction of ammonia with nitric acid
8) reaction of potassium oxide with sulfuric acid
9) reaction of calcium hydroxide with hydrochloric acid
10) reaction of zinc with phosphoric acid
11) reaction of sodium hydrogencarbonate with sulfuric acid
12) reaction of potassium hydroxide with sulfuric acid

SECTION B- Maths in Chemistry

Each task below has some information and examples done for you. Read the examples and then complete the tasks.

1. **Standard Forms**

LEARNING OUTCOME
Be comfortable with using both decimals and standard form, and converting between them.

THEORETICAL OVERVIEW

Chemists need to be able to manage large and small numbers. Sometimes the size of these numbers can make them difficult to use in calculations.

e.g. a H atom has a mass of... 0.000000000000000000000001661 grams
there are... 7886200000000000000000000 molecules in a cup of water

Standard form

When doing calculations, it is a lot easier to write these numbers in standard form. Standard form moves the decimal point, and gives the size of the number as a power of 10.

Converting numbers into standard form

Numbers in standard form are written as:

$$a \times 10^{x}$$

where a is a number from 1 to 9, and x is the number of decimal places the decimal point has been moved.

If the decimal point moves to the **left** then x is a **positive number.** If the decimal point move to the **right** then x is a **negative number.**

For example:

$156000000.0 = 1.56 \times 10^{8}$ (8)

The decimal point has been moved 8 places to the **left**, so x = 8.

$0.000429 = 4.29 \times 10^{-4}$ (4)

The decimal point has been moved 4 places to the **right**, so x = -4.

Converting numbers back into decimals

To convert from standard form to a decimal, you move the decimal x times in the opposite direction to the rules above.

For example:

$3.78 \times 10^{-5} = 000003.78 = 0.0000378$ (5)

Here, the $^{-5}$ tells you that you need to move the decimal point **left** 5 places.

Rounding

Rounding a number is a way of shortening numbers so they are easier to use in calculations. The table shows 4.563 rounded to different numbers of decimal places (d.p.).

4.563	
3 d.p.	4.563
2 d.p.	4.56
1 d.p.	4.6
0 d.p.	5

4.56 is closer to 4.6 than to 4.5, so it is rounded 'up' to 5, when rounding to 0 d.p.

Standard form on your calculator

To be able to make calculations involving standard form, you will need to know how to use standard form on your calculator.

Standard form button [x10^x]

Here are some examples of how to use this button:

[3] [•] [5] [x10^x] [4]
which inputs 3.5×10^4

[4] [x10^x] [3] [×] [6] [x10^x] [5]
which inputs the calculation $4 \times 10^3 \times 6 \times 10^5$

WORKED EXAMPLE

A nanotube has a radius of 5×10^{-8} m and is 2.693×10^{-3} m long.

a) Write the length of the nanotube as a decimal to 4 decimal places.

b) The formula for the volume of the nanotube is $\pi \times r^2 \times l$, where r is the radius and l is the length. Perform the following calculation on your calculator to find the volume in standard form to 2 decimal places:

$$\pi \times (5 \times 10^{-8})^2 \times 2.693 \times 10^{-3}$$

Solution

a) $2.693 \times 10^{-3} = 0.002693$ *(move the decimal place 3 places to the right)*
0.0027 *(round up to 2 significant figures)*

b) $2.115077254 \times 10^{-17}$ *(in standard form)*
$= 2.12 \times 10^{-17}$ *(rounded down to 3 significant figures)*

PRACTICE QUESTIONS

1. Write the following in standard form:
   a) 4 250 000 J
   b) 0.012 m
   c) 623 000 000 000 s
   d) 0.0000007896 kg
2. Write the following numbers out in full:
   a) 6.72×10^{-6} mol
   b) 7.59×10^{4} atoms
   c) 9.91×10^{-4} mol dm^{-3}
   d) 8.143×10^{2} cm^3
3. Round the following to the given number of decimal places (d.p.):
   a) 2.465 g to 2 d.p.
   b) 7.9623 g to 3 d.p.
   c) 3.14159 g to 3 d.p.
   d) 0.956 g to 1 d.p.
4. A drug developer dissolves a mass of 1.6289 g of a new drug in a volume of 5.00 m^3 of water.
   a) Write down the mass in grams of the new drug dissolved in the water to 2 decimal places.
   b) Calculate the concentration of the drug solution in g m^{-3}, by dividing the mass by the volume. Give your answer in standard form.

2. Units with powers

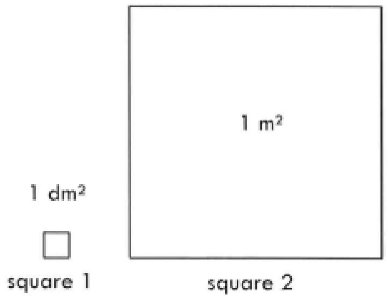
Converting units with powers

Units for area (e.g. m^2) and volume (e.g. m^3) have powers (i.e. ^{2} and ^{3}). It is more complex to convert between units with multiple dimensions. It may surprise you that 1 m^3 is 1 000 000 times larger than 1 cm^3.

Areas

Square 2 has 10 times the width and height of square 1.
However, square 2 does **not** have 10 times the area of square 1.
Square 2 has **100 times the area** of square 1.

This is 10 squared (10^2) which is 10×10.
(height, width)



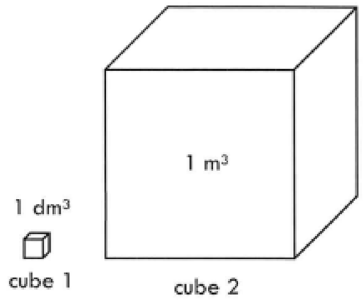
Volumes

Cube 2 has 10 times the width, height and depth of cube 1.

However, cube 2 does **not** have 10 times the volume of cube 1.

Cube 2 has **1000 times the volume** of cube 1.

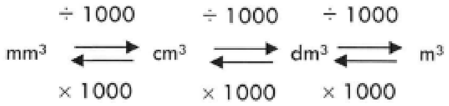
This is 10 cubed (10^3) which is $10 \times 10 \times 10$.
(height, width, length)



> To convert a value in m^3 to a value in dm^3, you have to multiply by 1000, and divide for the reverse calculation.

e.g.

$3\ m^3 = 3000\ dm^3$



WORKED EXAMPLES

1 **'Convert 400 cm^3 to dm^3.'**
This is going from a smaller unit to a larger unit, so we need to divide.
$400 \div 10^3 = 0.4\ dm^3$

2 **'Convert 8.2×10^{-17} m^2 to nm^2'**
This is going from a larger unit to a smaller unit, so we need to multiply.
$8.2 \times 10^{-17} \times (10^9)^2 = 8.2 \times 10^{-17} \times 10^{18} = 82\ nm^2$

Inverse units

Inverse units include units such as 'per gram' and 'per mole'. These are represented as '/ g' or '/ mol', or more commonly at A Level, 'g^{-1}' and 'mol^{-1}'.

'Per' units are written as 'unit^{-1}', e.g. kg^{-1}, which means 'per kilogram'.

These are important for working with compound units, which are made up of two or more different units, like metres per second ($m\ s^{-1}$), or grams per mole ($g\ mol^{-1}$).

When converting between inverse units, the conversion works the other way round to normal:

To go from a **smaller** unit to a **larger** unit you need to **multiply**.
To go from a **larger** unit to a **smaller** unit you need to **divide**.

For example, to go from grams to kilograms, you multiply by 1000. But to convert *per* gram to *per* kilogram, you divide by 1000.

$$mg^{-1} \underset{\div 1000}{\overset{\times 1000}{\rightleftarrows}} g^{-1} \underset{\div 1000}{\overset{\times 1000}{\rightleftarrows}} kg^{-1}$$

WORKED EXAMPLE

'Convert 950 s^{-1} to ms^{-1}.'

This is going from a smaller unit to a larger unit so we need to divide.

$950 \div 10^3 = 0.950\ ms^{-1}$

Converting concentrations

Concentrations can be given in either mol dm^{-3} or g dm^{-3}. To convert between them you can use an adapted version of the mole equation (which you will meet in your course if you don't know it already):

moles = $\frac{mass}{M_r}$, so

$$\text{mole concentration (mol dm}^{-3}) = \frac{\text{mass concentration (g dm}^{-3})}{M_r}$$

WORKED EXAMPLE

'Convert 0.20 g dm^{-3} into mol dm^{-3} for H_2SO_4'

Solution

M_r of H_2SO_4 = 2×1 + 32.1 + 4×16 = 98.1

Concentration (mol dm^{-3}) = $\frac{0.20}{98.1}$

= 0.00204 mol dm^{-3}

WORKED EXAMPLE

'Convert 0.320 mol dm^{-3} into g dm^{-3} for NaCl.'

Solution

M_r of NaCl = 23.0 + 35.5 = 58.5

Concentration (g dm^{-3}) = Concentration (mol dm^{-3}) × M_r

= 0.320 × 58.5

= 18.72 g dm^{-3}

PRACTICE QUESTIONS

1. How many times bigger is:
   a) 1 m^3 than 1 dm^3?
   b) 10 m^3 than 1 dm^3?
   c) a cube with sides 2 cm long than a cube with sides 1 cm long?
   d) 2 m^2 than 1 m^2?
   e) 5 m^2 than 10 cm^2?

2. Convert the following quantities:
   a) 5 m^3 into mm^3
   b) 3 cm^3 into m^3
   c) 20 m^2 into dm^2
   d) 100 m^2 into mm^2
   e) 8.8×10^{-17} mm^3 into km^3
   f) 24.55 cm^3 in dm^3
   g) 0.250 dm^3 in cm^3
   h) 3.0 J g^{-1} into J kg^{-1}
   i) 18 mol cm^{-3} into mol dm^{-3}

3. Convert the following concentrations:
   a) 4.60 g dm^{-3} into mol dm^{-3} for KNO_3
   b) 0.500 mol dm^{-3} into g dm^{-3} for NaOH
   c) 11.3 g dm^{-3} into mol dm^{-3} for $MgSO_4$
   d) 0.350 mol dm^{-3} into g dm^{-3} for Na_2CO_3

4. In a titration experiment, the mean titre was recorded as 23.38 cm^3. Convert this value into dm^3.

5. 'A gas at 25 °C and a pressure of 150 kPa occupies a volume of 30 dm^3.

   Convert all of these values into suitable units for use in the ideal gas equation.'

   The ideal gas equation is:

$$pV = nRT$$

   where: p = pressure in Pa (Pascals)
   V = volume in m^3
   n = amount of gas in moles
   R = 8.31 J K^{-1} mol^{-1}
   T = temperature in K

3. Significant Numbers

THEORETICAL OVERVIEW

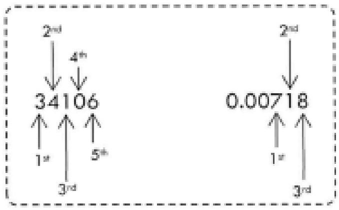
'Long numbers'

1 ÷ 7 = 0.142857142857142857142...

This number is so long that it would be impractical to try to use it in a calculation. When making calculations, you can use *significant figures* to shorten long numbers.

Significant figures

A significant figure is a digit in a number that gives you information about its value. The first significant figure is the first **non-zero** digit.



Rounding

You can **round** a value to a number of significant figures. To round to 2 significant figures, you look at the 3rd significant figure: if it is larger than 5, round up; if it is smaller than 5, round down.

WORKED EXAMPLE

For example, the two numbers on the right above rounded to 2 significant figures are:

34 000 (2 s.f.) *0.0072 (2 s.f.)*

Significant figures in the answer

Rounding values to a number of significant figures makes calculations simpler, but it does lead to a less precise, and potentially less accurate answer if the rounding is done too early.

Two key points to remember when using significant figures in calculations are:

1. Don't round any numbers until **the very end** of the calculation
2. Give your final answer to the **smallest number** of significant figures used in the calculation

You cannot give your final answer to more significant figures than you have used in the calculation because this would mean giving a **more accurate** answer than the values you have used to calculate it.

Example:

1.0 g + 1.0 g = 2.0 g
(2 s.f., 2 s.f., 2 s.f.)

1 g + 1.0 g = 2 g
(1 s.f., 2 s.f., 1 s.f.)

The answers have the **same number of significant figures** as the values with the **smallest number of significant figures**.

WORKED EXAMPLE

The equation for the thermal decomposition of calcium carbonate into calcium oxide and carbon dioxide is the following:

$$CaCO_3 \rightarrow CaO + CO_2$$

In an experiment, 4.36758 g of $CaCO_3$ decomposes into 3.605 g of CaO.

a) Give the mass of $CaCO_3$ used to 3 significant figures.

b) All of the mass lost is due to CO_2 leaving the flask.
Calculate the mass of CO_2 produced, using the *unrounded* numbers and then giving your answer to an appropriate number of significant figures.

Solution

a) *The first 3 significant figures are 4.36, but the next digit is a 7 (above 5) so you have to round up = 4.37 (to 3 significant figures).*

b) *The mass of CO_2 evolved = 4.36758 − 2.605 = 1.76258 g. Remember that the values should not be rounded until the end.*

The smallest number of significant figures used in the calculation is 4, so the final answer must be given to 4 significant figures.

= 1.763 g

PRACTICE QUESTIONS

1. Round the following numbers to the given number of significant figures:
   a) 76 489 to 2 s.f.
   b) 0.0061283 to 3 s.f.
   c) 18 990 to 3 s.f.
   d) 0.010034 to 2 s.f.
   e) 0.0034067 to 4 s.f.
   f) 1.9999 to 4 s.f.

2. The number of moles of a substance can be calculated using:

$$\text{number of moles} = \frac{\text{mass}}{\text{molar mass}}$$

Calculate the number of moles of the following substances, giving your answers to appropriate numbers of significant figures:
   a) Mass of $MgCO_3$ = 16.35 g, molar mass of $MgCO_3$ = 84.3 g mol^{-1}
   b) Mass of $CoCl_2$ = 77 g, molar mass of $CoCl_2$ = 129.9 g mol^{-1}
   c) Mass of $CaCO_3$ = 160.0 g, molar mass of $CaCO_3$ = 100.1 g mol^{-1}

Reading list

Essential reading

GCSE Rates of Reactions/ Atomic Structure from a GCSE Chemistry/ Science Text book

Suggested reading

Chem guide: Fundamentals of Organic Chemistry