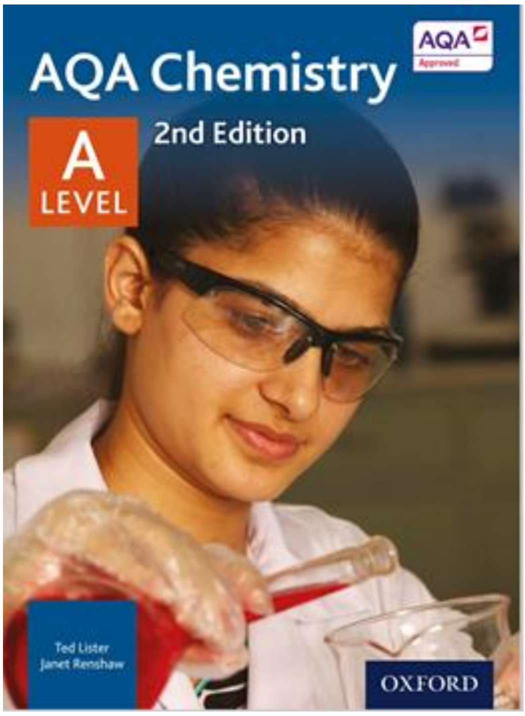
A level Chemistry

GCSE to A level Transition pack

Section 1 - Introduction



Name ……………………………………………………………………………………

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Contents

Section 1: Introduction

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Section 1: Introduction

1. Welcome to A level Chemistry!

Fill in the table below when you know who your chemistry teachers will be. They will be your point of contact if you have any queries.

Teacher	Email address	What side of the course they are covering.

In the space below write down your reasons for studying chemistry:

2. Why study A level Chemistry?

Chemistry students get to investigate a huge range of ideas: the big question you'll ask yourself is 'what is the world made of?'
If you choose it as career, you have the potential to help solve all sorts of problems. You could work on a cure for cancer, or you might develop a new food: the possibilities are endless.
Even if you don't decide to work in chemistry, studying it still develops useful and transferable skills for other careers. You'll develop research, problem solving and analytical skills, alongside teamwork and communication. Universities and businesses regard these skills highly.

3. Possible Degree options:

If you decide to continue studying at university, an A level in Chemistry will be useful in a variety of different degree course:

For example:

Chemistry (obviously!), Mathematics, Biology, Physics, Medicine, Biochemistry, Chemical Engineering, Pharmacology, also subjects like Accountancy, Economics, and Computer Sciences.

4. Future Careers:

A level Chemistry will equip you with many skills, practical, mathematical, research, problem solving alongside teamwork and communication. These are all desirable skills in many careers.

Examples of possible careers:

Analytical Chemist, Chemical Engineer, Clinical Biochemist, Pharmacologist, Doctor, Physician's Assistant, Research Scientist (physical sciences), Toxicologist, Environmental Consultant, Higher Education Lecturer, Secondary School Teacher, Patent Attorney, Science Writer, Accountant, Business Analyst, Computer Programmer.

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5. Course information and specification:

You will have 2 different chemistry teachers, who will each cover different topics. One of your teachers will mainly cover the inorganic and physical chemistry topics, the other will cover the organic chemistry topics.

You will cover the following topics in the first year (AS level):

AS and A-level

Physical chemistry

- Atomic structure
- Amount of substance
- Bonding
- Energetics
- Kinetics
- Chemical equilibria, Le Chatelier's principle and K_c
- Oxidation, reduction and redox equations

Inorganic chemistry

- Periodicity
- Group 2, the alkaline earth metals
- Group 7 (17), the halogens

Organic chemistry

- Introduction to organic chemistry
- Alkanes
- Halogenoalkanes
- Alkenes
- Alcohols
- Organic analysis

During the second year, you will build on these topics and study the following topics:

A-level only topics

Physical chemistry

- Thermodynamics
- Rate equations
- Equilibrium constant K_p for homogeneous systems
- Electrode potentials and electrochemical cells
- Acids and bases

Inorganic chemistry

- Properties of Period 3 elements and oxides
- Transition metals
- Reactions of ions in aqueous solution

Organic chemistry

- Optical isomerism
- Aldehydes and ketones
- Carboxylic acids and derivatives
- Aromatic chemistry
- Amines
- Polymers
- Amino acids, proteins and DNA
- Organic synthesis
- NMR spectroscopy
- Chromatography

6. Resources and equipment:

During your course we will use the AQA A level Chemistry textbooks, you will be issued with your own copy, this will have a code for an online copy too.

- It might be useful to purchase a revision guide to help summarise key points. (The CGP revision guides are very useful, you can also get workbooks to aid your revision)
- There are many useful videos on Youtube you can use to help consolidate your learning
- For calculations, the following book is very good – “Calculations in AS/A level Chemistry” by Jim Clark
- There are many calculations in A level Chemistry so a good scientific calculator is beneficial.

7. Further Reading

Below is a list of further reading for A level students:

Online
Education in Chemistry Magazine: http://www.rsc.org/eic/e-magazine
The Mole Magazine: http://www.rsc.org/eic/mole
Chemistry World Online: www.rsc.org/chemistryworld/
RSC Journals: http://pubs.rsc.org/en/Journals?key=Title&value=Current
RSC membership: www.rsc.org/Membership/Networking/chemnet/
Biochemical Society: www.biochemistry.org/
Biochemistry for schools: www.biochem4schools.org/
Cambridge Science Podcasts: www.thenakedscientists.com/HTML/podcasts/
Oxford Science Podcasts:
http://podcasts.ox.ac.uk/units/mathematical-physical-life-sciences-division

Oxford Science Blog: www.ox.ac.uk/media/science_blog/
University of Bristol School of Chemistry Magazine:
http://www.bris.ac.uk/chemistry/courses/undergraduate/chemistry-explored.html

'Science & Ink' Cartoons: http://www.lab-initio.com/
The Periodic Table: http://www.webelements.com/
Theodore Gray's Periodic Table: http://www.periodictable.com/index.html
Molecule of the Month by the University of Bristol:
http://www.chm.bris.ac.uk/motm/motm.htm

Books
Bad Science by Dr Ben Goldacre, and http://www.badscience.net/
A Short History of Chemistry by J. R. Parrington
Acid Tongues and Tranquil Dreamers: Eight Scientific Rivalries That Changed the World, by Michael White
Crucibles: the Story of Chemistry from Ancient Alchemy to Nuclear Fission by Bernard Jaffe
Fast Food Nation by Eric Schlosser
Mauve: How One Man Invented a Color that Changed the World by Simon Garfield
Mendeleev's Dream by Paul Strathern
Molecular Origami by Bob Hanson
Molecules at an Exhibition: Portraits of Intriguing Materials in Everyday Life by John Elmsley

The Big Bang, a History of Explosives by G.I. Brown

Uncle Tungsten: Memories of a Chemical Boyhood by Oliver Sacks

Titration Practice Quizzes: http://www.rsc.org/learn-chemistry/resource/res00002012/titrations-quizzes-new-users-guide
How to read a scientific journal article: http://www.rsc.org/learn-chemistry/resource/res00001653/how-to-read-a-journal-article
Build an atom: http://www.rsc.org/learn-chemistry/resource/res00002413/iypt-activities#!cmpid=CMP00003366
Chemistry & Football: http://www.rsc.org/learn-chemistry/resource/res00000862/chemistry-and-sport-football
Chemistry in your bathroom: http://www.rsc.org/learn-chemistry/resource/res00001050/chemistry-in-your-bathroom-resource
Women in Chemistry: http://www.rsc.org/learn-chemistry/resource/res00001023/faces-of-chemistry-women-in-chemistry
Making Aspirin Screen Experiment: http://www.rsc.org/learn-chemistry/resources/screen-experiment/aspirin/experiment/1
Chemistry of Fireworks: https://www.youtube.com/embed/HOBhUQqT4CE

Prof. Peter Wothers (University of Cambridge) Demonstration Videos:
https://www.youtube.com/channel/UCgpV4wTwVNIueTwA79YjM8A
Crash Course Chemistry:
https://www.youtube.com/watch?v=uVFCOfSuPTo&list=PL8dPuuaLjXtPHzzYuWy6fYEaX9mQQ8oGr

Fun chemistry experiments to try at home:
Cracking Chemistry: http://www.rsc.org/learn-chemistry/resource/res00001318/cracking-chemistry
Outreach Science Festivals: http://www.rsc.org/learn-chemistry/resource/res00000918/outreach-science-festivals
5 minute crafts: https://www.youtube.com/watch?v=TKgzQmV1KEY
HooplaKidzLab: https://www.youtube.com/watch?v=YmafohV2RX8
Science Museum Learning Site: https://www.sciencemuseum.org.uk/learning
UCAS Chemistry: https://www.ucas.com/job-subjects/chemistry
Catalyst Musuem: http://www.catalyst.org.uk/

Quantitative Chemistry Problem Solving: http://www.rsc.org/learn-chemistry/resources/problem-solving-tutor/
LearnChemistry Experimentation Hub: http://www.rsc.org/learn-chemistry/collections/experimentation

8. Transition skills: Knowledge Audit

Complete the following Knowledge audit

Rank each of the skills red, orange or green

(Red = not confident, amber = some confidence, green confident)

For each section ranked red and amber, complete the relevant section in the transition work booklets.

Section 2 – General Scientific Skills

Topic	R	A	G
1. Prefixes			
2. Significant figures			
3. Converting length, area, volume			
4. Rearranging equations			
5. Variables			
6. Drawing lines of best fit			
7. Constructing graphs			
8. Calculating gradients – straight lines			
9. Calculating gradients - curves			
10. Accuracy Vs Precision			
11. Improving Experiments – Accuracy, Precision and Reliability			
12. Ratios			

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Section 3: Chemistry

Topic:	R	A	G
1. Periodic Table			
2. Chemical symbols and common ions			
3. Word equations			
4. Balancing equations			
5. Moles			
6. Empirical Formula			
7. Organic Chemistry			

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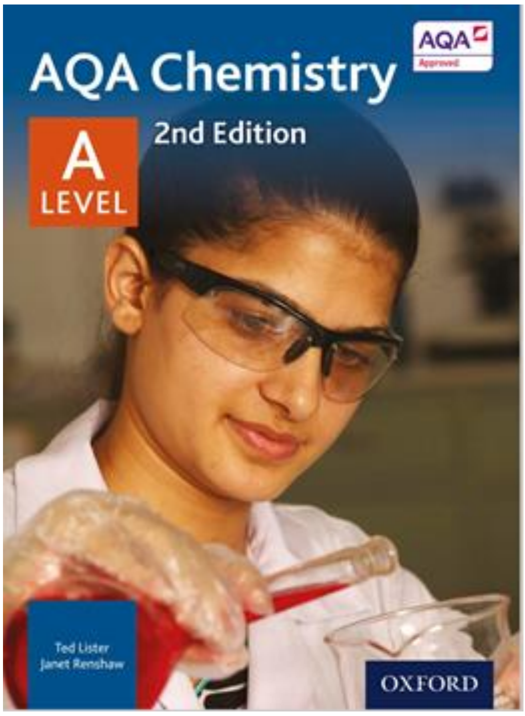
A level Chemistry

GCSE to A level Transition pack

Section 2 – Scientific skills



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Section 1: Introduction

1. <u>Prefixes</u>

In Chemistry we have to deal with quantities from the very large to the very small. A prefix is something that goes in front of a unit and acts as a multiplier. This sheet will give you practice at converting figures between prefixes.

Symbol	**Name**	**What it means**		**How to convert**	
P	peta	10^{15}	1000000000000000		↓ x1000
T	tera	10^{12}	1000000000000	↑ ÷ 1000	↓ x1000
G	giga	10^{9}	1000000000	↑ ÷ 1000	↓ x1000
M	mega	10^{6}	1000000	↑ ÷ 1000	↓ x1000

k	kilo	10^3	1000	↑ ÷ 1000	↓ x1000
			1	↑ ÷ 1000	↓ x1000
m	milli	10^{-3}	0.001	↑ ÷ 1000	↓ x1000
µ	micro	10^{-6}	0.000001	↑ ÷ 1000	↓ x1000
n	nano	10^{-9}	0.000000001	↑ ÷ 1000	↓ x1000
p	pico	10^{-12}	0.000000000001	↑ ÷ 1000	↓ x1000
f	femto	10^{-15}	0.000000000000001	↑ ÷ 1000	

Have a go:

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Convert the figures into the units required.
Convert these figures to suitable prefixed units.

6 km	=	6×10^{3} m
54 Mm	=	m
0.086 µg	=	g
753 GPa	=	Pa
23.87 mm/s	=	m/s

640 Gg	=	640×10^{9} g
	=	0.5×10^{-6} A
	=	93.09×10^{9} m
kN	=	32×10^{5} N
nm	=	0.024×10^{-7} m

Convert the figures into the prefixes required.

s	**ms**	**µs**	**ns**	**ps**
134.6	134.6×10^3	134.6×10^6	134.6×10^9	134.6×10^{12}
96.21				
0.773×10^3				

mm	**m**	**km**	**µm**	**Gm**
12873				
0.295				
0.005723 x 10-6				

kg	**Mg**	**mg**	**g**	**Gg**
94.76				
0.000765×10^3				

823.46×10^{-6}				

2. Significant Figures

1. **All non-zero numbers ARE significant.** The number 33.2 has THREE significant figures because all of the digits present are non-zero.

2. **Zeros between two non-zero digits ARE significant.** 2051 has FOUR significant figures. The zero is between a 2 and a 5.

3. **Leading zeros are NOT significant.** They're nothing more than "place holders." The number 0.54 has only TWO significant figures. 0.0032 also has TWO significant figures. All of the zeros are leading.

4. **Trailing zeros when a decimal is shown ARE significant.** There are FOUR significant figures in 92.00 and there are FOUR significant figures in 230.0.

5. **Trailing zeros in a whole number with no decimal shown are NOT significant.** Writing just "540" indicates that the zero is NOT significant, and there are only TWO significant figures in this value.

6. **For a number in scientific notation: N x 10^x, all digits comprising N ARE significant by the first 5 rules; "10" and "x" are NOT significant.** 5.02 x 10^4 has THREE significant figures.

Have a go:

For each value state how many significant figures it is stated to.

Value	Sig Figs	Value	Sig Figs	Value	Sig Figs	Value	Sig Figs
2		1066		1800.45		0.07	
2.0		82.42		2.483×10^4		69324.8	
500		750000		0.0006		0.0063	
0.136		310		5906.4291		9.81×10^4	
0.0300		3.10×10^4		200000		40000.00	
54.1		3.1×10^2		12.711		0.0004×10^4	

<u>When adding or subtracting numbers</u>

Round the final answer to the **least** number of decimal places in the initial values.

Eg. 10.2 + 0.88 – 5.776 (= 5.304) = **<u>5.3</u>** (to 1d.p. , since 10.2 only contains 1 decimal place)

Have a go at the activity on the next page:

Add the values below then write the answer to the appropriate number of significant figures

Value 1	**Value 2**	**Value 3**	**Total Value**	**Total to correct sig figs**
51.4	1.67	3.23		
7146	–32.54	12.8		
20.8	18.72	0.851		
1.4693	10.18	–1.062		
9.07	0.56	3.14		
739762	26017	2.058		
8.15	0.002	106		
152	0.8	0.55		

When multiplying or dividing numbers

Round the final answer to the **least** number of significant figures in the initial values.

E.g. 4.02 x 3.1 ¸ 0.114 = (109.315…) = **110** (to 2s.f. as 3.1 only has 2 significant figures.

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Have a go:

Multiply the values below then write the answer to the appropriate number of significant figures

Value 1	Value 2	Total Value	Total to correct sig figs
0.91	1.23		
8.764	7.63		
2.6	31.7		
937	40.01		
0.722	634.23		

Divide value1 by value 2 then write the answer to the appropriate number of significant figures

Value 1	Value 2	Total Value	Total to correct sig figs
5.3	748		
3781	6.434		
91×10^2	180		

5.56	22×10^{-3}		
3.142	8.314		

<u>When calculating a mean</u>

1) Remove any **obvious** anomalies (circle these in the table)
2) Calculate the mean with the remaining values, and record this to the **least** number of decimal places in the included values

E.g. Average 8.0, 10.00 and 145.60:

1) Remove 145.60

2) The average of 8.0 and 10.00 is <u>**9.0**</u> (to 1 d.p.)

<u>Have a go:</u>

Calculate the mean of the values below then write the answer to the appropriate number of significant figures

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Value 1	**Value 2**	**Value 3**	**Mean Value**	**Mean to correc sig figs**
1	1	2		
435	299	357		
5.00	6.0	29.50		
3.038	4.925	3.6		
720.00	498.0	268		
0.00040	0.00039	0.000380		
34	30.314	29.7		
23.000	320.00	320.0		
1.4	0.039	260.1		

3. Converting Length, area and volume

Whenever substituting quantities into an equation, you must always do this in SI units – such as time in seconds, mass in kilograms, distance in metres…

If the question doesn't give you the quantity in the correct units, you should always convert the units **first**, rather than at the end. However sometimes the question may give you an area in mm^2 or a volume in cm^3, and you will need to convert these into m^2 and m^3 respectively before using an equation.

To do this, you firstly need to know your length conversions:

1m = 100 cm = 1000 mm   (1cm = 10 mm)

Therefore:

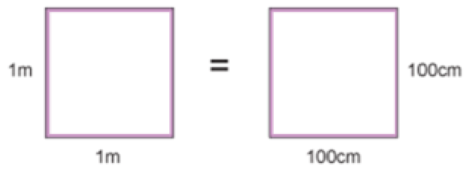
m à cm	x 100	cm à m	¸ 100
m à mm	x 1000	m à mm	¸ 1000

Always think –

"Should my number be getting larger or smaller?" This will make it easier to decide whether to multiply or divide.

Converting Areas

A 1m x 1m square is equivalent to a 100cm x 100cm square.



Therefore, $1m^2 = 10\ 000cm^2$

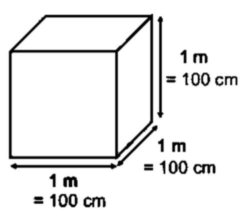
Similarly, this is equivalent to a 1000mm x 1000mm square;

So, $1m^2 = 1\ 000\ 000\ mm^2$

m^2 à cm^2	x 10 000	cm^2 à m^2	¸ 10 000
m^2 à mm^2	x 1 000 000	m^2 à mm^2	¸ 1 000 000

Converting Volumes

A 1m x 1m x 1m cube is equivalent to a 100cm x 100cm 100cm cube.



Therefore, $1m^3 = 1\ 000\ 000\ cm^3$

Similarly, this is equivalent to a 1000mm x 1000mm x 1000mm cube;

So, $1m^3 = 10^9\ mm^3$

m^3 à cm^3	x 1 000 000	cm^3 à m^3	¸ 1 000 000
m^3 à mm^3	x 10^9	m^3 à mm^3	¸ 10^9

<u>Have a go at the activities below</u>

6 m^2	=	cm^2
0.002 m^2	=	mm^2
24 000 cm^2	=	m^2
46 000 000 mm^3	=	m^3
0.56 m^3	=	cm^3

750 mm^2	=	m^2
5×10^{-4} cm^3	=	m^3
8.3×10^{-6} m^3	=	mm^3
3.5×10^2 m^2	=	cm^2
30×10^5 mm^2 + 4 500 cm^2	=	m^2

Now use the technique shown on the previous page to work out the following conversions:

31×10^8 m^2	=	km^2
59 cm^2	=	mm^2
24 dm^3	=	cm^3
4 500 mm^2	=	dm^2
5×10^{-4} km^3	=	m^3

(*Hint: There are 10 cm in 1 dm)*

A Volumetric flask contains 1 dm^3 of acid. What is its volume in cm^3?

Volume = ________________ cm^3

For the following, think about whether you should be writing a smaller or a larger number down to help decide whether you multiply or divide.

Eg. *To convert 5 m/s into m/minute – you will travel more metres in 1 minute than in 1 second, therefore you should multiply by 60 to get 300 m/minute.*

5 N/cm^2	=	N/m^2
750 g/m^3	=	g/cm^3
3 m/s	=	km/h
65 kN/cm^2	=	N/mm^2
54 g/cm^3	=	kg/m^3

4. Rearranging equations

There are not many equations used in A level Chemistry as there are in Physics. But rearranging equations is still a useful skill, and you will still need to be able to do it for the equations you do use.

Have a go:

Rearrange each equation into the subject shown in the middle column.

Equation		Rearrange Equation
$pV = nRT$	R	
$e = \frac{1}{2}mv^2$	v	

Concentration = m/vol	***m***	
pV = nRT	***T***	

5. Variables

A variable is a quantity that takes place in an experiment. There are three types of variables:

Independent variable – *this is the quantity that you **change***

Dependent variable – *this is the quantity that you **measure***

Control variable – *this is a quantity that you **keep the same** so that it does not affect the results*

You can only have one independent variable and one dependent variable, but the more control variables you have the more accurate your results will be.

Further to these, you can also split the independent variable category – this can be continuous or discrete.

A continuous variable can take *any* numerical value, including decimals. You will construct line graphs for continuous variables.

A discrete variable can only take *specific* values or labels (eg. integers or categories). You will construct bar charts for discrete variables.

Have a go:

*For the case study below, state the independent variable, dependent variable, and any control variables described. **Add further control variables**, and state what type the* *independent variable is and what type of graph you will present the results with (if required).*

Case study 1 – *Measuring the effect of concentration on rate of reaction*

The aim of this experiment is to find out how if changing the concentration of acid used in a reaction changes the rate of the reaction. 50cm3 of 0.1M HCl is added to 1 g of marble chips. The rate is measured by using a gas syringe and monitoring the volume of gas every minute. This is repeated with 0.5M HCl, 1M HCL and 2M HCl

Independent variable: ____

Dependent variable: ____

Control variables: ____

____

Type of independent variable: ____

Graph: ____

6. Drawing Lines of Best Fit

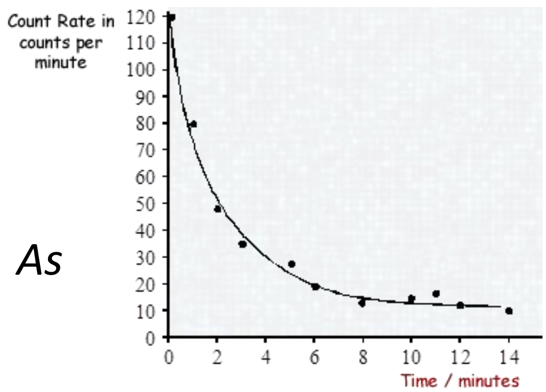
When drawing lines of best fit, draw a *smooth* straight or curved line that passes through the majority of the points. If you can, try to have an even number of points above and below the line if it can't go through all points.

When describing the trend, use the phrase….

"As 'X' increases, 'Y' *increases/decreases* in a *linear/non-linear* fashion."

Substitute the quantities into X and Y, and choose either of the two options to describe the graph.

Eg.



As time increases, the count rate decreases in a non-linear fashion.

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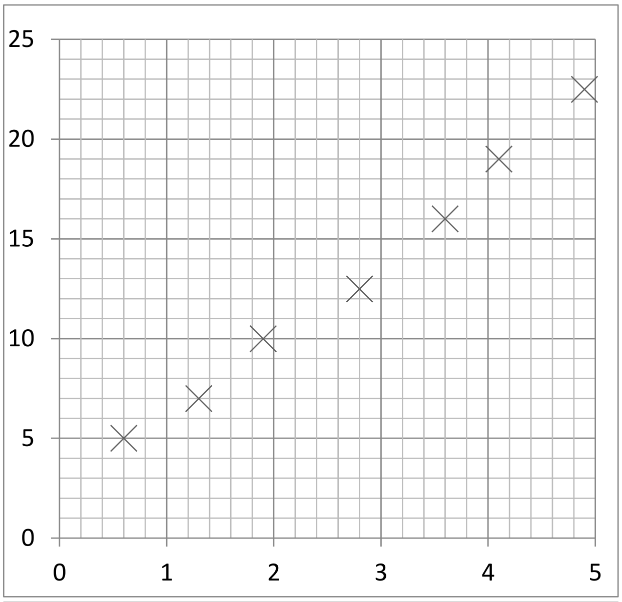
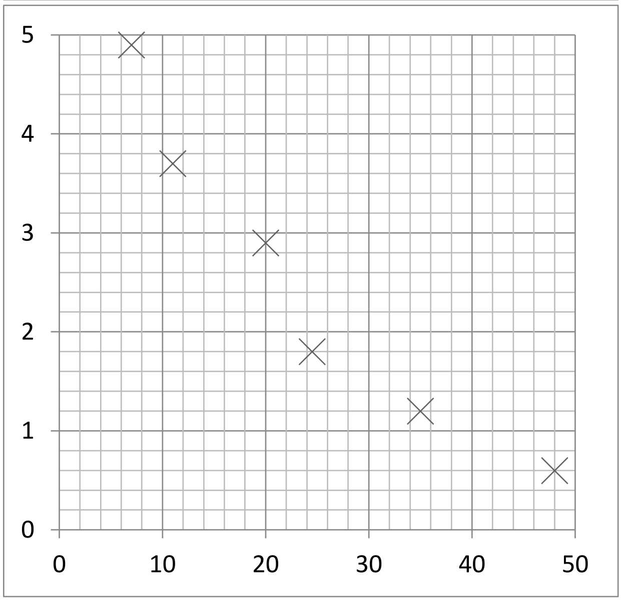
Have a go at the activities on the next few pages:

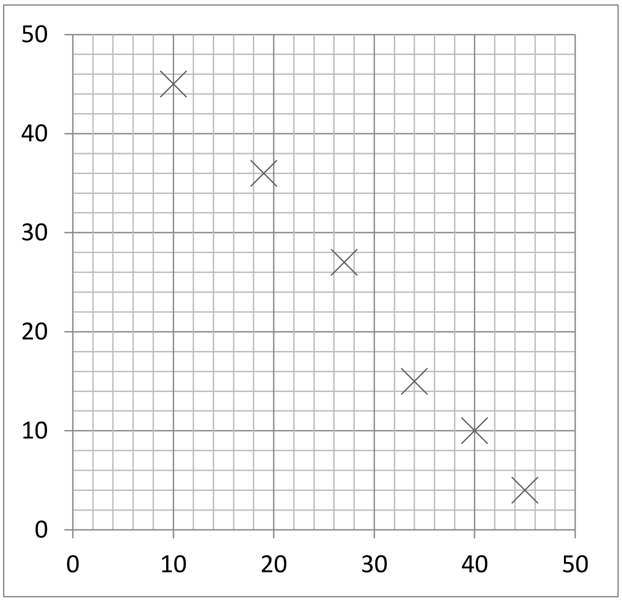
Draw a line of best fit for each of the graphs and describe the trend shown by each (call the quantities X and Y).

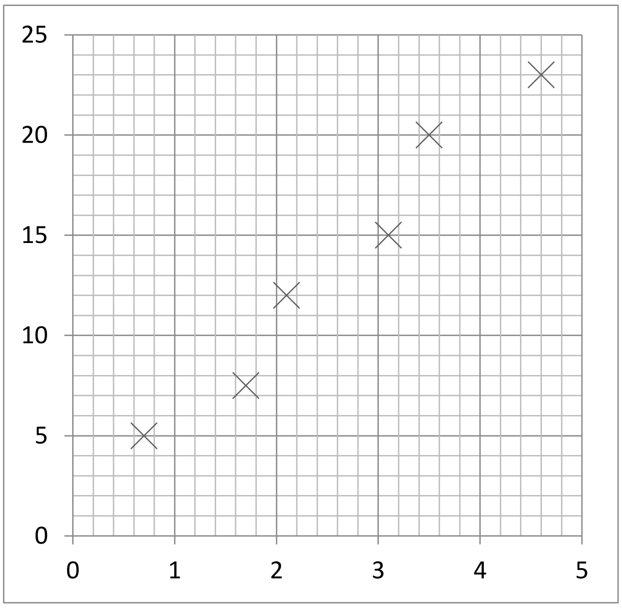
1. **2.**



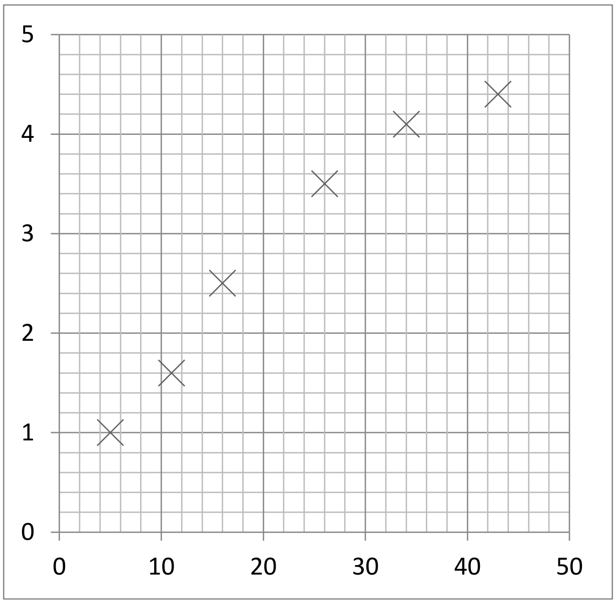


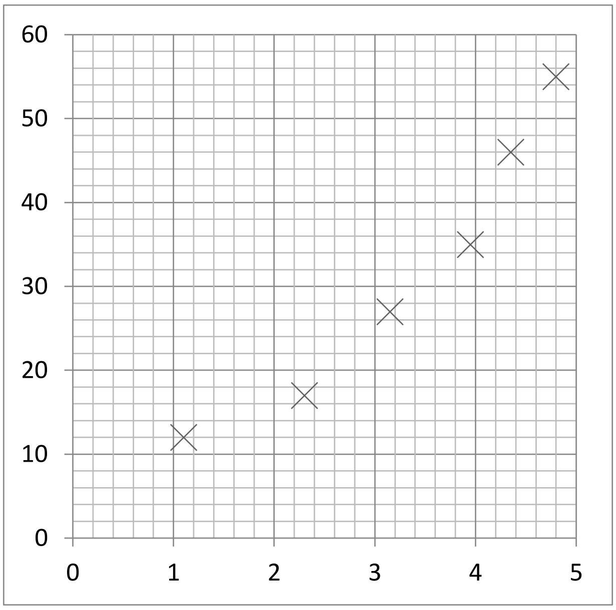
3. **4.**





5. **6.**





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7. Constructing Graphs

When drawing graphs, you will be marked on the following criteria:

1) Axes – Your independent variable is on the x axis, and your dependent variable is on the y axis. Both axes need to be labelled.
2) Units – Add units to your axes when labelling.
3) Scale – Make your scale as large as possible so that your data fills most of the page. **You don't have to start your axes at the origin**. *Make sure you have a regular scale that goes up in nice numbers – 1, 2, 5, 10 etc…*
4) Points – mark each point with a cross using a sharp pencil. Don't use circles or dots as points.
5) Line of best fit – draw a smooth line of best fit – straight or curved depending on what pattern your data follows.

An easy way to remember these points is…..**S** cale

L ine

A xes (**U** nits)

P oints

Have a go:

Plot graphs for the following sets of data, including a line of best fit for each.

(This is a physics example, but still useful to practice!!)

Surface area of pendulum (cm^2)	**Time taken for pendulum to stop (s)**
5.0	170
6.2	127
7.4	99
8.0	86
8.8	70
9.9	56

Current (A)	**Voltage (V)**
0.07	1.46
0.14	1.44
0.21	1.42
0.30	1.40
0.41	1.38
0.57	1.33
0.81	1.29
1.10	1.21

8. Calculating Gradients – straight lines

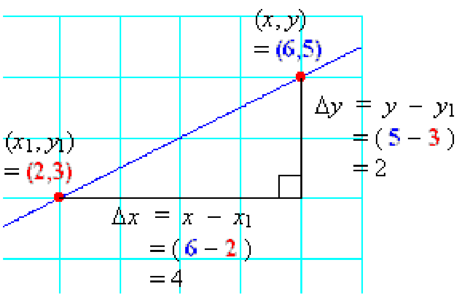
Gradients are a useful tool that show how fast or slow quantities change – eg speed tells us how fast distance is changing, or how quickly energy is being lost over time.

To calculate the gradient, pick any two points on the line as far away as possible and draw a large triangle between them.

The gradient is given by:

$$gradient = \frac{diffference\ in\ y\ values}{difference\ in\ x\ values}$$

But make sure the you subtract the values in the same order! Remember – if the line slopes up, the gradient should be positive; if the line slopes down, then the gradient should be negative.



$$Gradient = \frac{\text{difference in y}}{\text{difference in x}}$$

$$= \frac{2}{4}$$

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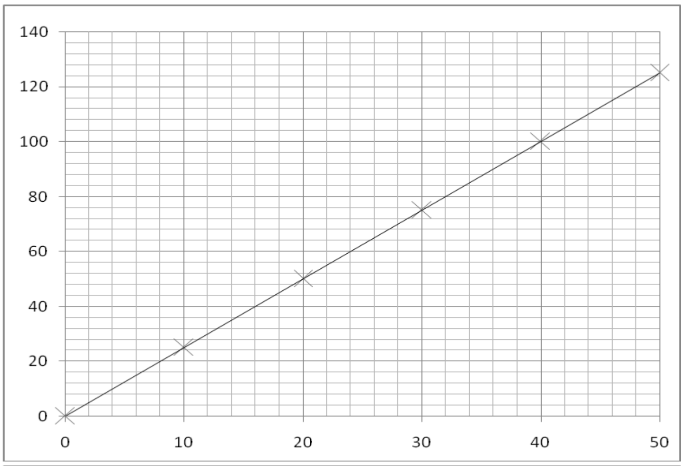
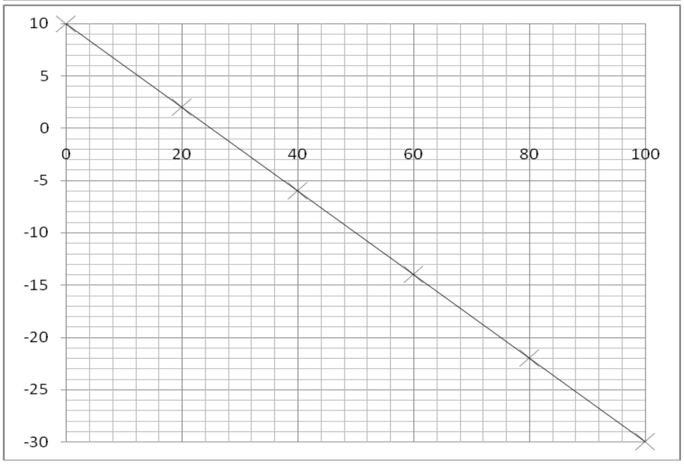
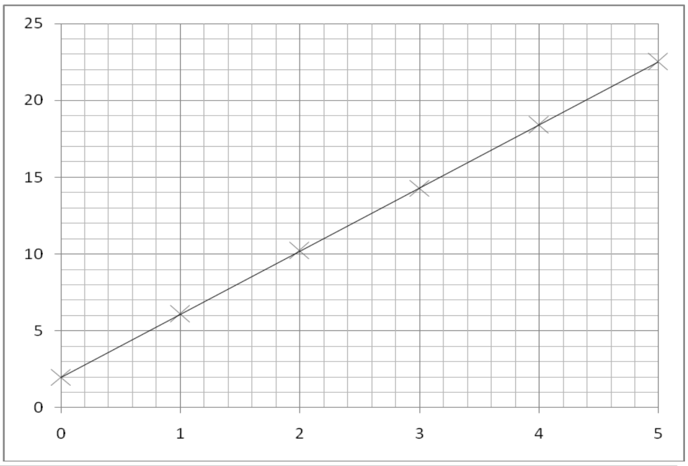
<u>= 0.5</u>

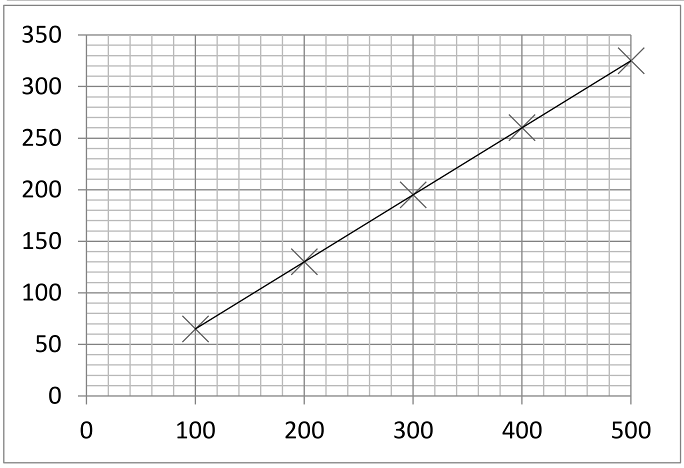
<u>Have a go:</u>

Calculate the gradients of the graphs below.






0
5
10
15
20
25
0
1
2
3
4
5


0
50
100
150
200
250
300
350
0
100
200
300
400
500

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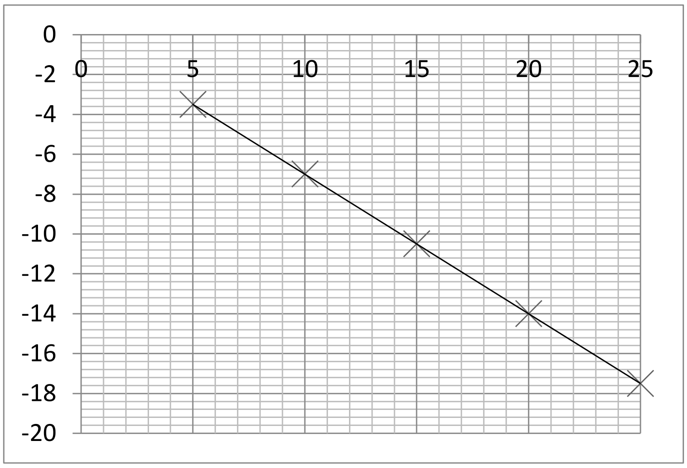
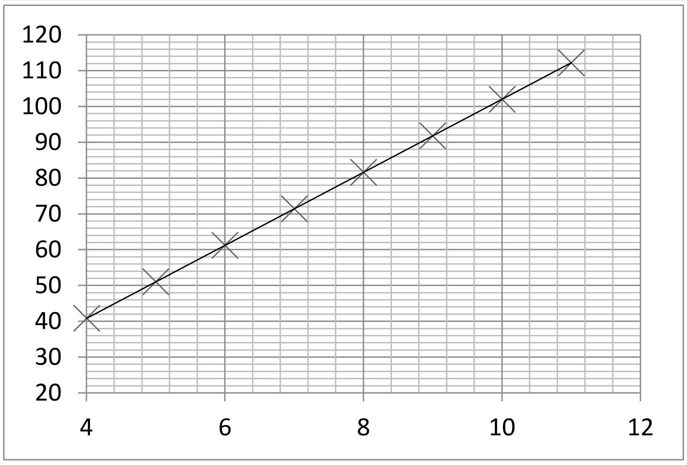
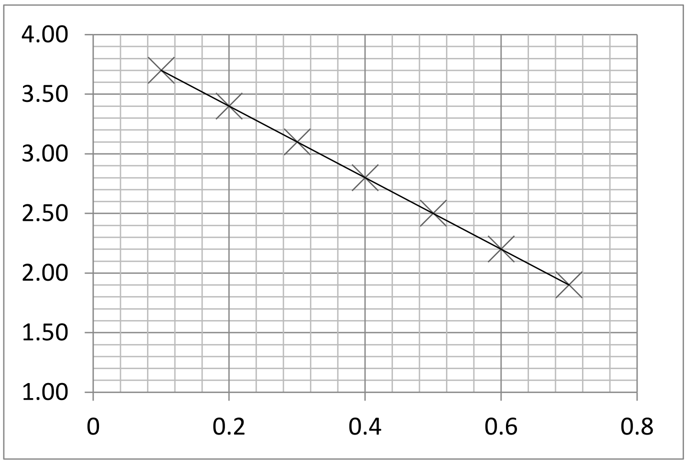
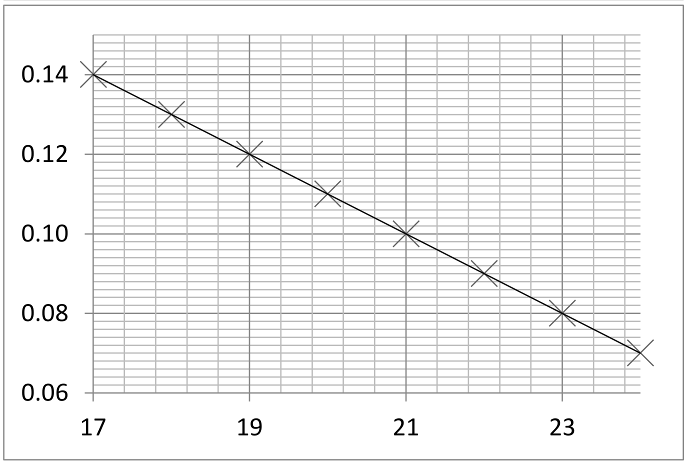








9. Calculating Gradients – Curved lines

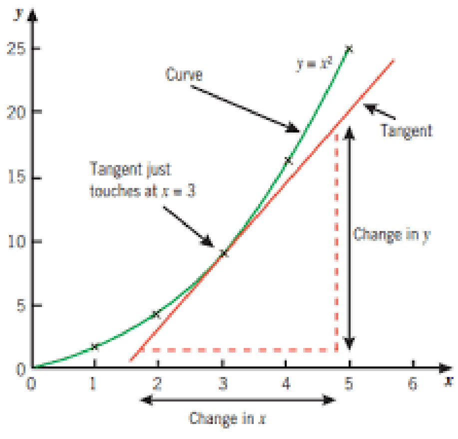
Most graphs in real life are not straight lines, but curves; however it is still useful to know how the quantity changes over time, hence we still need to calculate gradients. When you study the rates topic, you will need to do this.

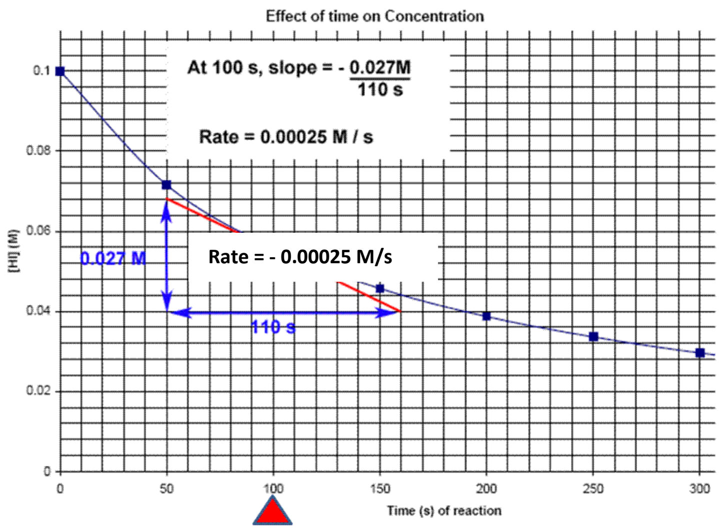
If we want to know the gradient at a particular point, firstly we need to draw a *tangent* to the curve at that point.

A tangent is a straight line that follows the gradient at the required point. Once we have drawn the straight line tangent, its gradient can be calculated in exactly the same way as the previous page showed.

Tip – make sure your tangents and gradient triangles are as big as possible to be as accurate as you can!

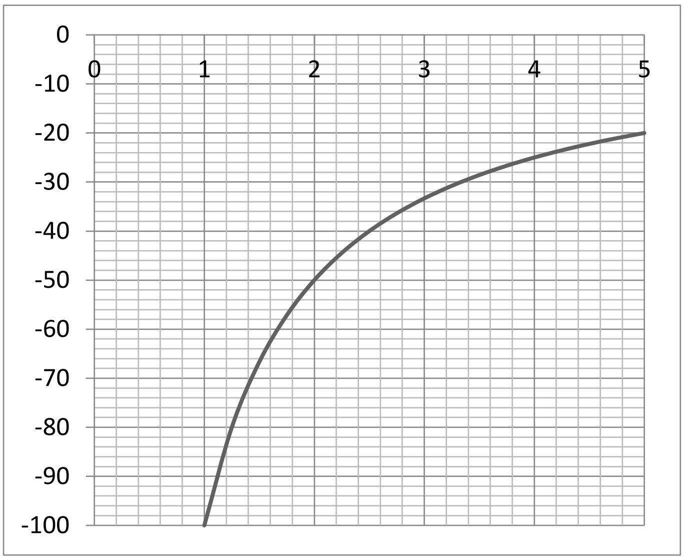
Examples of drawing tangents and calculating the gradient of a tangent:

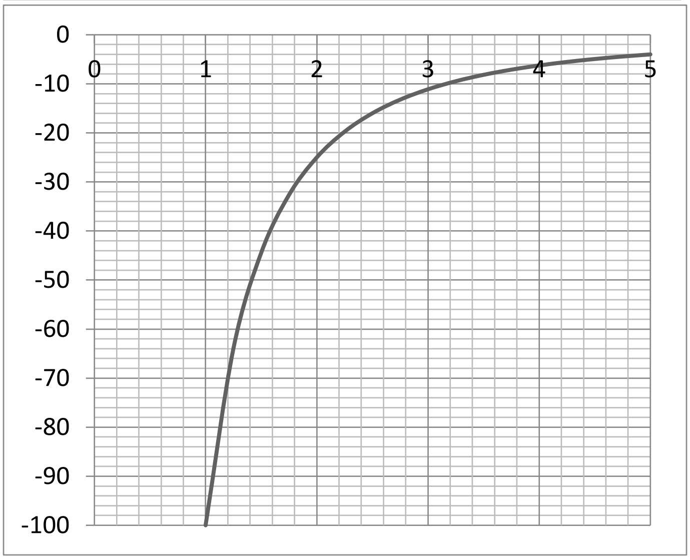




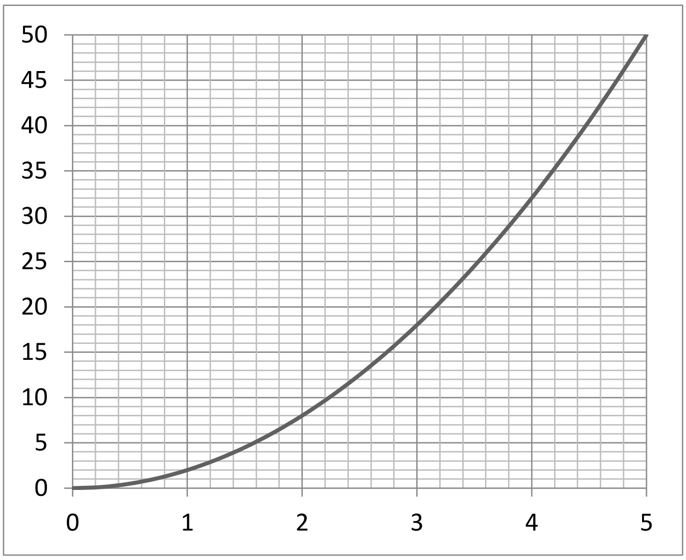
Have a go at the activities on the next page:

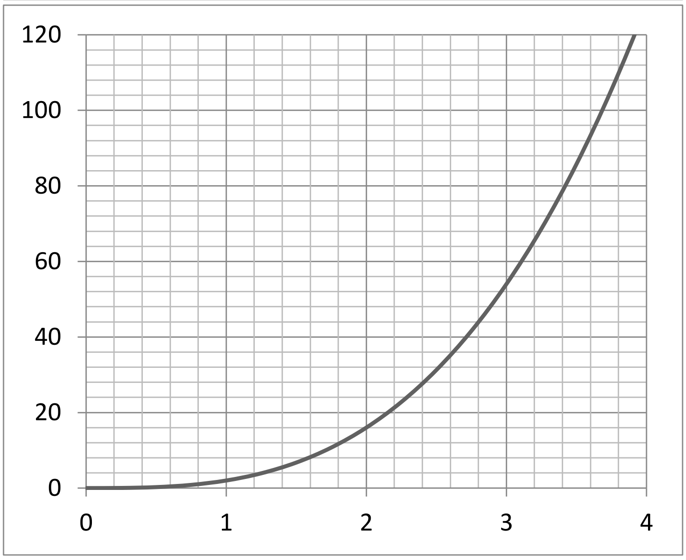
Draw a tangent to the line and calculate its gradient at the following x-axis values:





2.0 and 3.9 1.5 and 3.0





2.2 and 4.0   1.6 and 3.4

10. Accuracy vs Precision

A more ***accurate*** result is one that is closer to the true value, *if the true value lies within the uncertainty of the reading.*

A more ***precise*** result is measured to a higher number of decimal places.

Eg. The true temperature of the room is 22.4° . One thermometer gives a reading of 23°, and another gives a reading of 22.7°. Which is the most accurate and precise?

Even though the 22.7° thermometer is closer to the true value, when taking the uncertainty of the two readings into account, this reading gives a temperature between 22.6° and 22.8° (the true value is outside of this range), whereas the other thermometer gives a range of 22°-24°(which the true value lies between). <u>Therefore even though it is not as precise, the 23° reading is more accurate.</u>

<u>**Have a go at the following activities:**</u>

1. India is weighing things. She uses one forcemeter that measures to the nearest 0.1 N, and another that measures to 1 N. Actual weight: 4.3 N.

		
	Recorded Force: 4.4 N	**Recorded Force: 4 N**
Most Accurate:		
Most Precise:		

Explanation:

____
____
____

2. Bella wins a race in a time of 13.7 s. Two spectators timed her using an electronic stopwatch which measures to 1/100th of a second, and an analogue stopwatch which measures to 1 s.

		
	Recorded Time: 13.90 s	**Recorded Time: 14 s**
Most Accurate:		
Most Precise:		

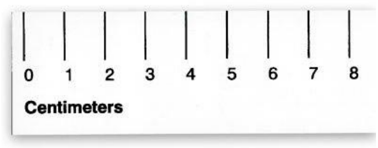
Explanation:

____

____

____

3. Ellie is determined the answer the question "how long is a piece of string?" She measures it using two rulers. Actual length: 5.0 cm

		
	Recorded Length: 5 cm	**Recorded Length: 4.8 cm**
Most Accurate:		
Most Precise:		

Explanation:

____
____
____

4. Isabelle is finding the masses of various insects. She uses one balance that measures to the nearest 0.1 g, and another that measures to 0.01 g. Actual mass: 0.25 g.

		
	Recorded Mass: 0.3 g	**Recorded Mass: 0.24 g**
Most Accurate:		
Most Precise:		

Explanation:

____

____

____

11. Improving Experiments – Accuracy, Precision and Reliability

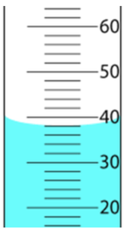
When improving **accuracy**, you must describe how to make sure your *method* obtains the best results possible. You should also try to *use as large quantities as possible as this reduces the percentage error in your results*. Also make your range as large as possible, with small intervals between each reading.

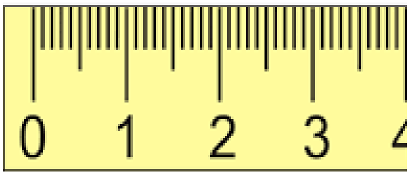
Precision refers to the smallest scale division provided by your measuring instrument, or what is is the smallest non-zero reading you can obtain from that instrument. Whenever referring to increasing precision in your answers, you must also state the instrument you are referring to.

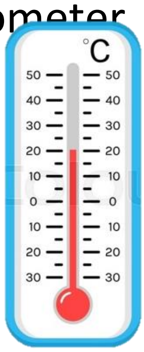
Reliability refers to how 'trustworthy' your results are. You can improve reliability by repeating and averaging your experiment, as well as removing anomalies.

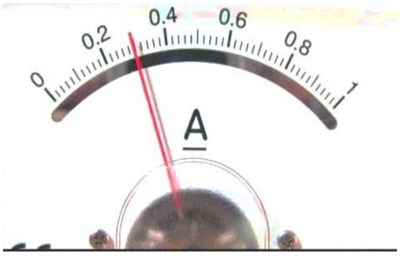
Have a go at the activities on next pages:

Complete the table below to state how to use the measuring instruments as accurately as possible, as well as stating the precision (smallest scale division) of each instrument.

Measuring Instrument	**Accuracy** What procedures should you use to ensure you gain accurate results?	**Precision** State the precision of the instruments shown in the diagram.
Measuring Cylinder 		

Mass Balance 		
Ruler 		
Measuring Instrument	**Accuracy** What procedures should you use to	**Precision** State the precision of

	ensure you gain accurate results?	the instruments shown in the diagram.
Thermometer 		
Stop clock 		

Ammeter / Voltmeter 		

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12. Ratios

Understanding ratio allows us to easily compare separate quantities. We can then examine patterns, comment on the relationship, or use ratios to help us solve equations. We use this skill to calculate empirical formulas in chemistry.

For example:

- Use 3 parts red paint to 1 part white paint.
- Use 1 teabag to 250 ml of water.
- Use 1 shovel of cement to 2 shovels of sand.

The order of the ratio is very important.

The number of teabags used per ml of water would be **1:250**. Saying that the answer was 250:1 would mean something very different.

We can use ratios to scale measurements, drawings, and calculations up and down.

Have a go:

Simplify the following ratios (Example 6:4 = 3:2):

1. 120:50

2. 64:24

3. 13:52

4. 100:10 000

5. 24:72

6. 18:90

7. 56:88

8. 36:144

9. A toy is made from red bricks and yellow bricks.

Number of red bricks: Number of yellow bricks = 5:2.

There are 210 more red bricks than yellow bricks.

How many red bricks are in the toy?

10. There are 100 balls in a bag. The balls are red, blue, green or white. The ratio of blue to red is 5:1. There are twice as many blue as green. $\frac{1}{4}$ of the balls are green.

How many white balls are in the bag?

11. One day, 460 people visit a zoo. 280 are adults. The ratio of women to men is 4:3.

180 are children. $\frac{3}{5}$ of them are boys. Jane says that altogether there were more females visiting the zoo.

Show that she is correct.

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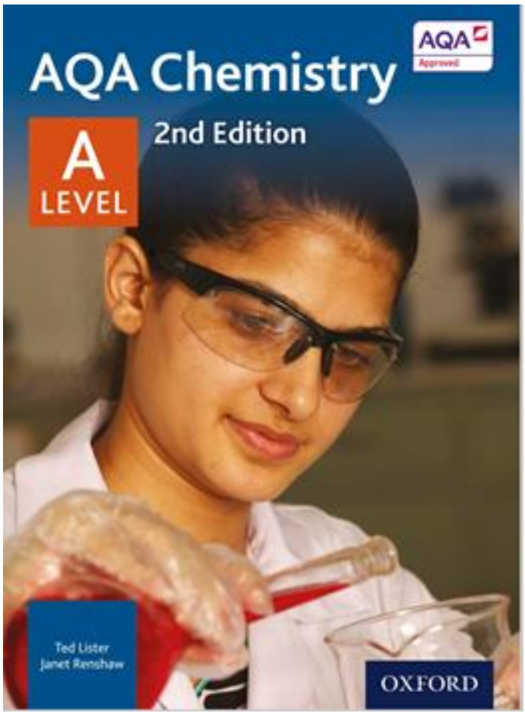
A level Chemistry

GCSE to A level Transition pack

Section 3 – Chemistry Skills



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Contents

Section 3: Chemistry Skills

Chemistry Skills:	1. Periodic table

Have a go:

On the periodic table on the following page:

- Draw a line showing the metals and non-metals.
- Colour the transition metals blue.
- Colour the halogens yellow.
- Colour the alkali metals red.
- Colour the noble gases green.
- Draw a blue arrow showing the direction of periods.
- Draw a red arrow showing the direction of groups.
- Draw a blue ring around the symbols for all gases.
- Draw a red ring around the symbols for all liquids.

Key

relative atomic mass **symbol** name atomic (proton) number

1	2											3	4	5	6	7	0
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
							1.0 **H** hydrogen 1										4.0 **He** helium 2
6.9 **Li** lithium 3	9.0 **Be** beryllium 4											10.8 **B** boron 5	12.0 **C** carbon 6	14.0 **N** nitrogen 7	16.0 **O** oxygen 8	19.0 **F** fluorine 9	20.2 **Ne** neon 10
23.0 **Na** sodium 11	24.3 **Mg** magnesium 12											27.0 **Al** aluminium 13	28.1 **Si** silicon 14	31.0 **P** phosphorus 15	32.1 **S** sulfur 16	35.5 **Cl** chlorine 17	39.9 **Ar** argon 18
39.1 **K** potassium 19	40.1 **Ca** calcium 20	45.0 **Sc** scandium 21	47.9 **Ti** titanium 22	50.9 **V** vanadium 23	52.0 **Cr** chromium 24	54.9 **Mn** manganese 25	55.8 **Fe** iron 26	58.9 **Co** cobalt 27	58.7 **Ni** nickel 28	63.5 **Cu** copper 29	65.4 **Zn** zinc 30	69.7 **Ga** gallium 31	72.6 **Ge** germanium 32	74.9 **As** arsenic 33	79.0 **Se** selenium 34	79.9 **Br** bromine 35	83.8 **Kr** krypton 36
85.5 **Rb** rubidium 37	87.6 **Sr** strontium 38	88.9 **Y** yttrium 39	91.2 **Zr** zirconium 40	92.9 **Nb** niobium 41	96.0 **Mo** molybdenum 42	[98] **Tc** technetium 43	101.1 **Ru** ruthenium 44	102.9 **Rh** rhodium 45	106.4 **Pd** palladium 46	107.9 **Ag** silver 47	112.4 **Cd** cadmium 48	114.8 **In** indium 49	118.7 **Sn** tin 50	121.8 **Sb** antimony 51	127.6 **Te** tellurium 52	126.9 **I** iodine 53	131.3 **Xe** xenon 54
132.9 **Cs** caesium 55	137.3 **Ba** barium 56	138.9 **La** * lanthanum 57	178.5 **Hf** hafnium 72	180.9 **Ta** tantalum 73	183.8 **W** tungsten 74	186.2 **Re** rhenium 75	190.2 **Os** osmium 76	192.2 **Ir** iridium 77	195.1 **Pt** platinum 78	197.0 **Au** gold 79	200.6 **Hg** mercury 80	204.4 **Tl** thallium 81	207.2 **Pb** lead 82	209.0 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac** † actinium 89	[267] **Rf** rutherfordium 104	[268] **Db** dubnium 105	[271] **Sg** seaborgium 106	[272] **Bh** bohrium 107	[270] **Hs** hassium 108	[276] **Mt** meitnerium 109	[281] **Ds** darmstadtium 110	[280] **Rg** roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

* 58 – 71 Lanthanides	140.1 **Ce** cerium 58	140.9 **Pr** praseodymium 59	144.2 **Nd** neodymium 60	[145] **Pm** promethium 61	150.4 **Sm** samarium 62	152.0 **Eu** europium 63	157.3 **Gd** gadolinium 64	158.9 **Tb** terbium 65	162.5 **Dy** dysprosium 66	164.9 **Ho** holmium 67	167.3 **Er** erbium 68	168.9 **Tm** thulium 69	173.1 **Yb** ytterbium 70	175.0 **Lu** lutetium 71
† 90 – 103 Actinides	232.0 **Th** thorium 90	231.0 **Pa** protactinium 91	238.0 **U** uranium 92	[237] **Np** neptunium 93	[244] **Pu** plutonium 94	[243] **Am** americium 95	[247] **Cm** curium 96	[247] **Bk** berkelium 97	[251] **Cf** californium 98	[252] **Es** einsteinium 99	[257] **Fm** fermium 100	[258] **Md** mendelevium 101	[259] **No** nobelium 102	[262] **Lr** lawrencium 103

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Chemistry Skills:	2. Chemical formulae

In Chemistry it is useful to just know some elements, compounds and ions. Below are lists of useful chemical symbols and formulae:

Elements				Compounds	
Al	aluminium	Mg	magnesium	NH_3	ammoni**a**
Ar	argon	Hg	mercury	$CaCO_3$	calcium carbonate
Br_2	bromine	Mg	magnesium	CO	carbon monoxide
Ca	calcium	Ne	neon	CO_2	carbon dioxide
C	carbon	Ni	nickel	$CuSO_4$	copper sulfate
Cl_2	chlorine	N_2	nitrogen	HCl	hydrochloric acid
Cr	chromium	O_2	oxygen	CH_4	methane
Co	cobalt	P_4	phosphorus	HNO_3	nitric acid
Cu	copper	Pt	platinum	NO	nitrogen monoxide
F_2	fluorine	K	potassium	NO_2	nitrogen dioxide
Au	gold	Si	silicon	NaCl	sodium chloride
He	helium	Ag	silver	NaOH	sodium hydroxide
H_2	hydrogen	Na	sodium	SO_2	sulfur dioxide
I_2	iodine	S_8	sulfur	H_2SO_4	sulfuric acid
Fe	iron	Sn	tin	H_2O	water
Pb	lead	Ti	titanium		
Li	lithium	Zn	zinc		

Common ions:

+1	H^+ hydrogen ions NH_4^+ ammon**ium** ions Group 1 ions (e.g. Na^+ sodium ions)
+2	Group 2 ions (e.g. Ca^{2+} calcium ions)
+3	Group 3 ions (e.g. Al^{3+} aluminium ions)

–1	NO_3^- nitrate ions OH^- hydroxide ions Group 7 ions (e.g. Br^- bromide ions)
–2	CO_3^{2-} carbonate ions SO_4^{2-} sulfate ions
–3	PO_4^{3-} phosphate ions

Have a go at completing the tables:

	name	formula
1	sodium ions	
2	sodium	
3	sulfide ions	
4	sulfate ions	
5	sulfur	
6	aluminium oxide	
7	barium hydroxide	
8	silver(I) nitrate	
9	ammonium carbonate	
10	sodium phosphate	

	name	formula
1	oxygen	
2	oxide ions	
3	copper(II) ions	
4	copper	
5	ammonia	
6	ammonium chloride	
7	magnesium nitrate	
8	barium sulfate	
9	sodium oxide	
10	aluminium bromide	

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Chemical skills:	3. Word Equations

You should be able to identify reactions from their symbol equations and write word equations

On the next page there is an activity to practice writing word equations.

Have a go:

Convert the following equations into word equations. Here is an example

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

sodium carbonate + hydrochloric acid → sodium chloride + water + carbon dioxide

1) $2\,Mg + O_2 \rightarrow 2\,MgO$

....

2) $2\,K + Br_2 \rightarrow 2\,KBr$

....

3) $Cu + S \rightarrow CuS$

....

4) $CuCO_3 \rightarrow CuO + CO_2$

....

5) $PbI_2 \rightarrow Pb + I_2$

....

6) $CuBr_2 \rightarrow Cu + Br_2$

....

7) $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$

....

8) $Na_2CO_3 + H_2SO_4 \rightarrow Na_2SO_4 + CO_2 + H_2O$

....

9) $KBr + AgNO_3 \rightarrow AgBr + KNO_3$

....

10) $MgSO_4 + Ba(NO_3)_2 \rightarrow BaSO_4 + Mg(NO_3)_2$

....

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Chemistry Skill:	4. Balancing equations

- An equation is balanced when there are the same number of atoms of each type on both sides of the equation.
- An equation can only be balanced by putting numbers in front of formulas – <u>you cannot change the formula itself</u>.
- Equations can be written with state symbols: (s) = solid, (l) = liquid, (g) = gas, (aq) = aqueous (dissolved in water).

How to balance an equation:

a) Calculate how many atoms of each type are on each side of the equation.

b) If the numbers are the same then the equation is balanced.

c) If the numbers are not the same, then numbers are put in front of the formulas (this adds more of that substance). You cannot change the formulas (this would make a different substance). Hint – start with unbalanced elements that only appear in one substance on each side of the equation.

d) Keep doing this until the equation is balanced.

e.g. $CH_4 + O_2 \rightarrow CO_2 + H_2O$

Have a go at the questions on the next page:

Questions

Put your final answers here although you may wish to do your working on a separate sheet of paper or on the back.

1) $Ca + O_2 \rightarrow CaO$

2) $Na_2O + H_2O \rightarrow NaOH$

3) $Al + O_2 \rightarrow Al_2O_3$

4) $Na + Cl_2 \rightarrow NaCl$

5) $Na_2CO_3 \rightarrow Na_2O + CO_2$

6) $K + O_2 \rightarrow K_2O$

7) $C_4H_8 + O_2 \rightarrow CO_2 + H_2O$

8) $Fe_2O_3 + HCl \rightarrow FeCl_3 + H_2O$

9) $F_2 + KBr \rightarrow KF + Br_2$

10) $C_5H_{12} + O_2 \rightarrow CO_2 + H_2O$

11) $NH_3 + O_2 \rightarrow NO + H_2O$

12) $HNO_3 \rightarrow NO_2 + H_2O + O_2$

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Chemistry Skills:	5. Moles

A mole is the amount of a substance that contains 6.02×10^{23} particles.
The mass of 1 mole of any substance is the relative formula mass (M_r) in grams.

Examples:

One mole of carbon contains 6.02×10^{23} particles and has a mass of 12.0 g

Two moles of copper contains 12.04×10^{23} particles, and has a mass of 127 g

1 mole of water contains 6.02×10^{23} particles and has a mass of 18 g

The amount in moles of a substance can be found by using the formula:

$$Amount\ of\ moles\ in\ a\ substance = \frac{mass\ of\ substance}{relative\ formula\ mass}$$

<u>Have a go at completing the table on the next page:</u>

Substance	Mass of substance	Amount/moles	Number of particles
Helium			18.12×10^{23}
Chlorine	14.2		
Methane		4	
Sulfuric acid	4.905		

Use a periodic table to answer the next set of questions:

2) Calculate the mass of each of the following substances. Give your answers to 3 sig figs.

a) 4.00 moles of N_2 ....

....

b) 0.100 moles of HNO_3 ....

....

c) 0.0200 moles of K_2O ....

....

d) 2.50 moles of PH_3 ....

....

e) 0.400 moles of C_2H_5OH ....

....

f) 10.0 moles of $Ca(OH)_2$ ....

....

Chemistry Skills:	6. Empirical Formula

If you measure the mass of each reactant used in a reaction, you can work out the ratio of atoms of each reactant in the product. This is known as the empirical formula. This may give you the actual chemical formula, as the actual formula may be a multiple of this. For example, hydrogen peroxide is H_2O_2 but would have the empirical formula HO.

Use the following to find an empirical formula:

1. Write down reacting masses
2. Find the amount in moles of each element
3. Find the ratio of moles of each element

Example:

A compound contains 2.232 g of ion, 1.284 g of sulfur and 1.920 g of oxygen. What is the empirical formula?

Element	Iron	Sulfur	Oxygen
mass/relative atomic mass	2.232/55.8	1.284/32.1	1.920/16.0
Amount in moles	0.040	0.040	0.120
Divide by smallest value	0.040/0.040	0.040/0.040	0.120/0.040
Ratio	1	1	3

So the empirical formula is $FeSO_3$.

Have a go:

Work out the following empirical formulas:

1. The smell of a pineapple is caused by ethyl butanoate. A sample is known to contain only 0.180 g of carbon, 0.030 g of hydrogen and 0.080 g of oxygen. What is the empirical formula of ethyl butanoate?

2. Find the empirical formula of a compound containing 0.0578 g of titanium, 0.288 g of carbon, 0.012 g of hydrogen and 0.384 g of oxygen.

3. 300 g of a substance are analysed and found to contain only carbon, hydrogen and oxygen. The sample contains 145.9 g of carbon and 24.32 g of hydrogen. What is the empirical formula of the compound?

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Chemistry Skills:	7. Organic Chemistry

Organic Chemistry is the study of carbon compounds and hydrocarbons.

At GCSE, you studied different groups and their properties, alkanes, alkenes, alcohols, carboxylic acids and esters.

<u>Have a go:</u>

1) Propane and propene are hydrocarbons.

a) What is a *hydrocarbon*? ....

.... (1)

b) Complete the table about these two molecules. (6)

	propane	propene
displayed structure		
molecular formula		
saturated or unsaturated?		
effect on bromine water		

2) Ethene is an unsaturated hydrocarbon that can be formed by cracking alkanes such as decane ($C_{10}H_{22}$).

a) What does the term unsaturated mean? ....

....

.... (1)

b) Draw the displayed structure of ethene.

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