AAQ Level 3 National Extended Certificate in Applied Science

Bridging work summer 2026

AAQ BTEC Level 3 in Applied Science is equivalent in size to one A Level and aims to give a coherent introduction to study of the applied science sector.

Across the two-year course you will study 5 units:

What does the qualification cover?

The qualification has been developed in consultation with higher education representatives and sector experts from associated professional bodies to ensure students have the knowledge, understanding and skills they need to progress to, and thrive in, higher education.

360 GLH which is equivalent in size to one A Level.

4 units mandatory units, of which 3 are externally assessed.

2 optional units, of which one must be selected. Mandatory content (75%). External assessment (50%)

The qualification has four mandatory units covering the following topics:

Unit 1 Principles and Applications of Biology – Structure and function of cells and tissues, biological molecules, enzymes and their role in organisms

Unit 2 Principles and Applications of Chemistry – Structure of the Periodic Table and its implications on physical and chemical properties of substances, through analysis of different bonding methods

Unit 3 Principles and Applications of Physics – Waves and their applications; force principles and their application in transportation and construction of electrical circuits

Unit 4 Practical Scientific Procedures and Techniques – Practical applications across the sciences, including chromatography, colorimetry and electrical circuits.

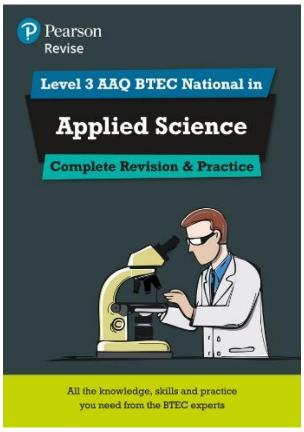
Unit 5 Scientific Investigation Skills – Investigative research, including planning, data collection, analysis and evaluation.

How is the course assessed?

A combination of assessment styles will give you confidence that you can apply your knowledge to succeed in the workplace. Firstly, a series of set tasks set in a work-related scenario. Next, you will be required to complete, in controlled conditions, a practical task tackling an everyday challenge and finally, there is a written exam.

- Unit 1 – an externally assessed written 1hr exam worth 50 marks
- Unit 2 – an externally assessed written 1hr exam worth 50 marks
- Unit 3 – an externally assessed written 1hr exam worth 50 marks
- Unit 4 – Internally assessed coursework, externally moderated
- Unit 5 – Internally assessed coursework, externally moderated

<u>Recommended Textbooks / Revision Guides</u>



ISBN:9781292759753

Price £21.99

We would encourage students to purchase a copy of the revision workbook. These can be bought online and will also be available to purchase through the MCAS app from September 2026.

Biology Tasks to Complete

These Biology bridging tasks are designed to help you to review the core principles that you learnt during your GCSE's and to prepare yourself for the first topic that will be taught at the beginning of year 12. You must bring this work to your first BTEC lesson in September.

Cell Structure

Task 1

In September, you will be expected to be able to identify and describe the function of a range of organelles in plant and animal cells.

Find a diagrammatical representation of an animal and a plant cell showing its ultrastructure. Produce a summary table of the following organelles found in cells: Nucleus, Nucleolus, Ribosome, Mitochondrion, Golgi apparatus, Golgi vesicles Lysosome, Rough Endoplasmic Reticulum, Smooth Endoplasmic Reticulum, Chloroplast, Cell wall and Cell Vacuole. For each organelle you must include a diagram showing its structure, state whether it is found in plants and/or animal cells and give a brief (no more than 15 words) description of its function.

The following online websites will give you information about the organelles found in cells.

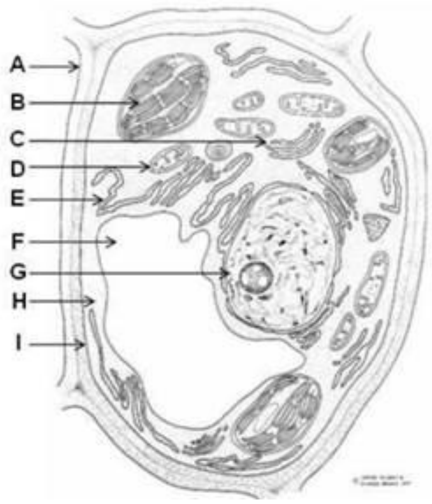
http://tinyurl.com/p784phe

https://www.youtube.com/watch?v=cj8dDTHGJBY

Task 2

Once you have completed your research, name each organelle below.

Plant cell



A

B

C

D

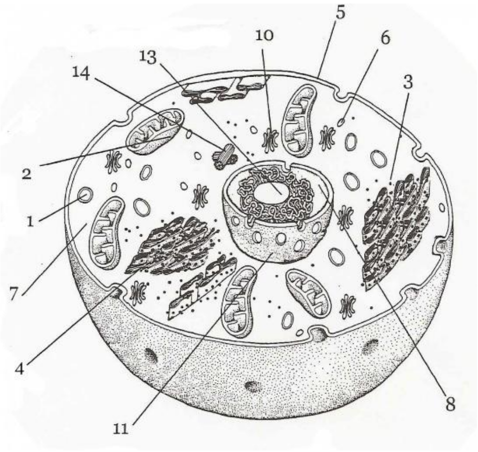
E

F

G

H

Animal cell



1

2

3

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10

11

12

13

1. Which of the organelles listed above are not bound by a membrane.

2. Which of the organelles contains nucleic acid?

1. Complete the table to show the roles of the components in prokaryotic cells.

Component of prokaryotic cell	Structure	Function
Circular DNA		Contains the genetic information for the replication of cells
Cell membrane	Made of phospholipids and proteins.	
Cell wall		A physical barrier which excludes certain substances and protects against mechanical damage and osmotic lysis.
Ribosomes		Site of protein synthesis
	DNA in the form of small circular strands.	Has the genes that may aid survival of bacteria in adverse conditions.

Chemistry Tasks to Complete

These Chemistry bridging tasks are designed to help you to review the core principles that you learnt during your GCSE's and to prepare yourself for the first topic that will be taught at the beginning of year 12. You must bring this work to your first BTEC lesson in September.

1. **Revise key ideas on atomic structure, bonding and mole calculations and complete the tasks from the "pre-knowledge topics" below (topics 1-3).**

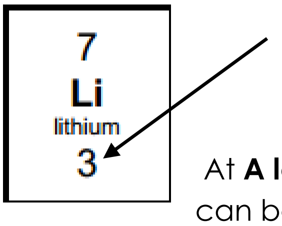
Pre-Knowledge Topics

Task 1 – Electronic structure, how electrons are arranged around the nucleus

A periodic table can give you the proton / atomic number of an element, this also tells you how many electrons are in the ***atom***.

You will have used the rule of electrons shell filling, where:

The first shell holds up to 2 electrons, the second up to 8, the third up to 8 and the fourth up to 18 (or you may have been told 8).



Atomic number =3, electrons = 3, arrangement 2 in the first shell and 1 in the second or Li = 2,1

At **A level** you will learn that the electron structure is more complex than this, and can be used to explain a lot of the chemical properties of elements.

The 'shells' can be broken down into 'orbitals', which are given letters: 's' orbitals, 'p' orbitals and 'd' orbitals.

You can read about orbitals here:

http://bit.ly/pixlchem1

http://www.chemguide.co.uk/atoms/properties/atomorbs.html#top

Now that you are familiar with s, p and d orbitals try these problems, write your answer in the format:

$1s^2$, $2s^2$, $2p^6$ etc.

Q1.1 Write out the electron configuration of:

a) Ca b) Al c) S d) Cl e) Ar f) Fe g) V

Q1.2 Extension question, can you write out the electron arrangement of the following ***ions***:

a) K^+ b) O^{2-} c) Zn^{2+}

Task 2 – Chemical equations

Balancing chemical equations is the stepping-stone to using equations to calculate masses in chemistry.

There are loads of websites that give ways of balancing equations and lots of practise in balancing.

Some of the equations to balance may involve strange chemicals, don't worry about that, the key idea is to get balancing right.

http://bit.ly/pixlchem7

http://www.chemteam.info/Equations/Balance-Equation.html

This website has a download; it is safe to do so:

http://bit.ly/pixlchem8

https://phet.colorado.edu/en/simulation/balancing-chemical-equations

Q2.1 Balance the following equations

a. H_2 + O_2 → H_2O

b. S_8 + O_2 → SO_3

c. HgO → Hg + O_2

d. Zn + HCl → $ZnCl_2$ + H_2

e. Na + H_2O → $NaOH$ + H_2

f. $C_{10}H_{16}$ + Cl_2 → C + HCl

Task 3 – Measuring chemicals using relative mass and the mole

From this point on you need to be using an A level periodic table, not a GCSE one you can view one here:

http://bit.ly/pixlpertab

https://secondaryscience4all.files.wordpress.com/2014/08/filestore_aqa_org_uk_subjects_aqa-2420-w-trb-ptds_pdf.png

Now that we have our chemical equations balanced, we need to be able to use them in order to work out masses of chemicals we need or we can produce.

The ***mole*** is the chemists equivalent of a dozen, atoms are so small that we cannot count them out individually, we weigh out chemicals.

For example: magnesium + sulfur → magnesium sulfide

$$Mg + S \rightarrow MgS$$

We can see that one atom of magnesium will react with one atom of sulfur, if we had to weigh out the atoms we need to know how heavy each atom is.

From the periodic table: Mg = 24.3 and S = 32.1

If I weigh out exactly 24.3g of magnesium this will be 1 mole of magnesium, if we counted how many atoms were present in this mass it would be a huge number (6.02×10^{23}!!!!), if I weigh out 32.1g of sulfur then I would have 1 mole of sulfur atoms.

So 24.3g of Mg will react precisely with 32.1g of sulfur, and will make 56.4g of magnesium sulfide.

Here is a comprehensive page on measuring moles, there are a number of descriptions, videos and practice problems.

You will find the first 6 tutorials of most use here, and problem sets 1 to 3.

http://bit.ly/pixlchem9

http://www.chemteam.info/Mole/Mole.html

Q3.1 Answer the following questions on moles.

a) How many moles of phosphorus pentoxide (P_4O_{10}) are in 85.2g?
b) How many moles of potassium in 73.56g of potassium chlorate (V) ($KClO_3$)?
c) How many moles of water are in 249.6g of hydrated copper sulfate(VI) ($CuSO_4.5H_2O$)? For this one, you need to be aware the dot followed by $5H_2O$ means that the molecule comes with 5 water molecules so these have to be counted in as part of the molecules mass.
d) What is the mass of 0.125 moles of tin sulfate ($SnSO_4$)?
e) If I have 2.4g of magnesium, how many g of oxygen(O_2) will I need to react completely with the magnesium? $2Mg + O_2 \rightarrow MgO$

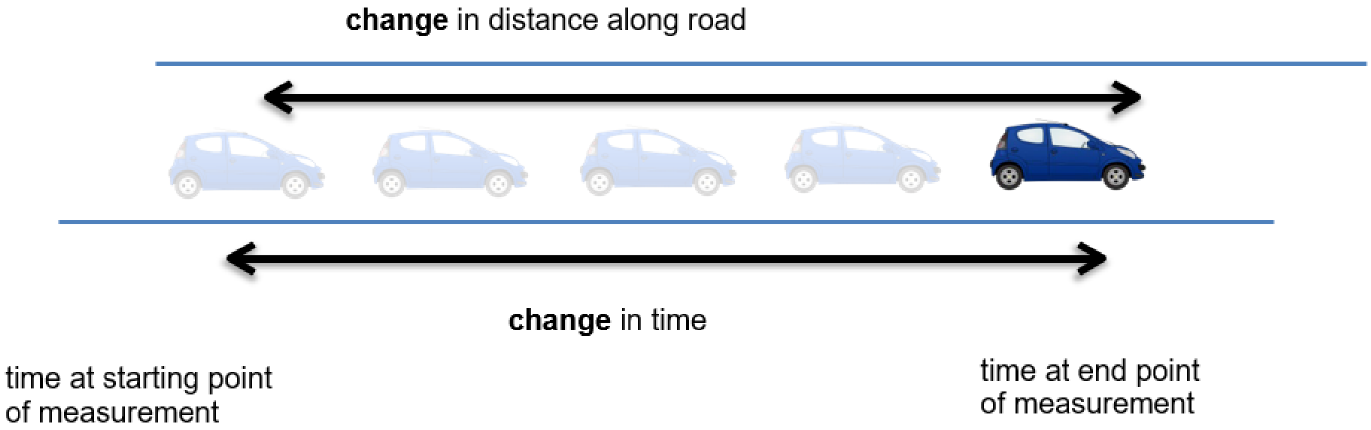
Physics Tasks to Complete

The delta symbol (Δ)

The delta symbol (Δ) is used to mean ‘change in’. For example, at GCSE, you would have learned the formula:

$$\text{speed} = \frac{\text{distance}}{\text{time}} \quad \text{which can be written as} \quad s = \frac{d}{t}$$

What you often measure is the **change** in the distance of the car from a particular point, and the **change** in time from the beginning of your measurement to the end of it.



As the distance and the speed are changing, you use the delta symbol to emphasise this. The A-level version of the above formula becomes:

$$\text{velocity} = \frac{\text{displacement}}{\text{time}} \quad \text{which can be written as} \quad v = \frac{\Delta s}{\Delta t}$$

Note: the delta symbol is a property of the quantity it is with, so you treat ‘Δs’ as one thing when rearranging, and you cannot cancel the delta symbols in the equation above.

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1. What is the difference between:

   a. **speed** and **velocity**

   b. **distance** and **displacement**

Understanding and using SI units

All measurements have a size (eg 2.7) and a unit (eg metres or kilograms).
Sometimes, there are different units available for the same type of measurement. For example, milligram, gram, kilogram and tonne are all units used for mass. Some values like strain and refractive index are not followed by a unit.

To reduce confusion, and to help with conversion between different units, there is a standard system of units called the SI units which are used for most scientific purposes.

These units have all been defined by experiment so that the size of, say, a metre in the UK is the same as a metre in China.

There are seven SI base units, which are given in the table.

Physical quantity	Unit	Abbreviation
Mass	kilogram	kg
Length	metre	m
Time	second	s
Electric current	ampere	A
Temperature	kelvin	K
Amount of substance	mole	mol

All other units can be derived from the SI base units. For example, area is measured in metres square (written as m^2) and speed is measured in metres per second (written as $m\ s^{-1}$ this is a change from GCSE, where it would be written as m/s).

Some derived units have their own unit names and abbreviations, often when the combination of SI units becomes complicated. Some common derived units are given in the table below.

Physical quantity	Unit	Abbreviation	SI unit
Force	newton	N	$kg\ m\ s^{-2}$
Energy	joule	J	$kg\ m^2\ s^{-2}$
Frequency	hertz	Hz	s^{-1}

Using prefixes and powers of ten

Very large and very small numbers can be complicated to work with if written out in full with their SI unit. For example, measuring the width of a hair or the distance from Manchester to London in metres (the SI unit for length) would give numbers with a lot of zeros before or after the decimal point, which would be difficult to work with.

So, we use prefixes that multiply or divide the numbers by different powers of ten to give numbers that are easier to work with. You will be familiar with the prefixes milli (meaning 1/1000), centi (1/100), and kilo (1 × 1000) from millimetres, centimetres and kilometres.

There is a wide range of prefixes. Most of the quantities in scientific contexts will be quoted using the prefixes that are multiples of 1000. For example, we would quote a distance of 33 000 m as 33 km.

Kg is the only base unit with a prefix.

The most common prefixes you will encounter are given in the table.

Prefix	Symbol	Power of 10	Multiplication factor	
Tera	T	10^{12}	1 000 000 000 000	
Giga	G	10^{9}	1 000 000 000	
Mega	M	10^{6}	1 000 000	
kilo	k	10^{3}	1000	
deci	d	10^{-1}	0.1	1/10
centi	c	10^{-2}	0.01	1/100
milli	m	10^{-3}	0.001	1/1000
micro	μ	10^{-6}	0.000 001	1/1 000 000
nano	n	10^{-9}	0.000 000 001	1/1 000 000 000
pico	p	10^{-12}	0.000 000 000 001	1/1 000 000 000 000
femto	f	10^{-15}	0.000 000 000 000 001	1/1 000 000 000 000 000

Activity 1 SI units and prefixes

1. Re-write the following quantities using the correct SI units.
   a. 1 minute
   b. 1 milliamp
   c. 1 tonne
2. What would be the most appropriate unit to use for the following measurements?
   a. The wavelength of a wave in a ripple tank
   b. The temperature of a thermistor used in hair straighteners
   c. The half-life of a source of radiation used as a tracer in medical imaging
   d. The diameter of an atom
   e. The mass of a metal block used to determine its specific heat capacity
   f. The current in a simple circuit using a 1.5 V battery and bulb

Activity 2 Converting data

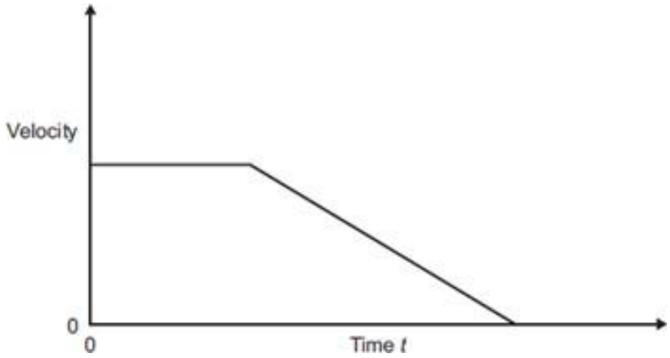
Re-write the following quantities.

1. 1.5 kilometres in metres
2. 450 milligrams in kilograms
3. 96.7 megahertz in hertz
4. 5 nanometers in metres
5. 3.9 gigawatts in watts

Activity 3 Gradients and areas

1. A car is moving along a road. The driver sees an obstacle in the road at time $t = 0$ and applies the brakes until the car stops.

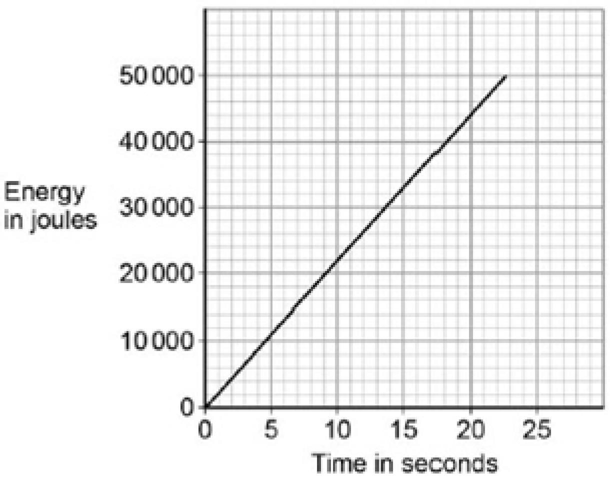
   The graph shows how the velocity of the car changes with time.



   From the list below, which letter represents:
   - the negative acceleration of the car
   - the distance travelled by the car?

   a. The area under the graph
   b. The gradient of the sloping line
   c. The intercept on the y axis

2. The graph shows how the amount of energy transferred by a kettle varies with time.



   The power output of the kettle is given by the gradient of the graph.

   Calculate the power output of the kettle.

Practical science tasks to complete – Used in all 3 sciences

Task 1. 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.

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

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

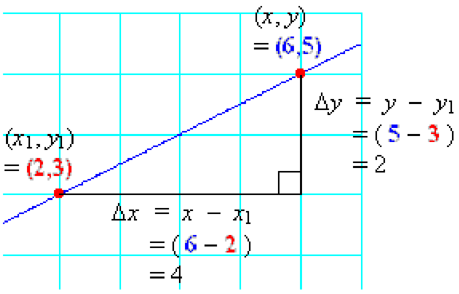
Task 2. Calculating gradients of straight lines

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:

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

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.

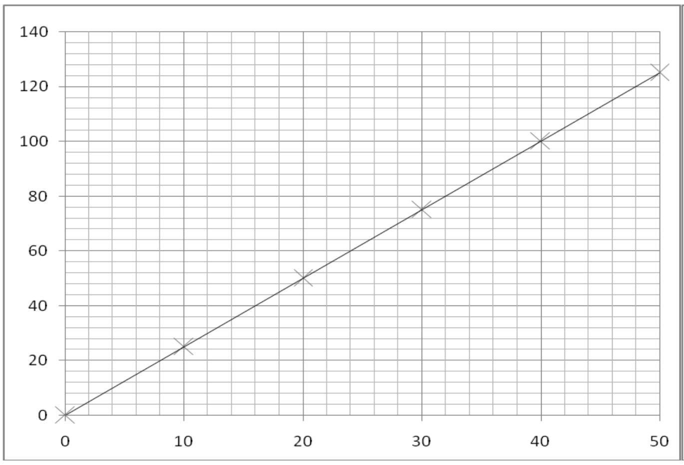


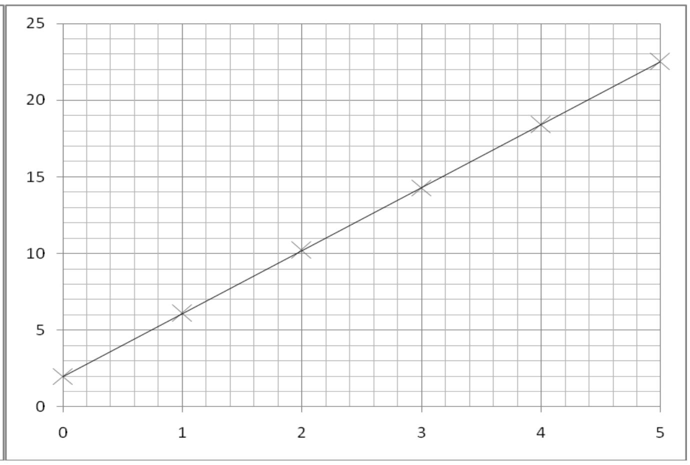
$$\text{Gradient} = \frac{difference\ in\ y}{difference\ in\ x}$$

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

= 0.5

Calculate the gradients of the graphs below





Task 3. Identifying errors

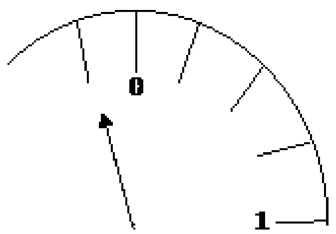
There are two main types of error in science:

1) Random error
2) Systematic error

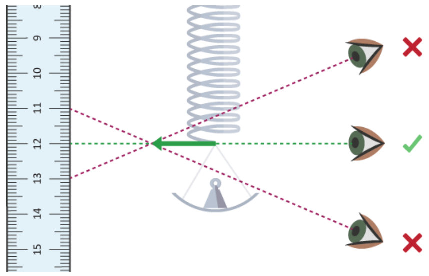
Random errors can be caused by changes in the environment that causes readings to alter slightly, measurements to be in between divisions on a scale or observations being perceived differently by other observers. These errors can vary in size and can give readings both smaller and larger than the true value.
The best way to reduce random error is to use as large values as possible (eg. Large distances) and repeat and average readings, as well as taking precaution when carrying out the experiment.

Systematic errors have occurred when all readings are shifted by the same amount away from the true value.
The two main types of systematic error are:

i) *Zero error* – this is where the instrument does not read zero initially and therefore will always produce a shifted result (eg. A mass balance that reads 0.01g before an object is placed on it). Always check instruments are zeroed before using.
ii) *Parallax error* – this is where a measurement is not observed from eye level so the measurement is always read at an angle producing an incorrect reading. Always read from eye level to avoid parallax.



Zero Error



Parallax Error

Repeat and averaging experiments will not reduce systematic errors as correct experimental procedure is not being followed.

There are occasions where readings are just measured incorrectly or an odd result is far away from other readings – these results are called **anomalies**. Anomalies should be removed and repeated before used in any averaging.

For each of the measurements listed below identify the most likely source of error what type of error this is and one method of reducing it.

Measurement	Source of error	Type of error
A range of values are obtained for the length of a copper wire		
The reading for the current through a wire is 0.74 A higher for one group in the class		
A range of values are obtained for the rebound height of a ball dropped from the same start point onto the same surface.		