Adapted by CLCC June 2020
Using resources from Oxford A level resources (Kerboodle)

Transition Pack for Level 3 Applied Science Part 2

(summer pack)

Get ready for Science! Your second guide to help you get ready for Level 3 Applied Science.

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The following tasks are for you to complete over the summer holidays to help you prepare for the Level 3 Applied Science course. Please bring the completed booklets with you to your first lesson. Some tasks are general skills that check that you are confident with some ideas met at GCSE in terms of Maths skills and Practical skills in Science.

Don't worry too much if you are not sure about some of these new ideas we will cover them during the year but it will give you a head start and hopefully you will find them interesting.

If you do have any questions about the tasks in the booklet or the course please email myself (Dr Derry) or Mrs Fox - we are always happy to help.

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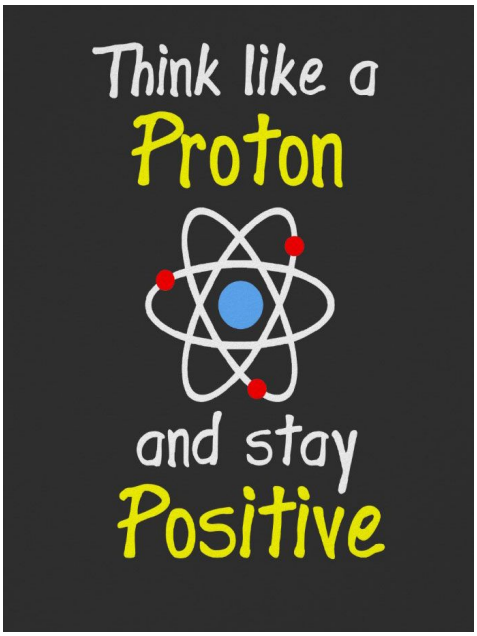

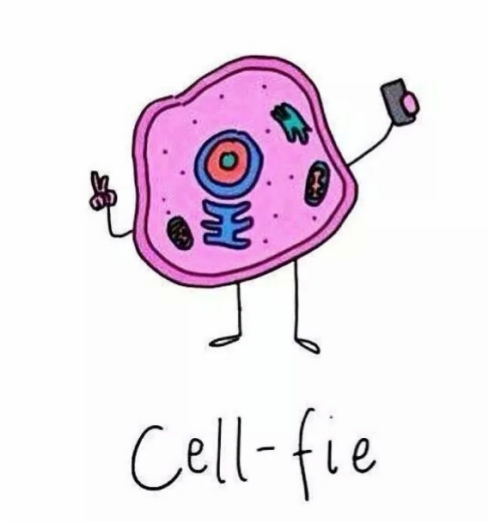

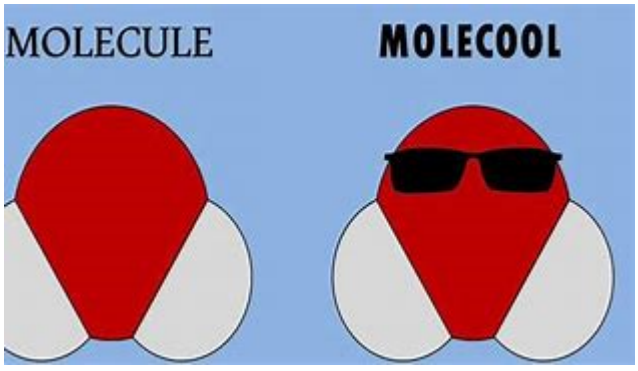

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Transition from GCSE to Level 3 Applied Science

Moving from GCSE Science to A Level can be a daunting leap. You'll be expected to remember a lot more facts, equations, and definitions, and you will need to learn new maths skills and develop confidence in applying what you already know to unfamiliar situations.

This work pack aims to give you a head start by helping you:

- to pre-learn some useful knowledge from the first chapters of your A Level course
- understand and practice **some of the** maths skills you'll need.

Retrieval questions

You need to be confident about the definitions of terms that describe measurements and results. Learn the answers to the questions below then cover the answers column with a piece of paper and write as many answers as you can. Check and repeat.

Practical science key terms

When is a measurement valid?	when it measures what it is supposed to be measuring
When is a result accurate?	when it is close to the true value
What are precise results?	when repeat measurements are consistent/agree closely with each other
What is repeatability?	how precise repeated measurements are when they are taken by the *same* person, using the *same* equipment, under the *same* conditions
What is reproducibility?	how precise repeated measurements are when they are taken by *different* people, using *different* equipment
What is the uncertainty of a measurement?	the interval within which the true value is expected to lie
Define measurement error	the difference between a measured value and the true value
What type of error is caused by results varying around the true value in an unpredictable way?	random error
What is a systematic error?	a consistent difference between the measured values and true values
What does zero error mean?	a measuring instrument gives a false reading when the true value should be zero
Which variable is changed or selected by the investigator?	independent variable
What is a dependent variable?	a variable that is measured every time the independent variable is changed
Define a fair test	a test in which only the independent variable is allowed to affect the dependent variable
What are control variables?	variables that should be kept constant to avoid them affecting the dependent variable

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Basic components of living systems

Learn the answers to the questions below then cover the answers column with a piece of paper and write as many answers as you can. Check and repeat.

What is the formula to calculate magnification?	magnification = $\frac{\text{size of image}}{\text{actual size of object}}$
Why are cells stained before being viewed with a light microscope?	staining increases contrast between different cell components, makes them visible, and allows them to be identified
What is an eyepiece graticule?	a glass disc that fits on top of the eyepiece lens that is marked with a fine scale from 1 to 100
What is a stage micrometer?	a microscope slide with a very accurate scale in micrometers (μ) engraved on it
What is a scientific drawing?	a labelled line drawing that is used to highlight particular features and does not include unnecessary detail or shading, it should always have a title and state the magnification
What is magnification?	how many times larger an image is than the actual size of the object being viewed
What is resolution?	the ability to see individual objects as separate entities
What is the function of the nucleus?	controls the metabolic activities of the cell as it contains genetic information in the form of DNA
What is the nucleolus?	area within the nucleus that is responsible for producing ribosomes
What is the function of mitochondria?	site of production of ATP in the final stages of cellular respiration
What are vesicles?	membranous sacs that are used to transport materials in the cell
What are lysosomes?	specialised forms of vesicles with hydrolytic enzymes that break down waste material in cells
What is the role of the cytoskeleton?	controls cell movement, movement of organelles within the cell, and provides mechanical strength to the cell
Name the three types of cytoskeletal filaments	microfilaments, microtubules, and intermediate fibres
Give two types of extension that protrude from some cells	flagella (whip-like protrusions) and cilia (tail-like protrusions)
What is the endoplasmic reticulum (ER)?	a network of membranes enclosing flattened sacs called cisternae
What are the functions of the two types of ER?	smooth ER – lipid and carbohydrate synthesis, and storage rough ER – synthesis and transport of proteins
What is the function of the Golgi apparatus?	plays a part in modifying proteins and packaging them into vesicles

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Maths skills

1 Units and prefixes

A key criterion for success in Science is the use of correct units and the management of numbers. You have already attempted some questions on prefixes – here are a couple more to have a go at!

Multiplication factor	Prefix	Symbol
10^{9}	giga	G
10^{6}	mega	M
10^{3}	kilo	k
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n

Practice questions

1 A burger contains 4500000J of energy. Write this in: **a** kilojoules **b** megajoules.

2 HIV is a virus with a diameter of between 9.0×10^{-8} m and 1.20×10^{-7} m. Write this range in nanometres.

3 **a** 300 μm to m **b** 5 MJ to mJ **c** 10 GW to kW

2 Decimals, standard form, and significant figures

2.1 Decimal numbers

A decimal number has a decimal point. In science, you must write your answer to a sensible number of decimal places.

Practice questions

1 New antibiotics are being tested. A student calculates the area of clear zones in Petri dishes in which the antibiotics have been used. List these in order from smallest to largest.

$0.0214\ cm^2$ $0.03\ cm^2$ $0.0218\ cm^2$ $0.034\ cm^2$

2 A student measures the heights of a number of different plants. List these in order from smallest to largest.

22.003 cm 22.25 cm 12.901 cm 12.03 cm 22 cm

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2.2 Significant figures

When you use a calculator to work out a numerical answer, you know that this often results in a large number of decimal places and, in most cases, the final few digits are 'not significant'. It is important to record your data and your answers to calculations to a reasonable number of significant figures. Too many and your answer is claiming an accuracy that it does not have, too few and you are not showing the precision and care required in scientific analysis.

Numbers to 3 significant figures (3 s.f.): 7.88 25.4 741 0.000 147 9.42×10^{-5} 1.56×10^{8}

0.0147 0.245 39 400 96 200 000

Notice that the zeros before the figures and after the figures are *not* significant – they just show you how large the number is by the position of the decimal point. Any zeros between the other significant figures *are* significant; numbers to 3 significant figures where the zeros *are* significant: 207 4050 1.01

If the value you wanted to write to 3.s.f. was 590, then to show the zero was significant you would have to write: 590 (to 3.s.f.) or 5.90×10^{2}

Practice questions

6 Write the following numbers to **i** 2 s.f. and **ii** 3 s.f.

a 7644 g
b 27.54 m
c 4.3333 g
d 5.995×10^{2} cm^{3}

7 The average mass of oxygen produced by an oak tree is 11800 g per year. Give this to 2 significant figures.

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4 Magnification

To look at small biological specimens you use a microscope to magnify the image that is observed. The microscope was developed in the 17th century. Anton van Leeuwenhoek used a single lens and Robert Hooke used two lenses. The lenses focus light from the specimen onto your retina to produce a magnified virtual image. The magnification at which observations are made depends on the lenses used.

A cheek cell has a 0.06 mm diameter. Under a microscope it has a diameter 12 mm. What is the magnification?

magnification = image size (mm) ÷ object size (mm) or $M = \frac{I}{O}$

Substitute the values and calculate the answer:

M = 12 mm/0.06 mm = 12/0.06 = 200 (magnification has no units)

Practice questions

Calculate the magnification of a hair that has a width of 6.6 mm on a photograph. The hair is 165 µm wide.

Remember: Use the same units. A common error is to mix units when performing these calculations. Begin each time by converting measurements to the same units for both the real specimen and the image.

4.1 Calculating the magnifying power of lenses

Lenses each have a magnifying power, defined as the number of times the image is larger than the real object. The magnifying power is written on the lens.

To find the magnification of the virtual image that you are observing, multiply the magnification powers of each lens used. For example, if the eyepiece lens is ×10 and the objective lens is ×40 the total magnification of the virtual image is 10 × 40 = 400.

Practice questions

1 Calculate the magnification of the virtual image produced by the following combinations of lenses:

a objective ×10 and eyepiece ×12 **b** objective ×40 and eyepiece ×15

4.2 Calculating the magnification of images

Drawings and photographs of biological specimens should always have a magnification factor stated. This indicates how much larger or smaller the image is compared with the real specimen. The magnification is calculated by comparing the sizes of the image and the real specimen. Look at this worked example.

The image shows a flea which is 1.3 mm long. To calculate the magnification of the image, measure the image (or the scale bar if given) on the paper (in this example, the body length as indicated by the line A–B).

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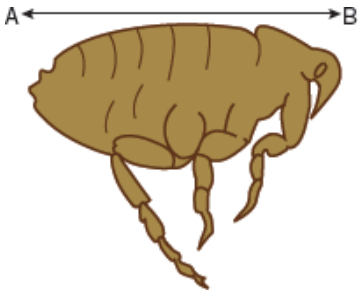


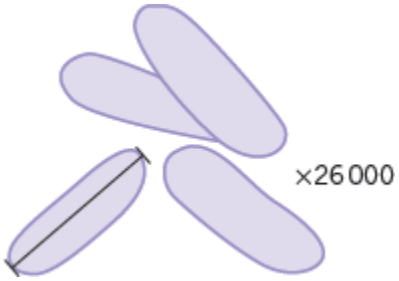
For this image, the length of the image is 42 mm and the length of the real specimen is 1.3 mm.

magnification = length of image / length of real specimen = 42/1.3 = 32.31

The magnification factor should therefore be written as ×32.31

Practice questions

2 Use the magnification factor to determine the actual size of a bacterial cell.



5 Percentages and uncertainty

A percentage is simply a fraction expressed as a decimal. It is important to be able to calculate routinely, but is often incorrectly calculated in exams. These pages should allow you to practise this skill.

5.1 Calculating percentages as proportions

To work out a percentage, you must identify or calculate the total number using the equation:

$$\text{Percentage} = \frac{\text{number you want as a percentage of total number}}{\text{total number}} \times 100\%$$

For example, in a population, the number of people who have brown hair was counted.

The results showed that in the total population of 4600 people, 1800 people had brown hair. The percentage of people with brown hair is found by calculating:

$$\frac{\text{number of people with brown hair}}{\text{total number of people}} \times 100$$

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$= \frac{1800}{4600} \times 100 = 39.1\%$

Practice questions

1 The table below shows some data about energy absorbed by a tree in a year and how some of it is transferred.

Energy absorbed by the tree in a year	3 600 000 kJ/m^2
Energy transferred to primary consumers	2240 kJ/m^2
Energy transferred to secondary consumers	480 kJ/m^2

Calculate the percentage of energy absorbed by the tree that is transferred to

a primary consumers **b** secondary consumers.

2 One in 17 people in the UK has diabetes.

Calculate the percentage of the UK population that have diabetes.

5.2 Calculating the percentage change

When you work out an increase or a decrease as a percentage change, you must identify, or calculate, the total original amount:

$$\% \text{ increase} = \frac{\text{increase}}{\text{original amount}} \times 100$$

$$\% \text{ decrease} = \frac{\text{decrease}}{\text{original amount}} \times 100$$

Remember: When you calculate a percentage change, use the total *before* the increase or decrease, not the final total.

Practice questions

3 Convert the following mass changes as percentage changes.

Sucrose conc. / mol dm^{-3}	Initial mass / g	Final mass / g	Mass change / g	Percentage change in mass
0.9	1.79	1.06		
0.7	1.86	1.30		
0.5	1.95	1.70		
0.3	1.63	1.76		
0.1	1.82	2.55		

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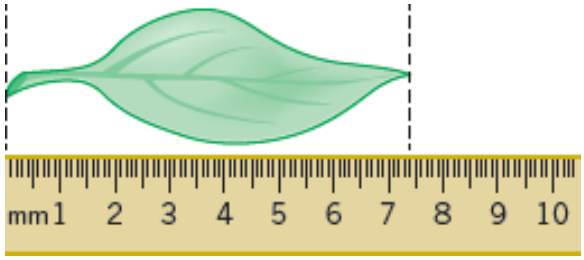
5.3 Measurement uncertainties

When you measure something, there will always be a small difference between the measured value and the true value. This may be because of the size of the scale divisions on your measuring equipment, or the difficulty of taking the measurement. This is called an uncertainty.

To estimate the uncertainty of a measurement with an instrument with a marked scale such as a ruler, a good rule of thumb is to let the uncertainty be equal to half the smallest division on the scale being used.



Using a ruler with a mm scale, the length of the leaf seems to be 74 mm. The smallest division is 1 mm, so the uncertainty is 0.5 mm.

The true length is therefore 74 mm +/− 0.5 mm.

Practice questions

4 Give the uncertainty for the following pieces of equipment:

a large measuring cylinder with 2 cm^3 divisions

b digital stopwatch timer measuring to the nearest hundredth of a second

c thermometer with 0.1 °C divisions.

2 Balancing chemical equations

When new substances are made during chemical reactions, atoms are not created or destroyed – they just become rearranged in new ways. So, there is always the same number of each type of atom before and after the reaction, and the total mass before the reaction is the same as the total mass after the reaction. This is known as the conservation of mass.

The equation shows the correct formulae but it is not balanced. $H_2 + O_2 \rightarrow H_2O$

While there are two hydrogen atoms on both sides of the equation, there is only one oxygen atom on the right-hand side of the equation against two oxygen atoms on the left-hand side. Therefore, a two must be placed before the H_2O.

$H_2 + O_2 \rightarrow 2H_2O$ Now the oxygen atoms are balanced but the hydrogen atoms are no longer balanced. A two must be placed in front of the H_2.

$2H_2 + O_2 \rightarrow 2H_2O$

The number of hydrogen and oxygen atoms is the same on both sides, so the equation is balanced.

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Practice questions

Balance the following equations.

a C + O2 → CO **b** N2 + H2 → NH3 **c** C2H4 + O2 → H2O + CO2

Seneca Learning (spend about 2 hours on this)

Your next task is to complete the Seneca GCSE **refresher sections** for Physics and Biology (you don't need to do the taster sections). As you do the GCSE refresher pages complete for us a revision aid of your choice – I suggest a mind map but if you prefer you can do a fact sheet, flash cards or even a power point.

Physics is at https://app.senecalearning.com/classroom/course/eb1a286f-2cf3-486d-a591-5494d8b256c7/section/6254010a-c9e2-477d-a457-2605b09d8af6/session

Biology is at https://app.senecalearning.com/classroom/course/76917ca0-ac10-43c9-8742-e49b861417b2/section/85450ad6-7203-4528-8be0-8a1eac5eff33/session

Research Task (spend about 2 hours on this)

Now for your creative side! We would like you to research a Science area of your choice and present it in a medium of your choice – could be a poster; a power point with your voice recorded over the top; a video or even a flip motion video involving props. This is your chance to do something fun that we can share with the class in September!

Some possible topics that you may find interesting;

Are we made from stardust?
How do endoscopes look inside the body?
How do we use different parts of the electromagnetic spectrum
History of the periodic table
What is a titration?
Can I do chromatography at home?
What does a cell really look like inside? – Did GCSE teach me everything?
How do drugs effect the brain?
How does the body send signals from the brain elsewhere?
What is atherosclerosis?

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