Hi All and welcome to A level biology! Over the next few weeks you will be completing work that will help you to prepare for your A level studies. You will be focussing on the first two topics, which are cell structure and plant transport and also some maths skills, which are really important for A level biology.

There are four activities to complete, one each week. I have also attached a reading list. If you are at Redhill you have probably seen this already. If at any point you complete the tasks quickly, or if you would like to read more around the subject, this will be an excellent reference point for you.

1. There are 3 assignments to complete. The first two recap the cell structure and plant transport topics from GCSE. You must complete these as a minimum. The third and forth assignments introduce these topics at A level. You will find these more challenging, but remember we will be studying these topics together in September. Don't panic if there are some things you don't understand!

2. If you have time look at the reading list and pick something to read to extend your wider biological knowledge. You will be able to find second hand copies of the books on ebay.

Task 1:

Work through the booklet, reading the information and then completing any questions. All of the maths skills in this booklet you will have covered in GCSE. When you have finished, use the mark scheme to check your answers. Remember to look at the reading list if you have more time.

Standard Form:

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

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

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

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

In standard form, the power of 10 shows the number of places the decimal point must be shifted to give the number in decimal form. A positive power will shift to the right, and a negative power will shift to the left.

Decimal	Standard Form
134 000	1.34×10^5
0.0034	3.4×10^{-3}
82 000 000	8.2×10^7
270	2.7×10^2
0.000 000 000 026	2.6×10^{-11}

$8.7 \times 10^{-4} = 0.00087$

Shift 4 left

In standard form, the digit number also contains the number of significant figures in the number. The exponential number positions the decimal point.

To convert to standard form, shift the decimal until there is one non-zero digit left of the decimal point, and count the number of places the decimal point has "moved" (this will be negative if your initial number was less than one). This number is the power of 10.

$328\,000 = 3.28 \times 10^5$

Example Q 1: 0.0125 moles of a particular substance were dissolved in 2.5 dm^3 of water. What is the concentration of this substance? Give your answer in standard form.

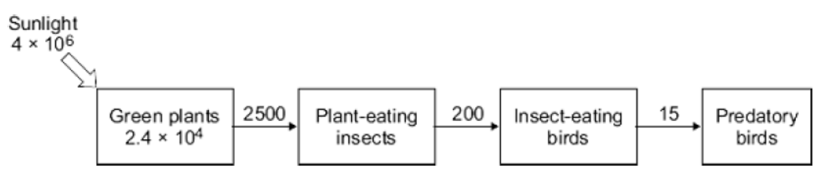
To type a number in standard form on your calculator,
- Input the digit number followed by the multiplication sign.
- Locate the "10^x" symbol, and use this to insert the exponent.
- Check your equation for any needed brackets.

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

Example Q 2: A cross section of an artery contains 9.2×10^{-9} m^3 of blood. If this blood has a mass of 7.1×10^{-3} g, calculate the density of the blood. Leave your answer in standard form.

The diagram shows the annual flow of energy through a habitat.

The figures are in kJ m^{-2}.



(a) (i) Calculate the percentage of the energy in sunlight that was transferred into energy in the green plants.

Show clearly how you work out your answer.

....

....

....

....

Answer = ...

(2)

Rounding and Significant Figures

There are some simple rules to use when working out significant figures.

Rule 1: All non-zero digits are significant.
For example, 78 has 2 significant figures, 9.543 has four significant figures and 340 has two significant figures.
Rule 2: Intermediate zeros are significant.
For example, 706 has 3 significant figures, and 5.90076 has six significant figures.
Rule 3: Any leading zeroes are not significant.
For example, 0.00567 has 3 significant figures (5, 6 and 7; ignore the leading zeroes).
Rule 4: Zeroes at the ends of numbers containing decimal places are significant.
For example, 45.60 has 4 significant figures and 330.00 has 5 significant figures.

Significant Figures and Rounding:

In rounding, when the next number is 5 or more round up, while if it is 4 or less don't round up.

Measurement expressed by rounding to decimal places	Number of decimal places	Measurements expressed by rounding to significant figures	Number of significant figures	Measured to the nearest
23.33600	5	23.336	5	100 thousandth
23.3360	4	23.34	4	Ten thousandth
23.336	3	23.3	3	Thousandth
23.34	2	23	2	Hundredth
23.3	1	20	1	Tenth
23	0	-	-	Whole number

If you aren't sure how to round your answer, you can work out the number of significant figures that you should round to by looking at the measurements you're using in the calculation. Just count the number of significant figures for each measurement and use the lowest number of significant figures for your answer.

E.g. $1.2 \div 1.85 = 0.648648648$ 1.2 has 2 sf, 1.85 has 3 sf. So round your answer to 2 sf = 0.65

<u>Significant figures and standard form:</u>

In standard form only the significant figures are written as digits, for example 5.600×10^3 has four significant figures. If this were written as a straight number it would be 5600. This looks like it has only two significant figures but the significant figures are defined as the ones that contribute to its precision. Writing the number as 5600 implies precision only to the nearest whole hundred (could be 5600.44 or 5633). Using standard form allows precision to remain clearly as part of the stated number because all significant figures are written.

<u>Example Qs:</u>

1. The growth rate of a plant is 0.023735 cm hour^{-1}. What is the rate to: a) 3 decimal places? b) 3 significant figures?

2. A student is calculating the average growth rate of a tray of seedlings by dividing the average change in seedling height by the incubation time. The average change in seedling height is 17.5cm and the incubation time is 60 days. What is the average growth rate (in cm day^{-1})? Give your answer to an appropriate number of significant figures.

<u>Units and prefixes:</u>

One of the reasons we use the international system of units is because it makes the conversion of units (especially those with different prefixes) mathematically simple.

We use prefixes as shorthand for standard form when using commonly occurring very large or very small numbers. For example, the length 0.0000000023 m may be written as 2.3×10^{-9} m

2.3 is the **digit number** and is kept. 10^{-9} is known as the **exponential number** and can be replaced with the prefix *'n'* pronounced as '**nano**'. Hence: 0.0000000023 m = 2.3×10^{-9} m = 2.3 nm

<u>Standard Units (SI Units)</u>

You should always clearly write units in your calculations:

Base Units:

- Metre (m) for length, height distance
- Kilogram (kg) for mass
- Second (s) for time
- Mole (mol) for the amount of a substance

Derived Units:

- Square metres (m^2) for area
- Cubic metre (m^3) for volume
- Cubic centimetre (cm^3) or ml for volume
- Degrees Celcius (℃) for temperature
- Mole per litre (mol dm^{-3}) for concentration
- Joule (J) for energy
- Pascal (Pa) for pressure
- Volt (V) for electrical potential

You may also encounter these non-SI units:

- Litre (cubic decimetre) (L, dm^3) for volume
- Minute (min) for time
- Hour (h) for time

To accommodate the huge range of dimensions in our measurements, units may be further modified using appropriate prefixes. Here is a table to show the range of dimensions in our measurements. In Biology we tend to use the shaded rows the most.

Division	Factor or exponential number	Prefix	Length	units	Mass	units	Volume	units	Time	units
One billion times	10^9	giga								
One million times	10^6	mega								
One thousand times	10^3	kilo	kilometre	km	kilogram	kg				
Whole unit	10		metre	m	gram	g	litre	L or dm^3	second	S
Tenth	10^{-1}	deci								
One hundredth	10^{-2}	centi	centimetre	cm						
One thousandth	10^{-3}	milli	millimetre	mm	milligram	mg	millilitre	ml or cm^3	millisecond	ms
One millionth	10^{-6}	micro	micrometre	µm	microgram	µg	microlitre	µl	microsecond	µs

One thousand millionth or one billionth	10^{-9}	nano	nanometre	nm	nanogram	ng	nanolitre	nl	nanosecond	ns

Example 1

The length of a DNA nucleotide is 0.6 nm.

a) Convert this number into meters. Give your answer in standard form.

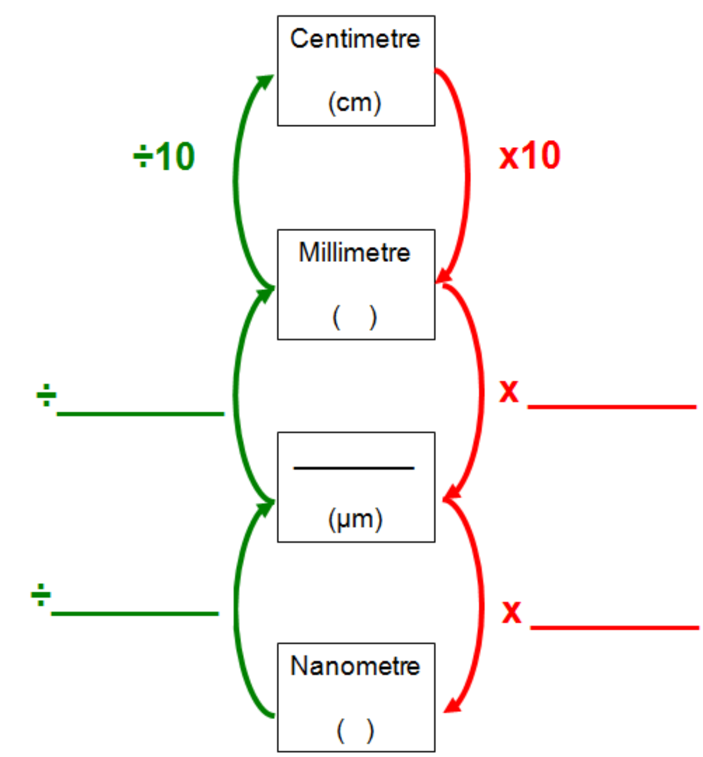
b) If a strand of DNA is 1.6 m long, how many nucleotides is it made up of? Give your answer to 1 decimal place and in standard form.

<u>Converting between units:</u>

If you are converting a smaller unit to a larger one you divide. If you are converting a larger unit to a smaller one you multiply.

Divide by 1000 for each step to convert in this direction →				
nano	micro	milli	Whole unit	Kilo
e.g. nm	e.g. µm	e.g. mm	e.g. m	e.g. km
← Multiply by 1000 for each step to convert in this direction				

1) Complete the diagram below to show: names of the units of measurement, unit symbols, mathematical operations for converting between units.



2) Complete the table below to show the corresponding value nanometres, micrometres and millimetres for the measurements given in each row. The first row has been completed for you. Ensure that your answers use the correct unit symbols.

Nanometre	**Micrometre**	**Millimetre**
5	0.005	0.000005
1		
	1	
		1
	3	
7		
		0.5

Example Qs:

1. Convert 1m to mm
2. Convert 1m to µm
3. Convert 20,000 µm to mm:

(c) The table below shows some features of gas exchange of a fish at rest.

Volume of oxygen absorbed by the gills from each dm^3 of water / cm^3	7
Mass of fish / kg	0.4
Oxygen required by fish / $cm^3\ kg^{-1}\ hour^{-1}$	90

(i) Calculate the volume of water that would have to pass over the gills each hour to supply the oxygen required by the fish. Show your working.

.... dm^3

(2)

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.

For example:

- Use 3 parts red paint to 1 part white paint.
- Use 1 teabag to 250 ml of water.

The order of the ratio is very important. We can use ratios to scale measurements, drawings, and calculations up and down.

We can write a ratio as a fraction by scaling the ratio so that it is divided by the total number of parts.

Example: To make mortar, we need 1 part cement, and 2 parts sand. The total number of parts for one batch of mortar is $1 + 2 = \mathbf{3}$. Thus the ratio for creating mortar is **1:2** which can also now be expressed as $\mathbf{\frac{1}{3}}:\mathbf{\frac{2}{3}}$

From this form, it is easy to see how much of the total mixture is sand $(\frac{2}{3})$ and how much is concrete $(\frac{1}{3})$.

Example Qs:

Here is a list of ingredients.

Serves 4 people	
Bacon	50 g
Minced beef	450 g
Chopped tomatoes	400 g
Button mushrooms	100 g
Beef stock	125 ml

Marco is making a meal for 14 people using these ingredients.

Work out the number of grams of minced beef he needs.

Ali, Beth and Clare take a test.

The ratio of Ali's score to Beth's score is 5 : 3
Ali scored 10 more marks than Beth.

Clare scored 7 more marks than Ali.

Work out each of their scores.

Researchers investigated some characteristics of people from different parts of England. In the north of England they selected 200 people and recorded their phenotypes for three different characteristics.

Their results are shown in the figure below.

Phenotype produced by dominant allele	Number of people	Phenotype produced by recessive allele	Number of people
Tongue roller	131	Non-tongue roller	58
Right-handed	182	Left-handed	14
Straight thumb	142	Hitch-hiker thumb	50

Calculate the ratio of straight thumb to hitch-hiker thumb in this study.

Averages

Mean
- The mean is the **total** of the numbers **divided** by how many numbers there are.
- To work out the mean:
- Add up all the numbers. 7 + 9 + 11 + 6 + 13 + 6 + 6 + 3 + 11 = 72
- Divide the answer by how many numbers there are. There are 9 numbers. 72 ÷ 9 = 8 **So the mean value is 8.**

Median is the **middle** value.
- To work out the median:
- Put the numbers in order: 3 6 6 6 **7** 9 11 11 13
- The number in the middle of the list is the median. **So the median value is 7.**
- If there are two middle values, the median is **halfway** between them. Work out the median for this set of numbers:
- 3 6 6 6 **7 8** 9 11 11 13. There are two middle values, 7 and 8. The median is **halfway** between 7 and 8, so the median is **7.5**.

Mode
- The mode is the value that appears the **most**.
- To work out the mode:
- Put the numbers in order: 3 **6 6 6** 7 9 11 11 13
- Look for the number that appears the most. 6 appears more than any other number. **So the mode value is 6.**

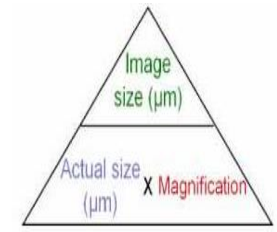
Percentages

- A percentage is simply expressing a fraction as a decimal.
- Percentage as proportion and fraction: e.g. percentage of pin eyed plants is 323/790 = 0.41 x 100 = 41%
- Percentage as chance e.g. in genetics – ¼ x 100 = 25% of cystic fibrosis child from two parents.

- Percentage change. E.g. in osmosis experiments. A sample weighed 18.50g at the start and at the end it weighed 11.72g.
- Percentage change = mass change ÷ starting mass x 100 =
- Mass change 18.50-11.72 = 6.78g ÷ 18.50 x 100 = -36.7% (Remember it is negative because it was a loss in mass).

Rearranging equations

- The individual parts of terms in equations are all related, but sometimes you might know all the values of the terms except one.
- The equation can be re-written so that the unknown term can be calculated – changing the subject of an equation.
- E.g. magnification = size of image ÷ size of real object
- Can be rearranged to: Size of image = magnification x real size and Real size = image size ÷ magnification

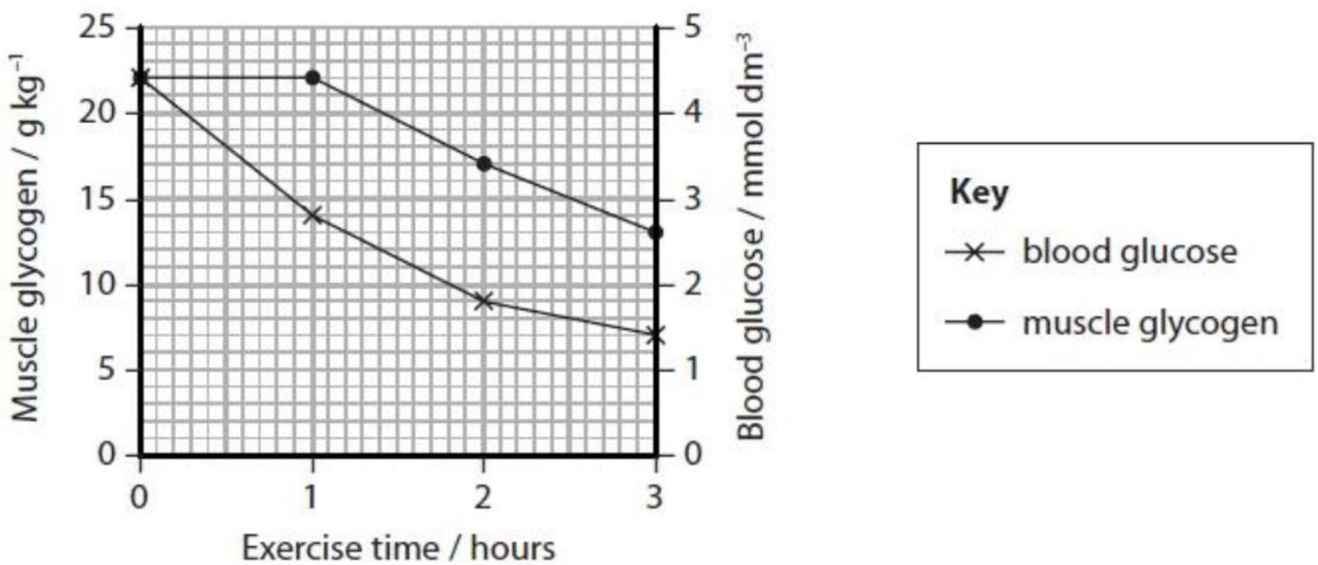


Percentage Change Questions

13.

Carbohydrates are the body's main energy source.

The graph shows the change in concentration of blood glucose and muscle glycogen during exercise.



Calculate the percentage change in muscle glycogen during the three hours of exercise.

(2)