# Maths Skills Practise

# A Level Biology includes the use of a range of maths skills.

As a starting point, work through the quizzes below to ensure that you can demonstrate some of the skills that you should be familiar with from GCSE Maths and Science.

Advice on all the skills tested below can be found through the OCR Maths in Biology page at <https://www.ocr.org.uk/qualifications/by-subject/biology-related/maths-for-biology/>

# Maths skills – M0.1 Recognise and make use of appropriate units in calculations

### Quiz – converting between units

Answers to all of these questions should use standard form e.g. use 5.6 x 103 rather than 5600, use 4.2 x 10-2 rather than 0.042.

1. How many?

| mm in a m |  |  | µm in a mm |  |
| --- | --- | --- | --- | --- |
| µm in a m |  |  | nm in a µm |  |
| nm in a mm |  |  | nm in a m |  |
| mm in a µm |  |  | m in a µm |  |
| µm in a nm |  |  | mm in a nm |  |
| µ*l* in a litre |  |  | m*l* in a litre |  |
| µ*l* in a m*l* |  |  | ms in a s |  |
| µs in a ms |  |  |  |  |

1. Convert each of the following into metres.

| (a) | 70 nm |  |
| --- | --- | --- |
| (b) | 5 µm |  |
| (c) | 1 mm |  |
| (d) | 0.2 mm |  |

1. Convert each of the following into µm.

| (a) | 4 m |  |
| --- | --- | --- |
| (b) | 200 nm |  |
| (c) | 17 mm |  |
| (d) | 0.3 nm |  |

1. Areas. How many?

| (a) | μm2 in a m2 |  |
| --- | --- | --- |
| (b) | μm2 in a mm2 |  |

1. Volumes. How many?

| (a) | mm3 in a cm3 |  |
| --- | --- | --- |
| (b) | μm3 in a mm3 |  |

1. Convert each of these into more sensible units using standard form to express your answers if appropriate.

| (a) | 0.0003 μm |  |
| --- | --- | --- |
| (b) | 0.004 km |  |
| (c) | 4500000 nm |  |
| (d) | 0.0007 s |  |

### Quiz – Rates of change

1. Express these rates of change with the correct units:

| (a) | 2 μg per cm3 |  |
| --- | --- | --- |
| (b) | 200 kJ per m2 per year |  |
| (c) | 10 g per dm3 |  |
| (d) | 15 cm3 per minute |  |

1. In an experiment you were measuring the growth rate of *Salmonella*. You started with 100 *Salmonella* and after 2 hours you had 6500 *Salmonella*. What is the bacterial growth rate?

|  |
| --- |

1. In an experiment you were measuring the growth rate of *Salmonella*. You started with 80 *Salmonella* and after 4 hours you had 5000 *Salmonella*. What is the bacterial growth rate?

|  |
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1. How would you express the following in numbers and units?
2. A woodlouse crawled 5 cm in 10 min.

|  |
| --- |

1. A patient’s drip flowed with 10 drips every 30 s.

|  |
| --- |

1. The growth of a slime mould colony was 40 cells per millimetre cubed per hour.

|  |
| --- |

1. A breathing rate of 20 breaths in 30 s.

|  |
| --- |

1. A change in temperature of 1.2 degrees over three years.

|  |
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# Maths skills – M0.2 Recognise and use expressions in decimal and standard form

### Quiz

1. Convert each of these into standard form, to one decimal place.

|  |  |  |
| --- | --- | --- |
| 1) | 40000000 |  |
| 2) | 8567 |  |
| 3) | 0.0000007 |  |
| 4) | 0.07607 |  |
| 5) | 4500067 |  |
| 6) | 93 |  |
| 7) | 7 |  |
| 8) | 62545 |  |

1. Multiply these numbers, giving your answer in standard form to one decimal place:

|  |  |  |
| --- | --- | --- |
| 1) | (1 x 104) x ( 6 x 103)  |  |
| 2) | (3 x 104) x (3 x 10-1)  |  |
| 3) | (2 x 10-2) x (3 x 10-3) |  |
| 4) | (4 x 102) x (5 x 103)  |  |

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# Maths skills – M0.3 Use ratios, fractions and percentages

### Quiz – Percentages: Practice calculations

Learners may be tested on their ability to:

• Calculate percentage yields

• Calculate surface area to volume ratio

• Use scales for measuring

• Represent phenotypic ratios (monohybrid and dihybrid crosses)

1. Ventricular systole lasts for 0.3 s. The cardiac cycle lasts for 0.8 s. What percentage of the cardiac cycle is ventricular systole?
2. In an onion root tip squash, 200 cells were observed and each cell was assigned to a stage of the cell cycle. Here are the results:

|  |  |
| --- | --- |
| **Stage** | **Number of cells** |
| Interphase | 150 |
| Prophase | 20 |
| Metaphase | 12 |
| Anaphase | 4 |
| Telophase | 8 |
| Cytokinesis | 6 |

What percentage of cells were at each stage of the cell cycle?

1. A soil sample weighed 2.4 g. After heating at 100 0C in an oven to evaporate the water, it weighed 1.8 g. What percentage of the soil sample was water?
2. Stearic acid has the formula C17H35COOH. What percentage of the atoms in stearic
acid are:

| (a) | carbon? |  |
| --- | --- | --- |
| (b) | hydrogen? |  |
| (c) | oxygen? |  |

### Quiz – Percentage yield: Practice calculations

1. In the following examples you are given the actual yield and the theoretical yield. Calculate the percentage yield.

| (a) | Actual yield = 40 g | Theoretical yield = 60 g |  |
| --- | --- | --- | --- |
| (b) | Actual yield = 60 g | Theoretical yield = 100 g |  |
| (c) | Actual yield = 90 g | Theoretical yield = 130 g |  |
| (d) | Actual yield = 23 g | Theoretical yield = 60 g |  |

1. In the hydrolysis of a sample of triglycerides, the theoretical yield of fatty acids is 9.0 g. The actual yield was 7.2 g. What was the percentage yield for this synthesis?

### Quiz – Ratio: Practice calculations

1. Calculate the surface area-to-volume ratios of the following cuboids:

| (a) | A cuboid with sides: 2 cm x 2 cm x 2 cm |  |
| --- | --- | --- |
| (b) | A cuboid with sides: 1 m x 2 m x 4 m |  |
| (c) | A cuboid with sides: 1 mm x 1 mm x 8 mm |  |

### Quiz – Phenotypic ratio: practice calculations

1. Plants were grown either in the light or the dark and the length of the stem was measured.

|  |  |
| --- | --- |
| **Growing conditions** | **Stem length (cm)** |
| Light | 10 |
| Dark | 25 |

1. What was the ratio of stem length, light to dark?

|  |
| --- |

1. What was the ratio of stem length, dark to light?

|  |
| --- |

1. The stem length experiment was repeated by growing plants under four different coloured lights:

|  |  |
| --- | --- |
| **Light used for growth** | **Stem length (cm)** |
| Blue | 25 |
| Green | 3 |
| Yellow | 10 |
| Red | 15 |

What was the ratio of stem length blue to green to yellow to red?

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1. Let’s say colour of naked mole rats is determined by a single gene and brown colour (B) is dominant to white colour (b). If two heterozygous (Bb) naked mole rats were mated, what is the expected ratio of brown naked mole rats to white naked mole rats?

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# Maths skills – M4.1 Calculate the circumference, surface areas and volumes of regular shapes

### Quiz

Calculate the following correct to 3 significant figures.

**1.** Circumference of circle

Radius =

| a) 0.50 µm |  |
| --- | --- |
| b) 3.00 mm |  |

**2.** Area of circle

Radius =

| a) 0.50 µm |  |
| --- | --- |
| b) 3.00 mm |  |

**3.** Surface area of cuboid

| a) | b = 4.00 cm | l = 6.00 cm | h = 1.00 cm |  |
| --- | --- | --- | --- | --- |
| b) | b = 3.00 mm | l = 4.00 mm | h = 3.00 mm |  |

**4.** Volume of cuboid

| a) | b = 4.00 cm | l = 6.00 cm | h = 1.00 cm |  |
| --- | --- | --- | --- | --- |
| b) | b = 3.00 mm | l = 4.00 mm | h = 3.00 mm |  |

**5.** Surface area of cylinder

| a) | r = 0.500 µm | l = 4.00 µm |  |
| --- | --- | --- | --- |
| b) | r = 3.00 mm | l = 10.0 mm |  |

**6.** Volume of cylinder

| a) | r = 0.500 µm | l = 4.00 µm |  |
| --- | --- | --- | --- |
| b) | r = 3.00 mm | l = 10.0 mm |  |

**7.** Surface area of sphere

| a) r = 0.500 µm |  |
| --- | --- |
| b) r = 3.00 mm |  |

**8.** Volume of sphere

| a) r = 0.50 µm |  |
| --- | --- |
| b) r = 3.00 mm |  |

**9.** Calculate the surface area to volume ratio of a mitochondrion that is approximately cylindrical in shape and has a length of 7.0 µm and a radius of 0.50 µm.

|  |
| --- |

# M1.1 – Use an appropriate number of significant figures

#### Quiz

1. In each case convert to the number of significant figures quoted.

a) 2342 to 3 sig fig

b) 2342 to 2 sig fig

c) 456 to 2 sig fig

d) 0.07842 to 3 sig fig

e) 0.07842 to 2 sig fig

f) 0.003004 to 3 sig fig

(Note: for questions 2 to 4 you should be able to identify the appropriate number of significant figures to which to give your answer as well as convert the calculated result to that number of sig figs. If you are finding the calculations themselves difficult please refer to M2.3 and M2.4).

2. A hypothermic patient was rewarmed from 30.6°C to 37.1°C over the course of 3.4 h. What was the rate of warming (use °C h-1 as your units)?

3. A willow coppice woodland in the UK has an area of 1.15 ha. (ha is the symbol for hectare – an area of land equal to 10,000 m2). When the willow harvest is taken each year, and dried, it yields 9 odt (oven-dry tonnes) of biomass. What is the productivity of the land (the amount of biomass produced per unit area) in units of odt ha-1?

4. A model cell is made of visking tubing (partially permeable membrane) containing sucrose solution and is immersed in distilled water. In 23.5 min the volume of the model cell increases by 1.0 cm3 due to inflow of water by osmosis. What is the rate of osmosis in units of cm3 min-1?

# M1.2 – Find arithmetic means

## Quiz - calculate the mean:

1. Students measured the number of carrots eaten by rabbits over 24 hours. Calculate the mean number of carrots eaten.

Carrots eaten per rabbit:

6 5 8 5 9 6 7 7 7 8

1. The number of stomata on the upper and lower sides of 5 leaves of a plant were counted.

|  |  |
| --- | --- |
| **No. of stomata on lower side of leaf** | **No. of stomata on upper side of leaf** |
| 45 | 6 |
| 48 | 9 |
| 47 | 11 |
| 50 | 7 |
| 46 | 7 |

How do the mean numbers of stomata compare on the upper and lower sides of the leaf?

# M1.6 – Understand the terms mean, mode and median

### Quiz

Plants were grown in both the sun and the shade and height measurements taken. Calculate the mean, mode and median for each set of data.

|  |  |
| --- | --- |
| **Height in sun (cm)** | **Height in shade (cm)** |
| 244 | 104 |
| 265 | 83 |
| 312 | 131 |
| 199 | 99 |
| 278 | 118 |
| 345 | 150 |
| 236 | 162 |
| 197 | 118 |
| 266 | 146 |
| 237 | 128 |

|  |  |  |
| --- | --- | --- |
|  | **Height in sun (cm)** | **Height in shade (cm)** |
| **Mean** |  |  |
| **Mode** |  |  |
| **Median** |  |  |

Numbers of mucus-secreting goblet cells were counted per colonic intestinal crypt in patients with Crohn’s disease and healthy patients. Calculate the mean, mode and median for each set of data.

|  |  |
| --- | --- |
| **Number of goblet cells – Crohn’s disease patients** | **Number of goblet cells – Healthy patients** |
| 9 | 15 |
| 11 | 12 |
| 7 | 14 |
| 15 | 9 |
| 10 | 11 |
| 8 | 13 |
| 7 | 12 |
| 12 | 10 |
| 13 | 16 |
| 7 | 11 |

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|  |  |  |
| --- | --- | --- |
|  | **Crohn’s disease patients** | **Healthy patients** |
| **Mean** |  |  |
| **Mode** |  |  |
| **Median** |  |  |