# M1.8 Make order of magnitude calculations

### Tutorials

Learners may be tested on their ability to:

* use and manipulate the magnification formula,



### Order of magnitude

Orders of magnitude are used to make approximate comparisons of size or quantity. If two numbers have the same order of magnitude, they are about the same size. If two numbers differ by one order of magnitude, one is about ten times larger than the other. If they differ by two orders of magnitude, they differ by a factor of about 100, and so on.

|  |  |
| --- | --- |
| [**Powers**](https://simple.wikipedia.org/wiki/Exponent#Powers_of_ten)**of ten** | **Order ofmagnitude** |
| 0.0001 | −4 |
| 0.001 | −3 |
| 0.01 | −2 |
| 0.1 | −1 |
| 1 | 0 |
| 10 | 1 |
| 100 | 2 |
| 1,000 | 3 |
| 10,000 | 4 |

For example, if you were comparing the surface of an orange with that of the earth, one would say the surface of the earth is many orders of magnitude larger than that of the orange.

The formula used to calculate magnification is:



You can rearrange the formula to calculate any of the three unknowns, as long as you have the other two. However for this to work you must make sure that both quantities/sizes are in the same units.

For example take the following micrograph showing a section of mouse pancreas at high power, one acinus (a cluster of cells) is circled. The magnification of the micrograph is x400 and the length of the circled acinus is 32 mm. We want to calculate the actual size of the acinus.



Magnification 🡪 x400

Length of the circled acinus in the image 🡪 32 mm

We want to calculate the actual size of the acinus. This means we need to rearrange the magnification formula (*rearranging formulas is covered in detail in section M2.2*) to make the size of real object the subject of the equation. This gives us the size of the real object equals the size of the image divided by the magnification.





In this example this means the actual size of the acinus is equal to 32 mm (the size of the acinus in the image) divided by 400 (the magnification). Therefore the actual size of the acinus is 0.080mm, or in more appropriate units, 80 µm.

32 mm / 400 = 0.080 mm = 80 µm

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