## Magnification

This is quite straightforward if you follow a few simple steps

1. Learn the magnification equation and how to rearrange it
2. Learn how to use scale bars
3. Learn how to convert between mm, µm and sometimes nm
4. Measure in mm
5. Do not work in mixed units instead convert to the same units (usually µm but not always you need to read the question carefully to be sure)

**The actual size will be smaller than the image size. This is one way you can check that your answer is sensible.**

Actual Size

The size of the object in real life!

In a question you could be asked to calculate this or you may be given it to use in a calculation.

This will have units of length eg mm or µm

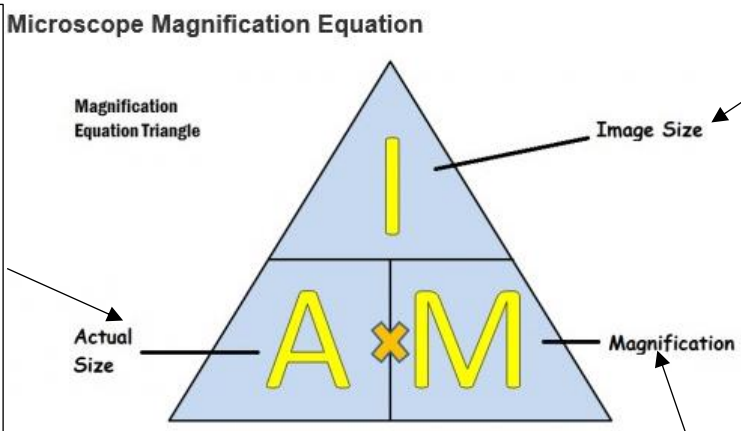



Image size

This is the size of the diagram or photo in the question.

You can measure this.

**Measure in mm**

You will usually need to convert this to µm

Rearranging the equation

I = A x M

A = I ÷ M

M = I ÷ A

Magnification

This how many times larger the image is compared to the object in real life!

It does not have units but you should put an X in front of the value you calculate.

### Work your way through these questions

1. Figure 5.1 shows a single celled organisms called a paramecium
   Note that the diagram has a magnification value next to it of X600

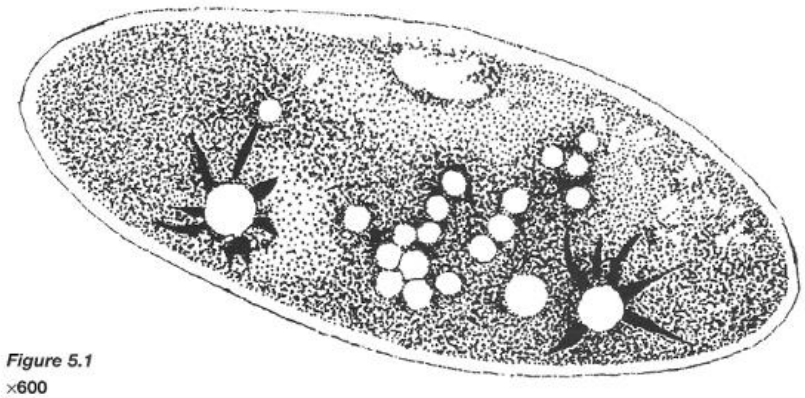


*Figure 5.1*
×600

A mm is 1000 times larger than a µm

To convert mm to µm you need to multiply by 1000

You need to calculate the actual length of the paramecium
So you need to use the equation A = I ÷ M
First measure the length of the paramecium in mm then convert to µm
Length of the paramecium = ……mm which is …… µm
Now put the values into the equation and calculate the actual length = …… µm

2. Figure 5.2 shows a plant cell containing seven chloroplasts
   Note the image has a magnification of X9000

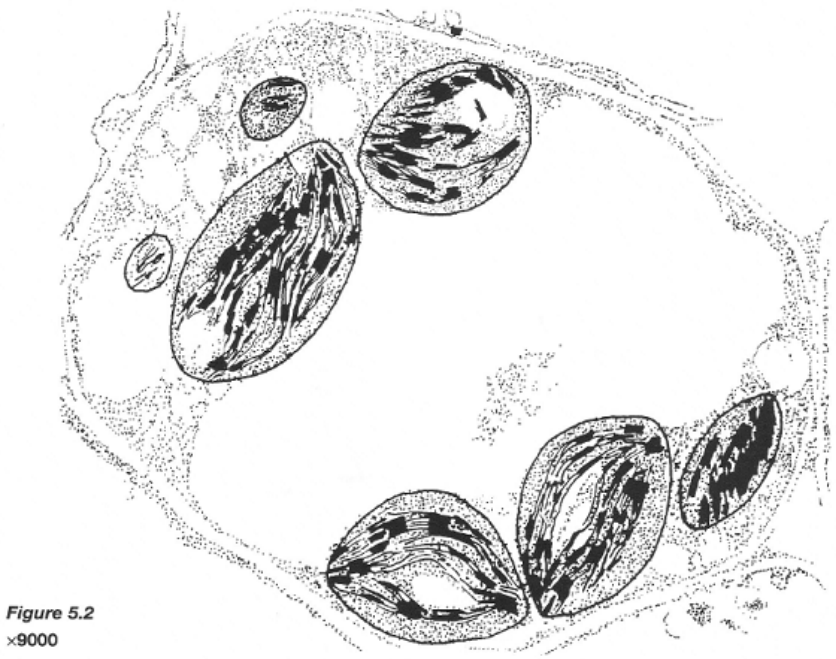


*Figure 5.2*
×9000

You need to calculate the mean length (in μm) of the four largest chloroplasts.
Use the method you used in the previous question.
**Show your workings as a series of steps**. You will not gain credit if you put the answer without showing how you arrived at it.

Mean length of the chloroplasts = …….

3. Figure 5.3 shows a bacterium.
   Its actual length is 2 μm. Calculate the magnification of the image. **You must show all workings**.

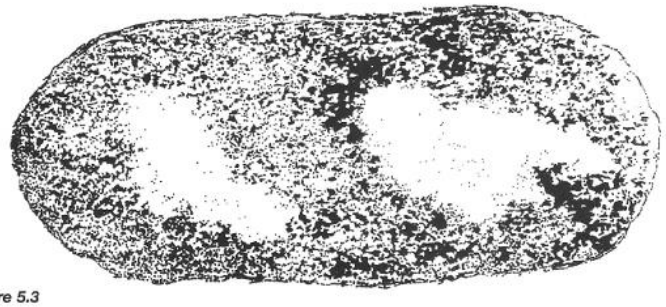


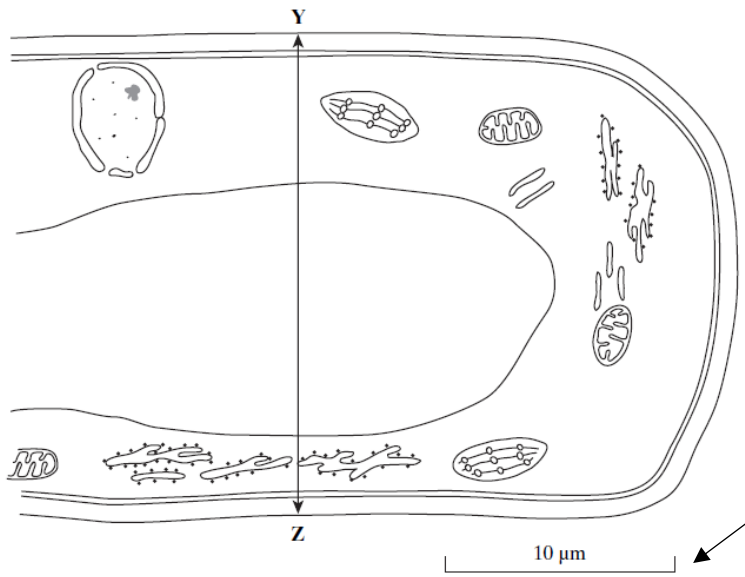
*Figure 5.3*

Magnification = …….

- Scale bars are the bars alongside diagrams or images that give an indication of size
- You can use scale bars to work out the magnification of the image

4. Try this question (BYB1 Jun 04) by following the instructions

(b) The drawing shows part of a plant cell as seen with an electron microscope.




This is a scale bar

To calculate the magnification you need to

- Measure the length of the scale bar in mm
- Convert mm to the units used (in this case µm)
- Then divide by the printed value (in this case 10 µm)

(ii) Calculate the actual width of the cell from **Y** to **Z**. Give your answer in micrometres (µm) and show your working.

Answer ..... µm
*(2 marks)*

Exam technique

**It says show your working**

So show the steps

If you just write the answer and make an error you will score 0

If you make an error but show your workings you may be awarded one of the marks

5. Figure 5.4 represents a 7 week old embryo
Use the scale bar to calculate the magnification of this image. **Show your working**

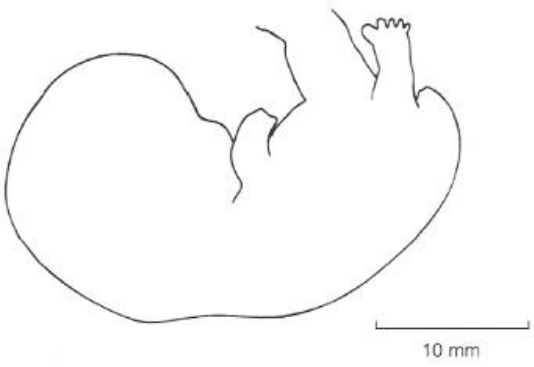



***Figure 5.4***

Magnification = .....

6. Figure 5.6 represents and electronmicrograph of a pollen grain.
   Work out the actual width of this pollen grain. **Show all steps in your working**. Include appropriate units.


*Figure 5.6*

Actual width = ……

7. Figure 5.7 shows red blood cells inside an arteriole
   Work out the actual diameter of the red blood cell of the middle bottom red cell. **Show all workings** and include correct units.

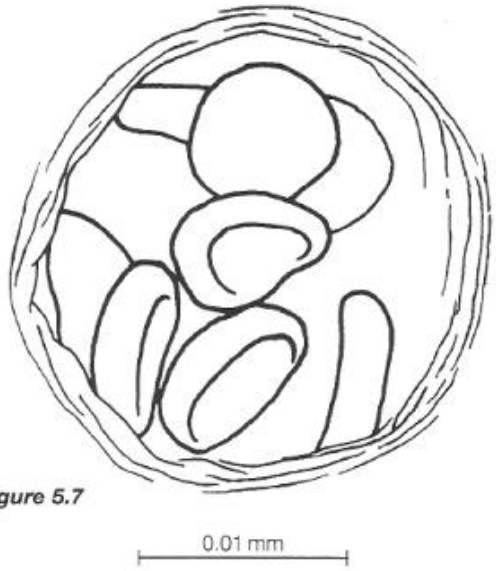



*Figure 5.7*

Actual width = ……

8. Figure 5.9 represents a bacteriophage (a virus that infects bacteria). These are extremely small.
   The actual size length of this bacteriophage (excluding tail fibres) is 200nm.
   Work out the magnification of this image. **Show all workings**.
   A nm is 1000 times smaller than a µm (so µm x 1000 = nm)

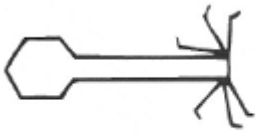


*Figure 5.9*

Magnification = ……