3. What would you need to do if you were only given a scale bar and asked to calculate actual size? Demonstrate by finding the length of this stoma in μm. Show your working.

\[
\text{Magnification} = \frac{12000}{20} = 600 \times \\
\text{Actual size} = \frac{62}{600} = 0.103 \times 1000 = 103.4 \mu m
\]

4. a. Calculate the length of this epithelial cell.
   b. Calculate the diameter of the nucleus of this cell.

\[
\text{Magnification} = \frac{27000 \mu m}{10 \mu m} = 2700 \times \\
\text{a)} \frac{89 \mu m}{2700} = 0.033 \times 1000 = 33.9 \mu m \\
\text{b)} \frac{28 \mu m}{2700} = 0.0103 \times 1000 = 10.3 \mu m
\]

5. a. Calculate the diameter of the main body of this human egg cell AND the thickness of one section of the zona pellucida.

\[
\text{Egg} = \frac{32 \mu m}{3.25} = 0.098 \times 1000 = 98.5 \mu m
\]

\[
\text{Zona} = \frac{7 \mu m}{3.25} = 0.0215 \times 1000 = 21.5 \mu m
\]

\[
\text{Magnification} = \frac{13 \times 1000}{40} = 325 \times
\]

\[
\text{Zona pellucida}
\]

\[
40 \mu m \\
13 \mu m
\]
Calculations in Microscopy

Use these calculations to find the magnifications or actual sizes of images.
1. Convert all units to make them the same (where appropriate)
2. Perform calculations
3. Convert answers to appropriate SI units, using scientific notation where needed.

\[
\text{magnification} = \frac{\text{measured length}}{\text{scale bar label}}
\]
\[
\text{e.g.} \quad \frac{30\text{mm}}{2\mu m} = \frac{30000\mu m}{2\mu m} = \frac{30000\mu m}{2\mu m}
\]

\[
\text{magnification} = 15,000 \times
\]

\[
\text{actual size} = \frac{\text{measured length}}{\text{magnification}}
\]
\[
\text{e.g.} \quad \frac{450\text{mm}}{15,000} = \frac{0.03\text{mm}}{15,000}
\]

1. Calculate the magnification of these scale bars:

\[
\frac{67\mu m}{10mm \times 1000 = 10,000\mu m}
\]

2. Calculate the actual size of these images:

\[
\text{Diatom x 1,000}
\]

\[
\text{distance & line } = 32\text{mm}
\]

\[
\text{magnification} = 1000 \times
\]

\[
\frac{32\text{mm}}{1000} = 0.032\text{mm}
\]

\[
0.032 \times 1000 = 32\mu m
\]

\[
\text{Diatom x 5,000}
\]

\[
\text{distance & line } = 56\text{mm}
\]

\[
\text{magnification} = 5000 \times
\]

\[
\frac{56\text{mm}}{5000} = 0.0112\text{mm}
\]

\[
0.0112 \times 1000 = 11.2\mu m
\]
6. Calculate the length of this *Elodea* cell.

\[
\frac{105}{2000} = 0.04 \times 1000 = 47.7 \mu m
\]

\[
\frac{33}{10} = 3.3 \times 1000 = 3300 \mu m
\]

**Written questions:** (they might appear in this style in the exam)

1. A student views an image of a cell magnified 50000 times. The image is 60mm long.
   a. What is the actual length of the sample in the image?

   \[
   \frac{60}{50000} = 1.2 \times 10^{-3} \times 1000 = \boxed{1.2 \ mm}
   \]

   b. Is the cell more likely to be a plant cell, animal cell, bacterium or virus? Explain why.

   - **bacteria**
   - **animal cells are around 10 \mu m**
   - **plant cells are even larger than animal cells.**

2. A sperm cell has a tail 50\mu m long. A student draws it 50mm long. What is the magnification?

\[
50 \text{mm} \times \frac{1000}{50 \text{mm}} = \boxed{1000 \times}
\]