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B1 L4

B1 L4 Magnification and cell size: Exam questions worksheet

Mark scheme · Total 20 marks

/ means alternative answers. ( ) words in brackets are not needed for the mark. **allow** = accept this answer. **ignore** = this does not lose or gain a mark. **do not accept** = this answer cannot score the mark. If a tick-box question has more than one box ticked, give 0 marks.

Question	Answers	Extra information	Mark	AO / Spec. ref.
01.1	1 cm → **10 mm** 1 mm → **1000 µm** 1 µm → **1000 nm**	3 correct lines = 2 marks. 1 or 2 correct lines = 1 mark. If more than one line is drawn from a unit, none of its lines scores. '100 µm' is not used.	2	AO1 4.1.1.5 (maths)
01.2	**a ribosome, 25 nm wide**	If more than one box is ticked, give 0 marks.	1	AO2 4.1.1.1 (maths)
		Question 01 total	**3**	
02.1	22 ÷ 400 (1) = 0.055 (mm) (1) 0.055 × 1000 = **55** (µm) (1)	Correct answer with no working = 3 marks. **allow** 22 000 µm ÷ 400 = 55 µm (units changed first) for 3 marks. 0.055 mm = 2 marks. 0.055 with the unit µm = 2 marks (the unit was not changed). **do not accept** 8800 (22 × 400: multiplied).	3	AO2 4.1.1.5 (maths)
02.2	**The drawing is 400 times bigger than the real cell.**	If more than one box is ticked, give 0 marks.	1	AO1 4.1.1.5
02.3	**5.5×10^{-5}** (m)	**allow** their 02.1 answer correctly written in metres in standard form. **do not accept** 55×10^{-6} m or 0.000 055 m (not standard form). **do not accept** 5.5×10^{5} m.	1	AO2 4.1.1.5 (maths)
		Question 02 total	**5**	
03	45 ÷ 30 (= 1.5) (1) 1.5 × 2 = **3** (µm) (1)	Correct answer with no working = 2 marks. **allow** 45 ÷ 15 = 3 µm (15 mm stands for 1 µm). **do not accept** 2 µm (the scale bar's label). **ignore** units.	2	AO2 4.1.1.5 (maths)
		Question 03 total	**2**	
04.1	1.8 ÷ 30 = 0.06 (mm) (1) 0.06 × 1000 = **60** (µm) (1)	Correct answer with no working = 2 marks. **allow** 1800 µm ÷ 30 = 60 µm. 0.06 mm = 1 mark. **do not accept** 54 (1.8 × 30).	2	AO2 4.1.1.1 (maths)

Question	Answers	Extra information	Mark	AO / Spec. ref.
04.2	at a higher magnification the field of view is smaller / narrower (1) each cell looks bigger / takes up more of the field of view, so fewer cells fit across it (1)	**allow** 'the field of view is only about a quarter as wide (about 0.45 mm)' for the first mark. **allow** 'only about 7 or 8 cells fit across' for the second mark. **do not accept** 'the cells get bigger' (the real cells do not change; their image does).	2	AO2 4.1.1.5
		Question 04 total	**4**	
05	Level of response: see the level descriptors and indicative content below.		6	AO2, AO3 4.1.1.5 4.1.1.1
		Question 05 total	**6**	
		TOTAL	**20**	

05 Level descriptors

Level	Marks	Descriptor
3	**5–6**	A clear, logical method. Both cells are measured with a ruler, both real sizes are calculated with real size = image size ÷ magnification (or magnification = size of image ÷ size of real object, rearranged), both are put in the same unit, and the plant cell's size is divided by the bacterium's size. The steps are in a logical order. (A way to improve the result or to check it is sensible is credit-worthy but not needed for Level 3.)
2	**3–4**	Measuring and using the magnification for at least one micrograph, with an idea of comparing the two sizes. One step, such as changing to the same unit, may be missing or unclear.
1	**1–2**	Simple statements, such as 'measure the cells' or 'the plant cell is bigger', with no clear method.
0	**0**	No relevant content.

05 Indicative content

- measure the length of a plant cell in micrograph A with a ruler (in mm)
- measure the length of a bacterium in micrograph B with a ruler (in mm)
- real size = image size ÷ magnification
- plant cell: divide its image length by 200
- bacterium: divide its image length by 20 000
- change both real sizes into the same unit (such as µm: × 1000)
- divide the real size of the plant cell by the real size of the bacterium
- the answer is how many times bigger the plant cell is
- measure several cells of each and use the mean
- measure the same dimension each time (such as the longest length)
- give the answer as an order of magnitude (for example, about 100 times = 2 orders of magnitude)
- check the answer is sensible: a plant cell is about 10 to 100 µm, a bacterium about 1 to 5 µm

Model answers

01.1 1 cm → 10 mm; 1 mm → 1000 µm; 1 µm → 1000 nm. **01.2** a ribosome, 25 nm wide. **02.1** 22 ÷ 400 = 0.055 mm; 0.055 × 1000 = 55 µm. **02.2** The drawing is 400 times bigger than the real cell. **02.3** 55 µm = 0.000 055 m = 5.5×10^{-5} m.

03 45 ÷ 30 = 1.5; 1.5 × 2 µm = 3 µm. **04.1** 1.8 ÷ 30 = 0.06 mm = 60 µm. **04.2** At × 400 the field of view is smaller: only about a quarter as wide, about 0.45 mm across. Each cell looks bigger and takes up more of the field of view, so fewer cells fit across it.

05 (Level 3) Use a ruler to measure the length of one plant cell in micrograph A, in mm. Work out its real length: real size = image size ÷ magnification, so divide the image length by 200. Do the same for one bacterium in micrograph B, dividing its image length by 20 000. Change both real lengths into µm by multiplying by 1000, so they are in the same unit. Then divide the real length of the plant cell by the real length of the bacterium. This tells you how many times bigger the plant cell is. For example, a plant cell image 20 mm long gives 20 ÷ 200 = 0.1 mm = 100 µm, and a bacterium image 40 mm long gives 40 ÷ 20 000 = 0.002 mm = 2 µm, so the plant cell is 100 ÷ 2 = 50 times longer. To make the answer more reliable, measure several cells of each type and use the mean. Check it is sensible: a plant cell should be about one to two orders of magnitude bigger than a bacterium.

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