1. A cell is observed to divide once every hour, doubling the total number of cells.

   A student estimates the number of cells after ten hours to be 1024.

   Explain why this number is an estimate and is not an exact number of cells after ten hours.

   --- **[2]**

2. Nanotechnology involves structures that are about the same size as some molecules.

   Write down these structures in order of size.

    Start with the smallest structure.

   molecule   human hair   atom   cell

   _____   _____   _____   _____

   [1]

3.   Amir works in a laboratory. His job is to identify the pathogens that cause plant diseases.

Amir plans to look at a sample of infected plant tissue using a light microscope.

The table shows some information about the cells in the sample.

Cell type	Diameter (µm)	Diameter (m)
Plant cell		8×10^{-5}
Bacterium	2	

(i) What is the diameter of the bacterium, in m, in standard form?

Put a (ring) around the correct answer.

2×10^{6} m 20^{6} m 2×10^{-6} m 20^{-6} m   [1]

(ii) What is the diameter of the plant cell, in µm?

Put a (ring) around the correct answer.

80^{-6} µm   80 µm   75 µm   40 µm   0.00008 µm   [1]

(iii) Amir knows that:

•   most viruses measure less than 250 nm in diameter
•   his light microscope will not allow him to see objects smaller than 1 µm in diameter.
Can Amir use his light microscope to see viruses in the sample of infected plant cells?
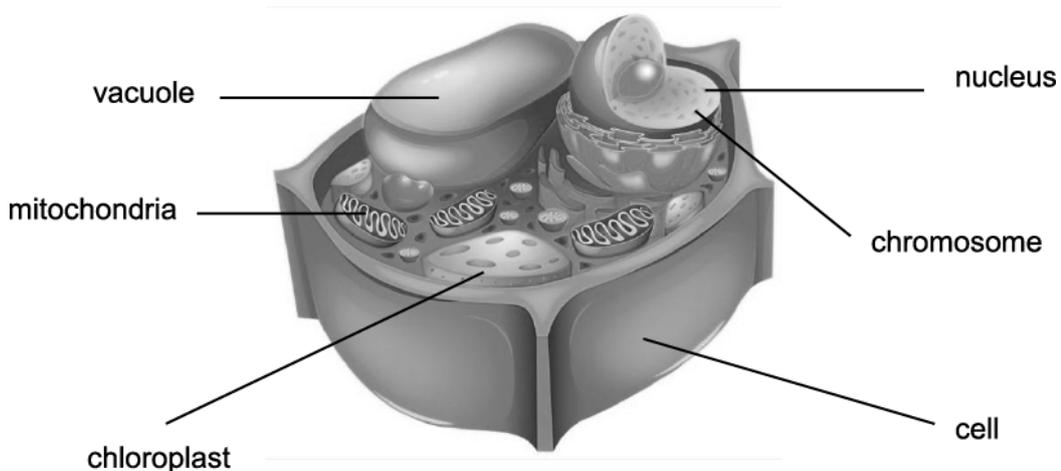
Explain your answer.

--[2]

(iv) Suggest a piece of apparatus that Amir could use to see viruses in the infected plant cells.

Explain your answer.

-- [2]

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4. The use of microscopes has greatly increased our understanding of the structure and function of the cell.

The diagram shows a typical cell and some of the structures found inside it.

Write down the name of each structure in order, starting with the largest and ending with the smallest.

The first one has been done for you.

cell   _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _   _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _   _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _   _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _   **[3]**

END OF QUESTION PAPER

Question			Answer/Indicative content	Marks	Guidance
1			**Any two from** Run out of space / food ✔ Conditions may not stay the same ✔ Some will die ✔ Not all cells divide at the same rate ✔	2	
			Total	2	
2			atom molecule cell human hair	1	**Examiner's Comments** Surprisingly the question on ordering the sizes of various structures was poorly answered, many candidates were under the impression that the cell was the smallest structure.
			Total	1	
3		i	2×10^{6} m 20^{6} m **(2 x 10⁻⁶ m)** ✔ 20^{-6} m	1 (AO 2.2)	
		ii	80^{-6} µm **(80 µm)** ✔ 75 µm 40 µm 0.00008 µm	1 (AO 2.2)	
		iii	*No because:* 250 nm = 0.25 µm / is smaller than 1 µm ✔ (viruses are) too small for his light microscope to see/resolve ✔	2 (AO 3.2b) (AO 3.1a)	no mark for saying no; the mark is for the explanation
		iv	electron microscope ✔ because it provides greater magnification / higher resolving power / can see things smaller than 1 µm ✔	2 (AO 2.1) (AO 1.1)	IGNORE references to scanning or transmission DO NOT ALLOW "electric/electronic" microscope DO NOT ALLOW "lets you see smaller things" or similar unless explained **Examiner's Comments** The highly variable responses to parts (i) – (iv) of question 3 (d) suggest that candidates need to develop a better understanding of size, scale and the relationship between units (B4.2.2a). In addition, it was common to see incorrect references to "electric", "electrical" and "electronic" microscope in part (iv).

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Question			Answer/Indicative content	Marks	Guidance
			Total	6	
4			All correct award 3 marks Any 3 or 4 correct award 2 marks Any 2 correct award 1 mark	3	Vacuole, nucleus, chloroplast, mitochondria, chromosome
			Total	3	