

Cell specialization: practice questions

4 questions • 13 marks • mark scheme at the back

For IB Diploma Biology SL undefined. **HL only** is additional higher level content, for HL students only.

Name

Total / 13

1 PAPER 1A STYLE

[1 mark]

Which human cell normally has the largest diameter?

- A. ☐ Red blood cell
- B. ☐ Lymphocyte
- C. ☐ Egg cell
- D. ☐ Head of a sperm cell

2 PAPER 1B STYLE

[5 marks]

Agar cubes containing an indicator were placed in acid. The indicator changes colour as acid diffuses into the agar. After 4 minutes the percentage of each cube's volume that had changed colour was estimated. The data are for practice. (a) Calculate the surface area-to-volume ratio of the 2 cm cube. [1] (b) Describe the relationship between SA:V and the percentage of volume that changed colour. [1] (c) Explain what these results suggest about the constraints on cell size. [2] (d) State one way in which agar cubes are a simplified model of cells. [1]

Diffusion of acid into agar cubes

Side length / cm	Surface area / cm ²	Volume / cm ³	SA:V	Volume changed colour after 4 min / %
1	6	1	6 : 1	94
2	24	8	?	66
3	54	27	2 : 1	49

Answer =

3 PAPER 2A STYLE

[4 marks]

(a) State the two properties of stem cells. [2] (b) Outline the role of the stem cell niche in adult bone marrow. [2]

4 PAPER 2A STYLE

[3 marks]

Distinguish between totipotent, pluripotent and multipotent stem cells, giving an example of each.

Mark scheme

One mark for each point unless a maximum is given. Words in brackets are not needed for the mark.

1. [1]

C C: the egg is about 110 μm across; red blood cells are about 7–8 μm and a sperm head about 5 μm [1]

2. [5]

- (a) $24 \div 8 = 3 : 1 / 3 \text{ cm}^{-1}$ [1]
- (b) the higher the SA:V, the greater the percentage of volume that changed colour / positive correlation [1]
- (c) exchange depends on surface area but the need for exchange depends on volume [1]
- (c) large cells have a smaller SA:V, so materials cannot be exchanged / reach the centre fast enough [1]
- (c) so cells must stay small / divide before they become too large [1]
- (c) max 2
- (d) any one: cells are not cubes / agar is not living and has no metabolism / agar has no plasma membrane or membrane proteins [1]

3. [4]

- (a) can divide endlessly / repeatedly [1]
- (a) can differentiate along different pathways / into different cell types [1]
- (b) bone marrow contains stem cells that produce blood cells [1]
- (b) the niche maintains the stem cells (undifferentiated) [1]
- (b) the niche promotes proliferation and differentiation when more blood cells are needed [1]
- (b) max 2

4. [3]

- totipotent: can form any cell type, including placenta / a whole organism, for example the zygote / very early embryo cells [1]
- pluripotent: can form any body cell but not a whole organism, for example embryonic stem cells [1]
- multipotent: can form a limited range of related cell types, for example bone marrow stem cells [1]
- An example is needed for each mark