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IB · HL · Biology

🕐 1 hour   ❓ 11 questions

Structured Questions

Cell Specialisation

Stem Cells / Cell Specialisation / Specialised Cells (HL) / Examples of Specialised Cells (HL)

Easy (5 questions)	/26
Medium (4 questions)	/27
Hard (2 questions)	/11
Total Marks	**/64**

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Easy Questions

1 (a) *Amoeba proteus* is a unicellular organism that inhabits freshwater ponds and streams. At its largest size, *Amoeba proteus* can be visible to the naked eye.

State how the surface area to volume ratio changes as the *Amoeba proteus* grows.

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(1 mark)

(b) Gaseous exchange allows the *Amoeba* to carry out aerobic respiration.

State which aspect of the surface area to volume ratio has the greater effect on the rate of gaseous exchange.

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(1 mark)

(c) The contractile vacuole of the *Amoeba* helps to maintain its osmotic equilibrium by excreting excess water from the cell.

State which aspect of the surface area to volume ratio would depend on this organelle.

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(1 mark)

2 (a) Glia and skeletal muscle cells are two examples of specialised cells that were once stem cells.

Define the term stem cell.

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(2 marks)

(b) All the cells in an organism contain the same set of genes, but the specialised cells mentioned in part (a) can differentiate by expressing some genes and not others.

State the term used to describe an organism's entire set of genes.

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(1 mark)

3 (a) Explain why cells differentiate, using examples within your answer.

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(5 marks)

(b) Embryonic stem cells are described as totipotent.

Define the term *totipotent.*

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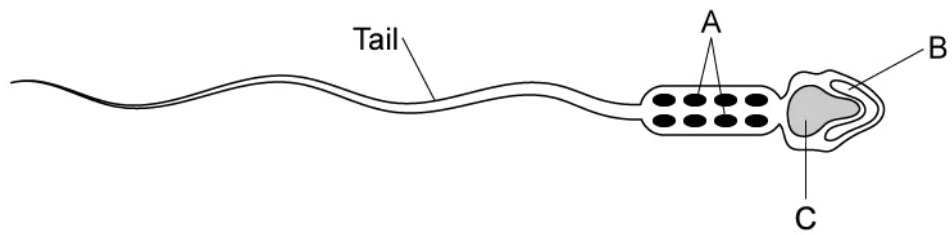...

(2 marks)

4 (a) The diagram below shows the structure of a mature human sperm cell.

Identify structures **A**-**C.**

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(3 marks)

(b) Describe the role of structure **A** within the sperm cell shown in part a).

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(2 marks)

(c) A sperm cell is an example of a haploid cell.

(i)   Define the term **haploid**.

[1]

(ii)   Explain the importance of a sperm cell being haploid.

[1]

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(2 marks)

(d) Structure **B** in part a) assists with the process of fertilisation.

Identify the substances contained within structure **B** that assist with fertilisation.

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(1 mark)

5 (a) The human ovum is the only human cell that is large enough that, if isolated, could be seen by the naked eye.

Explain why the ovum is large compared to other human cell types.

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(1 mark)

(b) Draw an annotated diagram of a mature human ovum.

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(4 marks)

Medium Questions

1 (a) A patient with a spinal cord injury was treated using stem cell therapy using the following process:

    1. Stem cells were collected from the patient's own tissues
    2. Stem cells were cultured in laboratory for one month to increase their numbers
    3. Stem cells were injected into the injury site
    4. Stem cells were allowed to develop into nerve cells

State **two** properties of stem cells that made this therapy possible.

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(2 marks)

(b) Suggest why the stem cells used in part (a) were taken from the patient and not from a stem cell donor.

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(2 marks)

2 (a) Calculate the surface area to volume ratio of a cube where each edge measures 2 cm.

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(2 marks)

(b) When first hatched, the young tadpoles of some frog species are less than 1.5 mm long and have not yet developed gills.

Suggest how these young tadpoles are able to get enough oxygen to their cells without developed gills.

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(2 marks)

(c) A researcher calculated the surface area of a large number of frog eggs. She calculated the mean surface area to be 10.12 mm^2. Frog eggs are generally spherical. She calculated the surface area using the following equation: $4\pi r^2$.

(i)   Rearrange this equation to find r^2 and use it to calculate the mean r^2 of these frog eggs.

(ii)   Calculate the mean diameter of these frog eggs. Give your answer to 3.s.f.

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(3 marks)

3 (a) Identify **two** features of cells of the human body that maximise surface area to volume ratio.

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(2 marks)

(b) Explain why surface area to volume ratio is an important factor in limiting cell size.

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(6 marks)

(c) The presence of millions of highly specialised alveoli in the lungs contributes to the efficiency of gas exchange by providing a large surface area.

Describe and explain how cells of the alveoli are adapted for function in the gas exchange surface.

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(2 marks)

(d) An adult has a total alveolar surface area of 5.2×10^7 mm^2. One alveolus has a surface area of 0.104 mm^2.

Calculate how many alveoli this person has in each lung. Give your answer as an ordinary number, **not** in standard form.

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(2 marks)

4 Draw an annotated diagram of a mature human sperm cell.

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(4 marks)

Hard Questions

1 (a) A plant palisade mesophyll cell is 4 μm in width and depth, and 25 μm in length. Its shape is approximately cuboid.

Calculate the surface area to volume ratio of this cell.

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(3 marks)

(b) The palisade cell in part (a) has a large central vacuole. The vacuole has the same overall cuboid shape as the cell itself, but its outer surfaces are located 500 nm inside the plasma membrane of the cell.

Calculate the surface area to cytoplasmic volume ratio.

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(3 marks)

(c) Vacuoles have important roles in plant cell storage and support.

Use your answers to parts (a) and (b) to suggest an additional role of vacuoles in plant cells.

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(2 marks)

2 Explain the importance of the surface area to volume ratio for a growing bacterial cell.

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(3 marks)