

Sexual Reproduction in Mammals

Question Paper 1

Level	A Level
Subject	Biology
Exam Board	Edexcel
Topic	Cells & Viruses and Reproduction of Living Things
Sub Topic	Sexual Reproduction in Mammals
Booklet	Question Paper 1

Time Allowed: 54 minutes

Score: /45

Percentage: /100

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	77.5%	70%	62.5%	57.5%	45%	<45%

- 1 (a) In the space below, draw a sperm cell. On your diagram, label each of the following structures: **nucleus**, **mitochondria**, **flagellum** and **acrosome**. (4)

- (b) Explain the function of each of the following structures of a sperm cell.
- (i) Flagellum (1)

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- (ii) Mitochondria (2)

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- (iii) Acrosome (2)

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- 2 Infertility reduces the chance of successful fertilisation of the egg by a sperm cell. There are many causes of infertility in humans.

One cause of infertility is cigarette smoking. Men who smoke cigarettes have a 30% higher risk of infertility.

Cigarette smoke contains nicotine. The effects of nicotine on the quality of sperm cells have been studied in rats.

Male rats were given nicotine at levels of either 0.5 mg per kg of body mass or 1.0 mg per kg of body mass.

The sperm cells produced by these rats were compared with sperm cells produced by a control group of rats. The rats in the control group were not exposed to nicotine. The defects in the sperm cells produced were recorded and the results are shown in the table below.

Type of sperm cell	Percentage of each type of sperm cell (%)		
	Control	0.5 mg of nicotine per kg	1.0 mg of nicotine per kg
normal sperm cells	93.6	83.2	75.2
sperm cells with flagella defects	3.9		19.9
sperm cells with mid-piece defects	2.0	2.7	3.7
other defects, including missing heads	0.5	1.0	1.2

- (a) (i) Complete the table to give the percentage of sperm cells with flagella defects when the rats were given 0.5 mg of nicotine per kg of body mass.

(1)

- (1)

(1)

- (4)

This condition results in round-headed sperm cells being produced. These sperm cells do not possess an acrosome.

A black and white micrograph showing a dense collection of dark, spherical spores and thin, branching hyphae. The spores are scattered throughout the field of view, with a higher concentration on the right side where they are often attached to the hyphal structures. The background is a light, grainy texture.

Suggest why the sperm cells in photograph **B** would not be able to fertilise an egg.

(3)

(c) Suggest why a valid study on the effects of globozoospermia on fertility would have to be carried out on non-smokers.

(3)

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(Total for Question 2 = 13 marks)

3 Mammalian gametes have specialised structures related to their function.

- (a) The table below lists features found in egg cells and sperm cells. Complete the table by placing a cross (☒) in the appropriate box. (4)

Feature	Egg cell only	Sperm cell only	Both egg cell and sperm cell	Neither egg cell nor sperm cell
Acrosome	☒	☒	☒	☒
Cortical granules	☒	☒	☒	☒
Flagellum	☒	☒	☒	☒
Haploid nucleus	☒	☒	☒	☒

- (b) Gametes contain mitochondria. Describe the function of mitochondria in sperm cells. (2)

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(c) Explain the importance of meiosis in the production of gametes.

(4)

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(Total for Question 3 = 10 marks)

*(a) Describe and explain how, in mammals, events following the acrosome reaction prevent more than one sperm fertilising an egg.

This image shows a full page of white paper with horizontal dashed lines, typical of primary school writing paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Explain how meiosis gives rise to genetic variation in gametes.

- (c) In flowering plants, the growth of pollen tubes is affected by many factors. An investigation was carried out to study the effect of the concentration of a chemical called methylpurine on pollen tube growth.

Pollen grains from lily flowers were exposed to 0.01 mol dm^{-3} methylpurine at pollination.



Lily flowers

Magnification $\times 0.2$

After 48 hours, the lengths of the pollen tubes formed were measured and the mean length calculated.

This was repeated with two other concentrations of methylpurine and a control with no methylpurine.

The results are shown in the table below.

Concentration of methylpurine / mol dm^{-3}	Mean length of pollen tube after 48 hours / mm
0.0000	94
0.0001	95
0.0010	90
0.0100	28

- (i) The investigation was carried out at a constant temperature of 22.5°C .

Suggest why the temperature was kept constant.

(2)

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- (ii) Using the information in the table, describe the effect of methylpurine concentration on the mean length of pollen tubes from lily flowers.

(3)

- (iii) Methylpurine can inhibit messenger RNA (mRNA) synthesis.

Suggest how this can cause the change in mean pollen tube length.

(2)

(Total for Question 4 = 13 marks)