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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*	А	В	С	D	Е	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)
		(ii) Mitochondria	(2)
		(iii) Acrosome	(2)
		(Total for Question 1 = 9 ma	ulsa)

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.

	Percentage of each type of sperm cell (%)			
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)

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body mass compared with the control group.

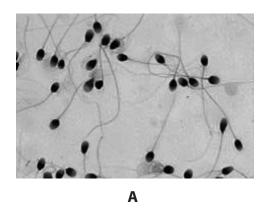
	(1)
	9/
(iii) Name the organelle that may be missing from the sperm cells with mid-p	iece defects.
	(1)
(iv) Using the information in the table, suggest why nicotine reduces the mov of the sperm cells.	ement
	(4)

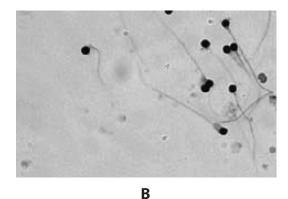
(ii) Using the information in the table, calculate the difference in the percentage of sperm cells with defective flagella in rats given 1.0 mg of nicotine per kg of

(b) A genetic cause of infertility is globozoospermia.

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

Photograph **A** shows normal sperm cells and photograph **B** shows sperm cells from a man with globozoospermia.





(3)

Magnification ×500

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

(-)
,

(c) Suggest why a valid study on the effects of globozoospermia on fertility would have to be carried out on non-smokers.	
	(3)
(Total for Question 2 = 13	marks)

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- **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	×	×	×	X
Cortical granules	×	×	×	×
Flagellum	×	×	×	×
Haploid nucleus	×	×	×	×

cells.		
	(2)	

(Total for Question 3 = 10 mark	
(c) Explain the importance of meiosis in the production of gametes.	4)

Se	everal processes lead up to fertilisation in animals and plants.	
*(a)	Describe and explain how, in mammals, events following the acrosome reaction prevent more than one sperm fertilising an egg.	(4)
		(- /
•••••		
(b) Animals produce haploid gametes by meiosis.	
	Explain how meiosis gives rise to genetic variation in gametes.	
		(2)

(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.



 $\label{eq:Lily flowers} \mbox{Magnification} \times \mbox{0.2}$

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)	
		(-/	

(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)		