Eukaryotic Cell Cycle & Division

Question Paper 3

Level	A Level
Subject	Biology
Exam Board	Edexcel
Topic	Cells & Viruses and Reproduction of Living Things
Sub Topic	Eukaryotic Cell Cycle & Division
Booklet	Question Paper 3

Time Allowed: **58 minutes**

Score: **/48**

Percentage: **/100**

Grade Boundaries:

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

1 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)

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

(4)

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(Total for Question 1 = 10 marks)

2 Several 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.

Lily flowers
Magnification × 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 2 = 13 marks)

3 Fertilisation in flowering plants starts with the growth of a pollen tube.

(a) An investigation was carried out to study the effect of cycloheximide (CH) on the growth of pollen tubes from pollen. Samples of pollen grains were obtained from *Impatiens glandulifera* (Himalayan balsam).

Impatiens glandulifera

Magnification ×0.5

The pollen samples were exposed to different concentrations of CH.

After one hour, the lengths of the pollen tubes in each sample were measured. A control experiment was also carried out without CH. The results are shown in the table below.

Cycloheximide (CH) concentration / µg cm^{-3}	**Mean pollen tube length after 1 hour / µm**
0 (control)	603
1	625
10	678
50	639
100	619
200	543

(i) Suggest why the temperature was kept constant throughout this investigation. Give an explanation for your answer.

(2)

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(ii) Use the information in the table to describe the effect of cycloheximide (CH) concentration on the growth of pollen tubes.

(3)

(iii) In the control, after two hours, all the pollen tubes contained gametes.

After two hours in the presence of cycloheximide (CH), none of the pollen tubes contained gametes.

Suggest which process in pollen grains could be inhibited by cycloheximide (CH).

(1)

*(b) Describe the process of fertilisation that takes place in flowering plants.

(4)

(c) Explain how meiosis produces genetic variation in gametes.

(2)

(Total for Question 3 = 12 marks)

4 Meiosis is involved in the production of gametes such as human egg cells and sperm cells.

(a) An investigation was carried out to study the effect of changing the temperature on spindle fibre formation in human egg cells during meiosis.

Five human egg cells undergoing meiosis at 37 °C were incubated at 25 °C for 10 minutes and then returned to 37 °C. After 20 minutes, the number of egg cells showing spindle fibre formation was recorded.

The investigation was repeated at three different incubation temperatures.

The results are shown in the table below.

Incubation temperature / °C	Number of human egg cells used	Number of human egg cells showing spindle fibre formation
25	5	0
28	5	2
33	5	5
37	5	5

(i) Suggest why some of the human egg cells were incubated at 37 °C throughout this investigation.

(1)

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(ii) Using the information in the table, describe the effect of temperature on spindle fibre formation in human egg cells.

(2)

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(b) A student made the statement that all 5 cells would have shown spindle fibre formation if the incubation temperature had been either 35 °C or 31 °C.

(i) Using the information in the table, give evidence to support part of this statement.

(2)

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(ii) Using the information in the table, give evidence that may **not** support part of this statement.

(2)

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*(c) Describe and explain **three** ways in which a human sperm cell is specialised for its function.

(6)

(Total for Question 4 = 13 marks)