PEARSON EDEXCEL A-LEVEL BIOLOGY B · 9BI0

BIOLOGY



EXAM QUESTION PACK

TOPIC 2: CELLS, VIRUSES AND REPRODUCTION OF LIVING THINGS

SEXUAL REPRODUCTION IN MAMMALS

SCORE	PERCENTAGE
/28	%

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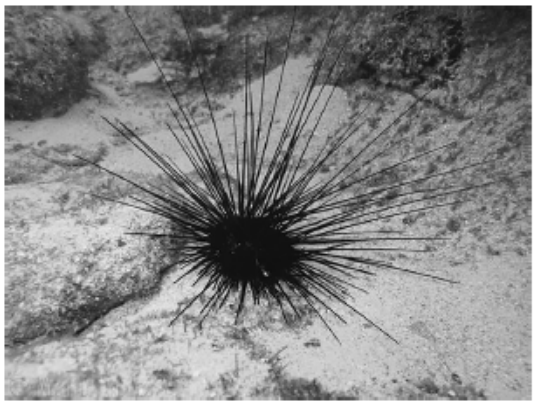
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Q1.

A sea urchin is an invertebrate animal that lives on the seabed.

The photograph shows a sea urchin.



Sea urchin embryos are often used to study embryonic development.
In the early stages of embryonic development, a sea urchin embryo is similar to a mammalian embryo.

(a) A scientist observed a fertilised sea urchin egg during the first few days after fertilisation.

Explain how this fertilised egg became a hollow structure.

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(b) The scientist found that 128 cells were present after a few days.

Calculate the number of rounds of cleavage that had taken place.

(1)

Answer .....

Q2.

A zygote is formed when gametes fuse at fertilisation.

Describe how the process of fertilisation results in the formation of a zygote from the gametes in humans.

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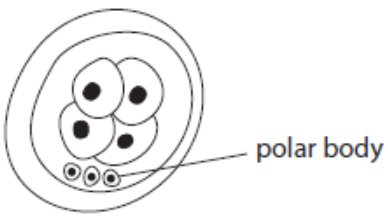
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(Total for question = 3 marks)

Q3.

In vitro fertilisation (IVF) is a technique in which eggs are taken from the ovaries and fertilised with sperm in a laboratory.

The resulting embryos are cultured until the four-cell stage, as shown in the diagram.



Two screening techniques used to identify embryos with chromosomal abnormalities are:

- polar body biopsy in which the polar bodies are removed and the chromosomes analysed

- pre-implantation genetic diagnosis (PGD) in which one cell from the four-cell stage embryo is removed and the chromosomes analysed.

Embryos without chromosome abnormalities are placed into the mother's uterus.

The success rates of both techniques are shown in the table.

Technique	Percentage of embryos that survive screening (%)	Percentage of embryos transferred to the uterus that lead to the birth of baby (%)
Polar body biopsy	87	21
PGD	74	29
Control	IVF with no screening	16

Analyse the data to comment on the effectiveness of the two techniques.

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(Total for question = 4 marks)

Q4.

Mitochondrial disorders may be caused by mutations in the genes coding for mitochondrial components. Some of these genes are found in mitochondrial DNA (mtDNA) and some are found in nuclear DNA.

Leigh syndrome is an example of a mitochondrial disorder. In this syndrome, a number of different proteins involved in respiration are affected.

These mutations may be inherited or may occur when DNA replicates.

Explain why mutations in nuclear DNA can be inherited from either the mother or the father whereas mutations in mtDNA are only inherited from the mother.

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(Total for question = 2 marks)

Q5.

Leigh syndrome is a genetic disorder inherited from the mother. The mother carries genes for the disorder in her mitochondrial DNA.

Scientists have developed a technique for producing 'three-parent' babies.

This ensures that a mother with Leigh syndrome will not pass on the genes for this disorder to her baby.

The technique involves:

- removing the nucleus from the ovum of the mother
- removing the nucleus from the ovum of a donor female to produce an enucleated ovum
- inserting the nucleus from the ovum of the mother into the enucleated donor ovum
- fertilising this ovum with the sperm of the father to produce a zygote
- implanting the resulting embryo into the uterus of the mother.

(i) The 'three-parent' baby produced by this technique will inherit mitochondrial DNA from the

(1)

☒ **A** donor female

☒ **B** donor female and father

☒ **C** mother

☒ **D** mother and father

(ii) Explain the importance of DNA replication during the development of this zygote into a blastocyst.

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(Total for question = 4 marks)

Q6.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

(i) The table shows the chromosome number and chromatid number of some of the cells formed during oogenesis in humans.

Cell type	Chromosome number	Chromatid number
ovum	23	23
primary oocyte	46	92
secondary oocyte	23	46

Which of the cells are haploid?

(1)

☒ **A** ovum and primary oocyte

☒ **B** ovum and secondary oocyte

☒ **C** primary oocyte and secondary oocyte

☒ **D** ovum alone

(ii) Explain how meiosis produces new combinations of alleles in gametes.

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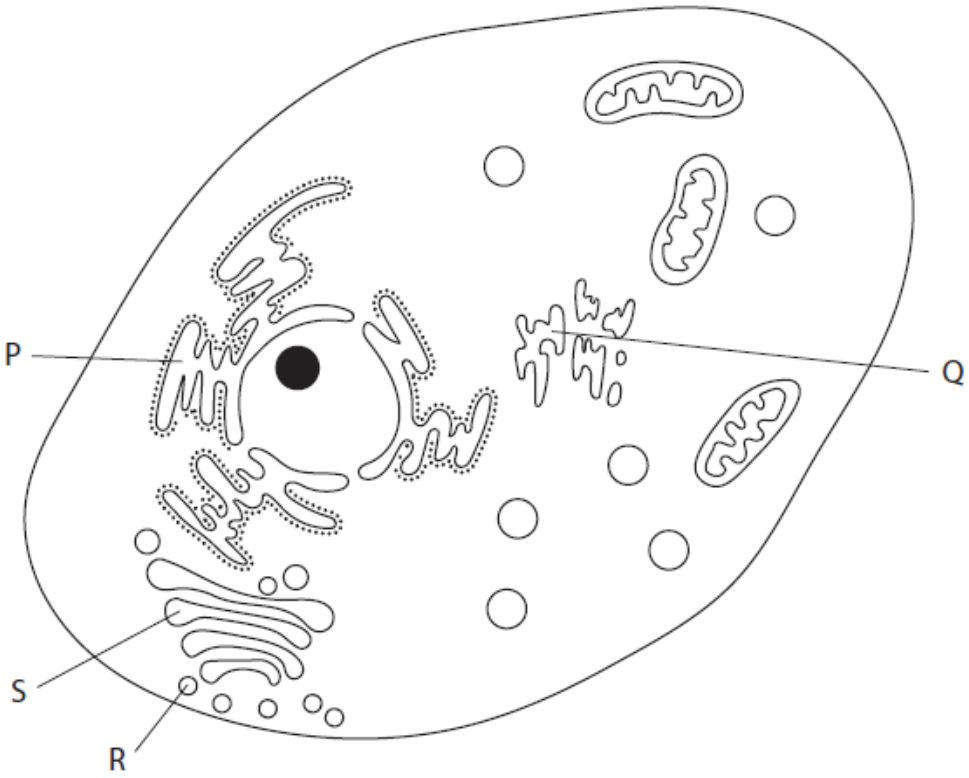
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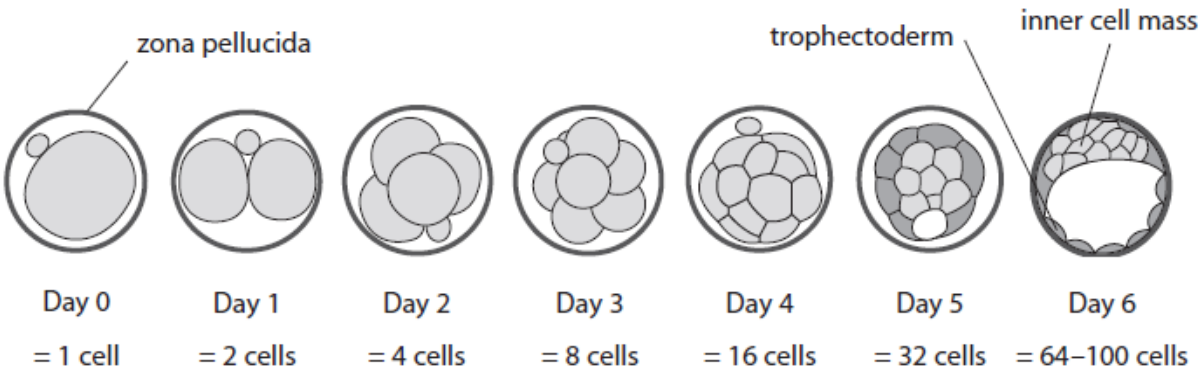
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Q7.

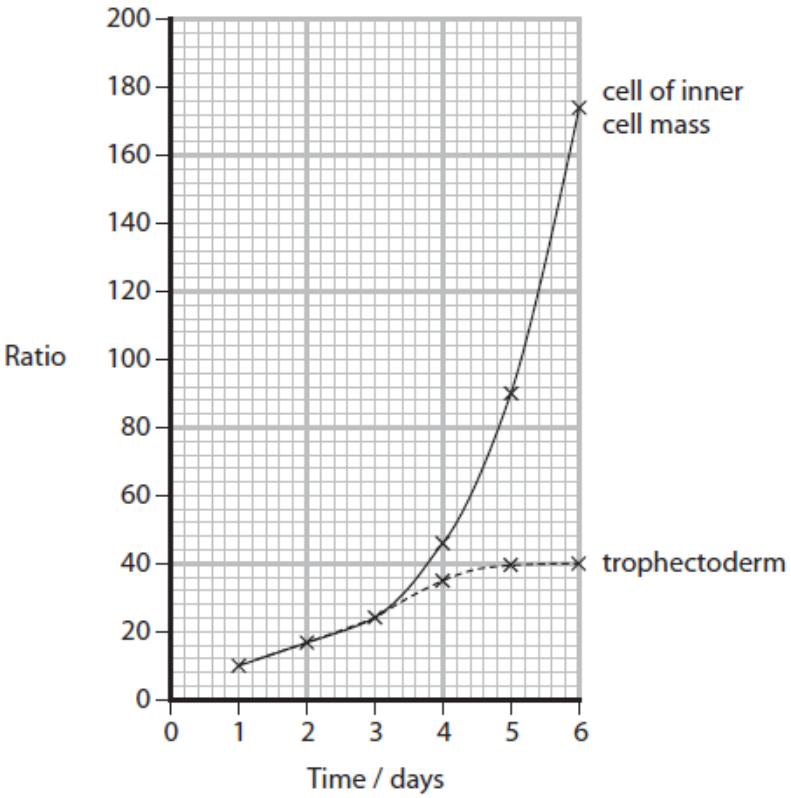
The diagram shows the structure of an animal cell.



The diagram shows the development of a zygote into a blastocyst.



The graph shows how the ratio of the volume of the nucleus to the volume of the cytoplasm of each embryonic cell changes as the blastocyst develops.



(i) The ratio shown in the graph can be calculated using the formula

$$\text{ratio} = \frac{\text{volume of nucleus}}{\text{total volume of cell} - \text{volume of nucleus}}$$

On day 2, the volume of the cell nucleus was 900 μm^3.

Calculate the total volume of this cell on day 2.

Give your answer to two significant figures.

(3)

Answer ..... μm^3

(ii) Comment on the changes in the ratios as the zygote develops into a blastocyst.

(3)

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(Total for question = 6 marks)