PEARSON EDEXCEL A-LEVEL BIOLOGY B · 9BI0

BIOLOGY



EXAM QUESTION PACK

TOPIC 2: CELLS, VIRUSES AND REPRODUCTION OF LIVING THINGS

EUKARYOTIC CELL CYCLE AND DIVISION

SCORE	PERCENTAGE
/45	%

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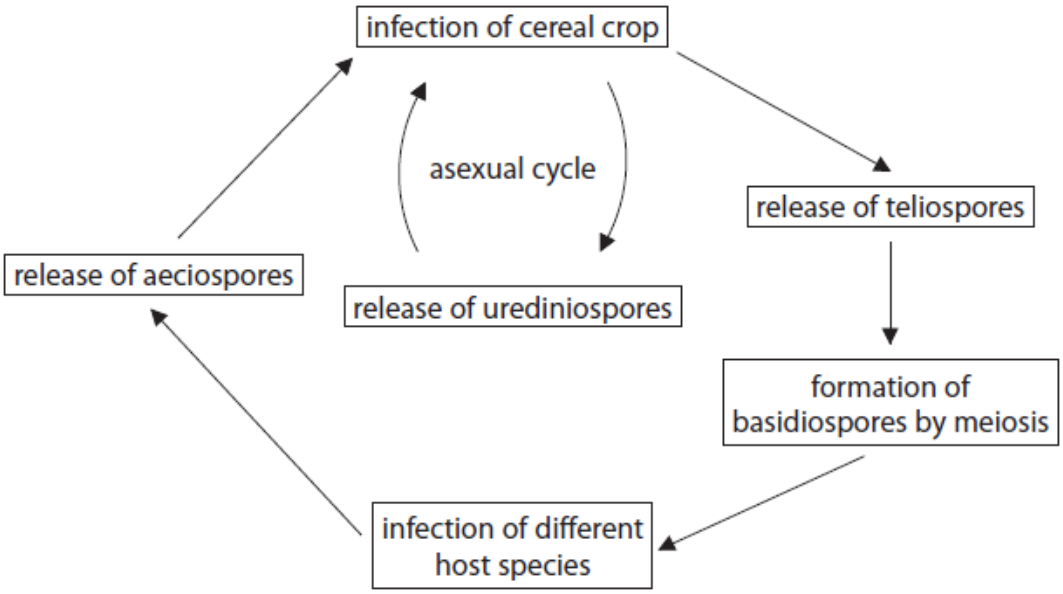
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Q1.

The stem rust fungus is responsible for destroying cereal crops and reducing grain yield.

The diagram shows some stages in the life cycle of the stem rust fungus.



Cereal crops have been genetically modified (GM) to produce plants that are resistant to stem rust fungus.

Analyse the diagram to deduce why the formation of basidiospores and urediniospores can produce a stem rust fungus to which these GM plants are no longer resistant.

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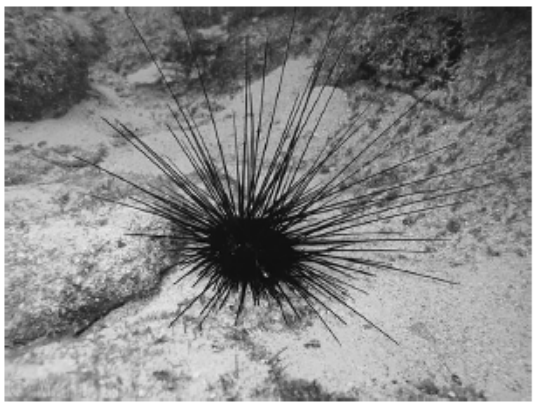
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(Total for question = 3 marks)

Q2.

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 .....

Q3.

Mosquitoes have cells with a diploid number (2n) of six.

The diagram shows two cells from a male mosquito at different stages of meiosis.



P Q

(i) Which row of the table shows the stages of meiosis of cells P and Q?

(1)

		P	Q
☒	**A**	anaphase II	anaphase I
☒	**B**	metaphase I	prophase I
☒	**C**	prophase I	anaphase II
☒	**D**	prophase II	metaphase II

(ii) Non-disjunction occurred during meiosis I.

Which of the following shows the number of chromosomes in each of the four sperm cells produced?

(1)

☒ **A** 4, 3, 3, 2

☒ **B** 4, 4, 2, 2

☒ **C** 6, 6, 7, 5

☒ **D** 7, 7, 5, 5

(Total for question = 2 marks)

Q4.

Down's syndrome in humans is caused by non-disjunction.

The chance of having a baby with Down's syndrome increases as the age of the mother increases.

At age 40, the probability of having a baby with Down's syndrome is 0.018.

In 2016 the number of women aged 40 in the UK was estimated to be 500 000.

The pregnancy rate for women in the UK aged 40 is 14 pregnancies per 1000 women per year.

Calculate the number of babies with Down's syndrome that were expected in 2016 in the UK.

(2)

Answer .....

(Total for question = 2 marks)

Q5.

In an investigation to determine the quantity of DNA in the nucleus of different cells from the plant *Tradescantia paludosa*, squash preparations of each tissue were stained for DNA in an identical manner.

The quantity of DNA in the nucleus of several cells was found by measuring the amount of light absorbed when the microscope was focused on a small area of the nucleus.

The results of this investigation are shown in the table below.

Nucleus of	Mean nuclear absorption / arbitrary units
Root tip cells in prophase	16.2
Root tip cells undergoing cytokinesis	8.3
Nucleus of pollen tube	4.2
Nucleus of endosperm	12.8

Analyse the data to explain the difference in the mean nuclear absorption of the nucleus of the

different cells.

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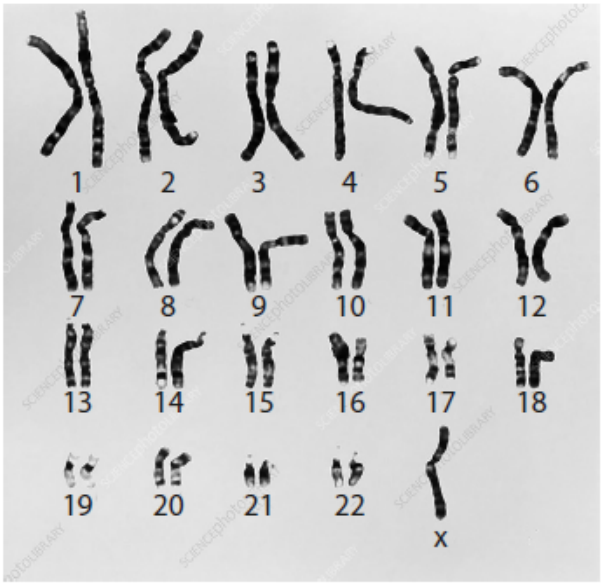
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(Total for question = 3 marks)

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 ☒.

The diagram shows a human karyotype.



(Source: © DEPT. OF CLINICAL CYTOGENETICS, ADDENBROOKES HOSPITAL/SCIENCE PHOTO LIBRARY)

(i) Which of the following identifies the human with this karyotype?

(1)

☒ **A** female with Down's syndrome

☒ **B** female with Turner's syndrome

☒ **C** male with Down's syndrome

☒ **D** male with Turner's syndrome

(ii) Which of the following would cause the karyotype in the diagram?

(1)

☒ **A** non-disjunction producing a monosomy

☒ **B** non-disjunction producing a polysomy

☒ **C** translocation producing a monosomy

☒ **D** translocation producing a polysomy

(Total for question = 2 marks)

Q7.

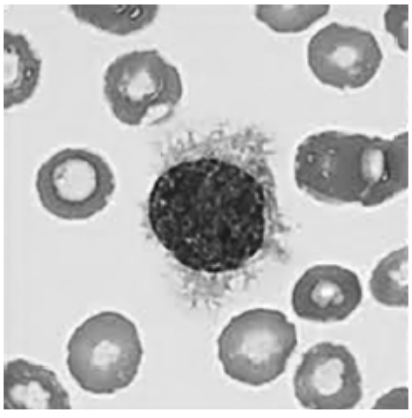
Leukaemia is a type of cancer involving abnormal white blood cells.

In 2015, scientists announced that 1 in 5 people aged 90 or over had mutations linked to leukaemia.

The current UK population is about 64 million, of which 0.8% are aged 90 or over.

Hairy cell leukaemia is a rare form of the disease in which there is an increase in the number of abnormal B lymphocytes.

The photomicrograph shows one of these B lymphocytes.



The hairy cell lymphocytes have an unusually large nucleolus.

State the function of the nucleolus in this hairy cell lymphocyte.

(1)

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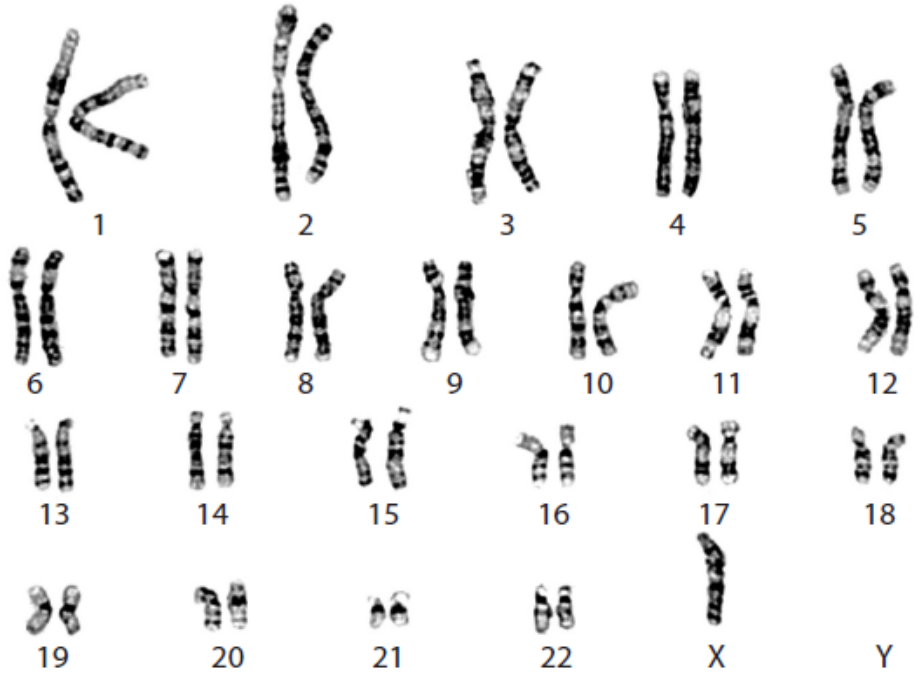
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Q8.

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

A karyotype shows the chromosomes found in the cells of an individual.

The photograph shows a karyotype from a child with a genetic condition.



(Source: © Dept. of Clinical Cytogenetics, Addenbrookes Hospital / Science Photo Library)

(i) Which of the following identifies the genetic condition shown in the photograph?

(1)

☒ **A** Down's syndrome due to monosomy

☒ **B** Down's syndrome due to polysomy

☒ **C** Turner's syndrome due to monosomy

☒ **D** Turner's syndrome due to polysomy

(ii) Which process would have caused the genetic condition shown by this karyotype?

(1)

☒ **A** base insertion

☒ **B** base substitution

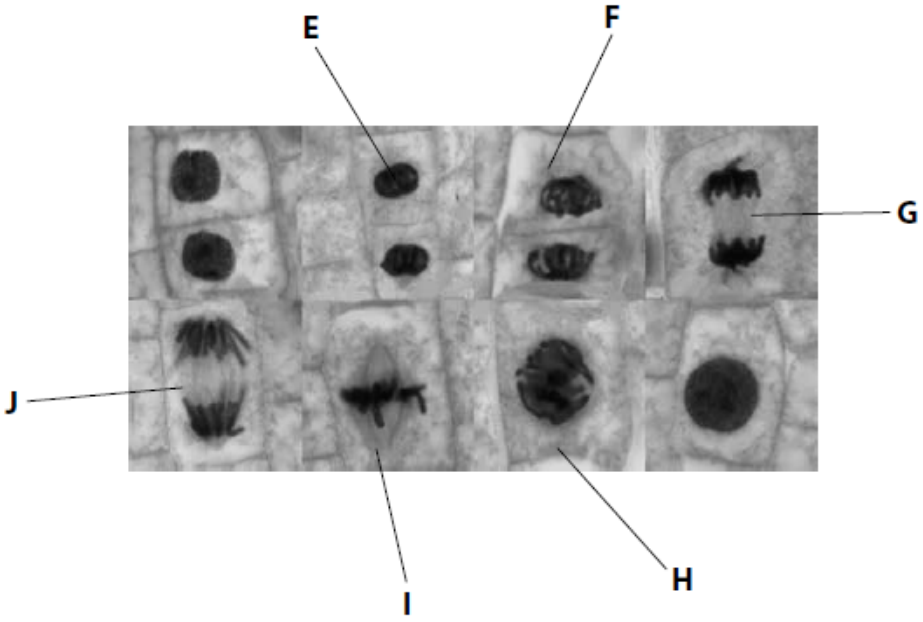
☒ **C** non-disjunction

☒ **D** translocation

(Total for question = 2 marks)

Q9.

The photograph below shows cells dividing by mitosis.



© Steve Gschmeissner / Science Photo Library

(a) The actual length of cell **J** is 23.5 µm.

(i) Calculate the magnification of this photograph.

(3)

Answer .....

(ii) Describe what has happened in cell **J**.

(4)

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(b) (i) Which sequence of letters represent the cells in order of their appearance in the phases of mitosis?

(1)

☒ **A** E, F, G, H, I, J

☒ **B** G, F, H, I, J, E

☒ **C** H, I, J, G, F, E

☒ **D** J, I, H, G, F, E

(ii) Give a reason why there are differences in the appearance of cells **E** and **G**.

(1)

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(Total for question = 9 marks)

Q10.

A zygote is formed when gametes fuse at fertilisation.

Explain how meiosis results in genetic variation in the gametes.

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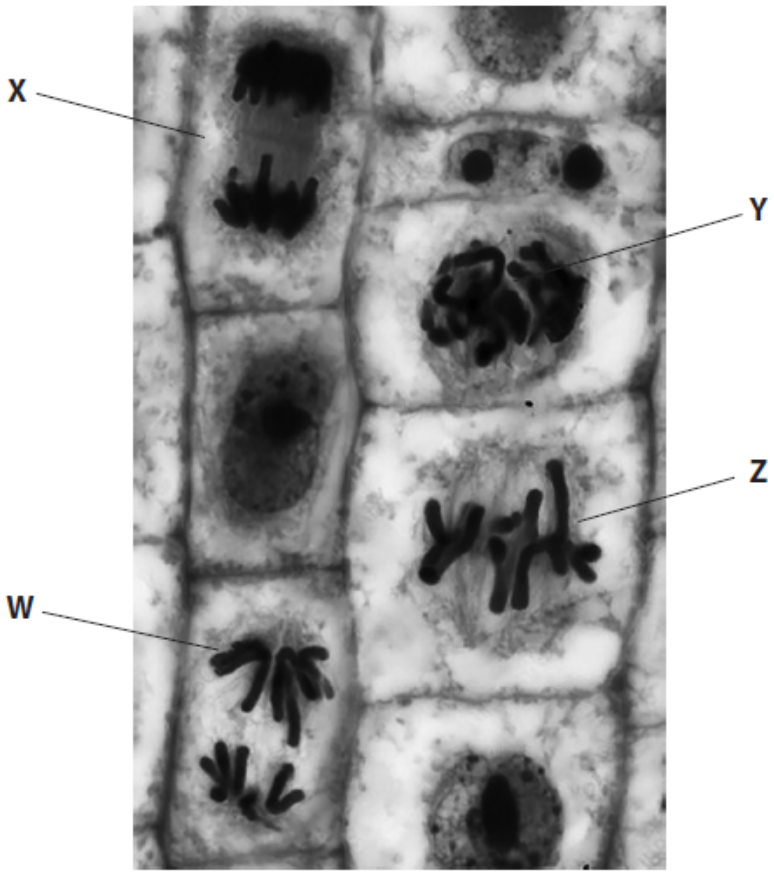
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(Total for question = 2 marks)

Q11.

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 ☒.

The photograph shows cells in different stages of mitosis.



(Source: © STEVE GSCHMEISSNER / Science Photo Library)

(i) Which of the following correctly identifies the stages shown in the photograph?

(1)

	W	X	Y	Z
☐ A	anaphase	telophase	prophase	metaphase
☐ B	anaphase	prophase	telophase	metaphase
☐ C	prophase	anaphase	metaphase	telophase
☐ D	telophase	metaphase	anaphase	prophase

(ii) Colchicine is a chemical that inhibits mitosis.

A student investigated the effect of colchicine on mitosis.

Two sets of genetically identical cells were grown in culture. Colchicine was added to one culture of cells but not to the other culture of cells.

Six hours after treatment, the mean percentages of cells in each stage of mitosis were determined.

The results are shown in the table.

Mitosis stage	Mean percentage of cells in stage ± Standard Deviation	
	cells cultured without colchicine	cells cultured with colchicine
interphase	84.8 ± 4.2	82.8 ± 3.2
prophase	10.2 ± 2.2	16.3 ± 3.1
metaphase	1.8 ± 0.4	0.8 ± 0.2
anaphase	1.8 ± 0.2	0.7 ± 0.1
telophase	1.4 ± 0.3	0.4 ± 0.1

Analyse the data to comment on how colchicine affects mitosis.

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(Total for question = 5 marks)

Q12.

In flowering plants, pollen grains grow pollen tubes that are involved in fertilisation, producing a zygote and endosperm.

(i) Which row of the table shows the correct description for these nuclei?

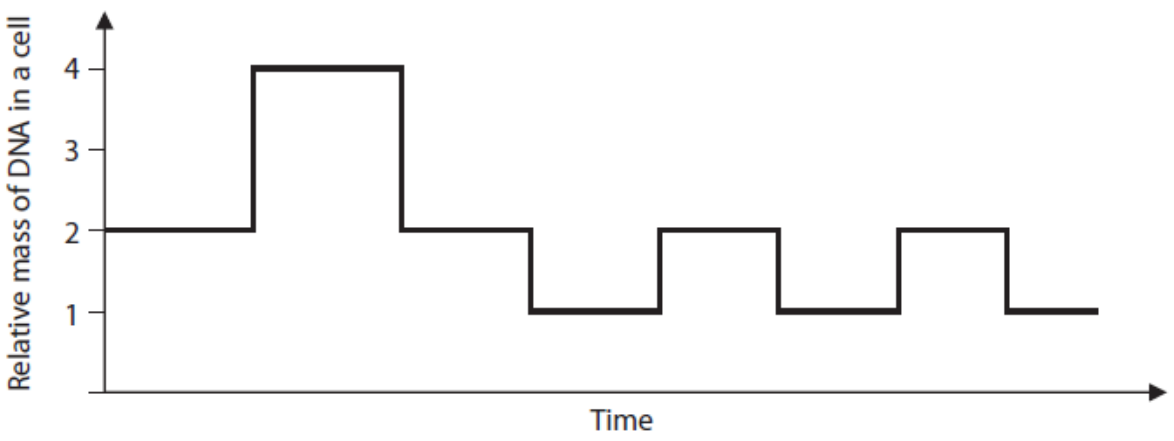
(1)

	Zygote nucleus	Endosperm nucleus	Pollen tube nucleus
☒ **A**	diploid	diploid	haploid
☒ **B**	diploid	triploid	haploid
☒ **C**	diploid	triploid	diploid
☒ **D**	haploid	triploid	diploid

(ii) The production of plant cell gametes involves both mitosis and meiosis.

The graph shows the DNA content of a cell during the production of a pollen grain.

(1)



The order of nuclear divisions shown in the graph is

☒ **A** meiosis, mitosis, mitosis

☒ **B** meiosis, mitosis, meiosis

☒ **C** mitosis, meiosis, meiosis

☒ **D** mitosis, mitosis, meiosis

(Total for question = 2 marks)

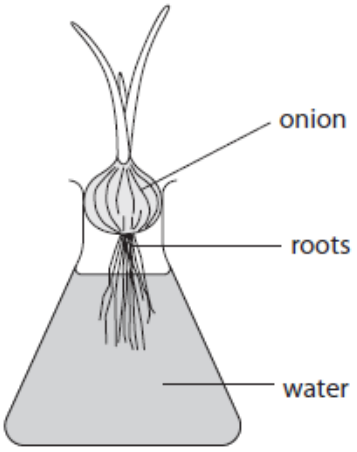
Q13.

A student read that some plants do not grow well in waterlogged soil.

The student formed the following hypothesis:

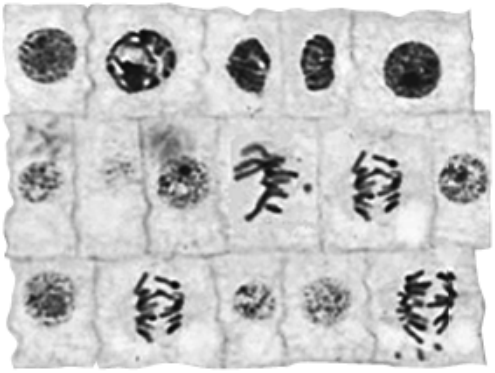
Adding water to soil inhibits mitosis in root cells.

To test this hypothesis, the student grew onion roots in the apparatus shown.



The tips of the onion roots were removed and observed for stages of mitosis.

The photomicrograph shows a preparation from one onion root tip.



Calculate the percentage of cells in this photomicrograph in anaphase.

(2)

Answer .....

(Total for question = 2 marks)

Q14.

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)

Q15.

Leukaemia is a type of cancer involving abnormal white blood cells.

In 2015, scientists announced that 1 in 5 people aged 90 or over had mutations linked to leukaemia.

The current UK population is about 64 million, of which 0.8% are aged 90 or over.

Leukaemia cells have a rapid growth rate and they tend to be small.

The cell cycle consists of three stages, interphase, mitosis and cytokinesis.

Explain which of these three stages would be shorter in a leukaemia cell.

(2)

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