You and your genes – 2021/20 GCSE 21st GCSE Biology B

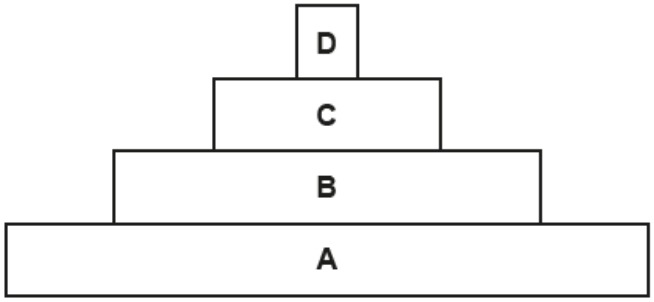
1. Nov/2021/Paper_J257_03/No.2

The diagram shows a pyramid of biomass for the following food chain.

Food chain

Tree → Insect → Sparrow → Kestrel

Pyramid of biomass



Dry weight (g/m^2)

1.5

11

37

809

(a) Which organism in the food chain would you place in **bar A** of the pyramid of biomass?

..... **[1]**

(b) Describe the general change in biomass that occurs between the trophic levels shown in the pyramid **and** give **two** reasons for this change.

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..... **[3]**

(c) The percentage efficiency of the biomass transfer between trophic levels can be calculated using the efficiency equation:

$$\textbf{Percentage efficiency} = \frac{\textbf{average biomass in higher trophic level } (g/m^2)}{\textbf{average biomass in lower trophic level } (g/m^2)} \times 100\,\%$$

Calculate the percentage efficiency of the biomass transfer between trophic levels 2 and 3.

Give your answer to **1** significant figure.

Efficiency = ... % **[3]**

2. Nov/2021/Paper_J257_03/No.5

DNA is found in both eukaryotic cells and prokaryotic cells.

(a) Explain the difference in how DNA is stored in these two types of cells.

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..... **[2]**

(b) **(i)** Describe the structure of DNA.

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..... **[3]**

(ii) A student talks about DNA with their friend.

The student tells their friend that all features in a person's phenotype are controlled by single genes in their DNA.

Give **one** reason why the student is wrong.

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..... **[1]**

3. Nov/2021/Paper_J257_04/No.3

Humans make gametes for use in sexual reproduction.

(a) Gametes are made by the process of meiosis.

(i) At the **start** of interphase a human cell has 46 chromosomes. The cell goes through interphase and meiosis to make gametes.

Complete the information in the table to explain what happens **during** and at the **end** of each stage of meiosis.

Stage	**What happens during the stage**	**Number of cells at the end of the stage**	**Number of chromosomes in each cell at the end of the stage**
Interphase	Each chromosome is copied	1	92
First stage of meiosis	Cell division	.....	.....
Second stage of meiosis	....	.....	.....

[2]

(ii) Explain why the number of chromosomes in each gamete is important during fertilisation.

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..... **[1]**

(b) Sexual reproduction in humans depends upon the menstrual cycle. The menstrual cycle is controlled by hormones.

(i) **Four** hormones interact to control the menstrual cycle.

Hormone A
- stimulates a follicle to mature in an ovary
- causes the ovary to release **hormone B**

Hormone B
- causes the uterus lining to thicken
- causes the pituitary gland to release **luteinising hormone (LH)**

Luteinising hormone (LH)
- causes ovulation from a mature follicle
- causes the follicle to break down in the ovary and release **hormone C**

Hormone C
- prepares the uterus lining to receive a fertilised egg
- stops the release of **hormone A** and **LH** by the pituitary gland

Write down the names of the three hormones **A**, **B** and **C**.

Hormone A .....

Hormone B .....

Hormone C .....

[3]

(ii) Sarah's ovaries cannot release any eggs.

Explain why it could be helpful for Sarah to take fertility medication which contains hormone A, and luteinising hormone (LH).

Hormone A: .....

.....

Luteinising hormone (LH): .....

.....

[2]

4. Nov/2021/Paper_J257_04/No.4

Scientists have created an image of a human female who lived 5700 years ago, as shown. The image is based on information in her genome.

(a) Describe what evidence her genome would have contained to show that she was female.

.....

..... **[1]**

(b) The scientists worked out that she had blue eyes.

Suggest how they could have worked this out from her genome.

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..... **[2]**

(c) Explain why scientists cannot be sure exactly what she looked like, even though they found her complete genome.

In your answer, include examples of other things, in addition to her genome, that could have affected her features.

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..... **[4]**

(d) The scientists investigated all parts of her genome, including her non-coding DNA.

Complete the sentences to explain why investigating her non-coding DNA helped the scientists to create their image of her.

Put a (ring) around the correct answers.

Chromosomes / Genes / Genetic variants in her non-coding DNA would have affected how her genes were expressed.

This would have affected her **chromosomes / genotype / phenotype**.

[2]

(e) The scientists found her complete genome in the remains of some of her cells. The cells were found in an ancient piece of tree gum that she had chewed.

The tree gum that she had chewed also contained DNA from a duck, probably from a meal she had eaten before she died.

Suggest how the scientists could have classified this extra DNA as duck rather than human.

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..... **[2]**

5. Nov/2021/Paper_J257_02/No.4

Growth in multicellular organisms involves an increase in the number of body cells. New cells are made by mitosis, which is part of the cell cycle.

There are two main phases in the cell cycle.

(a) The statements in the table describe events in the cell cycle.

For each statement tick (✓) **one** box to show which phase of the cell cycle is being described.

Event in the cell cycle	Takes place in interphase	Takes place in mitosis
Each chromosome is copied.		
The cell grows larger.		
The chromosome copies separate.		
The nucleus divides.		
The number of organelles increases.		

[2]

(b) Amir is observing the stages of mitosis in cells found in the root tips of garlic.

To prepare his slide he follows this method.

1. Cut a thin section of the root tip.
2. Place on the microscope slide.
3. Add a coverslip.

Describe how Amir would use the light microscope to view his slide.

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..... **[3]**

(c) When Amir looks at the slide using a light microscope, the chromosomes are still not clear.

Suggest **one** improvement he could make when preparing his slide that will make the chromosomes more visible.

..... **[1]**

6. Nov/2020/Paper_J257_03/No.7

Onion plants are grown for food.

(a) Onion plants can reproduce sexually or asexually.

Give **one** advantage of using each type of reproduction for growing onions.

Advantage of using **sexual reproduction**

.....

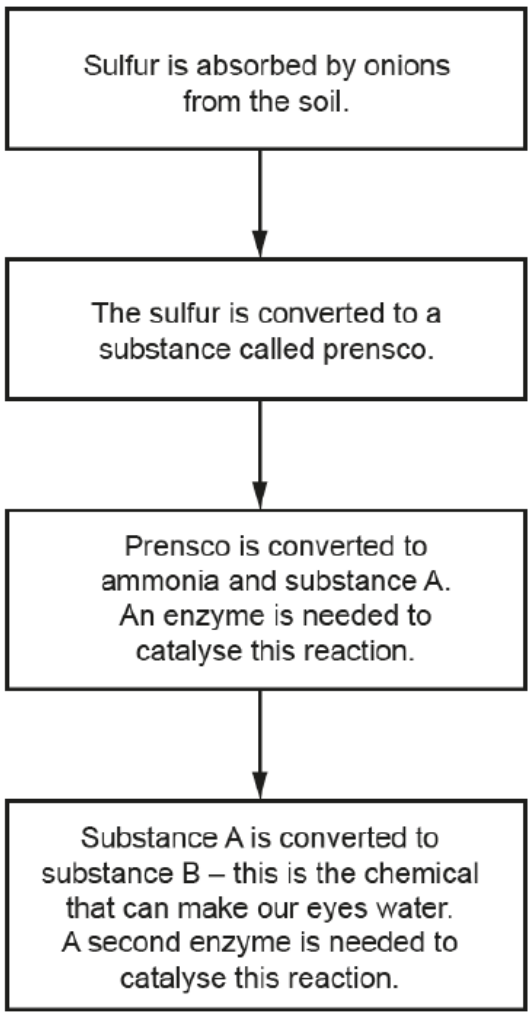
Advantage of using **asexual reproduction**

..... **[2]**

(b) When an onion is cut during food preparation, it can cause our eyes to water.

Research suggests that this is a result of a chemical that is made by the onion.

The diagram shows how the onion produces this chemical.



(i) Suggest which type of cell absorbs sulfate mineral ions from the soil.

..... **[1]**

(ii) It has been suggested that if you put the onions in freezing cold water or hot water before cutting the onion, it may reduce the quantity of substance B that causes our eyes to water.

Use the information in the diagram and your knowledge of enzymes to suggest why this may work.

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..... **[3]**

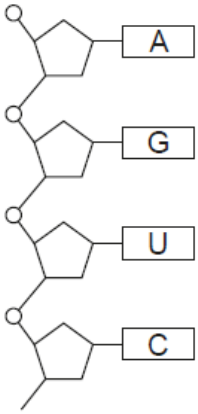
(c) Suggest how scientists could produce onions that make our eyes water less.

..... **[1]**

7. Nov/2020/Paper_J257_03/No.11

In protein synthesis a section of one strand of DNA is copied and a molecule of mRNA is formed.

The diagram shows a molecule of mRNA.



(a) Compare the structure of mRNA to the structure of DNA.

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.....

..... **[2]**

(b) Genetic variants can be found in both coding and non-coding DNA.

Complete the sentences to describe the effect of genetic variants in non-coding DNA.

Use words from the list.

You can use each word once, more than once, or not at all.

base **DNA** **gene** **genotype**

mutation **phenotype** **sugar** **protein**

Some sections of DNA do not code for a ..... .

Non-coding DNA controls whether a particular gene is expressed.

If there is a ..... in the non-coding DNA, particular proteins will not be made.

The absence of particular proteins could alter the ..... of the individual.

[3]

8. Nov/2020/Paper_J257_03/No.12

(a) Describe how two parents who are at risk of passing on a genetic disease could use modern technology to have a child that is disease-free.

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..... **[2]**

(b) Some diseases are referred to as sex-linked. XMEN syndrome is a very rare genetic disease which is carried on the X chromosome. It is a recessive disorder.

(i) XMEN syndrome is caused by a gene mutation.

What is a gene mutation?

.....

..... **[1]**

(ii) Is this disease likely to be seen more often in males or females?

Explain your answer.

Use your knowledge of sex determination in your answer.

.....

..... **[1]**

9. Nov/2020/Paper_J257_04/No.5

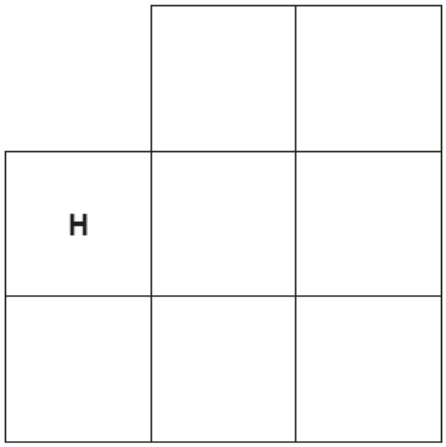
Huntington's disease is caused by a faulty allele of a single gene.

(a) The allele that causes the disease is dominant. The other allele is recessive.

A couple are planning to have a baby.

- The female's genotype is heterozygous dominant.
- The male's genotype is homozygous recessive.

Complete the Punnett square to show the predicted proportion of their offspring that will have Huntington's disease.



Proportion of offspring with Huntington's disease = ... in every ..... **[2]**

(b) Give **two** reasons why a Punnett square **cannot** be used to predict most of a person's features.

1 .....

.....

2 .....

..... **[2]**

(c) When a person has Huntington's disease, neurons in their brain start to die.
The person becomes confused. Eventually they cannot control their body movements and cannot speak.

(i) Explain why it is difficult to investigate brain function in a person with Huntington's disease.

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..... **[2]**

(ii) The neurons that make up the brain cannot undergo mitosis.

Explain what this means, and therefore why the brain damage caused by Huntington's disease does not heal.

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..... **[2]**

(iii) Doctors hope to use embryonic stem cells to treat the brain damage caused by Huntington's disease.

Explain how stem cells can be used for this type of treatment.

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..... **[2]**

(iv) Discuss risks and ethical issues associated with this type of treatment.

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..... **[2]**

(d) The allele that causes Huntington's disease contains instructions to make a protein that kills neurons in the brain.

Scientists have developed a drug that destroys the mRNA made from the instructions in the allele. This prevents the brain damage caused by Huntington's disease.

(i) Explain how the drug prevents the brain damage caused by Huntington's disease.

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..... **[3]**

(ii) The drug is injected into the patient's blood.

Give **two** reasons why the drug must be able to move through cell membranes but does **not** need to enter the cell nucleus.

1 .....

.....

2 .....

..... **[2]**

10. Nov/2021/Paper_J257_01/No.11

Tay-Sachs disease is an inherited disease caused by a recessive allele.

The symptoms of the disease start when a child is 3–6 months old. The disease is usually fatal.

Charlie and Eve decide they want to have a child. They do not have the disease, but they are concerned that they may be carriers of this disease and will pass it on to their child.

(a) Describe how Charlie and Eve could find out if they are carriers.

.....

.....

..... **[2]**

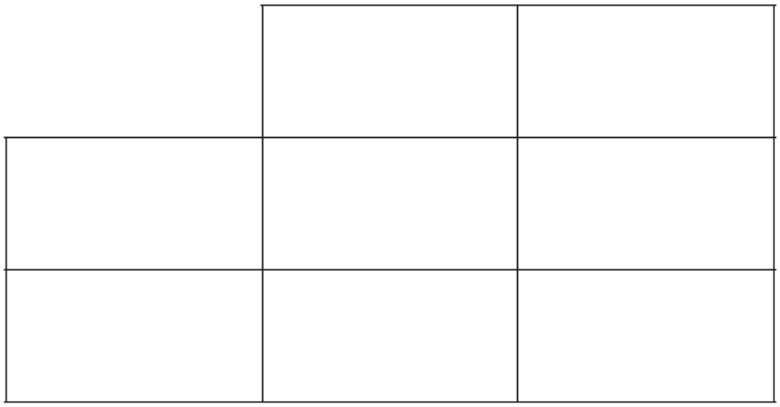
(b) Charlie and Eve find out they both have the genotype **Tt**.

What word is used to describe this genotype?

..... **[1]**

(c) Charlie and Eve still want to have a child.

Complete the Punnett square to find out the probability of their child having Tay-Sachs disease.



Probability of child having Tay-Sachs disease = ... **[3]**

(d) Charlie and Eve decide that they do not want to risk their child inheriting Tay-Sachs disease.

Suggest **two** ways in which they can have a child that does not have the disease.

1. .....

.....

2. .....

.....

[2]

11. Nov/2021/Paper_J257_02/No.4

Sarah and Ben are thinking about having a baby.

(a) Each body cell in Ben's body contains 46 chromosomes.

(i) How many chromosomes would you expect to find in one of Ben's sperm cells?

Number of chromosomes = ... **[1]**

(ii) How many chromosomes would you expect to find in one of Sarah's egg cells if it was fertilised by one of Ben's sperm cells?

Number of chromosomes = ... **[1]**

(b) Sarah and Ben decide they are not yet ready to have a baby.

(i) Explain how a contraceptive pill will help to prevent Sarah from becoming pregnant.

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..... **[3]**

(ii) Explain the advantages of Ben wearing a condom during sex even if Sarah is taking the pill.

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..... **[3]**

12. Nov/2021/Paper_J257_04/No.7

The genome is the entire genetic material of an organism. A copy of an organism's genome is stored in each one of its cells.

(a) Explain how the genetic material is stored in an animal cell **and** how it is used to control what happens in the cell.

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.....

.....

..... **[3]**

(b) Give **two** ways in which the genetic material is stored in a prokaryotic cell such as a bacterium.

1. .....

.....

2. .....

.....

[2]

(c) Scientists have created an image of a human female who lived 5700 years ago, as shown. The image is based on information in her genome.

The scientists found her complete genome in the remains of some of her cells.

(i) Describe what evidence her genome would have contained to show that she was female.

.....

.....

.....

..... **[2]**

(ii) The scientists worked out that she had blue eyes.

Suggest how they could have worked this out from her genome.

.....

.....

.....

..... **[2]**

(iii) Even though scientists found her complete genome, they cannot be sure that she looked exactly like the image.

Her genome is **not** the only factor that would have affected her features.

Describe **three** things in her environment or her lifestyle that could have affected her features.

1. .....

.....

2. .....

.....

3. .....

.....

[3]

(iv) How many of our features are affected by both our genome **and** our environment?

Tick (✓) **one** box.

All of our features	☐
A small number of our features	☐
Most of our features	☐
None of our features	☐

[1]

13. Nov/2020/Paper_J257_01/No.2

Some people can roll their tongues, others cannot.

Tongue rolling is inherited.

- The allele for tongue rolling is represented by **R**
- The allele for non-tongue rolling is represented by **r**.

(a) Jack's genotype is **RR**.

(i) Which **two** words can be used to describe Jack's genotype?

Put a (ring) around the **two** correct answers.

dominant **heterozygous** **homozygous** **recessive**

[2]

(ii) Jack's friend is unable to roll their tongue.

What will their genotype be?

Tick (✓) **one** box.

RR ☐

Rr ☐

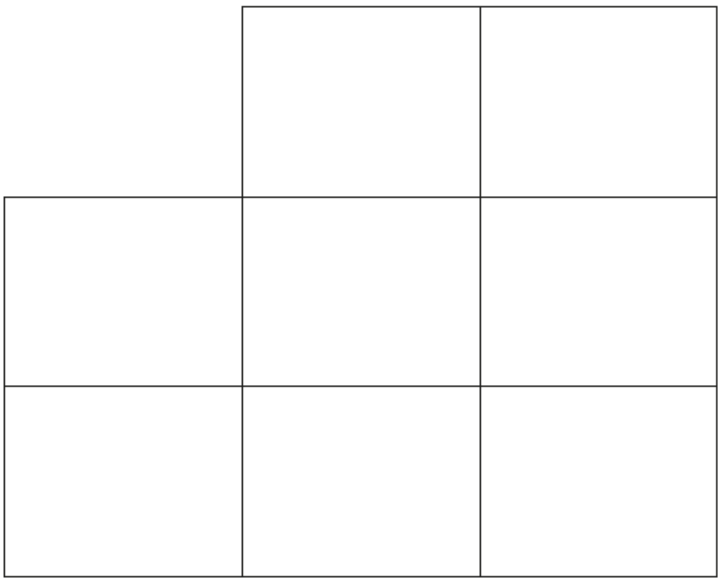
rr ☐

[1]

(iii) A male with the genotype **Rr** and a female with the genotype **Rr** have a baby.

Complete the Punnett square to show how the male and female can have a baby that can roll its tongue.

State the probability of the baby being able to roll its tongue.



Probability ..... **[3]**

(b) What word is used to describe the physical features observed as a result of genes?

Put a (ring) around the correct answer.

allele **environment** **phenotype**

[1]

(c) **(i)** Which statement defines the term **genome**?

Tick (✓) **one** box.

The chromosomes inherited from the mother ☐

The DNA found in the sperm cell ☐

The entire genetic material of an organism ☐

[1]

(ii) Where is DNA stored in an animal cell?

Tick (✓) **one** box.

Chloroplast ☐

Cytoplasm ☐

Nucleus ☐

[1]

14. Nov/2020/Paper_J257_01/No.5

Fig. 5.1 shows the life cycle of a male chicken.

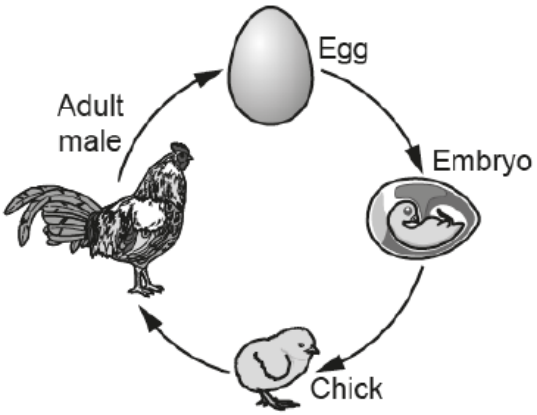


Fig. 5.1

(a) An adult male chicken has 78 chromosomes in a body cell.

The adult male chicken makes sperm cells.

How many chromosomes will there be in one sperm cell?

.....

[1]

(b) As a chick grows, the number of cells that make up its body increases.

What is the name given to the type of cell division involved in growth?

Tick (✓) **one** box.

Meiosis	☐
Mitosis	☐
Replication	☐

[1]

(c) Chickens reproduce sexually.

Give **one** biological advantage of sexual reproduction.

..... **[1]**

15. Nov/2020/Paper_J257_02/No.1

Cells contain DNA.

(a) Which **two** words describe the shape of a DNA molecule?

Tick (✓) **two** boxes.

- Double ☐
- Genome ☐
- Single ☐
- Helix ☐
- Triple ☐
- Nucleus ☐

[2]

(b) DNA is made from nucleotides.

Each nucleotide is made from a common sugar, a phosphate group and one other part.

What is the name of the other part?

..... **[1]**

(c) Put the structures in the correct order of size, from the largest to the smallest.

cell **chromosome** **gene** **nucleotide** **nucleus**

largest .....

.....

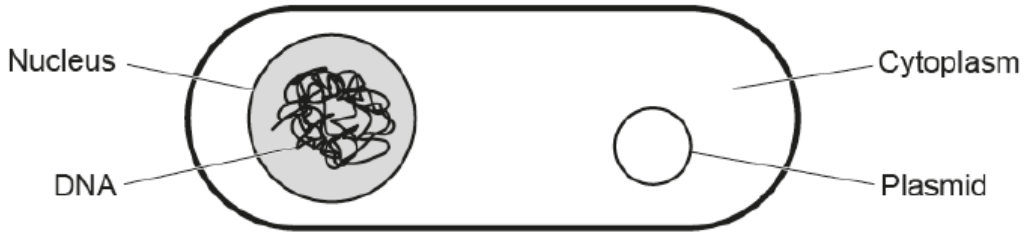
.....

.....

smallest .....

[4]

(d) Ali has made this diagram of a bacterium.



There is a mistake in Ali's diagram.

Identify **one** mistake in Ali's diagram of a bacterium.

.....

..... **[1]**

16. Nov/2020/Paper_J257_02/No.2

Gametes are types of cells used in sexual reproduction.

(a) Human female gametes are called egg cells.

What is the name of the human **male** gametes?

..... **[1]**

(b) How many gametes are required to make a new human life during sexual reproduction?

..... **[1]**

(c) Fertilisation takes place. The male gamete has the sex chromosome Y.

What sex chromosomes will the baby have, and what sex will it be?

Sex chromosomes .....

Sex .....

[2]

(d) Human female gametes are released during ovulation. Ovulation can be prevented by taking hormone contraceptive pills.

Eve starts taking hormone contraceptive pills to prevent getting pregnant.

Explain why Eve could still become pregnant if she has unprotected sex after taking the contraceptive pill.

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.....

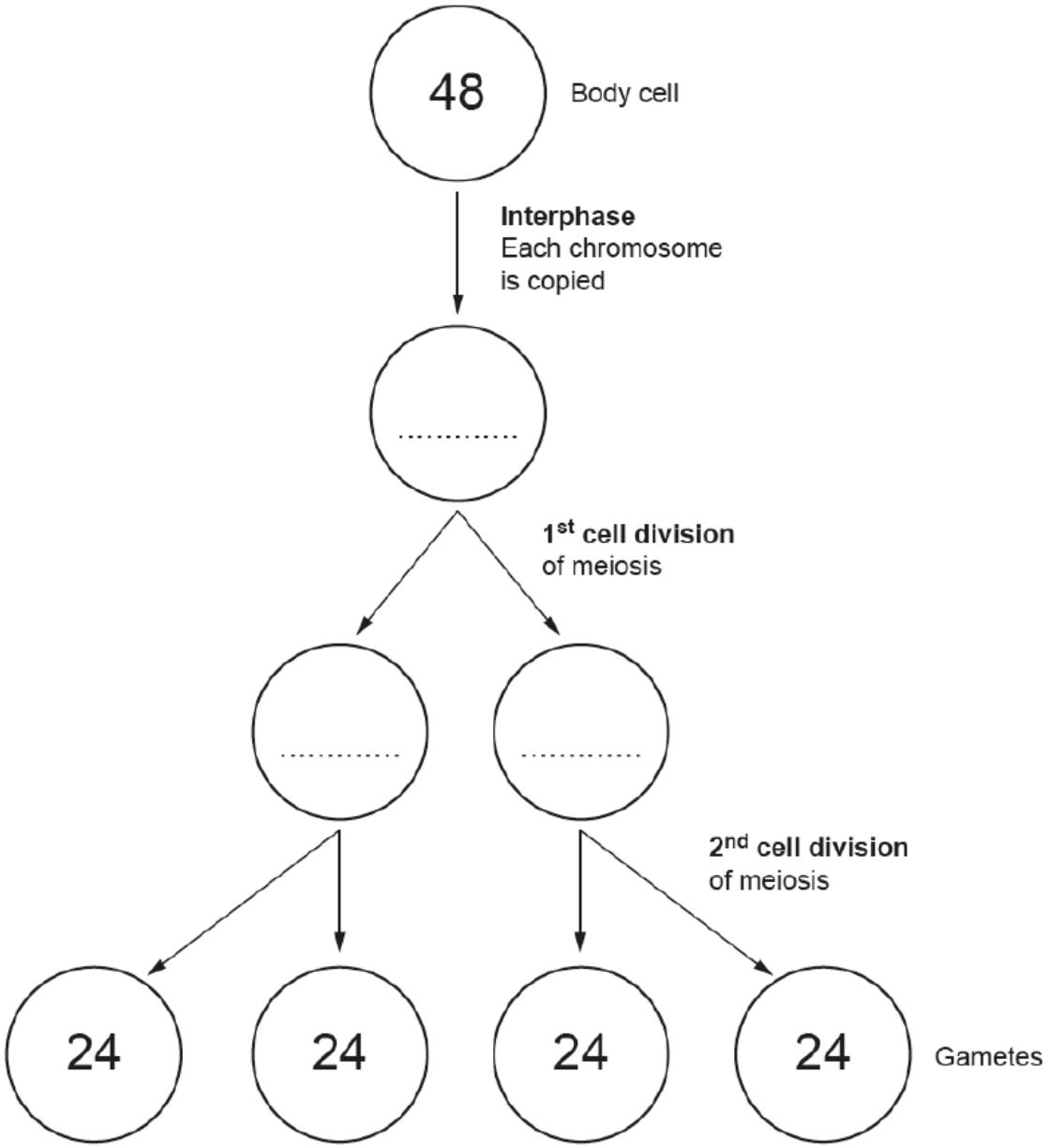
.....

..... **[2]**

(e) Gametes are made by a type of cell division called meiosis.

Meiosis in monkeys is shown in the diagram and it starts with a body cell. In monkeys, each body cell has 48 chromosomes.

Complete the diagram by writing the number of chromosomes in each empty cell.



[2]