OCR GCSE 21ST CENTURY BIOLOGY B · J257

BIOLOGY



EXAM QUESTION PACK

B1.2 HOW IS GENETIC INFORMATION INHERITED? (HIGHER)

SCORE	PERCENTAGE
/66	%

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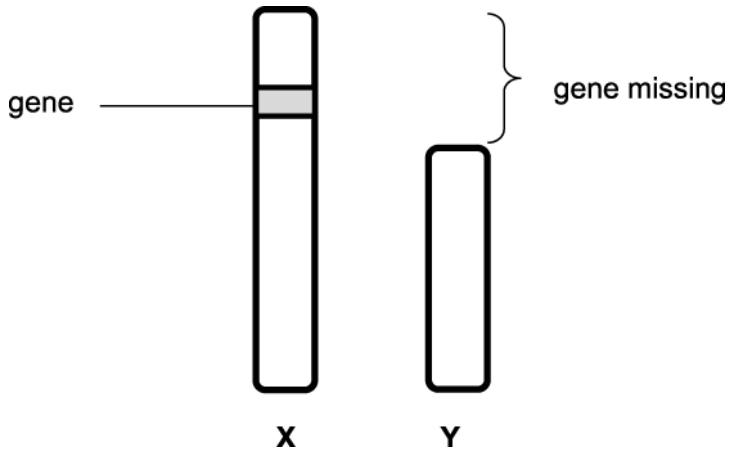
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1. Some diseases are inherited.

Haemophilia is an example of an inherited disease. It is caused by a **recessive allele**. The gene for haemophilia is located on the sex chromosomes.

Due to the location of the gene for haemophilia, females inherit two copies of the gene, but males only inherit one. For a male, this is shown on the diagram below.



Males **cannot** be carriers for haemophilia. They either have the disease or they do not.

(i) A female carrier has the genotype X^HX^h and a healthy male has the genotype X^HY.
Complete the Punnet square to show the probability of this couple having a son with haemophilia.

	X^H	X^h
X^H		
Y		

Probability =_____ **[2]**

(ii) Which of the following genotypes would a female with haemophilia have?

Put a tick (✓) in the correct box.

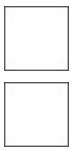
X^HX^H ☐

X^HX^h ☐

X^hX^h

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X^HX 

[1]

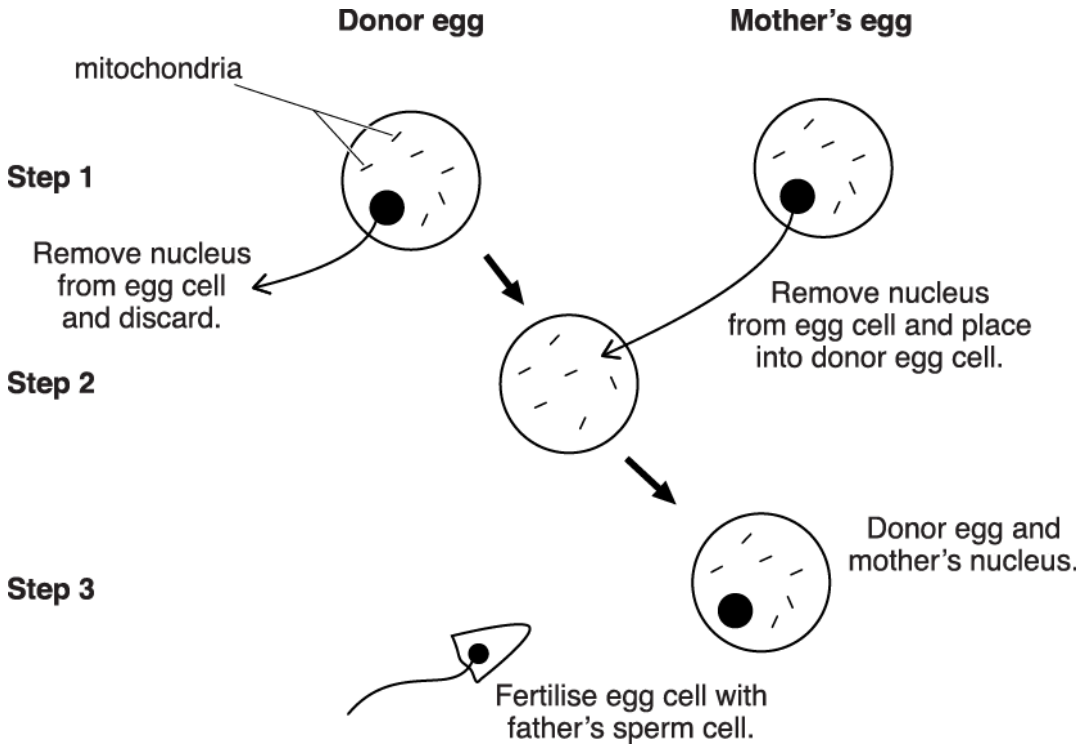
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2(a). Scientists use cell structures from three people to make a baby:

- the nucleus from a mother's egg cell
- the nucleus from a father's sperm cell
- the mitochondria from a donor's egg cell.

This technique will help prevent some genetic diseases caused by faulty mitochondria.

The diagram below shows how the process will be done.



Step 4 Fertilised egg cell is then placed in the mother's uterus.

Mitochondria contain 37 genes.

The nucleus of a fertilised egg cell contains 40 000 genes.

What percentage of its genes does the fertilised egg cell receive from the donor?

Give your answer to 2 decimal places.

Show your working.

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_____ % [2]

(b). Most of the baby's physical characteristics will be inherited from its father and mother.

Suggest why.

---[1]

(c). Genes code for proteins.

What type of protein could the genes in the mitochondria code for?

---[1]

(d). Babies created by this new technique will contain the DNA from 3 different individuals.

Some people do not agree with the use of this new technique.

Suggest and explain why.

---[3]

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(e). Approximately 1 in 200 children have faulty mitochondria.

1 in 6500 children will have serious diseases as a result.

Do you think this justifies the development of this new technique?

Explain your answer.

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[2]

(f). The DNA in the mitochondria of people affected by mitochondrial disease contains mutations.

A mutation is a change in the base sequence of the DNA.

Explain how these mutations can cause problems.

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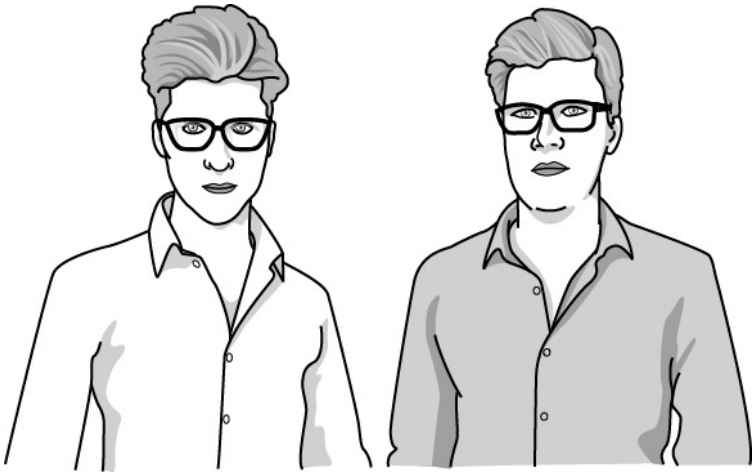
[2]

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3. Jack and Ted are identical twins.

Identical twins are an example of naturally occurring clones.



How many egg cells and sperm cells were needed during fertilisation to produce these identical twins?

Put a tick (✓) in the box next to the correct answer.

Two egg cells and two sperm cells. ☐

Two egg cells and one sperm cell. ☐

One egg cell and two sperm cells. ☐

One egg cell and one sperm cell. ☐

[1]

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4(a). Our genes and chromosomes contain genetic information.

Write a word in the gap to complete each sentence.

Genes are instructions for a cell that describe how to make _____.

Genes are sections of long molecules of _____ that make up chromosomes.

The combination of alleles an organism has is called its _____.

The observable characteristics of an organism are called its _____.

[2]

(b). Human body cells usually contain 23 pairs of chromosomes.

In males and females, 22 of these pairs of chromosomes look the same.

Write down the name of the pair of chromosomes that look different in males and females.

_____.

[1]

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5. Cathy is pregnant with triplets.

All three babies have the same father.

When the babies are born, two of the babies, **A** and **B**, are genetically identical to each other.

The third baby, **C**, is genetically different.

Explain why babies **A** and **B** are genetically identical and why baby **C** is not genetically identical to babies **A** and **B**.

The quality of written communication will be assessed in your answer.

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[6]

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6. Harold has cystic fibrosis.

Hilda is a carrier for the disease.

(i) Write down Harold and Hilda's genotypes.

Use **F** to represent the dominant allele and **f** to represent the recessive allele.

Harold's genotype: _____ Hilda's genotype: _____

[1]

(ii) Which row in the table correctly describes Harold and Hilda's genotypes?

Put a tick (✓) in the box at the end of the correct row.

Harold	Hilda	
heterozygous	homozygous dominant	
heterozygous	homozygous recessive	
homozygous dominant	heterozygous	
homozygous dominant	homozygous recessive	
homozygous recessive	homozygous dominant	
homozygous recessive	heterozygous	

[1]

7. Explain how a sample of fetal cells can be used to find out the sex of a fetus.

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[2]

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8. Harold has cystic fibrosis.

Hilda is a carrier for the disease.

Hilda is pregnant.

Harold is the father of the unborn baby.

Harold thinks that, because he has cystic fibrosis, the baby will definitely have cystic fibrosis.

Explain why Harold is **not** correct.

[2]

9. Explain how a **gene** can determine the sex of a fetus.

[3]

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10. Cystic fibrosis is an inherited disorder.

Sharon and Eric are both carriers for cystic fibrosis.

Sharon is pregnant. Eric is the father.

There is a chance that the fetus will have cystic fibrosis.

Calculate the probability that the fetus will have cystic fibrosis.

Use a genetic diagram or Punnett square to help you.

Use T = normal allele and t = cystic fibrosis allele.

probability of fetus having cystic fibrosis = _____ **[3]**

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11(a) Humans usually have two alleles for each gene.

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Genes determine the characteristics shown by the person.

Draw a straight line to connect each **word** with its correct **definition**.

word	definition
dominant	two alleles of a gene that are different
genotype	the genetic makeup of an organism
heterozygous	an allele that always shows an effect in the organism
homozygous	an allele that only shows an effect if both alleles of the pair are the same
phenotype	the observable characteristics of an organism
recessive	two alleles of a gene that are the same

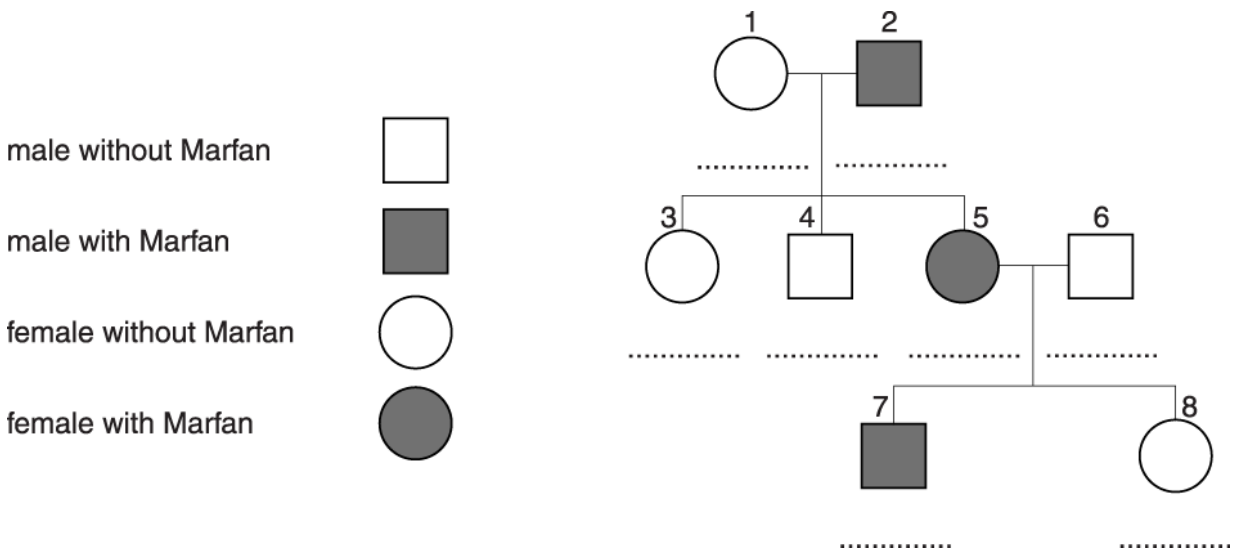
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(b). Marfan syndrome is a genetically inherited disorder.

(i) Look at the genetic diagram.



Marfan syndrome is caused by a dominant allele.
Complete the diagram to show the inheritance of Marfan syndrome.

Use **G** for the dominant allele and **g** for the recessive allele.

[3]

(ii) Write down the three possible combinations of genotypes for the parents of individual **6**.

Combination 1 _____ and _____

Combination 2 _____ and _____

Combination 3 _____ and _____

[2]

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(c). Janet and John are expecting a baby.

John has mild Marfan syndrome.

Marfan syndrome can produce a range of conditions from mild (long limbs and fingers) to severe (heart and lung defects).

Janet and John need to decide whether to have the fetus tested for Marfan syndrome.

Write down **three** things that Janet and John need to consider before deciding whether to have the test for Marfan syndrome.

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[3]

12. Ali and Mary do not have cystic fibrosis, but their baby does.

What does this tell us about Ali and Mary's genes for this disorder?

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[1]

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13. Plants can be infected by diseases caused by pathogens.

The plant disease ash dieback was first recorded in the early 1990s in Poland.

Since then, many thousands of trees in northern Europe have become infected.



Ash dieback was first found in eastern parts of Great Britain (GB) in 2012, and has been spreading across the country ever since.

The British outbreak of ash dieback started in woodland in Norfolk.

Much of the woodland has died, but one ash tree has shown tolerance to the disease. This tree was named 'Betty' by scientists. Tolerant trees have also been found in mainland Europe.

(i) Explain how scientists could use selective breeding to produce ash trees with improved tolerance.

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[3]

(ii) New woodland could be planted using cuttings from Betty.

Explain why this could be a **disadvantage** during a future outbreak of plant disease.

[2]

(iii) Explain how gene technology could be used to produce ash trees with improved tolerance.

[4]

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14. The Galapagos Islands are a group of 13 islands found in the Pacific Ocean.

Charles Darwin visited the Galapagos Islands during the 19th century.

He collected samples and made observations.

This work helped Darwin to develop a new explanation for the evolution of species.

(i) Which of the following are observations made by Darwin?

Tick (✓) **two** boxes.

There are differences between fossils and living examples of similar organisms. ☐

Pea plants with red flowers can produce offspring with white flowers. ☐

There is usually extensive variation within a population of a species. ☐

Some bacteria have become resistant to antibiotics. ☐

Isolated populations of the same species living in different places have different characteristics. ☐

[2]

(ii) Darwin suggested a theory to explain his observations.

Write down the name of the theory he suggested.

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[1]

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15(a) A gene affects whether people have dimples in their cheeks. There are different variants of this gene.

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An individual with the dominant variant, D, of this gene will have dimples.

Jack and his wife Nina both have dimples.

Their daughter Mia does not have dimples.

(i) Complete the table to show the genotype of each individual.

Individual	Genotype
Jack	
Nina	
Mia	

[3]

(ii) Jack and Nina decide to have another child.

What is the probability that the second child will have dimples?

Use the Punnett square to show your working.

Probability that the child will have dimples = ... **[2]**

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(b). Scientists consider this trait an 'irregular' dominant trait. This is because sometimes a person can have dimples but their children do not.

What could be responsible for this difference?

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[1]

END OF QUESTION PAPER

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