

B1 – 3 Genetics – Questions

Q1. Proteins are made up of amino acids.

The table shows the DNA bases that code for some of the amino acids found in proteins.

DNA bases	AAA	AAC	CAA	TAC	TTC
Amino acid	phe	leu	val	met	lys

Part of the DNA coding for a protein is:

T A C C A A T T C

(i) State the order of amino acids coded for by this sequence of DNA. (1)

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(ii) These amino acids will be joined together during protein synthesis. (1)
During which stage of protein synthesis will this take place?

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(iii) Complete the sentence by putting a cross (☒) in the box next to your answer. (1)
Amino acids are joined together

- ☒ **A** at the membrane
☒ **B** in the mitochondria
☒ **C** in the nucleus
☒ **D** at the ribosome

Q2. There are four blood groups: A, B, AB and O.

Explain how a father who is blood group A and a mother who is blood group B can have a child that has blood group O. (2)

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Q3. (i) Figure 14 shows the percentages of bases for three organisms.

organism	percentage of each base in DNA (%)			
	adenine	thymine	cytosine	guanine
Human	30.8	30.8	19.2	19.2
Beetle	28.4	28.4		
Ebola virus	23.7	17.0	26.2	27.0

Figure 14

Calculate the percentage of cytosine for the beetle. (2)

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(ii) Explain why the information given about the Ebola virus indicates that this virus does not have a typical DNA structure.

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Q4. Describe the causes of variation in a population.

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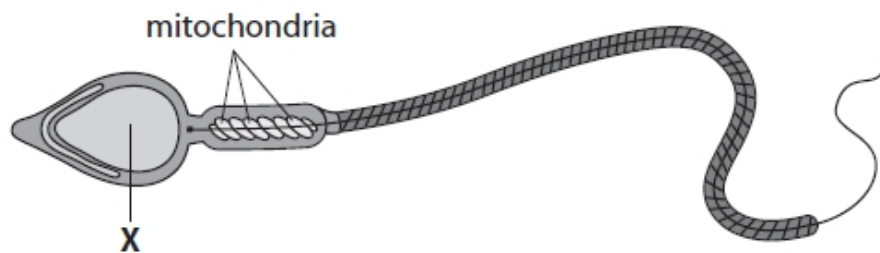
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Q5. The diagram shows a human sperm cell.



(a) (i) Structure **X** on the diagram contains DNA.

Name structure **X**.

(1)

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(ii) Which statement is true for DNA?

Place a cross (☒) in the box next to your answer.

(1)

- ☐ **A** DNA is made up of amino acids and bases.
- ☐ **B** DNA is made up of amino acids which give instructions to make proteins.
- ☐ **C** In DNA, the bases A and T are complementary.
- ☐ **D** Every gene in a DNA molecule contains only three bases.

(b) Sperm cells are involved in fertilisation.

Define fertilisation.

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(c) (i) Describe the function of mitochondria.

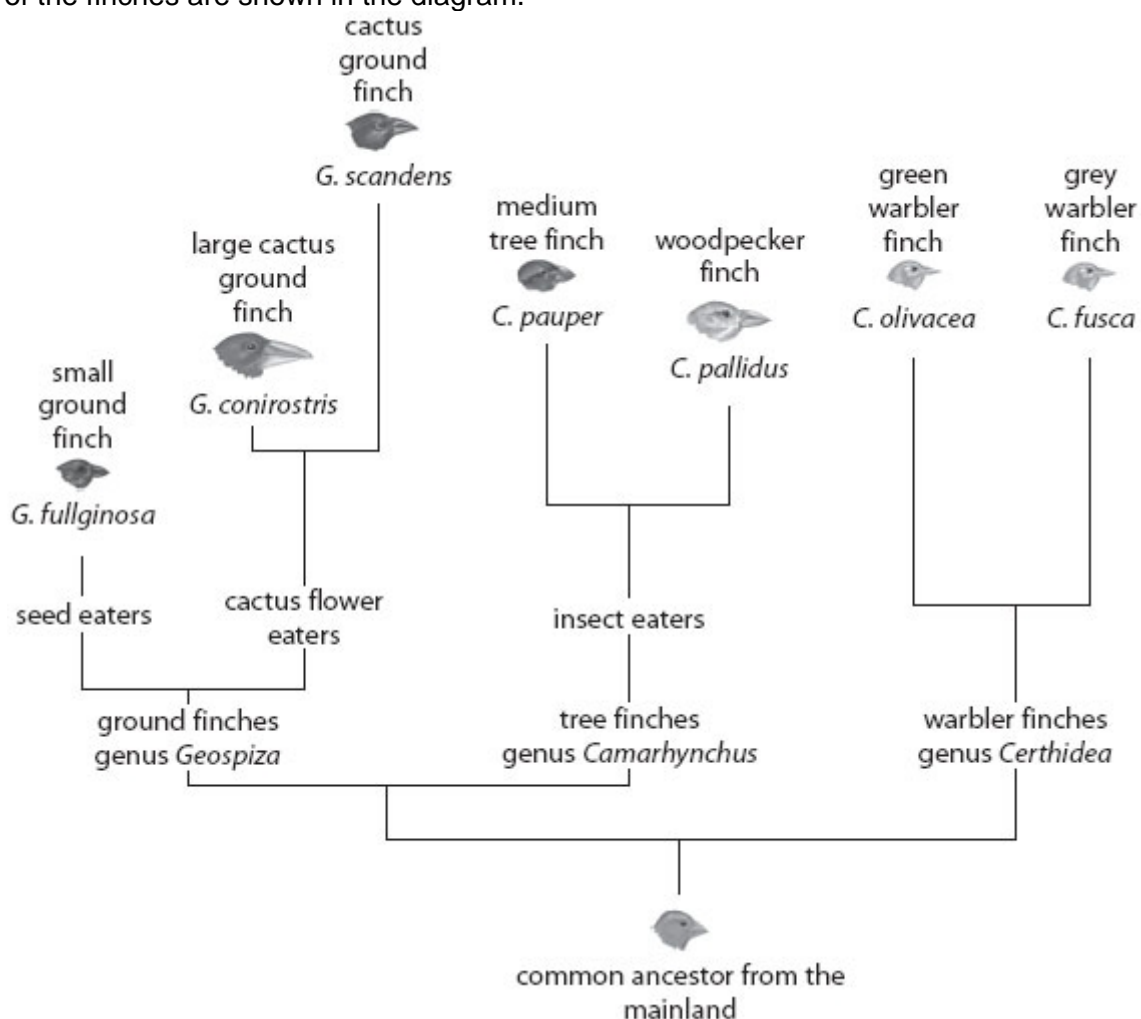
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(ii) Gene mutations in DNA can produce abnormal mitochondria.
Explain how a gene mutation can produce a different protein.

(2)

Q6. Charles Darwin studied the variety of finches on the Galapagos Islands.

He used this information to develop his theory of evolution.
Some of the finches are shown in the diagram.



(a) (i) State the genus and the species of the large cactus ground finch.

(2)

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(ii) Suggest how the size and shape of their beaks enabled all of these types of finches to survive. (2)

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(ii) Complete the sentence by putting a cross (☒) in the box next to your answer.

Darwin's finches are an example of speciation due to

(1)

- ☒ **A** selective breeding
- ☒ **B** geographic isolation
- ☒ **C** hybridisation
- ☒ **D** the development of ring species

(b) Suggest how these species of finches could have evolved.

(3)

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Q7. Gregor Mendel investigated the genetics of peas.

He did not know about genes but showed that inherited characteristics can be dominant or recessive.

Explain how Mendel used homozygous tall and homozygous short pea plants to show that the tall allele is dominant to the short allele.

(2)

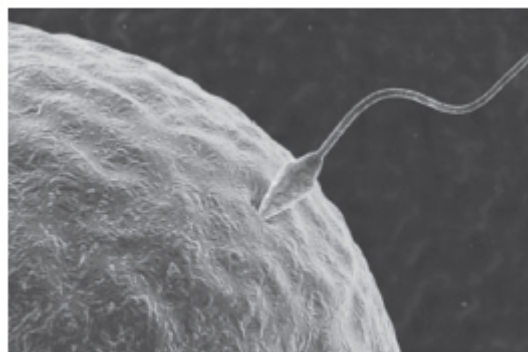
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Q8. The photograph shows a sperm cell and an egg cell just before fertilisation.



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Describe the structure of DNA.

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Q9. (a) Describe how a section of DNA determines the structure of a protein. (4)

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*(b) Describe the structure of DNA, including the roles of the scientists involved in its discovery. (6)

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Human DNA was sequenced during the Human Genome Project.
(c) Explain how the Human Genome Project has contributed to advances in medicine. (2)

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Q10. (i) Draw a Punnett square to show the offspring from a male homozygous dominant for Huntington's disease and a female homozygous recessive for Huntington's disease. (2)

(ii) State the probability that the offspring shown in the Punnett square will have Huntington's disease. (1)

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Q11. DNA and RNA are involved in the synthesis of proteins such as enzymes.

(a) Protein synthesis involves transcription and translation.

Which row shows the molecules involved in both transcription and translation?

Place a cross (X) in the box next to your answer.

(1)

	transcription	translation
<input type="checkbox"/> A	tRNA	tRNA
<input type="checkbox"/> B	mRNA	DNA
<input type="checkbox"/> C	tRNA	DNA
<input type="checkbox"/> D	mRNA	mRNA

(b) Describe what happens to the molecule produced by transcription before it is translated.

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(c) Explain how the lock and key hypothesis models how enzymes work.

You may use labelled diagrams in your answer.

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*(d) Describe how named factors affect the rate of enzyme-catalysed reactions.

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Q12. The antigens on pathogens can be proteins with a specific amino acid sequence.

Explain how the order of amino acids in a protein is determined by the sequence of the gene.

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Q13. Explain why sperm determine the sex of offspring at fertilisation.

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Q14. The images show a normal red blood cell and a red blood cell from someone who has sickle cell disease. Sickle cell disease is a genetic disorder caused by two recessive alleles.



Normal red blood cell



Red blood cell from someone who has sickle cell disease

(a) (i) Complete the sentence by putting a cross (☒) in the box next to your answer.
An individual with sickle cell disease is said to be

(1)

- ☒ **A** a carrier for sickle cell disease
☒ **B** heterozygous
☒ **C** homozygous dominant
☒ **D** homozygous recessive

(ii) Describe the main symptoms of sickle cell disease.

(3)

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(b) (i) A female with the genotype (**Dd**) and a male with the genotype (**DD**) for sickle cell disease are about to start a family.

Complete the Punnett square to show the possible genotypes of their offspring for sickle cell disease.

(2)

		Female gametes	
Male gametes			

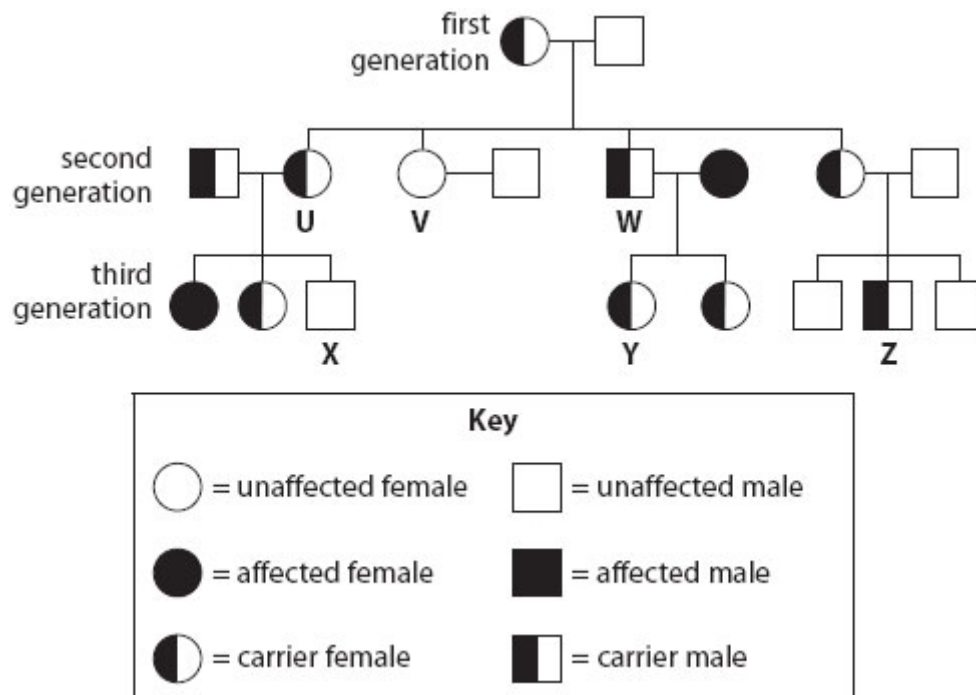
(ii) State the percentage chance that a child from these individuals will be

(2)

1. a carrier of sickle cell disease %
 2. an individual with sickle cell disease %

(Total for Question = 8 marks)

Q15. The family pedigree shows the inheritance of sickle cell disease through three generations.



(a) (i) Calculate the percentage of the offspring from the first generation who are heterozygous for sickle cell disease. (1)

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(ii) Explain why the offspring produced by the first generation parents are not the same as those predicted in a Punnett square. (2)

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(iii) Person **W** and his partner have a third child.
 State the probability that this child will have sickle cell disease.
 Complete the Punnett square to show this. (2)

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(iv) Complete the sentence by putting a cross (☒) in the box next to your answer.
 The genotype of person **V** is

- ☒ **A** homozygous dominant
☒ **B** homozygous recessive
☒ **C** heterozygous
☒ **D** carrier

(1)

*(b) Explain why it is important that individuals **X**, **Y** and **Z** have pedigree analysis completed before they consider having children.

You should use diagrams and mathematical calculations to illustrate your answer.

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Q16. There are four blood groups: A, B, AB and O.

The alleles for these blood groups are I^A , I^B , I^O

(i) The possible genotypes for blood group B are

(1)

- ☐ **A** $I^A I^B$ and $I^B I^O$
- ☐ **B** $I^B I^B$ and $I^A I^B$
- ☐ **C** $I^O I^O$ and $I^B I^O$
- ☐ **D** $I^B I^B$ and $I^B I^O$

(ii) Two parents produce offspring that can only have blood group AB.

Complete the Punnett square to show this inheritance.

(2)

Q17. Figure 4 shows a strawberry plant that has produced several runners and new strawberry plantlets are growing at the end of each runner. This is asexual reproduction.



Figure 4

(i) Explain why asexual reproduction in strawberries is beneficial to strawberry farmers. (2)

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(ii) Strawberry fruits, containing seeds, are produced after a flower is fertilised.
Explain why seed production is an advantage to the strawberry plant. (2)

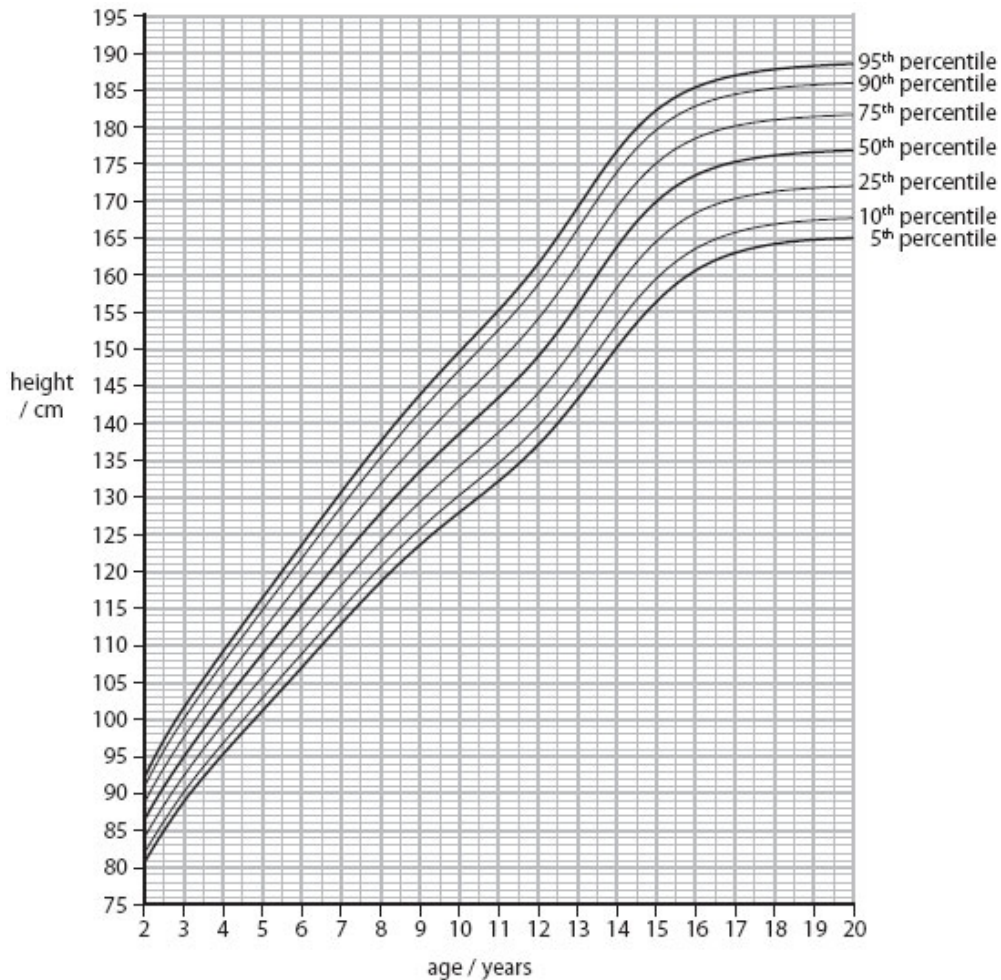
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Q18. Height can be used to monitor growth.
(a) The graph shows a percentile chart for height for males aged between 2 and 20 years.



(i) Describe how the height of males changes from the age of 2 to 20 years. (2)

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(ii) Calculate the difference in height of an 11 year old male in the 95th percentile and an 11 year old male in the 5th percentile. (2)

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(b) Protein is needed for growth.
(i) Name the first stage of protein synthesis. (1)

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(ii) Complete the sentence by putting a cross (☒) in the box next to your answer.
The second stage of protein synthesis produces a (1)

- ☒ A polypeptide made of amino acids
- ☒ B polypeptide made of bases
- ☒ C strand of mRNA made of amino acids
- ☒ D strand of mRNA made of bases

Q19. Human DNA was sequenced during the Human Genome Project.

Explain how the Human Genome Project has contributed to advances in medicine.

(2)

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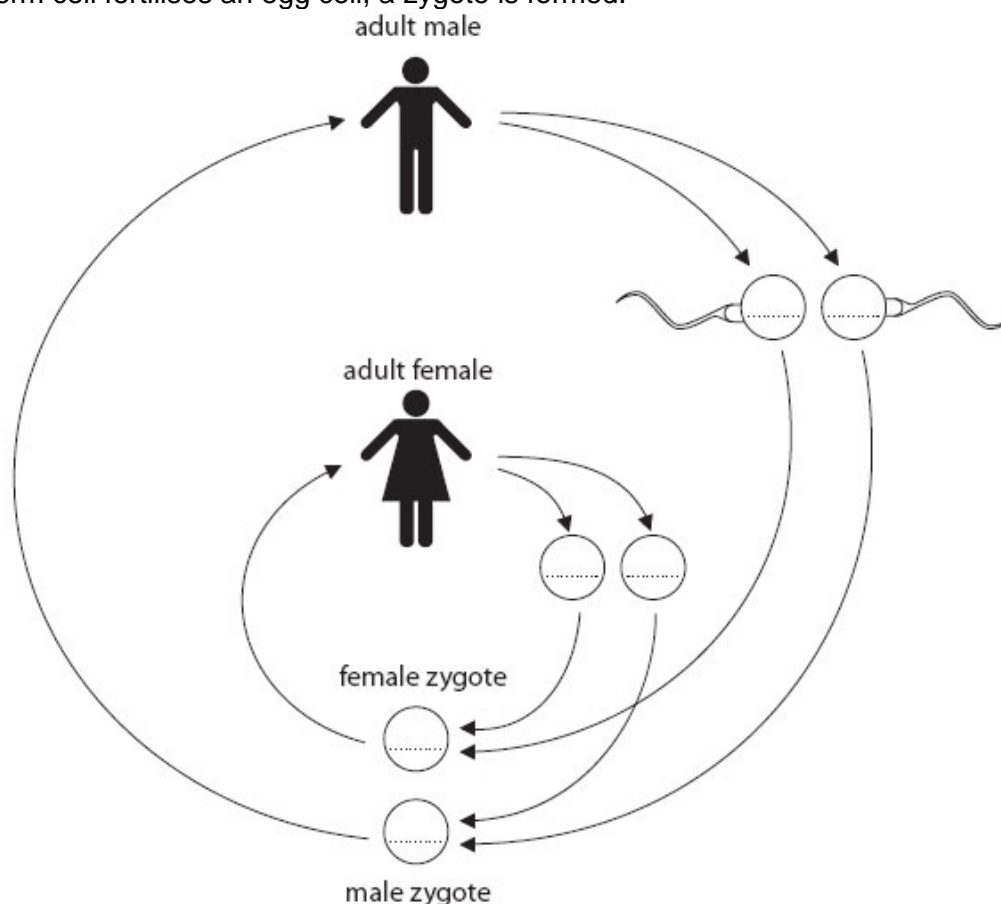
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Q20. The diagram shows the human life cycle.

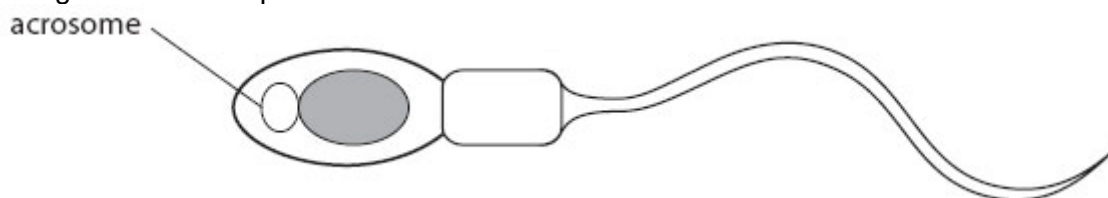
When a sperm cell fertilises an egg cell, a zygote is formed.



(a) Complete the diagram by writing the sex chromosomes in the egg cells, sperm cells, male zygote and female zygote.

(2)

(b) The diagram shows a sperm cell.



Complete the sentence by putting a cross (☒) in the box next to your answer.
The acrosome contains

- ☒ A enzymes to help get through the membrane of the egg cell
- ☒ B mitochondria to supply energy to swim
- ☒ C muscle fibres to swim
- ☒ D 23 chromosomes

(c) State why egg cells have a large amount of cytoplasm.

(1)

(1)

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(d) During ovulation an egg cell is released from the ovary.
Explain how changes in the levels of hormones result in ovulation.

(2)

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(e) Explain what happens to the uterus lining if the egg cell is fertilised.

(2)

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Q21. Corals are animals that live on the sea bed.
The photograph shows some species of coral.



After fertilisation, mitosis takes place to form an embryo.
The embryo develops into new coral.

(i) Describe mitosis.

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(ii) Describe how the embryo develops into new coral.

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Q22. Mutations can occur in DNA.

Describe what effect a mutation could have on the action of an enzyme.

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Q23. Information in a DNA strand can be transcribed to make a strand of mRNA.

Describe how this mRNA strand is then used to make proteins.

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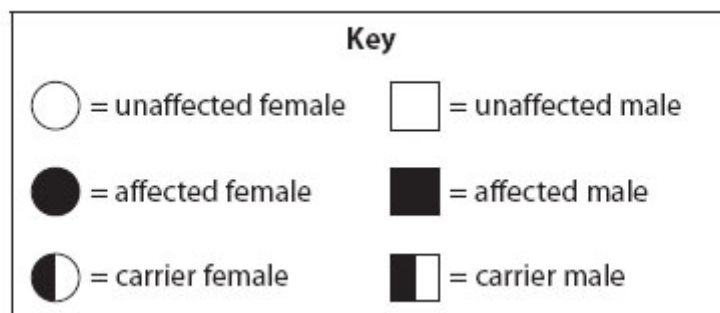
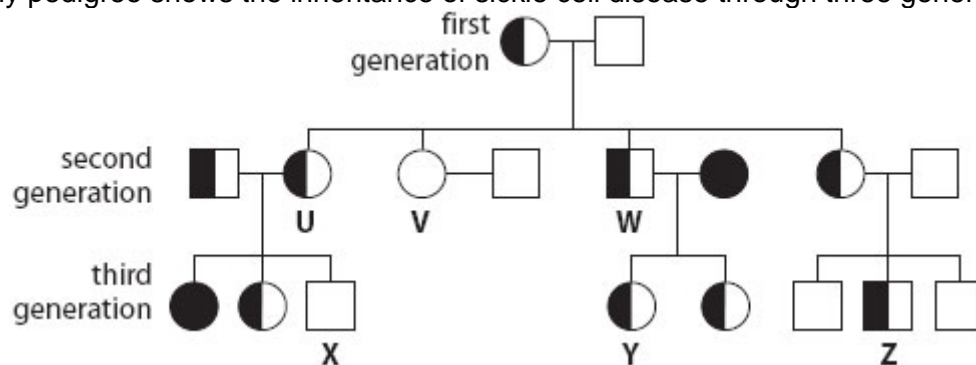
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Q24. The family pedigree shows the inheritance of sickle cell disease through three generations.



* Explain why it is important that individuals **X**, **Y** and **Z** have pedigree analysis completed before they consider having children.

You should use diagrams and mathematical calculations to illustrate your answer. (6)

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Q25. Height can be used to monitor growth.
 Protein is needed for growth.

(i) Name the first stage of protein synthesis. (1)

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(ii) Complete the sentence by putting a cross (☒) in the box next to your answer.
 The second stage of protein synthesis produces a (1)

- ☒ **A** polypeptide made of amino acids
- ☒ **B** polypeptide made of bases
- ☒ **C** strand of mRNA made of amino acids
- ☒ **D** strand of mRNA made of bases

Q26. Proteins are made up of amino acids.

(a) The table shows the DNA bases that code for some of the amino acids found in proteins.

DNA bases	AAA	AAC	CAA	TAC	TTC
Amino acid	phe	leu	val	met	lys

Part of the DNA coding for a protein is:

T A C C A A T T C

(i) State the order of amino acids coded for by this sequence of DNA. (1)

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(ii) These amino acids will be joined together during protein synthesis.
 During which stage of protein synthesis will this take place? (1)

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(iii) Complete the sentence by putting a cross (☒) in the box next to your answer.
 Amino acids are joined together (1)

- ☒ **A** at the membrane
- ☒ **B** in the mitochondria
- ☒ **C** in the nucleus
- ☒ **D** at the ribosome

(b) DNA can code for the amino acids in the active site of an enzyme.

Explain the role of the active site of an enzyme. (2)

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(c) Mutations can occur in DNA.

Describe what effect a mutation could have on the action of an enzyme.

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Q27. Resistant organisms

(a) The photograph shows the common rat *Rattus norvegicus*.



State the level of classification for both parts of the binomial name *Rattus norvegicus*.

(2)

Rattus

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norvegicus

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(b) Some rats have a mutation which enables them to eat the rat poison Warfarin and survive.

Suggest how the use of Warfarin could lead to an increase in the number of rats with this mutation. (2)

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(c) The allele for Warfarin resistance is recessive.

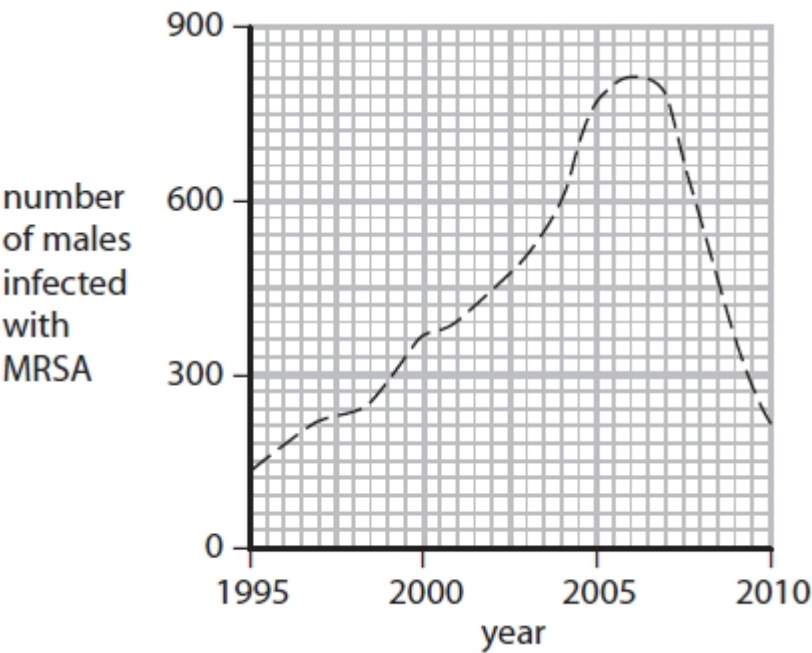
Complete the Punnett square to show how two rats, both heterozygous for Warfarin resistance, could produce Warfarin resistant offspring.

Use **R** and **r** to show the dominant and recessive alleles.

(2)

*(d) Hospitals have introduced programmes to reduce MRSA infections in patients because antibiotics have become less effective.

The graph shows the number of males infected with MRSA during their stay in hospital.



A programme of intensive use of antiseptics in hospitals has been used since 2005. Use the information given and your own scientific knowledge to explain the trends shown in the graph.

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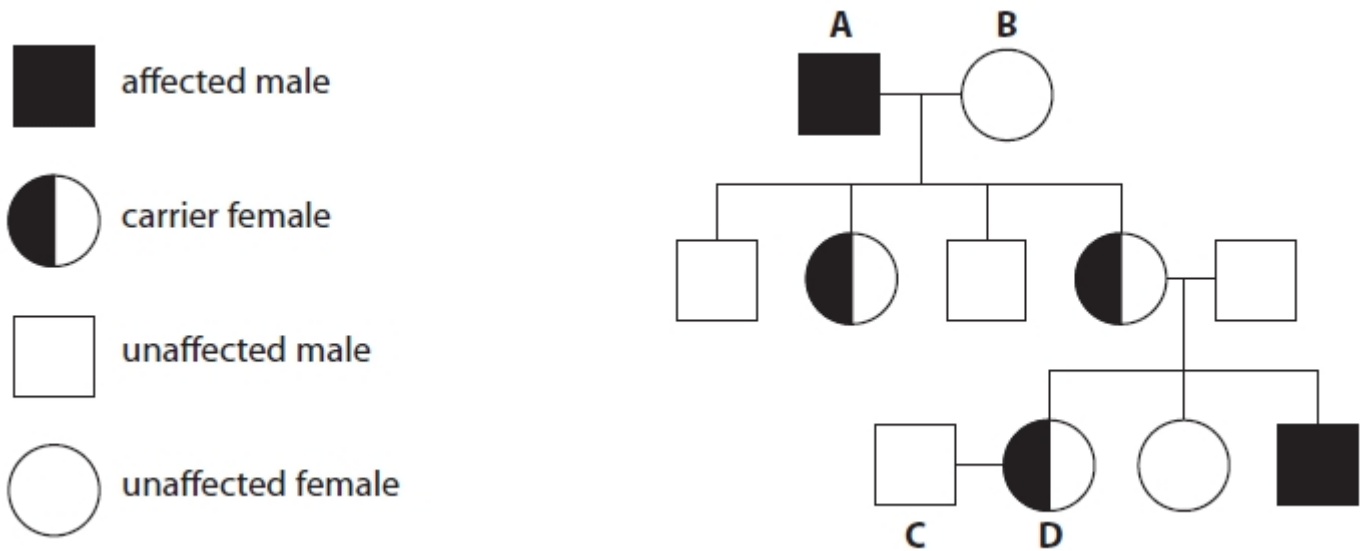
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Q28. Sex-linked genetic disorders

Haemophilia is a recessive sex-linked disorder.

This family pedigree shows the inheritance of haemophilia.



(a) (i) State the sex chromosomes of person **B**. (1)

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(ii) Explain why the male offspring from **A** and **B** do not have haemophilia. (2)

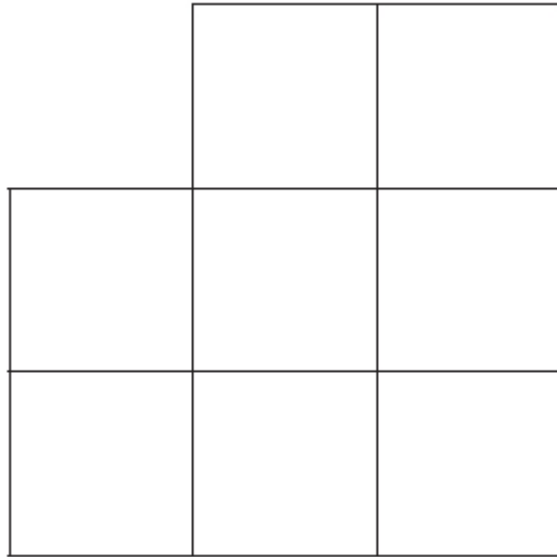
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(iii) Using the Punnett square, calculate the probability that individuals **C** and **D** could have a child with haemophilia. (3)



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(b) Haemophilia can be treated using a blood clotting factor produced in a fermenter.

The conditions inside a fermenter have to be carefully controlled.
Explain why **one** named condition must be controlled in a fermenter.

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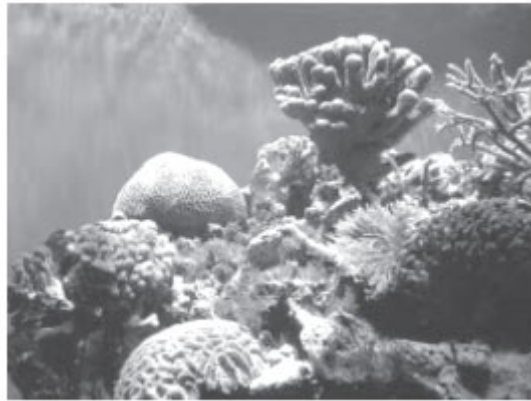
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Q29. Corals are animals that live on the sea bed.
The photograph shows some species of coral.



- (a) Corals can reproduce sexually, releasing sperm cells into the water.
The mass of DNA in one sperm cell from a species of coral is 0.5 picogram.
- (i) Suggest the mass of DNA that would be present in an unfertilised egg cell of the same species.

(1)

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- (ii) Complete the sentence by putting a cross (☐) in the box next to your answer.
The term used to describe the number of chromosomes in an egg or sperm cell is

(1)

- ☐ A diploid
☐ B gamete
☐ C haploid
☐ D zygote

- (iii) Complete the sentence by putting a cross (☐) in the box next to your answer.
The base pairs in DNA are

(1)

- ☐ A thymine with adenine, cytosine with guanine
☐ B thymine with guanine, adenine with cytosine
☐ C uracil with adenine, guanine with cytosine
☐ D uracil with thymine, guanine with cytosine

- (iv) Name the bond that joins the base pairs together.

(1)

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- (b) After fertilisation, mitosis takes place to form an embryo.
The embryo develops into new coral.

- (i) Describe mitosis.

(3)

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- (ii) Describe how the embryo develops into new coral.

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(Total for Question = 10 marks)

Q30.

The images show a normal red blood cell and a red blood cell from someone who has sickle cell disease. Sickle cell disease is a genetic disorder caused by two recessive alleles.



Normal red blood cell



Red blood cell from someone who has sickle cell disease

- (i) Complete the sentence by putting a cross (☒) in the box next to your answer.
An individual with sickle cell disease is said to be

(1)

- ☒ **A** a carrier for sickle cell disease
- ☒ **B** heterozygous
- ☒ **C** homozygous dominant
- ☒ **D** homozygous recessive

- (ii) Describe the main symptoms of sickle cell disease.

(3)

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Q31.

The bonds joining the two strands of a DNA molecule together are

(1)

- ☒ **A** weak peptide bonds
- ☒ **B** strong peptide bonds
- ☒ **C** weak hydrogen bonds
- ☒ **D** strong hydrogen bonds

(Total for question = 1 mark)

Q32.

Proteinase K is produced during protein synthesis.

(3)

[illegible]

Q33.

(4)

[illegible]

Q34.

(6)

[illegible]

Q35.

Duchenne muscular dystrophy is a sex-linked recessive genetic disorder caused by a mutation on a single gene on the X-chromosome.

The letter D can be used for the dominant allele and the letter d for the recessive allele.

Figure 5 shows the inheritance of Duchenne muscular dystrophy in a family.

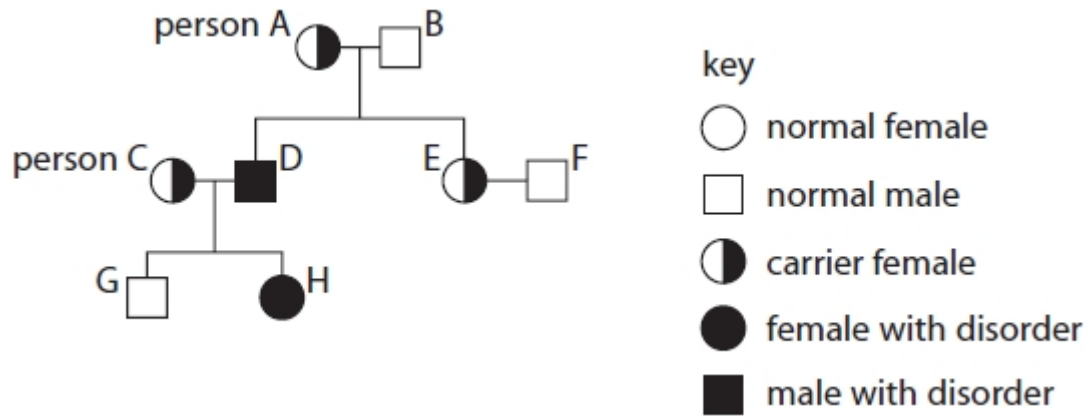


Figure 5

(i) What is the percentage chance of any child from person A inheriting the mutated allele?

(1)

- ☐ A 0%
- ☐ B 25%
- ☐ C 50%
- ☐ D 75%

(ii) Explain the conclusion that can be made about the genotype of person C.

(2)

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(Total for question = 3 marks)

Q36.

The enzyme proteinase K is used to extract DNA from skin cells.

(i) Explain why proteinase K is used to extract DNA from skin cells.

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(ii) Describe the safety precautions that should be used when handling human tissue in a laboratory.

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(iii) Proteinase K is usually stored at 4 °C.

Figure 10 shows the effect of storage temperature on the activity of proteinase K.

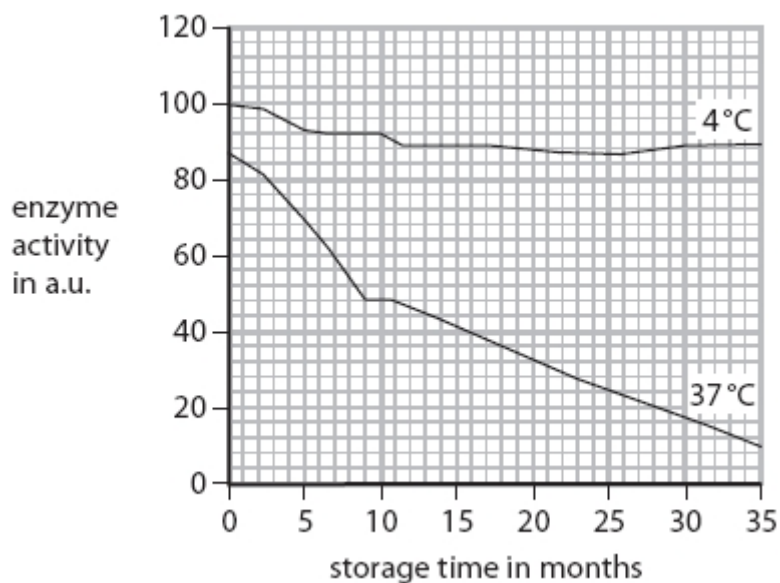


Figure 10

Explain how the activity of proteinase K changes when stored at 37 °C.

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(Total for question = 7 marks)

Q37.

The dodo was a flightless bird which is now extinct.
The photograph shows the skeleton of a dodo.



(a) (i) Explain why the dodo was placed in the kingdom Animalia.

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(ii) The dodo was classified as a chordate.

Using the information in the photograph, explain why scientists classified the dodo into the phylum Chordata.

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(iii) The binomial name for the dodo is *Raphus cucullatus*.

Complete the sentence by putting a cross (■) in the box next to your answer.

The name *Raphus* refers to the dodo's

(1)

- ☐ A family
☐ B genus
☐ C order
☐ D phylum

(b) The dodo lived on the small island of Mauritius. It became extinct in 1681.

Using your knowledge of natural selection, suggest why the dodo may have become extinct.

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(c) Complete the sentence by putting a cross (■) in the box next to your answer.

The formation of a new species due to geographical isolation is called

(1)

- ☐ A adaptation
- ☐ B competition
- ☐ C hybridisation
- ☐ D speciation

(d) Describe the causes of variation in a population.

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(Total for Question = 10 marks)

Q38.

There are four blood groups: A, B, AB and O.

Explain why males are more likely than females to have a sex-linked genetic disorder such as haemophilia.

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(Total for question = 3 marks)