GENETICS

REVISION QUESTIONS

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EXAM GUIDELINES

GENETICS AND INHERITANCE Paper 2: 45 marks	Term 2	4 weeks

CONTENT	ELABORATION
Introduction	❑ Mention of Mendel as the father of genetics
Concepts in inheritance	❑ Chromatin and chromosomes ❑ Genes and alleles ❑ Dominant and recessive alleles – The Law of Dominance ❑ Phenotype and genotype ❑ Homozygous and heterozygous
Monohybrid crosses	❑ Format for representing a genetics cross ❑ Mendel's Principle of Segregation ❑ Types of dominance: • Complete dominance – one allele is dominant and the other is recessive, such that the effect of the recessive allele is masked by the dominant allele in the heterozygous condition • Incomplete dominance – none of the two alleles of a gene is dominant over the other, resulting in an intermediate phenotype in the heterozygous condition • Co-dominance – both alleles of a gene are equally dominant whereby both alleles express themselves in the phenotype in the heterozygous condition ❑ Genetics problems involving each of the three types of dominance ❑ Proportion and ratio of genotypes and phenotypes
Sex determination	❑ 22 pairs of chromosomes in humans are autosomes and one pair of chromosomes are sex chromosomes/gonosomes ❑ Males have XY chromosomes and females have XX chromosomes ❑ Differentiate between sex chromosomes (gonosomes) and autosomes in the karyotypes of human males and females ❑ Representation of a genetic cross to show the inheritance of sex

CONTENT	ELABORATION
Sex-linked inheritance	❑ Sex-linked alleles and sex-linked disorders ❑ Genetics problems involving the following sex-linked disorders: • Haemophilia • Colour-blindness
Blood grouping	❑ Different blood groups are a result of multiple alleles ❑ The alleles I^A, I^B and i in different combinations result in four blood groups ❑ Genetics problems involving the inheritance of blood type
Dihybrid crosses	❑ Mendel's Principle of Independent Assortment ❑ Dihybrid genetics problems ❑ Determination of the proportion/ratio of genotypes and phenotypes
Genetic lineages/pedigrees	❑ A genetic lineage/pedigree traces the inheritance of characteristics over many generations ❑ Interpretation of pedigree diagrams
Mutations	❑ Definition of a mutation ❑ Effects of mutations: harmful mutations, harmless mutations and useful mutations ❑ Mutations contribute to genetic variation ❑ Definition of gene mutation and chromosomal mutation ❑ Mutations lead to altered characteristics in each of the following genetic disorders: • Haemophilia – absence of blood-clotting factors • Colour-blindness – due to absence of the proteins that comprise either the red or green cones/photoreceptors in the eye • Down syndrome – due to an extra copy of chromosome 21 as a result of non-disjunction during meiosis
Genetic engineering	❑ Genetic engineering uses biotechnology to satisfy human needs: • Stem cell research – sources and uses of stem cells • Genetically modified organisms – brief outline of process (names of enzymes involved are not required) and benefits of genetic modification • Cloning – brief outline of process and benefits of cloning
Paternity testing	❑ The role of each of the following in paternity testing: • Blood grouping • DNA profiles
Genetic links	❑ Mutations in mitochondrial DNA used in tracing female ancestry

- **Monohybrid Crosses - Questions 1 – 4**
- **Blood groups - Question 5 – 10**
- **Dihybrid crosses - Questions 11 – 19**
- **Pedigree diagrams - Questions 20 -24**
- **Sex-linked disorders - Questions 25 – 30**
- **Genetic engineering - Questions 31-32**

MULTIPLE CHOICE QUESTIONS:

QUESTION 1.1

1.1.2 When an individual that is homozygous dominant for a particular characteristic is crossed with an individual that is homozygous recessive for the characteristic, all the offspring would be ...

A homozygous dominant.
B homozygous recessive.
C heterozygous.
D pure-bred.

QUESTION 1.2

1.1.1 A genetic cross where both alleles of a gene are equally dominant is an example of …

A codominance.
B a dihybrid cross.
C incomplete dominance.
D complete dominance.

QUESTION 1.3 & 1.4

1.1.5 Two red-eyed fruit flies were mated and they produced 150 flies with red eyes and 48 flies with white eyes. From this information we can reasonably conclude that the ...

A white-eyed condition is recessive and both parents are heterozygous.
B red-eyed condition is dominant and both parents are homozygous for red eyes.
C white-eyed condition is recessive and both parents are homozygous for red eyes.
D red-eyed condition is recessive and both parents are heterozygous.

1.1.6 Which ONE of the following monohybrid crosses will result in a phenotypic ratio of 1 : 1? A cross where ...

A both parents are heterozygous.
B both parents are homozygous for the dominant characteristic.
C one parent is heterozygous and the other parent is homozygous recessive.
D one parent is heterozygous and the other parent is homozygous dominant.

QUESTION 1.5

1.1.8 One reason why some people are opposed to genetic modification is that ...

A the use of herbicides is reduced.
B crop yields are improved.
C the taste and quality of food is improved.
D the potential impact on human health is unknown.

QUESTION 1.6

1.1.2 The genotype for an individual with blood group A is …

A I^AI^A only.
B I^AI^A or ii.
C I^Ai only.
D I^AI^A or I^Ai.

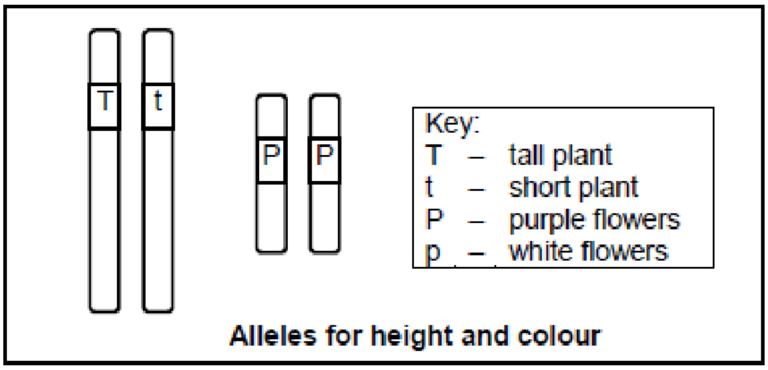
QUESTION 1.7

1.1.10 Four different phenotypes are possible in the F_1-generation if the parents' blood groups are ...

A B and B.
B A and B.
C O and AB.
D AB and AB.

QUESTION 1.8

1.1.3 The diagram below shows the alleles for height and flower colour in a flowering plant.



The plant is ...

A homozygous dominant for height and heterozygous for flower colour.
B heterozygous for height and homozygous dominant for flower colour.
C homozygous recessive for height and homozygous dominant for flower colour.
D heterozygous for height and heterozygous for flower colour.

QUESTION 1.9

1.1.7 Which ONE of the following resulted from Gregor Mendel's experiments with pea plants?

A The 'law' of inheritance of acquired characteristics
B The principle of independent assortment
C The 'law' of use and disuse
D The theory of evolution

QUESTION 1.10 & 1.11

QUESTIONS 1.1.8 AND 1.1.9 REFER TO THE INFORMATION BELOW.

In pea plants yellow seed colour (Y) is dominant over green seed colour (y). Smooth seed texture (S) is dominant over wrinkled seed texture (s).

A student crossed a plant which had yellow wrinkled seeds with a plant which had green smooth seeds.

1.1.8 Which ONE of the following shows possible alleles present in a gamete that is produced by the plant with yellow wrinkled seeds?

A YYss
B yySS
C yS
D Ys

1.1.9 Which ONE of the following is a possible representation of the genotypes of the P_1 generation?

A YYSS x yyss
B Yyss x yySs
C YYSS x yySs
D Yyss x YySs (9 x 2)

QUESTION 1.12

1.1.1 In a monohybrid cross, the genotype of all the F_1-plants is Aa. If the F_1-plants are crossed, what percentage of the F_2-generation will have the dominant phenotype?

A 25
B 50
C 75
D 100

QUESTION 1.13

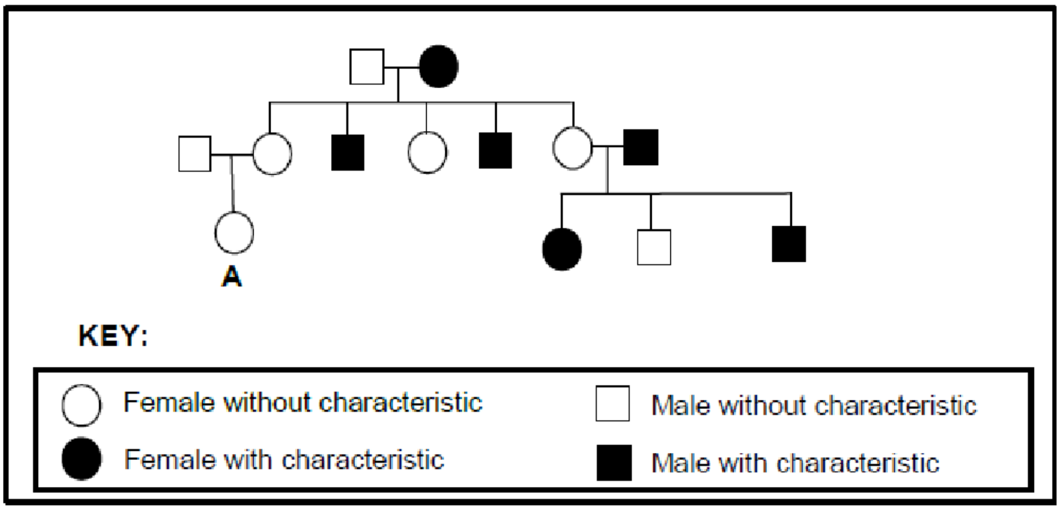
1.1.2 How many alleles control the human blood group?

A 4
B 3
C 2
D 1

QUESTION 1.14

QUESTION 1.1.8 IS BASED ON THE PEDIGREE DIAGRAM BELOW.

The pedigree diagram shows inheritance of a certain characteristic.



1.1.8 Use X^N and X^n to represent the relevant alleles of the characteristic. The possible genotype(s) of individual **A** will be …

A X^NX^n only.
B X^NX^N only.
C X^NX^N and X^NX^n.
D X^NX^N and X^nX^n.

QUESTION 1.15

1.1.9 A man with blood group **A** and a woman with blood group **B** have children. Their first child has blood group **AB** and the second child has blood group **O**.

Which prediction about the blood groups of future children is CORRECT?

A Future children have a 50% chance of having blood group **AB** and a 50% chance of having blood group **O**.
B All will have blood group **A** or **B**.
C Each future child will have an equal chance of having blood group **A**, **B**, **AB** or **O**.
D None of the future children will have blood group **A**.

QUESTION 1.16

1.1.4 A red flowering plant is crossed with a white flowering plant. All the offspring have pink flowers. When the two pink flowering plants are crossed, the next generation of flowering plants will have flowers that are …

A pink only.
B red only.
C white only.
D pink, red and white.

QUESTION 1.17 & 1.18

QUESTIONS 1.1.8 AND 1.1.9 ARE BASED ON THE GENETIC CROSS BELOW.

Two rose plants with pink flowers were crossed and it was found that although most of the offspring had pink flowers, some had red and some had white flowers.

1.1.8 If 152 plants were produced in the F_1-generation, how many of these plants were expected to have pink flowers?

A 38
B 114
C 76
D 152

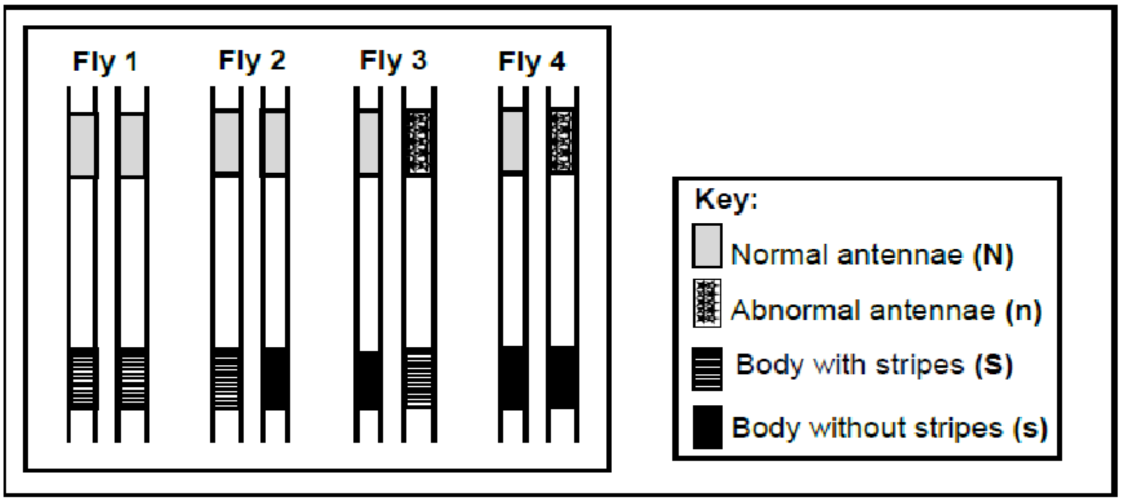
1.1.9 Breeders prefer to produce red roses. If the allele for red is **R** and the allele for white is **W**, which ONE of the following crosses would give the highest proportion of red roses?

A RR x WW
B RW x RW
C WW x RW
D RR x RW

QUESTION 1.19, 1.20 & 1.21

QUESTIONS 1.1.8 TO 1.1.10 ARE BASED ON THE DIAGRAM BELOW.

The diagram shows one pair of homologous chromosomes found in each of four fruit flies. The alleles for antenna shape (normal or abnormal) and body pattern (with stripes or without stripes) are indicated on the chromosomes.



1.1.8 Which fly is homozygous for antennae shape and heterozygous for body pattern?

A Fly **4**
B Fly **3**
C Fly **2**
D Fly **1**

1.1.9 What is the genotype of Fly **3**?

A NnSS
B NNSs
C NnSs
D NNss

1.1.10 Which ONE of the following will represent the possible gametes for Fly 4?

A Ns, NS
B NS
C nS
D Ns, ns (10 x 2)

QUESTION 1.22

1.1.3 What is the percentage chance of a woman having a female child?

A 25%
B 100%
C 50%
D 75%

QUESTION 1.23

1.1.5 If a recessive allele on the X-chromosome is passed on to the offspring it is an example of …

A sex-linked inheritance.
B incomplete dominance.
C multiple alleles.
D co-dominance.

Biological terms

DESCRIPTIONS	TERM
1. An allele that does not influence the phenotype when found in the heterozygous condition.	
2. A section of a DNA molecule that codes for a specific characteristic.	
3. The production of genetically identical copy of an organism using biotechnology.	
4. Two or more alternative forms of a gene at the same locus.	
5. A genetic cross involving two characteristics.	
6. A genetic disorder characterised by the absence of a blood-clotting factor.	
7. The sex chromosomes in an organism.	
8. The physical or functional expression of a gene.	
9. A genetic cross involving two different characteristics.	
10. The position of a gene on a chromosome.	
11. A diagram showing the inheritance of genetic disorders over many generations.	
12. Undifferentiated cells that can develop into any cell type.	
13. Type of inheritance where none of the two alleles is dominant over the other and an intermediate phenotype is produced.	

MENDEL'S LAWS:

LAW OF DOMINANCE:

- When two organisms with pure breeding✓
- contrasting traits✓are crossed
- all the individuals of the F_1 generation will display the dominant trait✓

OR

- If an organism is heterozygous✓
- the dominant allele✓
- will determine the phenotype✓ (3)

MENDEL'S PRINCIPLE OF SEGREGATION:

- The pair of alleles✔ on homologous chromosomes separate
- during meiosis✔/ anaphase/ gamete formation, so that
- only one allele of each pair is present in the gamete✔ / offspring
- can acquire one allele from each parent

LAW OF INDEPENDENT ASSORTMENT:

- Alleles of a gene for each characteristic segregate independently✔
- of the alleles of a gene for another characteristic✔
- the alleles for each gene will therefore come together randomly✔
  During gamete formation

Monohybrid crosses:

QUESTION 1

2.2 In dogs rough hair (**H**) is dominant to smooth hair (**h**). A heterozygous rough-haired dog is mated with a smooth-haired dog.

Represent a genetic cross to show the phenotypic ratio of the puppies. **(6)**

QUESTION 2

3.3 A farmer has an orchard of apple trees. Each apple produced expressed red and yellow colour equally (red-yellow apples). To extend his apple orchard, the farmer collected seeds from the red-yellow apples and grew them.

When the new trees matured, he found that some of the trees produced red apples (**R**), others produced yellow apples (**Y**) and the rest produced apples that were red-yellow.

3.3.1 Use a genetic cross to explain his results in the F_1 generation. (6)

3.3.2 What proportion of apples in the F_1 generation will be red-yellow apples? (1)

3.3.3 The farmer saw that the red-yellow apples sell the best. Name the phenotypes of the trees that he should cross in the future in order to ensure that any new trees will definitely produce only red-yellow apples. (2)
(9)

QUESTION 3

2.1 In rabbits, black fur is produced by the allele (**B**) and white fur by the allele (**b**).

The table below shows the genotypes of some rabbits.

RABBIT	GENOTYPE
1	BB
2	Bb
3	bb

2.1.1 What is the phenotype:

(a) Produced by the recessive allele (1)

(b) Of rabbit **2** (1)

2.1.2 Give the NUMBER only (**1**, **2** or **3**) of the rabbit(s) that is/are:

(a) Pure-bred

(b) Homozygous dominant (3)

2.1.3 Use a genetic cross to show the percentage chance of rabbits **1** and **3** having offspring with white fur. (6)

(11)

QUESTION 4

2.6 You have two rose plants, both with pink flowers. You cross them and find that, while most of the offspring are pink, some are red and some are white.

Use a genetic cross to show how breeding two pink flowering plants can result in pink, red and white flowering plants.

Use the letter **R** for the red allele and **W** for the white allele. **(6)**

Blood groups:

QUESTION 5

3.4 Human blood groups are controlled by multiple alleles.

3.4.1 Name ALL the alleles that control human blood groups. (3)

3.4.2 How many of the alleles named in QUESTION 3.4.1 can any individual inherit? (1)

3.4.3 Give a reason for your answer to QUESTION 3.4.2. (2)

3.4.4 A man has blood group **A** and his wife has blood group **B**. Their first child has blood group **AB** and the second child has blood group **O**.

What can one conclude about the blood groups of their future children? (3)

(9)

QUESTION 6

3.2 Human blood groups are controlled by multiple alleles.

3.2.1 How many alleles control blood groups? (1)

3.2.2 Which TWO alleles are codominant in the inheritance of blood groups? (2)

3.2.3 A man is heterozygous for blood group A and marries a woman who has blood group O. Use a genetic cross to show the phenotypic ratio of their offspring. (7)

(10)

QUESTION 7

3.2 A man has blood type **AB** and his sister has blood type **O**.

Determine the genotypes and phenotypes of their parents by doing a genetic cross. **(6)**

QUESTION 8

2.3 Mr and Mrs Phonela are concerned that their baby girl does not appear to resemble either of them. They suspect that the baby they were given at the hospital was not theirs. Mr Phonela is blood type **AB**, Mrs Phonela is blood type **B** and the baby they were given is blood type **O**.

2.3.1 Give the possible genotypes of:

(a) Mrs Phonela (2)

(b) The baby girl (1)

2.3.2 Explain why the baby girl with blood type **O** cannot be Mr and Mrs Phonela's daughter. (3)

2.3.3 Explain why the use of blood type for paternity testing is not conclusive. (2)

2.3.4 Using your knowledge of sex chromosomes, explain why the sex of a child is determined by the male gamete. (5)
(13)

QUESTION 9

2.2 The father of a child can be determined by analysing blood groups.

2.2.1 Explain how an analysis of blood groups can be used to determine paternity. (5)

2.2.2 A man and a woman both have blood group **B**.

Use a genetic cross to show how it is possible for them to have a child with blood group **O**. (6)
(11)

QUESTION 10

1.3 THREE babies (**X**, **Y** and **Z**) from three different sets of parents were born in a hospital. TWO of the babies were accidentally swopped. Blood groups of the parents were used to establish which baby belonged to which set of parents.

The blood groups of the parents and the babies are shown in the table below.

PARENTS	BABIES	BLOOD GROUPS OF PARENTS AND BABIES		
		Mother	Father	Baby
Mr and Mrs Pule	X	B	A	A
Mr and Mrs Chaka	Y	AB	B	O
Mr and Mrs Tau	Z	O	B	AB

1.3.1 Which TWO babies (from **X**, **Y** and **Z**) were swopped? (2)

1.3.2 Give the surnames of the biological parents of the two babies that were swopped. Write the correct surnames of the parents next to the letter (**X**, **Y** or **Z**). (2)

1.3.3 Give the possible genotype(s) of Mr Pule that could have produced baby **X**. (2)
(6)

Dihybrid crossing:

QUESTION 11

1.4 About 70% of people get a bitter taste when a substance called PTC is placed on their tongue. They are referred to as 'tasters'. All other people are unable to taste PTC and are referred to as 'taste-blind'. The 'taster' allele is dominant and the 'taste-blind' allele is recessive.

Also in humans, normal skin pigmentation is dominant to the albino condition (no pigmentation).

The letters in the key below must be used to represent the alleles for the different characteristics above.

Key:
T – taster
t – taste-blind
N – normal skin pigmentation
n – no skin pigmentation (albino)

A man who is heterozygous for both tasting PTC and skin pigmentation marries a woman who is taste-blind for PTC and is an albino.

1.4.1 State why the example above represents a dihybrid cross. (1)

1.4.2 Write down:

(a) The genotype of the woman (1)

(b) ALL the possible gametes of the man (2)

1.4.3 The man and woman have a child whose genotype is **ttNn**. What is the child's phenotype? (2)

1.4.4 A man and a woman are only able to produce children with the genotype **TtNn**. The woman's genotype is **ttnn**. State the only possible genotype of the man. (2)

(8)

QUESTION 12

2.2 In humans the allele for short fingers (brachydactyly), represented by **B**, is dominant over the allele for normal fingers (**b**). The allele for curly hair (**H**) is dominant over the allele for straight hair (**h**).

Andrew, with genotype **Bbhh**, married Susan, with genotype **bbHh**.

2.2.1 State how the phenotypes of Andrew and Susan differ from each other. (2)

2.2.2 Give ALL the possible genotypes of the gametes produced by Andrew. (2)

(4)

QUESTION 13

2.4 In guinea pigs the allele for a black coat colour (**B**) is dominant over the allele for a white coat colour (**b**). The allele for a rough coat texture (**R**) is dominant over the allele for a smooth coat texture (**r**).

A male guinea pig which is homozygous dominant for coat colour and heterozygous for coat texture was mated with a white female guinea pig that is heterozygous for coat texture.

2.4.1 How many characteristics of the guinea pigs are being investigated? (1)

2.4.2 Give the possible gametes of the female guinea pig. (2)

2.4.3 Two of the offspring of the F_1-generation were crossed. The genotypes of their offspring are represented in the Punnett square below, except at **(i)** and **(ii)**.

	BR	**Br**	**bR**	**br**
Br	BBRr	BBrr	BbRr	**(i)**
br	BbRr	Bbrr	**(ii)**	bbrr

Give the:

(a) Genotype of the offspring at **(i)** (1)

(b) Phenotype of the offspring at **(ii)** (1)

(c) Phenotypic ratio of all the offspring (2)

2.4.4 The parents in QUESTION 2.4.3 produced 64 offspring during their lifetime. How many of them would have had black, rough coats? Show ALL working. (2)

2.4.5 The owner of a pet shop would like to breed white guinea pigs with a smooth coat texture. In order to do this, he wants to breed a female that has a white, smooth coat with a male that has a black, rough coat.

State what the genotype of the male should be for him to breed white guinea pigs with smooth coats. (2)
(11)

QUESTION 14

1.4 The size and colour of unripe fruit in a plant species is genetically controlled. The allele for small fruit (**b**) is recessive to the allele for big fruit (**B**). The allele for yellow fruit colour (**g**) is recessive to the allele for green fruit (**G**).

1.4.1 State:

(a) The phenotype of the plant with the genotype **BbGg** (2)

(b) ALL possible genotypes of the gametes produced by the plant mentioned in QUESTION 1.4.1(a) (2)

1.4.2 In a cross between two plants with genotypes **BBGG** and **bbgg** what percentage of the offspring will be homozygous for both characteristics? (2)
(6)

QUESTION 15

3.1 In rice plants the allele for high yield (**H**) is dominant over the allele for low yield (**h**). The allele for a tall stem (**T**) is dominant over the allele for a short stem (**t**).

There are two varieties of rice plants, **A** and **B**.
The genotype of variety **A** is **HHtt**.
The genotype of variety **B** is **hhTT**.

A plant breeder wants to produce a rice plant variety with a high yield and a short stem.

3.1.1 Give the phenotype of variety **A**. (2)

3.1.2 Give ALL the possible genotypes of the gametes of variety **B**. (1)

3.1.3 Give the genotype(s) of the variety the plant breeder wants to produce. (2)

3.1.4 Explain why the plant breeder would want to produce a rice plant with a short stem. (1)

3.1.5 Describe how the plant breeder would be able to produce rice plants with a high yield and short stems only. (2)
(8)

QUESTION 16

2.1 The leaf colour in a plant is controlled by two alleles, green (**G**) and yellow (**g**). Thorns on plant stems are controlled by two alleles, presence of thorns (**T**) and no thorns (**t**).

Two plants with the genotypes **GGTT** and **ggtt** were crossed. Their offspring were then left to pollinate each other.

The table below shows the possible genotypes of the offspring of the second generation. Genotypes **(i)** and **(ii)** have been left out.

Gametes	**GT**	**Gt**	**gT**	**gt**
GT	GGTT	GGTt	GgTT	GgTt
Gt	GGTt	GGtt	**(i)…**	Ggtt
gT	GgTT	GgTt	ggTT	ggTt
gt	GgTt	Ggtt	ggTt	**(ii)…**

2.1.1 Give the:

(a) Genotype of **(i)** (1)

(b) Phenotype of **(ii)** (2)

2.1.2 List the FOUR genotypes of the offspring of the second generation that would be phenotypically different from the original pair of parents. (4)
(7)

QUESTION 17

1.6 Coat colour in mice is controlled by two alleles, black (**B**) and grey (**b**). Tail length is controlled by two alleles, long (**T**) and short (**t**).

The Punnett square below shows a part of the cross between two mice. Genotype **(i)** has been left out.

Parent 1

Parent 2

Gametes	**BT**	**Bt**	**bT**	**bt**
Bt	BBTt	BBtt	BbTt	Bbtt
Bt	BBTt	BBtt	BbTt	Bbtt
Bt	BBTt	BBtt	**(i)**	Bbtt
Bt	BBTt	BBtt	BbTt	Bbtt

1.6.1 Give the:

(a) Genotype of parent **1** (2)

(b) Phenotype of parent **2** (2)

(c) Genotype of offspring **(i)** (1)

1.6.2 What percentage of the offspring above is grey with short tails? (1)

1.6.3 State the genotypes of TWO gametes from the table above that will result in offspring that are heterozygous for both traits, if fertilisation occurs. (2)
(8)

QUESTION 18

1.4 Mendel observed some characteristics of the pea plant (*Pisum sativum)* which he suggested were controlled by inherited factors. He conducted a series of experiments in which he crossed pea plants with contrasting phenotypes to obtain the offspring of the $\mathbf{F_1}$ generation. At first his crosses were simple and involved only one pair of characteristics.

Mendel counted the number of offspring showing each of the variations.

His results are shown in the table below.

PLANT PART	CHARACTERISTIC	P_1 GENERATION	F_1 GENERATION
Seed	Seed texture	Round x wrinkled	All round
	Seed colour	Yellow x green	All yellow
Pod	Pod texture	Full x constricted	All full
	Pod colour	Green x yellow	All green
Flowers	Flower colour	Violet x white	All violet
Stem	Location of flower on stem	Axial x terminal	All axial
	Height of stem	Tall x short	All tall

1.4.1 Give the term for:

(a) The *inherited factors* that Mendel referred to (1)

(b) A cross involving only ONE characteristic (1)

1.4.2 Name the female structure of the flower where meiosis occurs. (1)

1.4.3 Use the information in the table above to give the NUMBER of EACH of the following:

(a) Characteristics of pods (1)

(b) Alleles for seed characteristics (1)

1.4.4 Give the characteristic that is:

(a) Dominant for flower colour (1)

(b) Recessive for stem height (1)

1.4.5 If the individuals of the $\mathbf{F_1}$ generation are crossed, how many phenotypes for seed colour would be expected in the $\mathbf{F_2}$ generation? (1)
(8)

QUESTION 19

3.3 In a plant species two characteristics, flower colour and plant height, were studied. Each of these characteristics has two variations: flowers may be red or white in colour and the plants may be tall or short.

Plants that are heterozygous for flower colour have red flowers and plants that are homozygous recessive for plant height are short.

The alleles for each characteristic are shown in the table below.

CHARACTERISTIC	DOMINANT ALLELE	RECESSIVE ALLELE
Flower colour	F	f
Plant height	H	h

3.3.1 What is the term given for a genetic cross involving two characteristics? (1)

3.3.2 Give the:

(a) Dominant phenotype for flower colour (1)

(b) Recessive phenotype for plant height (1)

(c) Phenotype of a plant that is heterozygous for flower colour and homozygous dominant for plant height (2)

(d) Genotype of a white flowering, short plant (2)

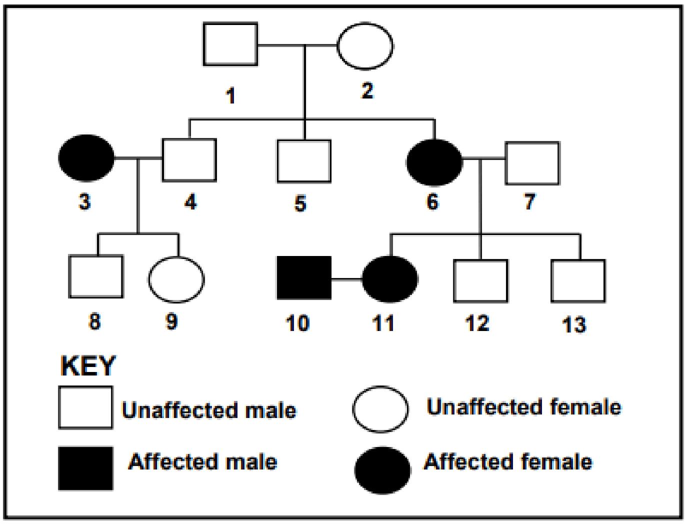
3.3.3 State Mendel's Law of Dominance. (3)
(10)

Pedigree diagrams:

QUESTION 20

2.2 A genetic disorder, phenylketonuria (PKU), is caused by a recessive allele (**n**).

An individual with the disorder is described as affected and an individual without it is described as unaffected. The pedigree diagram below illustrates inheritance of this disorder in a family.



2.2.1 Give the possible genotype(s) of individual **4**. (2)

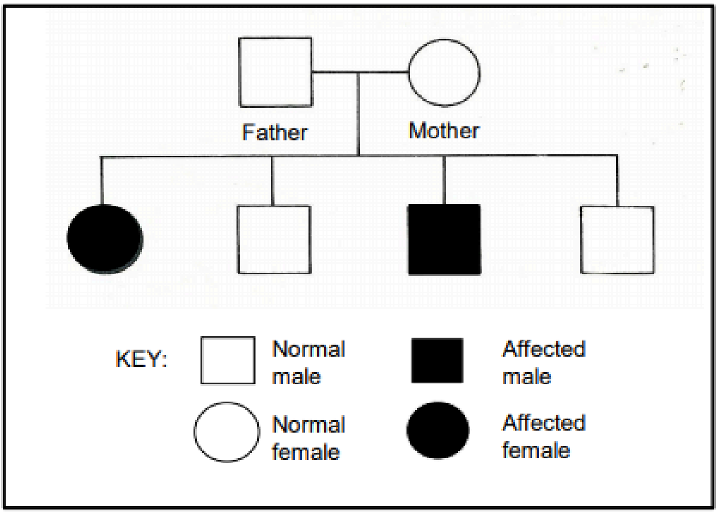
2.2.2 How many individuals in the second generation (individuals **3** to **7**) are homozygous recessive? (1)

2.2.3 Give the NUMBER only of any TWO individuals in the third generation (individuals **8** to **13**) that are heterozygous. (2)

2.2.4 Using information from the pedigree diagram above, explain why the allele for PKU cannot be sex-linked. (3)
(8)

QUESTION 21

3.5 The pedigree diagram below shows the pattern of inheritance of a certain genetic disorder controlled by a recessive allele. The dominant allele is represented by **N** and the recessive allele by **n**.



3.5.1 Explain why both parents must be heterozygous for this characteristic. (2)

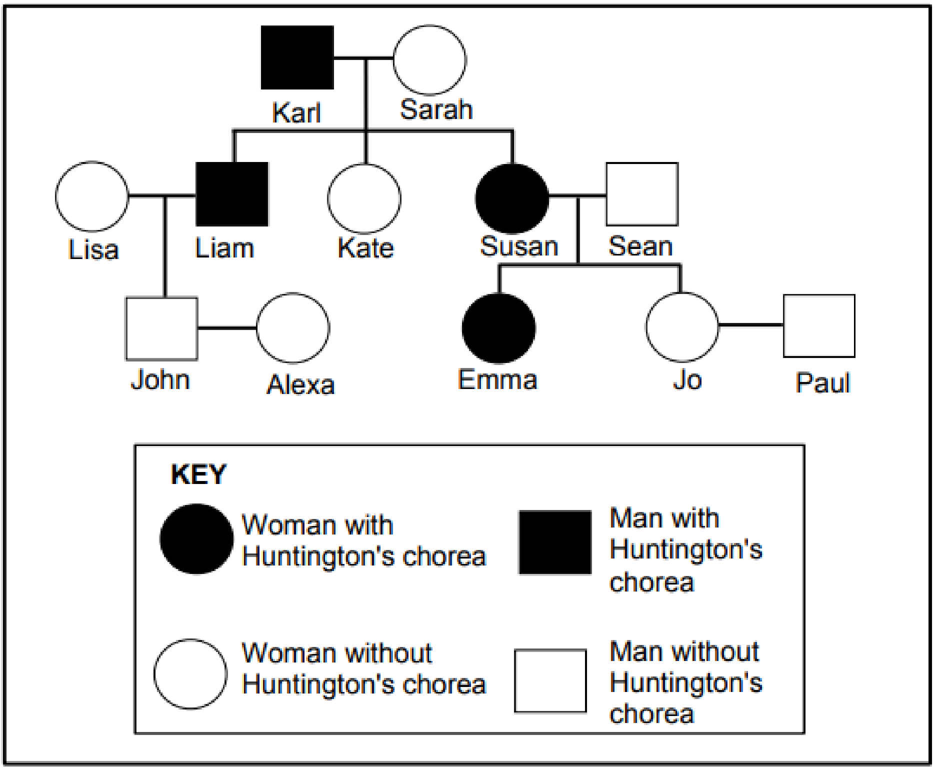
3.5.2 Give the possible genotype(s) of the normal children. (2)

3.5.3 Provide evidence from the pedigree diagram to show that this characteristic is not sex-linked. (2)
(6)

QUESTION 22

2.4 Huntington's chorea is a disease caused by a gene mutation that results in the degeneration of brain tissue. It is caused by a dominant allele (**H**).

The pedigree diagram below shows the inheritance of this disorder in a family.



2.4.1 What is:

(a) Susan's phenotype (1)

(b) Sarah's genotype (1)

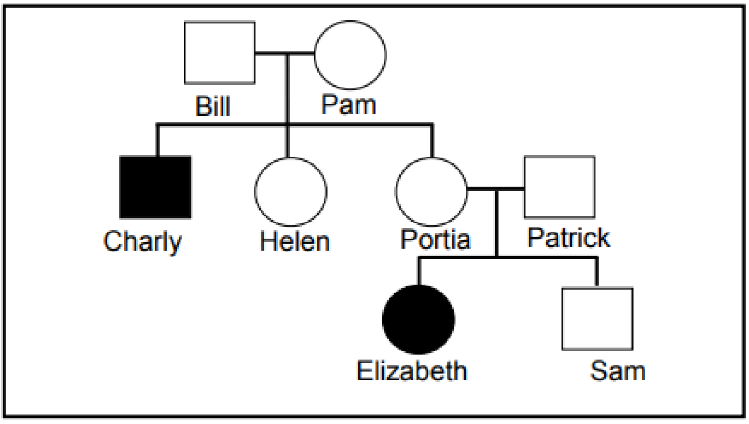
2.4.2 Emma plans to have a baby. What must the father's genotype be so that there is a 50% chance that their child will not have Huntington's chorea? (1)

2.4.3 Explain your answer to QUESTION 2.4.2. (3)
(6)

QUESTION 23

2.5 Tay-Sachs disease is caused by an autosomal recessive allele (**n**). Children with Tay-Sachs disease lose motor skills and mental functions. Over time, the children become blind, deaf, mentally retarded and paralysed. Tay-Sachs children die by the age of five.

The pedigree diagram below shows the inheritance of Tay-Sachs disease in a family.



[Source: www.tay-sachs.org]

2.5.1 Give:

(a) Charly's phenotype (2)

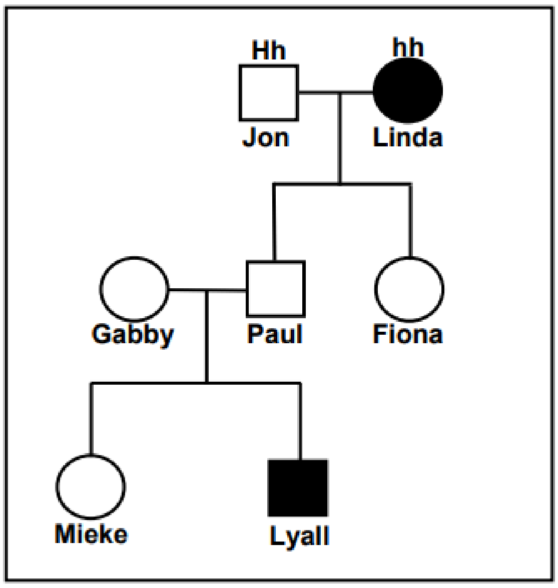
(b) Portia's genotype (2)

(c) Bill's genotype (2)

2.5.2 Explain why Patrick is normal, but a carrier of Tay-Sachs disease. (2)
(8)

QUESTION 24

2.2 The diagram below shows the pattern of inheritance of deafness in a family. The letter **H** represents the allele for hearing and **h** represents the allele for deafness.



2.2.1 How many of EACH of the following are represented in this diagram?

(a) Males (1)

(b) Generations (1)

2.2.2 Give the:

(a) Phenotype of Jon (1)

(b) Genotype of Paul (1)

2.2.3 Both Lyall's parents can hear, yet he is deaf.

Explain how he inherited deafness. (2)

2.2.4 Lyall marries a woman who is homozygous dominant for hearing. Use a genetic cross to show the percentage chance of them having a deaf child. (7)

(13)

Sex-linked disorders:

QUESTION 25

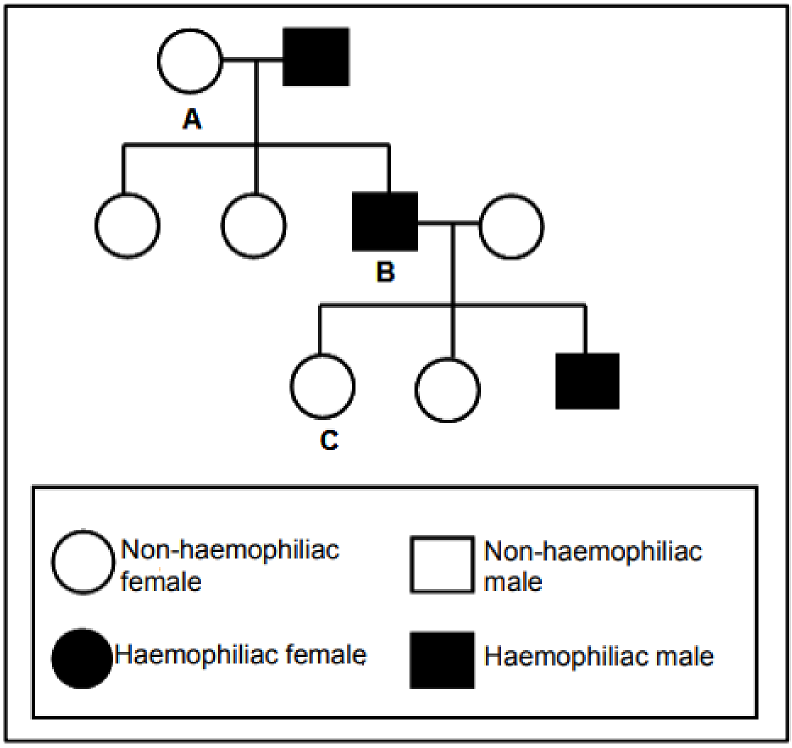
3.3 Haemophilia is a genetic disorder caused by a recessive allele on the X chromosome.

A haemophiliac female marries a normal male. Explain why all their sons will be haemophiliacs. **(4)**

QUESTION 26

1.5 Haemophilia is a genetic disorder resulting in the abnormal clotting of blood. It is caused by a recessive allele that is carried on the **X**-chromosome. The allele for normal clotting is $\mathbf{X^H}$ and the allele for haemophilia is $\mathbf{X^h}$.

The inheritance of haemophilia in a family is shown in the diagram below.



1.5.1 Give the percentage of the males with haemophilia in this family. (1)

1.5.2 Give the phenotype for individual **A**. (1)

1.5.3 Give the genotype for individual:

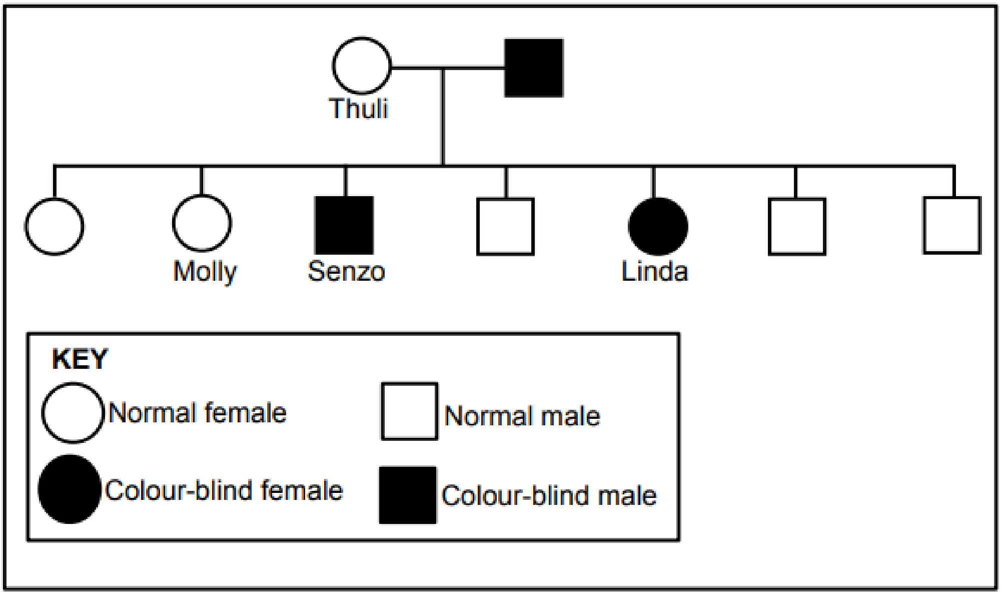
(a) **B** (1)

(b) **C** (2)
(5)

QUESTION 27

2.3 Colour-blindness (Daltonism) is a sex-linked disorder caused by a recessive allele (**X^d**).

The diagram below shows the inheritance of this disorder in a family.



2.3.1 Give the:

(a) Phenotype of Senzo (1)

(b) Genotype of Thuli (1)

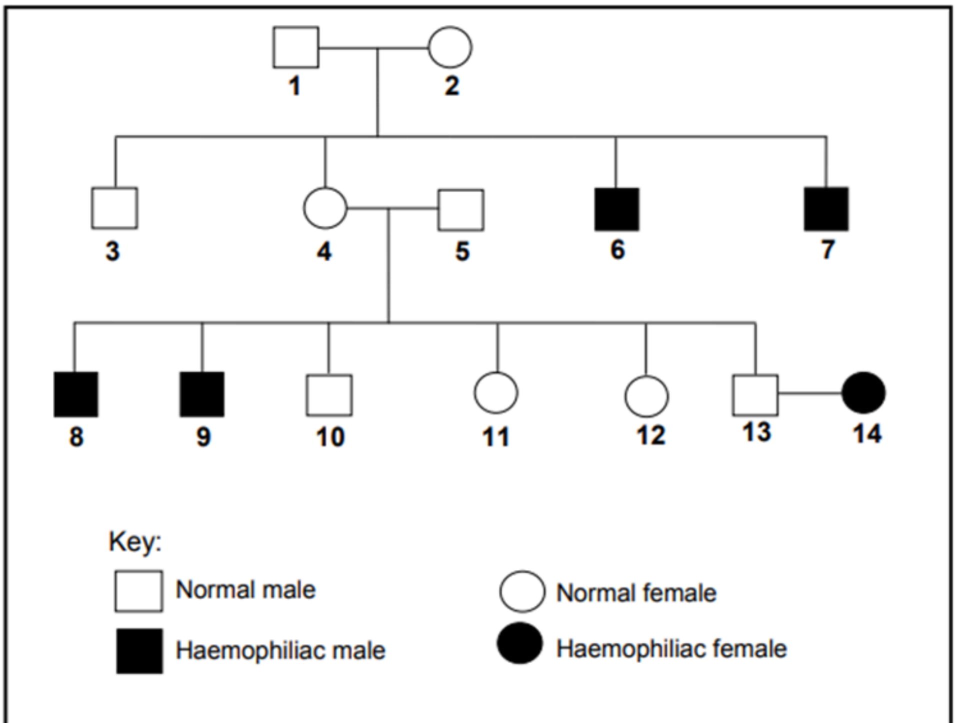
2.3.2 Describe how Linda inherited colour-blindness. (2)

2.3.3 Explain why there are generally more males than females with colour-blindness in a population. (4)

2.3.4 Molly married a 'normal male'. Use a genetic cross to show the possible genotypes and phenotypes of their children. (6)
(14)

QUESTION 28

3.5 The pedigree diagram below shows the inheritance of haemophilia in a family. The allele causing haemophilia is represented by X^h and the normal allele is represented by X^H.



Inheritance of haemophilia

3.5.1 Determine the:

(a) Phenotype of individual **4** (1)

(b) Genotype of individual **2** (2)

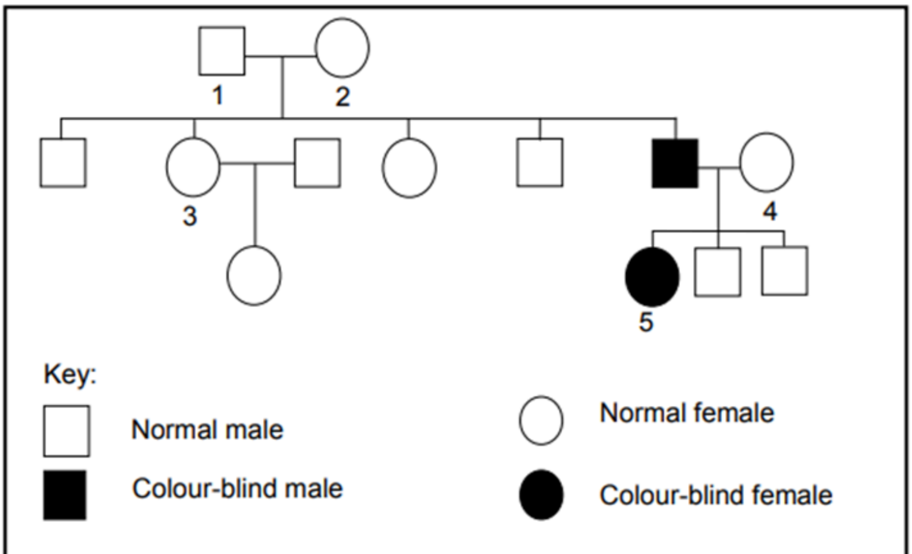
3.5.2 Explain why females have a smaller chance of suffering from haemophilia. (3)

3.5.3 Represent a genetic cross to show the percentage chance of individuals **13** and **14** having a haemophiliac son. (7)

(13)

QUESTION 29

2.1 The pedigree diagram below shows the inheritance of colour-blindness (Daltonism) in a family. Colour-blindness is sex-linked and is caused by a recessive allele (**d**). The ability to see colour normally is caused by a dominant allele (**D**).



Inheritance of colour-blindness

2.1.1 How many of the male offspring of parents **1** and **2** were normal? (1)

2.1.2 State the genotype of:

(a) Individual **2** (2)

(b) Individual **5** (2)

2.1.3 A person with a recessive allele for colour-blindness may not be colour-blind. Explain why males with an allele for colour-blindness are always colour-blind. (4)

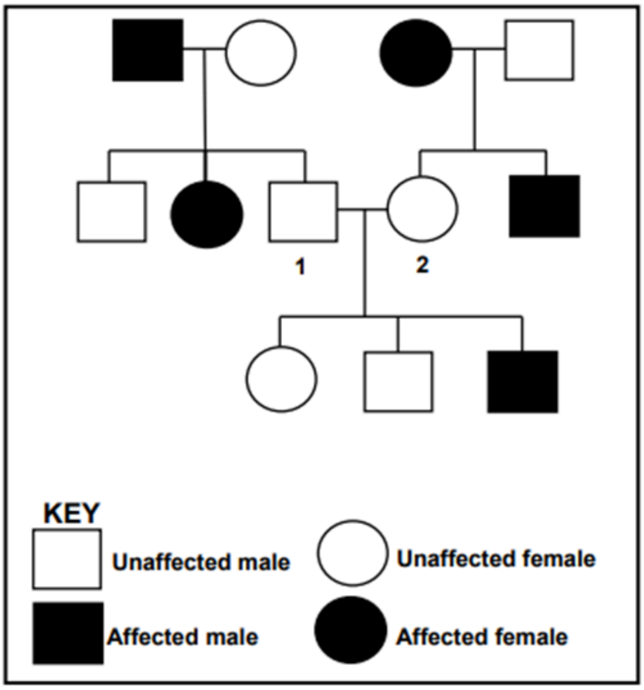
2.1.4 If individual **5** marries a normal male, what percentage of their daughters will have an allele for colour-blindness, but will NOT be colour-blind? (2)

(11)

QUESTION 30

3.3 A lack of immunity to infections (agammaglobulinemia) is a sex-linked recessive genetic disorder in humans. The dominant allele is represented by $\mathbf{X^A}$ and the recessive allele is represented by $\mathbf{X^a}$.

An individual with the disorder is described as affected and an individual without it is described as unaffected. The pedigree diagram below illustrates inheritance of this disorder.



3.3.1 Name the genotypes of individuals:

(a) **1** (2)

(b) **2** (2)

3.3.2 What percentage of the males in this pedigree diagram is affected? Show ALL working. (2)

3.3.3 Explain why any son of an affected female will always have this disorder. (3)
(9)

Genetic engineering:

QUESTION 31

2.4 Read the passage below and answer the questions that follow.

USE OF STEM CELLS

Dr Orly Lachan-Kaplan of Monash Immunology and Stem Cell Laboratories has used stem cell manipulation to create an ovary-like structure containing ova. Although it is not yet clear if the cells of this ovary-like structure are functional, she hopes that this method can be used to develop functional human ova.

[Source: http//monash.edu/news/releases/308]

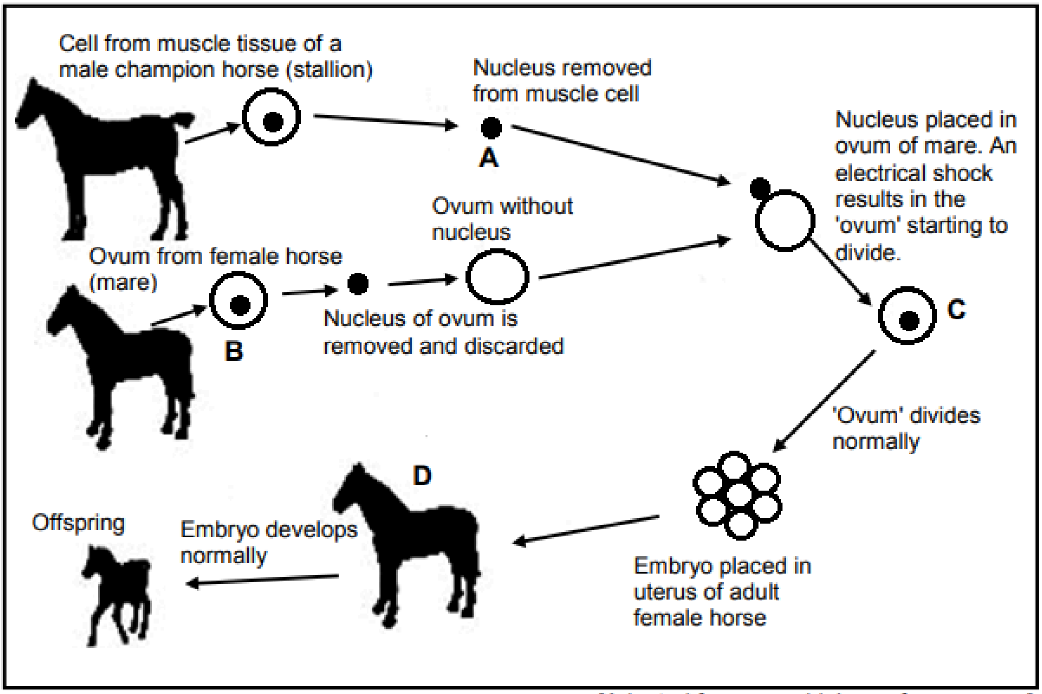
2.4.1 Name ONE source of stem cells. (1)

2.4.2 Explain why the characteristics of stem cells make them useful in treating some disorders. (3)

2.4.3 Explain ONE possible advantage of creating an ovary-like structure. (3)
(7)

QUESTION 32

3.5 The diagram below shows a genetic engineering process. A donor cell was taken from the muscle cell of a male champion horse (stallion) to create a new offspring.



[Adapted from www.biologyreference.com]

3.5.1 Name the:

(a) Genetic engineering process shown in the diagram above (1)

(b) Process that produced ovum **B** (1)

3.5.2 Why is the donor cell extracted from a champion horse? (2)

3.5.3 Explain why only the nucleus of the donor cell is used. (2)

3.5.4 A somatic cell in a horse contains 64 chromosomes.

How many chromosomes would there be in:

(a) Structure **A** (1)

(b) Ovum **B** (1)

(c) A muscle cell in organism **D** (1)

3.5.5 Explain why the 'ovum' labelled **C** cannot be considered a gamete. (2)
(11)