CAMBRIDGE IGCSE BIOLOGY · 0610

BIOLOGY



EXAM QUESTION PACK

TOPIC 17: INHERITANCE

SCORE	PERCENTAGE
/	%

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Inheritance – 2023 November IGCSE 0610

1. Nov/2023 /Paper_ 0610/11/No.33

Which statement about the human sex chromosomes is correct?

A Females have an X chromosome and a Y chromosome.

B Females have two Y chromosomes.

C Males and females have at least one X chromosome.

D Males and females have at least one Y chromosome.

2. Nov/2023 /Paper_ 0610/11/No.34

The inheritance of seed colour in pea plants is controlled by a single gene. The allele for yellow seed colour, Y, is dominant. The allele for green seed colour, y, is recessive.

What are the possible genotypes of a pea seed that is yellow?

A YY or yy only

B YY, Yy or yy

C YY or Yy only

D Yy or yy only

3. Nov/2023 /Paper_ 0610/13/No.30

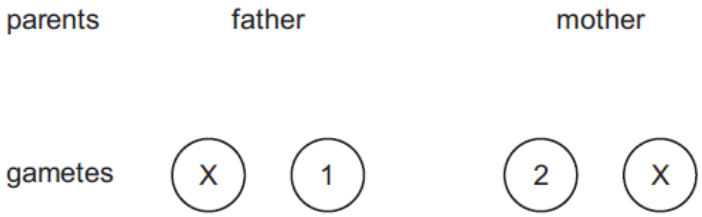
A pea plant with the genotype YY is crossed with a pea plant with the genotype yy.

What are the possible genotypes of the offspring?

A YY and yy **B** all Yy **C** Yy and yy **D** all YY

4. Nov/2023 /Paper_ 0610/13/No.34

The diagram shows part of a genetic diagram for the inheritance of sex in humans. The sex chromosomes in two gametes are shown.



What are the sex chromosomes in gametes 1 and 2?

	gamete 1	gamete 2
A	X	Y
B	X	X
C	Y	Y
D	Y	X

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5. Nov/2023 /Paper_ 0610/21/No.31

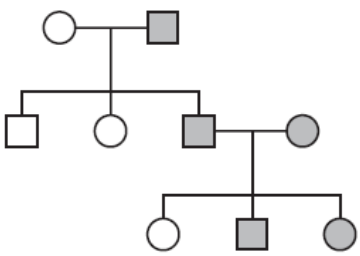
Which row shows correct information about mitosis?

	cells produced by mitosis	number of chromosomes in the daughter cells compared to the parent cell
A	are genetically different to the parent cell	half the number
B	are genetically different to the parent cell	the same number
C	are genetically identical to the parent cell	half the number
D	are genetically identical to the parent cell	the same number

6. Nov/2023 /Paper_ 0610/21/No.32

Polydactyly is a condition that can occur in cats and results in affected individuals having extra toes.

The diagram shows the inheritance of the condition in a family of cats.



key

- polydactyl female cat
- polydactyl male cat
- non-polydactyl female cat
- non-polydactyl male cat

What does the family tree show about the allele for polydactyly?

A It is codominant.

B It could be dominant or recessive.

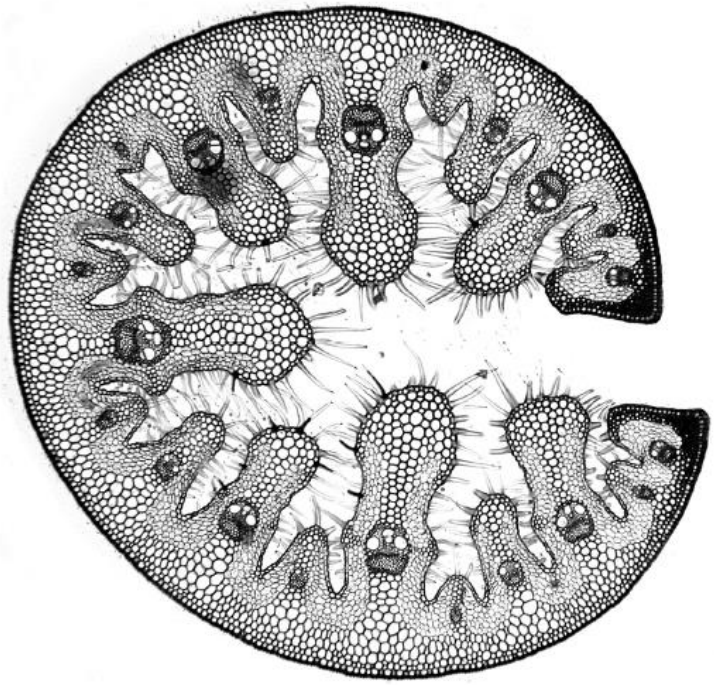
C It is dominant.

D It is recessive.

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7. Nov/2023 /Paper_ 0610/21/No.36

The photomicrograph shows a cross-section through a marram grass leaf.



Which feature is an adaptation of a xerophyte?

A the presence of chloroplasts

B the presence of fine hairs

C the presence of phloem tissue

D the presence of xylem vessels

8. Nov/2023 /Paper_ 0610/22/No.32

Why are cells in the pancreas the only body cells that produce insulin?

A All of the genes in the nucleus of a cell in the pancreas are expressed.

B Other body cells do **not** have the gene for insulin.

C The cells in the pancreas have twice as many genes as the other body cells.

D The gene for insulin is only expressed by cells in the pancreas.

9. Nov/2023 /Paper_ 0610/22/No.33

Which statement is correct?

A Mitosis always produces offspring that are homozygous.

B Mitosis produces cells that are genetically identical.

C Mitosis produces gametes in animals.

D Mitosis only produces haploid cells.

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10. Nov/2023 /Paper_ 0610/23/No.33

Pea plants produce either yellow or green seeds. Yellow (Y) is dominant to green (y).

What are the most likely phenotypes of the offspring of a cross between YY and Yy plants?

A 50% yellow and 50% green

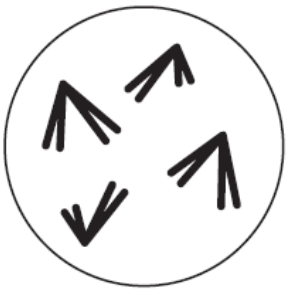
B 75% yellow and 25% green

C 100% yellow

D 100% green

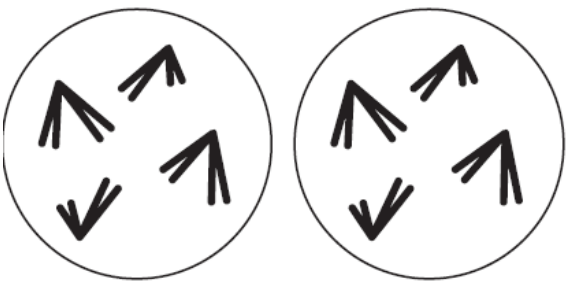
11. Nov/2023 /Paper_ 0610/23/No.34

The diagram shows the chromosomes of a cell after they have replicated and just before the cell divides by mitosis.

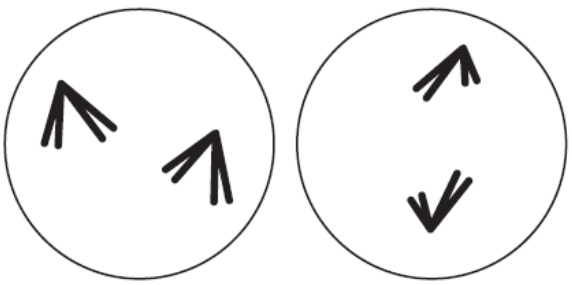


Which pair of cells will be produced at the end of mitosis?

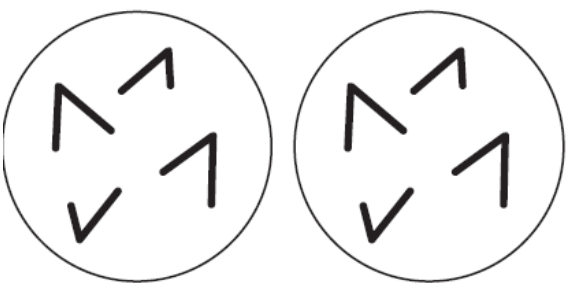
A



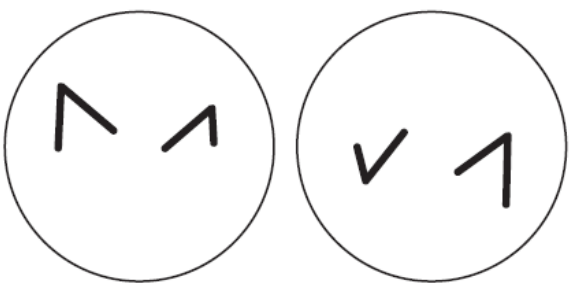
B



C



D



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Inheritance – 2023 June IGCSE Biology 0610

1. June/2023/Paper_0610/11/No.33

What is defined as a length of DNA that codes for a protein?

A amino acid

B antibody

C chromosome

D gene

2. June/2023/Paper_0610/11/No.34

A man has three sons.

What is the chance of his next child being a daughter?

A 0% **B** 25% **C** 50% **D** 100%

3. June/2023/Paper_0610/11/No.35

Which term is a genetic change?

A allele

B genotype

C mutation

D phenotype

4. June/2023/Paper_0610/12/No.31

Which human characteristics are inherited?

	blood group	eye colour	language	sex
A	✓	✓	✗	✓
B	✓	✓	✓	✗
C	✗	✓	✗	✓
D	✓	✗	✓	✓

key

✓ = inherited

✗ = not inherited

5. June/2023/Paper_0610/12/No.33

When breeding, which pair of parents will be pure-breeding for a particular characteristic?

A a heterozygous and a homozygous individual

B two heterozygous individuals

C two homozygous individuals

D two individuals with the same phenotype

6. June/2023/Paper_0610/12/No.34

In a pea plant, the allele for round seeds, R, is dominant to the allele for wrinkled seeds, r.

If plants with the genotype Rr are crossed, what are the likely proportions of offspring?

A all with round seeds

B all with wrinkled seeds

C 1 with round seeds : 1 with wrinkled seeds

D 3 with round seeds : 1 with wrinkled seeds

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7. June/2023/Paper_0610/21/No.30

The statements describe how a protein is made.

1 mRNA passes through a ribosome.

2 mRNA molecules carry a copy of the gene to the cytoplasm.

3 The gene coding for the protein is copied in the nucleus.

4 Ribosomes assemble amino acids into proteins.

What is the order of statements that describes how a protein is made?

A 2 → 1 → 3 → 4

B 2 → 3 → 4 → 1

C 3 → 1 → 2 → 4

D 3 → 2 → 1 → 4

8. June/2023/Paper_0610/21/No.31

Which parents could produce offspring with blood group O?

A heterozygous father with blood group A and heterozygous mother with blood group B

B heterozygous father with blood group A and homozygous mother with blood group B

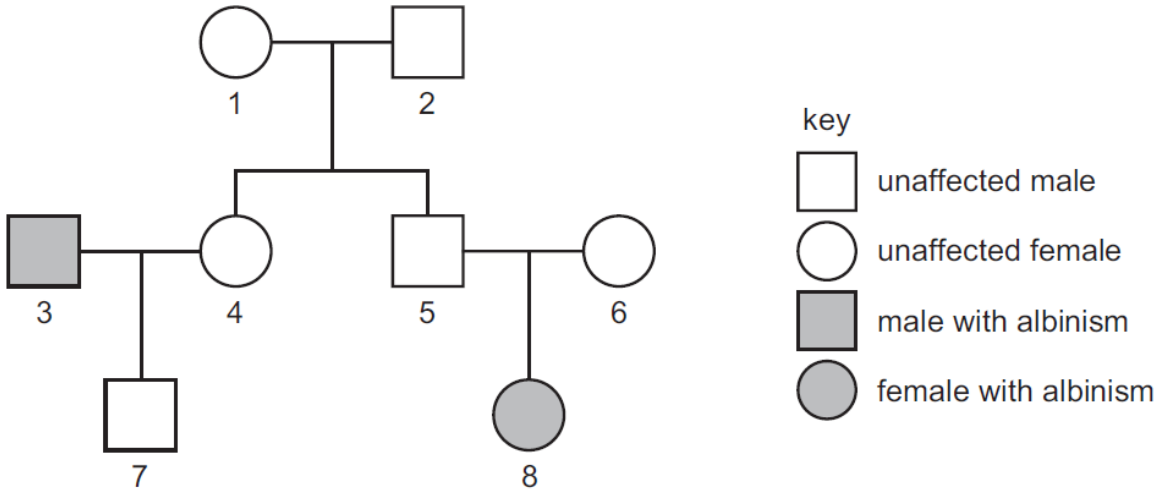
C homozygous father with blood group A and heterozygous mother with blood group B

D homozygous father with blood group A and homozygous mother with blood group O

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9. June/2023/Paper_0610/21/No.32

The diagram shows the inheritance of albinism in one family. Albinism is an inherited condition caused by a recessive allele.



Which individuals **must** be heterozygous for this condition?

A 1 and 2 **B** 4 and 7 **C** 5, 6 and 7 **D** 5 and 6 only

10. June/2023/Paper_0610/21/No.33

Which term is a genetic change?

A allele

B genotype

C mutation

D phenotype

11. June/2023/Paper_0610/22/No.31

A man of genotype I^AI^o and woman of genotype I^BI^o have a child.

What is the chance that the child will have the same blood group as one of its parents?

A zero **B** 1 in 4 **C** 1 in 2 **D** 3 in 4

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12. June/2023/Paper_0610/22/No.32

A man who has red-green colour blindness has a child with a woman who does **not** have red-green colour blindness. The child has red-green colour blindness. The man and woman decide to have another child.

What is the percentage probability that their next child will have red-green colour blindness?

A 0% **B** 25% **C** 50% **D** 100%

13. June/2023/Paper_0610/22/No.33

Which types of variation can be inherited?

	variation caused by genes	variation caused by the environment
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

key

✓ = yes

✗ = no

14. June/2023/Paper_0610/23/No.30

Which substance is coded for by a length of DNA?

A base

B glucose

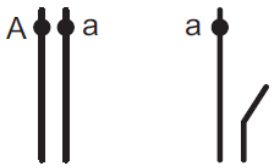
C glycerol

D lipase

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15. June/2023/Paper_0610/23/No.31

The diagram shows the sex chromosomes of a woman and of a man. Their genotypes for a recessive sex-linked condition are also shown.



What are the chances that their daughter will show the sex-linked condition?

A 0% **B** 25% **C** 50% **D** 75%

16. June/2023/Paper_0610/23/No.32

Which Punnett square shows a test cross that identifies a heterozygous parent?

A

	T	t
T	TT	Tt
t	Tt	tt

B

	T	T
T	TT	TT
t	Tt	Tt

C

	T	t
t	Tt	tt
t	Tt	tt

D

	T	T
t	Tt	Tt
t	Tt	Tt

17. June/2023/Paper_0610/41/No.5b-d

(b) Explain why body cells can have different specialised functions even though they contain the same genes.

.....

.....

.....

.....

..... [2]

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(c) Allele frequency in a population can be changed by natural selection and artificial selection.

State the meaning of the term allele.

.....

..... [1]

(d) Describe how artificial selection differs from natural selection.

.....

.....

.....

.....

.....

.....

..... [3]

18. March/2023/Paper_ 0610/12/No.33

In mice, the allele for black hair is dominant to the allele for brown hair.

Which proportion of offspring will have brown hair if a cross is made between a homozygous black mouse and a heterozygous black mouse?

A 0% **B** 25% **C** 50% **D** 100%

19. March/2023/Paper_ 0610/22/No.32

In humans, what is the genotype of a red-green colour-blind male?

A X^RX^R **B** X^rX^r **C** X^RY **D** X^rY

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20. March/2023/Paper_ 0610/32/No.3

Huntington's disease is a genetic disease caused by a mutation in a single gene.

The allele for Huntington's disease is dominant and is represented by the letter **H**.

The allele for **no** Huntington's disease is recessive and is represented by the letter **h**.

Fig. 3.1 is a pedigree diagram showing the inheritance of Huntington's disease in one family.

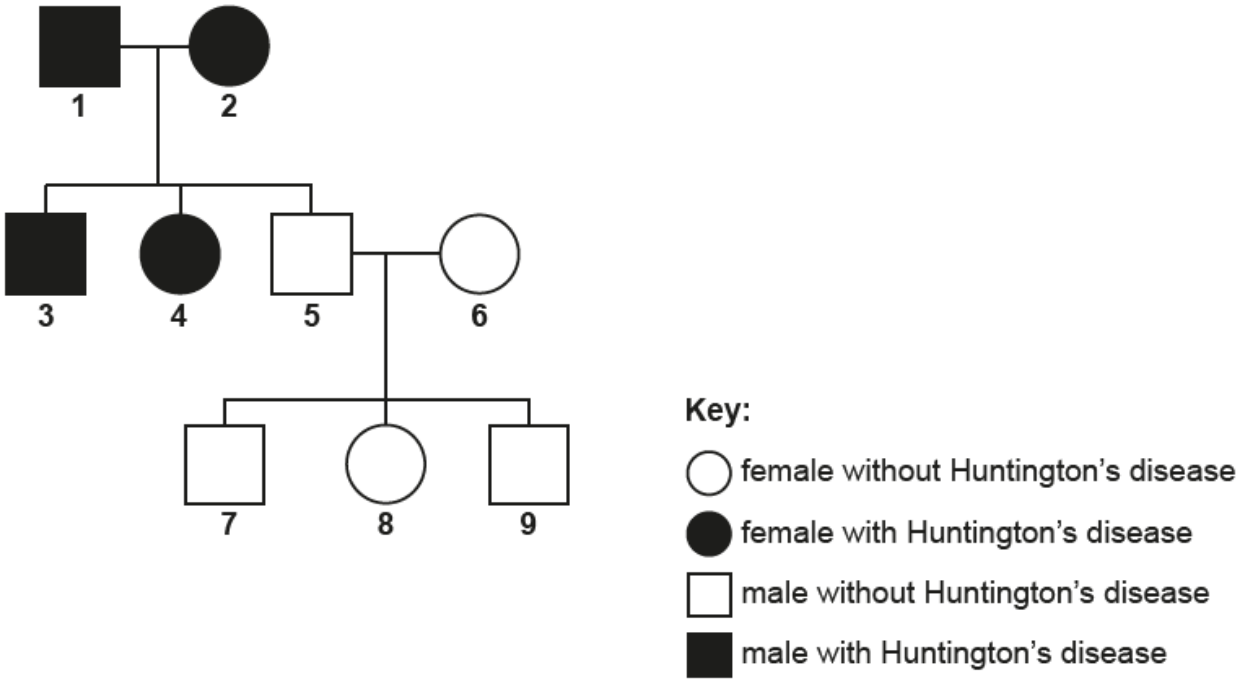


Fig. 3.1

(a) (i) State the number of males with Huntington's disease in Fig. 3.1.

..... [1]

(ii) State the **two** possible genotypes for person **3** in Fig. 3.1.

..... and .....

[2]

(iii) State the evidence from Fig. 3.1 that suggests that the allele for Huntington's disease is dominant.

.....

.....

..... [1]

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(b) A person that is heterozygous for Huntington's disease has a child with a person that is homozygous recessive.

Complete the Punnett square in Fig. 3.2 by writing in the gametes and offspring for this cross and calculate the percentage chance of the child inheriting Huntington's disease.

	.....	.....
.....	.....	.....
.....	.....	.....

Percentage chance of the child inheriting Huntington's disease .....

[3]

Fig. 3.2

(c) Chromosomes contain genetic information in the form of genes.

(i) Define the term gene.

.....

..... [2]

(ii) State where chromosomes are found in cells.

..... [1]

(iii) State the chromosomes involved in the inheritance of sex in humans.

..... [1]

[Total: 11]

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Inheritance – 2022 November IGCSE 0610 Biology

1. Nov/2022/Paper_12/No.33

In one species of plant, the allele for red-coloured fruit is dominant and is represented by the letter R. The allele for white-coloured fruit is recessive and is represented by the letter r.

Two plants that are heterozygous for fruit colour are crossed.

What are the possible genotypes of the offspring plants from this cross?

A RR, Rr and rr

B all Rr

C all rr

D Rr and rr only

2. Nov/2022/Paper_12/No.35

What can increase the genetic variation in a species?

A growth

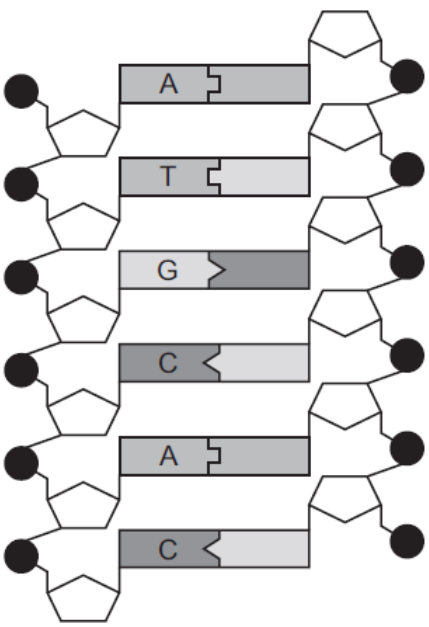
B malnutrition

C mitosis

D mutation

3. Nov/2022/Paper_21/No.7

The diagram shows a length of DNA.



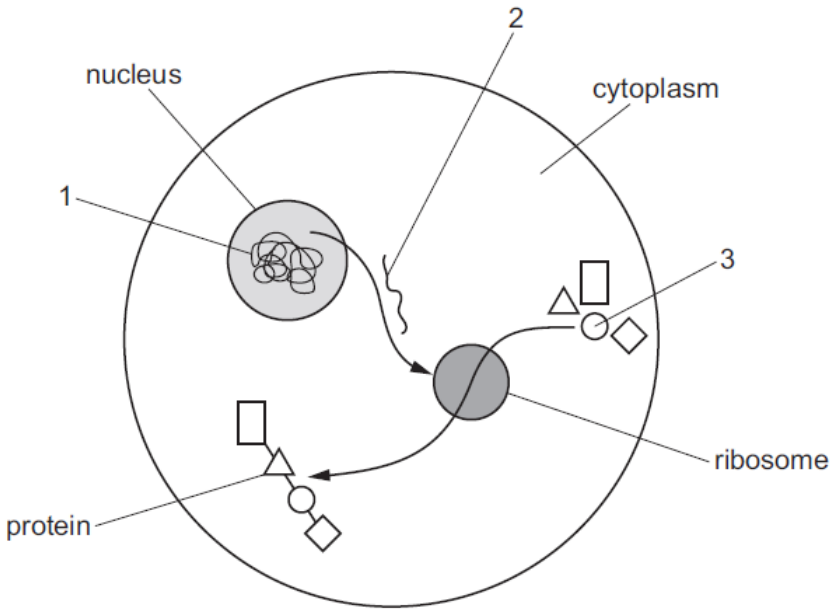
What is the sequence of bases in the unlabelled strand of DNA, starting from the top of the diagram?

A CGTACA **B** TACGTG **C** GCTAGA **D** ATGCAC

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4. Nov/2022/Paper_21/No.30

The diagram shows the stages of protein synthesis in a cell.



Which row identifies molecules 1, 2 and 3?

	1	2	3
A	DNA	amino acid	mRNA
B	amino acid	DNA	mRNA
C	DNA	mRNA	amino acid
D	mRNA	DNA	amino acid

5. Nov/2022/Paper_21/No.31

Which description of stem cells is correct?

A unspecialised cells that divide by meiosis to produce daughter cells that may become specialised for specific functions

B specialised cells that divide by mitosis to produce daughter cells that may become further specialised for specific functions

C unspecialised cells that divide by mitosis to produce daughter cells that may become specialised for specific functions

D specialised cells that divide by meiosis to produce daughter cells that may become specialised for specific functions

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6. Nov/2022/Paper_21/No.32

In some breeds of cattle, hair colour shows codominance. The coats may be red, white or roan (a mixture of red and white hairs).

What are the expected phenotypes when a parent with a red coat (H^RH^R) is crossed with a parent with a roan coat (H^RH^W)?

A 50% red : 50% roan

B 75% red : 25% roan

C 75% red : 25% white

D 50% red : 50% white

7. Nov/2022/Paper_22/No.7

DNA is a molecule consisting of two linked strands.

Part of a single strand of DNA has the sequence of bases shown.

ACCGTTGAA

What is the sequence of bases in the second strand?

A ACCGTTGAA

B GTTACCAGG

C TGGCAACTT

D CAATGGTCC

8. Nov/2022/Paper_22/No.30

What happens to the number of chromosomes when a cell divides by meiosis?

A doubles from diploid to haploid

B doubles from haploid to diploid

C halves from diploid to haploid

D halves from haploid to diploid

9. Nov/2022/Paper_22/No.31

A sex-linked condition is caused by a recessive allele. A healthy male and female are both unaffected by the condition but the female has one copy of the recessive allele.

What is the chance of their offspring being affected by the sex-linked condition?

A 50% of all their offspring

B 100% of male offspring and 0% of female offspring

C 25% of all their offspring

D 50% of male offspring and 25% of female offspring

10. Nov/2022/Paper_22/No.32

The diagram shows the unspecialised cells of a mammalian embryo soon after fertilisation.



What is the correct description of these cells?

A embryo cells undergoing meiosis

B gametes undergoing mitosis

C stem cells undergoing mitosis

D zygote undergoing meiosis

11. Nov/2022/Paper_23/No.8

Which statement about the structure of DNA is correct?

A DNA contains six types of base.

B DNA contains three strands coiled to form a helix.

C DNA is made of a chain of amino acids.

D DNA has two strands with cross-links between pairs of bases.

12. Nov/2022/Paper_23/No.32

The diagram shows the unspecialised cells of a mammalian embryo soon after fertilisation.



What is the correct description of these cells?

A embryo cells undergoing meiosis

B gametes undergoing mitosis

C stem cells undergoing mitosis

D zygote undergoing meiosis

13. Nov/2022/Paper_31/No.2

(a) Inheritance is the transmission of genetic information from generation to generation.

The boxes on the left show some of the terms used when describing inheritance.

The boxes on the right show definitions for these terms.

Draw **four** straight lines to link each term with its definition.

term	definition
	an allele that is expressed if it is present
dominant	
	genetic make-up of an organism
genotype	
	having two different alleles of a particular gene
heterozygous	
	having two identical alleles of a particular gene
phenotype	
	observable features of an organism

[4]

(b) The three structures listed are found inside cells.

allele **chromosome** **nucleus**

List these **three** components in order of size starting with the smallest.

..... smallest

.....

.....



largest

[1]

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(c) Table 2.1 contains statements about mitosis and meiosis.

Complete Table 2.1 by placing ticks (✓) in the boxes to show the correct statements about mitosis and meiosis.

Table 2.1

statement	mitosis	meiosis
a type of nuclear division		
gives rise to genetically different cells		
important for the repair of damaged tissues		
needed for growth		
produces gametes		
used in asexual reproduction		

[6]

[Total: 11]

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14. Nov/2022/Paper_33/No.2

(a) Fig. 2.1 shows a diagram of an animal cell.

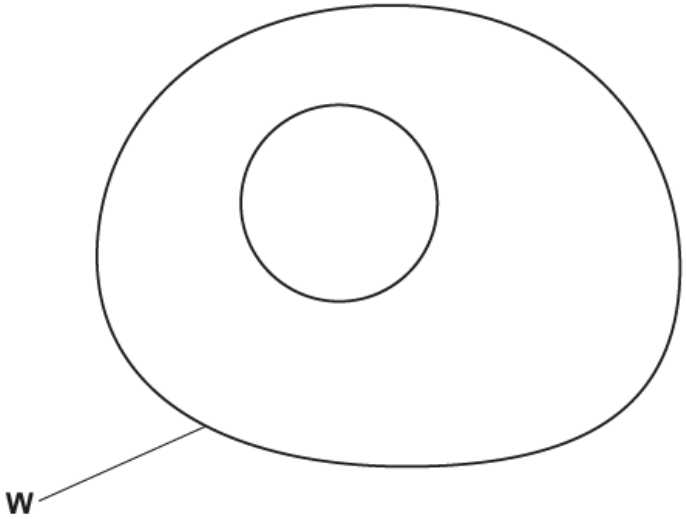


Fig. 2.1

(i) State the name of structure **W** on Fig. 2.1.

..... [1]

(ii) Write the letter **X** on Fig. 2.1 to show where chromosomes are found.

[1]

(iii) State what chromosomes are made from.

..... [1]

(b) **(i)** State the sex chromosomes that are found in the body cells of a human male.

..... [1]

(ii) A man and a woman have a child.

Complete the genetic diagram to show the inheritance of sex.

State the probability of the child being female.

		father	
mother			

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15. Nov/2022/Paper_41/No.4

Chromosomes are made of DNA.

(a) Describe the structure of a DNA molecule.

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

(b) **(i)** Outline how antibiotic resistance develops in a population of bacteria.

.....

.....

.....

.....

.....

.....

..... [3]

(ii) Scientists use differences in antibiotic-resistance genes to distinguish between different strains of the bacterium, methicillin-resistant *S. aureus* (MRSA).

Suggest why scientists use differences in base sequences to classify the strains of MRSA rather than using other methods.

.....

.....

..... [1]

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(iii) Explain why scientists are concerned that some strains of bacteria, such as *S. aureus*, have become resistant to antibiotics.

.....

.....

.....

.....

..... [2]

(c) **(i)** Describe how the use of antibiotics can be managed to reduce the development of resistant strains of bacteria.

.....

.....

.....

.....

..... [2]

(ii) Suggest why MRSA is unlikely to be transmitted from a mother to her unborn fetus.

.....

.....

..... [1]

(d) Many species of bacteria do not cause disease. Bacteria are very important in many biological processes.

State the names of **three** natural processes involving bacteria that are important to ecosystems.

1 .....

2 .....

3 .....

[3]

[Total: 16]

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Inheritance – 2022 June IGCSE 0610

1. June/2022/Paper_ 11/No.33

Beak shape in birds is controlled by genes passed from the parent birds to their offspring.

What is this an example of?

A selection

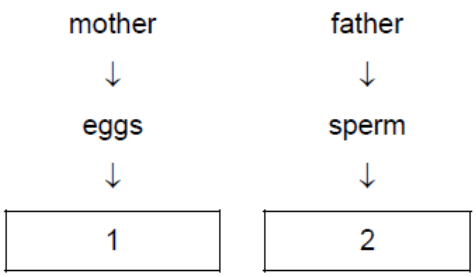
B fertilisation

C mitosis

D inheritance

2. June/2022/Paper_ 11/No.34

A student used a diagram to explain the inheritance of sex in humans.



Which statements should she use to complete boxes 1 and 2?

	box 1	box 2
A	all have an X chromosome	half have an X chromosome and half have a Y chromosome
B	all have a Y chromosome	half have an X chromosome and half have a Y chromosome
C	half have an X chromosome and half have a Y chromosome	all have an X chromosome
D	half have an X chromosome and half have a Y chromosome	all have a Y chromosome

3. June/2022/Paper_ 12/No.32

The diagram shows the inheritance of sex in humans.

		male gametes	
		X	Y
female gametes	X	XX	XY
	X	XX	XY

A man and a woman have one female child.

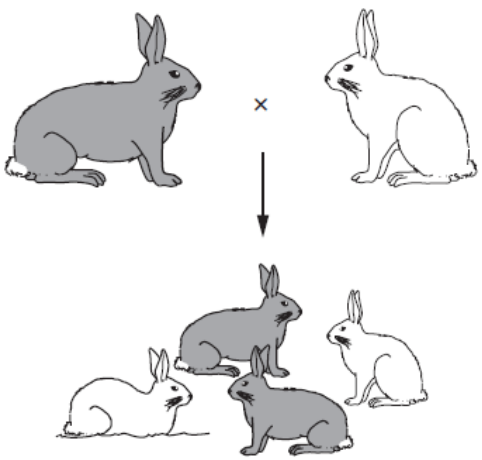
What is the chance of the couple's next child being female?

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

4. June/2022/Paper_ 12/No.33

In rabbits, the allele for dark fur, R, is dominant to the allele for white fur, r.

The diagram shows a cross between a rabbit with dark fur and a rabbit with white fur.



What are the genotypes of the parents?

A Rr and rr **B** RR and rr **C** RR and Rr **D** R and r

5. June/2022/Paper_ 13/No.34

Which sex chromosomes in the egg cell and in the sperm will produce a female child?

	sex chromosome in the egg cell	sex chromosome in the sperm
A	X	X
B	X	Y
C	Y	X
D	Y	Y

6.

7. June/2022/Paper_ 21/No.31

Pangolins are mammals. One species of pangolin has 40 chromosomes per body cell.

How many chromosomes will a sperm cell from this species of pangolin have?

A 10 **B** 20 **C** 40 **D** 50

8. June/2022/Paper_ 21/No.30

What is needed in the cytoplasm to make proteins at a ribosome?

A DNA and amino acids

B DNA only

C mRNA and amino acids

D mRNA only

9. June/2022/Paper_ 21/No.37

With which kingdoms do bacteria share the same genetic code?

A animal, plant, fungus and protoctist

B animal, plant and fungus only

C animal and plant only

D animal only

10. June/2022/Paper_ 23/No.8

DNA is made up of .....1..... strands coiled together. The strands contain chemicals called .....2..... . These chemicals form .....3..... , A pairing with T and C pairing with G.

Which words correctly complete gaps 1, 2 and 3?

	1	2	3
A	three	amino acids	cross-links
B	two	bases	cross-links
C	three	bases	proteins
D	two	amino acids	proteins

11. June/2022/Paper_ 23/No.30

Some fruit flies have orange eyes and others have red eyes.

If two orange-eyed fruit flies are crossed, their offspring always have orange eyes.

If two red-eyed fruit flies are crossed, their offspring can have orange eyes or red eyes.

What can be concluded from these observations?

A The allele for orange eyes is dominant.

B The allele for orange eyes is recessive.

C The alleles for orange and red eyes are codominant.

D This is an example of sex linkage.

12. June/2022/Paper_ 23/No.32

A woman with normal colour vision is a carrier for the colour blindness allele (X^BX^b). She has a male child with a man who has normal colour vision (X^BY).

What is the chance of the male child being colour-blind?

A 0% **B** 25% **C** 50% **D** 100%

13. June/2022/Paper_ 23/No.33

Sickle cell anaemia is a genetic disorder which results in severe illness in homozygous individuals. In some human populations, being heterozygous can be beneficial.

What could be the reason for this?

A Heterozygous individuals are not affected by the disorder.

B Heterozygous individuals are more resistant to malaria.

C The disorder is caused by a dominant allele.

D The disorder is sex-linked.

14. June/2022/Paper_ 23/No.34

Which statement about selective breeding is correct?

A It does not involve humans.

B It involves a struggle for survival.

C It always involves only one parent.

D It involves parents that possess desirable features.

15. June/2022/Paper_ 31/No.3(a_ d)

The inheritance of coat texture in guinea pigs is controlled by a single gene.

(a) Define the term gene.

.....

.....

.....

..... [2]

(b) Fig. 3.1 shows a photograph of a guinea pig with a rough coat and a guinea pig with a smooth coat.



rough coat smooth coat

Fig. 3.1

The allele for a rough coat is dominant and represented by the letter **R**.
The allele for a smooth coat is recessive and represented by the letter **r**.

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Fig. 3.2 is a pedigree diagram showing the inheritance of coat texture in some guinea pigs.

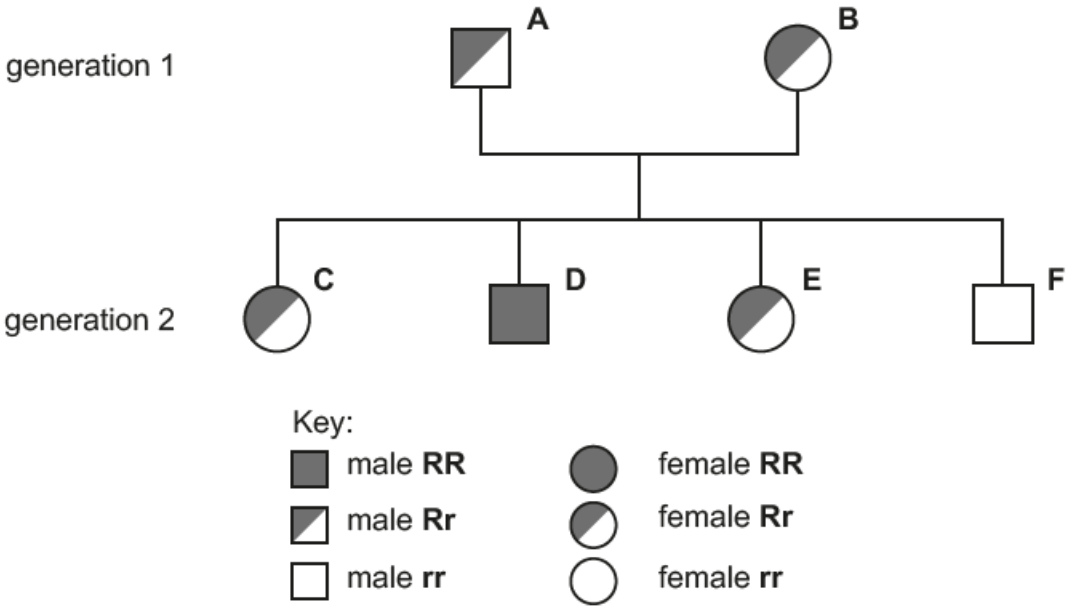


Fig. 3.2

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(i) State the total number of guinea pigs with smooth coats in Fig. 3.2.

..... [1]

(ii) State the letter of a guinea pig that has a homozygous dominant genotype in Fig. 3.2.

..... [1]

(iii) State the total number of male guinea pigs in Fig. 3.2.

..... [1]

(c) Two guinea pigs are bred together.

- The genotype of the male guinea pig is **RR**.
- The genotype of the female guinea pig is **Rr**.

Complete Fig. 3.3 to show the:

- possible genotypes of the offspring from this cross
- the probability of offspring having a smooth coat.

		male	
		.....	.....
female	.....	.....	.....
	.....	.....	.....

probability of offspring having a smooth coat .....

Fig. 3.3

[3]

(d) Complete the sentence about breeding.

Two identical homozygous individuals that breed together will be

..... -breeding. [1]

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16. June/2022/Paper_ 33/No.7(a_ b)

One type of nuclear division produces genetically identical cells.

(a) State the name and **one** role of the type of nuclear division that produces genetically identical cells.

name .....

role .....

.....

[2]

(b) Fig. 7.1 shows the mass of DNA in a cell undergoing this type of cell division. Two cell divisions complete in this time.

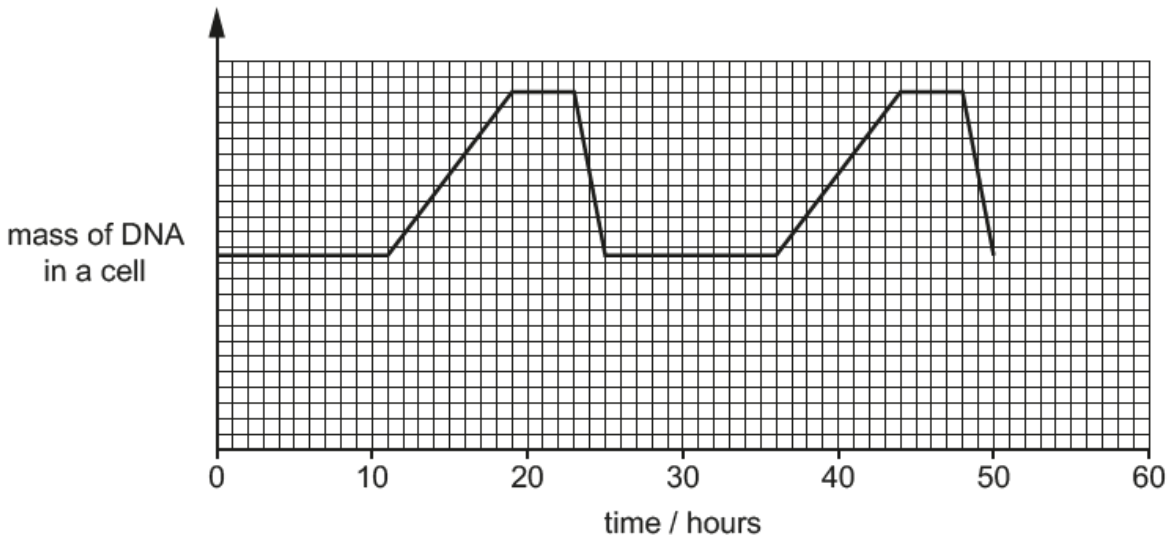


Fig. 7.1

Using the information in Fig. 7.1, calculate how long it takes for the DNA to double in mass.

..... hours [1]

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17. June/2022/Paper_ 42/No.3(c)

(c) Colour blindness can be caused by a mutation in a gene. The gene is located on the X chromosome.

Fig. 3.3 is a pedigree diagram of a family which has several people who are colour-blind.

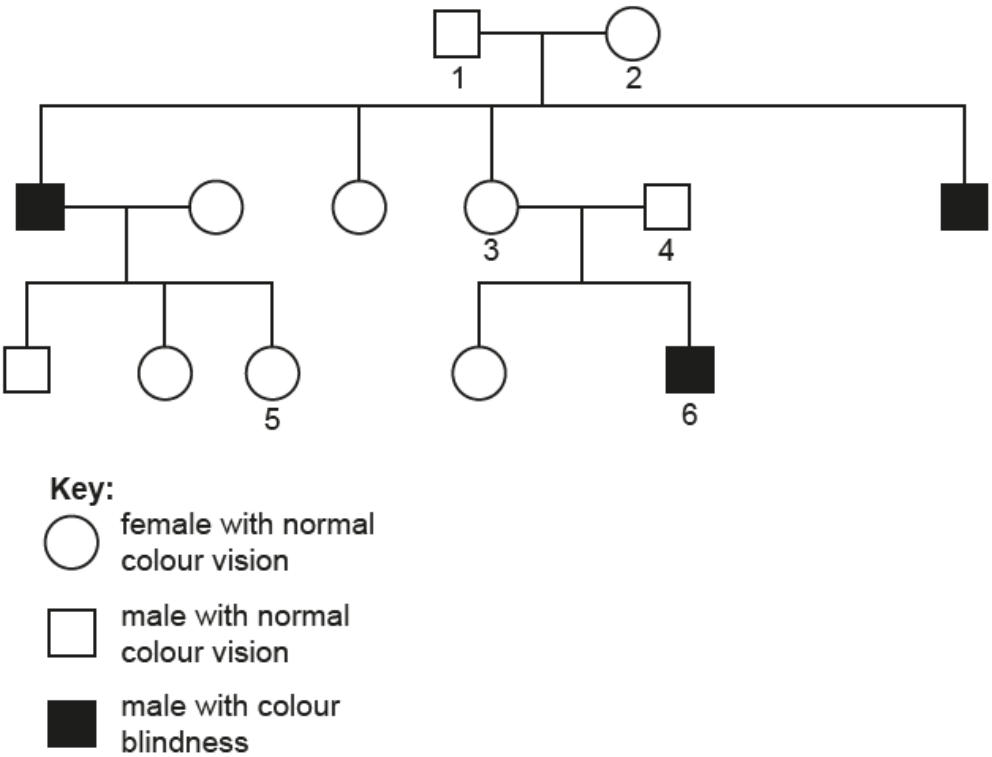


Fig. 3.3

(i) Colour blindness is sex-linked.

State the evidence from Fig. 3.3 that supports the idea that colour blindness is sex-linked.

.....

.....

..... [1]

(ii) State the genotype of person 5.

Use the symbols X and Y for the sex chromosomes and **A** for the dominant allele and **a** for the recessive allele of the gene for colour blindness.

..... [2]

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(iii) Use the information in Fig. 3.3 to complete the genetic diagram to show the probability of person **3** and person **4** having another child with colour blindness.

	person **3**		person **4**
parental phenotypes	female with normal colour vision		male with normal colour vision
parental genotypes	.....		.....
gametes	◯ ◯	+	◯ ◯

offspring genotypes .....

offspring phenotypes .....

probability of a child having colour blindness .....

[5]

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Inheritance – 2021 IGCSE 0610

1. Nov/2021/Paper_11/No.33

An allele is a version of which structure?

A amino acid

B chromosome

C gene

D protein

2. Nov/2021/Paper_11/No.34

Which are functions of mitosis?

1 growth

2 production of gametes

3 repair of damaged tissue

4 replacement of cells

5 asexual reproduction

A 1, 3, 4 and 5

B 1 and 3 only

C 2, 3 and 4

D 2 only

3. Nov/2021/Paper_12/No.33

Which of these determine the sex of humans?

A X and Y genes

B X and Y alleles

C X and Y chromosomes

D X and Y genotypes

4. Nov/2021/Paper_12/No.34

Part of a tree branch is broken off and planted in the soil. A new tree grows from the branch.

Which row is correct?

	the cells in the new tree are formed by		the cells in the original tree and in the new tree will be genetically	
	meiosis	mitosis	different	identical
A	✓	✗	✓	✗
B	✗	✓	✗	✓
C	✗	✓	✓	✗
D	✓	✗	✗	✓

key

✓ = correct

✗ = not correct

5. Nov/2021/Paper_12/No.35

A species of insect usually has pale-coloured wings. This helps to camouflage them on pale-coloured tree trunks. A few of the insects in this species have darker coloured wings.

After a number of years the tree trunks become darker in colour due to environmental changes. The insects with dark-coloured wings become more common than insects with pale-coloured wings in this species.

Which process causes this change in the proportion of insects with dark-coloured wings?

A biotechnology

B conservation

C natural selection

D selective breeding

6. Nov/2021/Paper_13/No.35

A species of insect usually has pale-coloured wings. This helps to camouflage them on pale-coloured tree trunks. A few of the insects in this species have darker coloured wings.

After a number of years the tree trunks become darker in colour due to environmental changes. The insects with dark-coloured wings become more common than insects with pale-coloured wings in this species.

Which process causes this change in the proportion of insects with dark-coloured wings?

A biotechnology

B conservation

C natural selection

D selective breeding

7. Nov/2021/Paper_21/No.30

Some descriptions of different human cells are listed.

1 contains 46 chromosomes

2 haploid nucleus

3 diploid nucleus

4 contains one set of unpaired chromosomes

Which descriptions are correct for the nucleus of a human gamete?

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

8. Nov/2021/Paper_21/No.31

Which adaptive feature is only found in female gametes?

A acrosome containing enzymes

B flagellum

C jelly coat

D nucleus containing chromosomes

9. Nov/2021/Paper_21/No.32

A man of genotype I^AI^B and woman of genotype I^BI^o have a child.

What is the chance that the child will have the same blood group as one of its parents?

A zero **B** 1 in 4 **C** 1 in 2 **D** 3 in 4

10. Nov/2021/Paper_22/No.31

Which statement about a diploid human cell is correct?

A There are 22 chromosomes and an X or a Y chromosome.

B There are 22 pairs of chromosomes and two sex chromosomes.

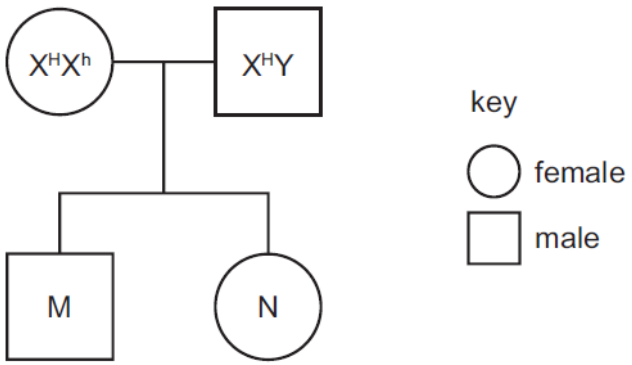
C There are 23 chromosomes.

D There are 23 pairs of chromosomes and two sex chromosomes.

11. Nov/2021/Paper_22/No.32

The gene for haemophilia is found on the X chromosome and the allele for haemophilia is recessive.

In the pedigree diagram the dominant allele is shown as X^H and the recessive allele is shown as X^h.



What is the probability of child M having haemophilia?

A 0.00 **B** 0.25 **C** 0.50 **D** 1.00

12. Nov/2021/Paper_23/No.34

Which statement about a person who is heterozygous for the sickle-cell allele is correct?

A They are not resistant to malaria and their genotype is Hb^AHb^S.

B They are not resistant to malaria and their genotype is Hb^SHb^S.

C They are resistant to malaria and their genotype is Hb^AHb^S.

D They are resistant to malaria and their genotype is Hb^SHb^S.

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13. Nov/2021/Paper_32/No.3

(a) A species of pea plant can produce green or yellow peas.

Fig. 3.1 shows a photograph of a green pea and a yellow pea.



pea A **pea B**

Fig. 3.1

The colour of peas is controlled by a single gene:

- The allele for yellow peas is dominant and is represented by the letter **G**.
- The allele for green peas is recessive and is represented by the letter **g**.

(i) Use your knowledge and this information to complete Table 3.1.

Table 3.1

genotype of pea **A**	
phenotype of pea **B**	
phenotype of a pea with a heterozygous genotype	

[3]

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(ii) Two pea plants were crossed.

Complete the genetic diagram in Fig. 3.2 to show the outcome of the cross.

		parental gametes	
		g	**g**
parental gametes	**G**	.....	.....
	g	.....	.....

ratio of yellow offspring : green offspring ..... : .....

[2]

Fig. 3.2

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(b) Cystic fibrosis is a disease caused by a recessive allele in humans.

Fig. 3.3 is a pedigree diagram showing the inheritance of cystic fibrosis in a family.

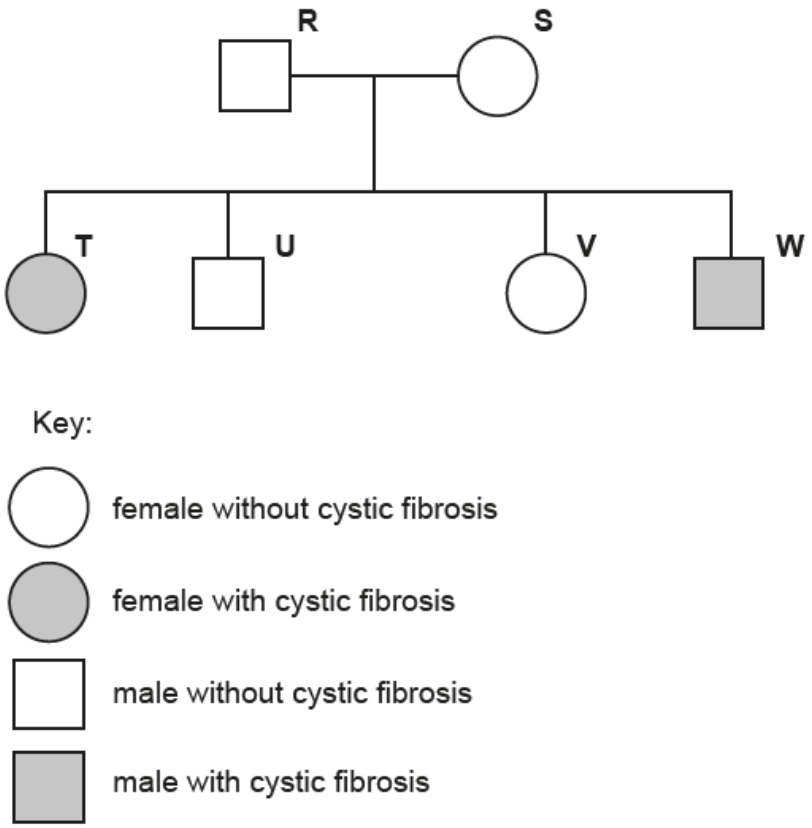


Fig. 3.3

(i) State the number of people that have cystic fibrosis.

..... [1]

(ii) Identify the letter of a person that **must** have a heterozygous genotype.

..... [1]

(iii) Person **U** has a homozygous dominant genotype.

Circle the probability of person **U** having a child with cystic fibrosis.

0% **25%** **50%** **75%** **100%** [1]

[Total: 8]

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14. Nov/2021/Paper_33/No.5

(a) A class of students measured their wrist circumference, as shown in Fig. 5.1.

Wrist circumference is an example of a characteristic that shows **continuous** variation in humans.



Fig. 5.1

Fig. 5.2 shows the results of the investigation.

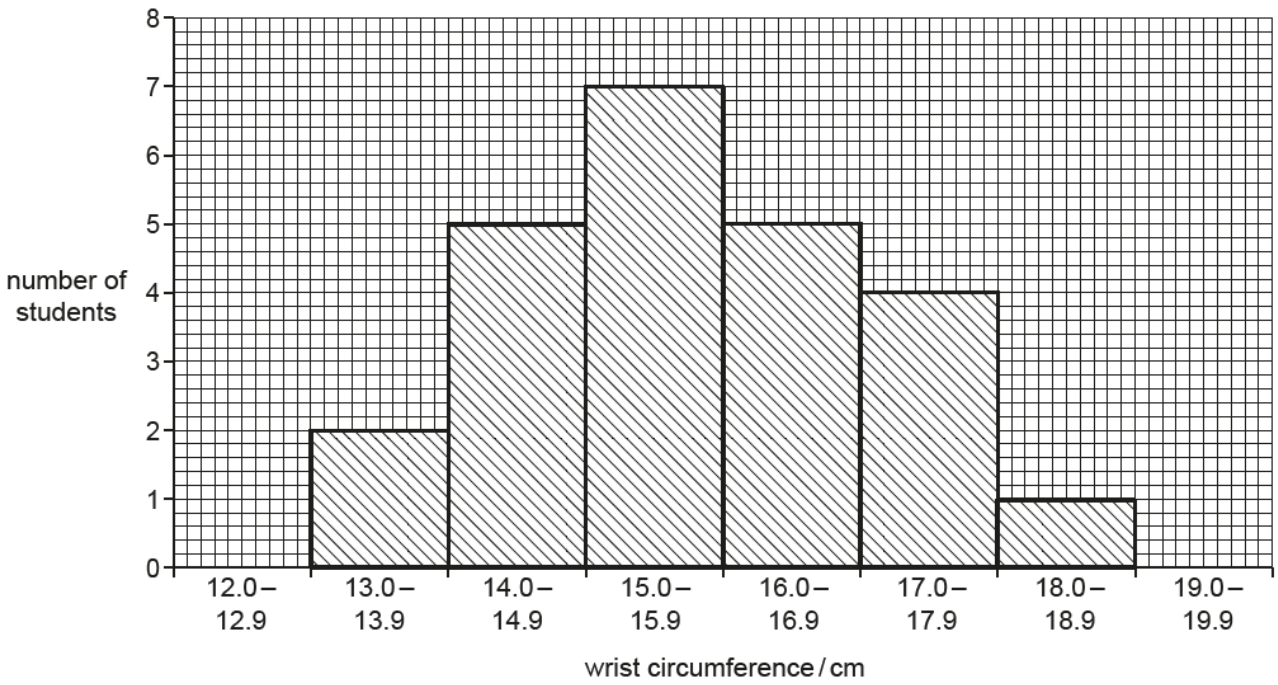


Fig. 5.2

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(i) Calculate the total number of students in this investigation.

..... [1]

(ii) State the most frequent wrist circumference range.

..... [1]

(iii) Explain how these data show that wrist circumference is an example of continuous variation.

.....

.....

..... [1]

(b) State **one** example of discontinuous variation.

..... [1]

(c) Variation can be caused by mutation.

Complete the sentences about mutation.

A mutation is a ..... change.

Mutation is the way new ..... are formed which are versions of a gene.

Mutation can be caused by ..... radiation and some chemicals.

[3]

[Total: 7]

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15. Nov/2021/Paper_33/No.9

(a) Define inheritance.

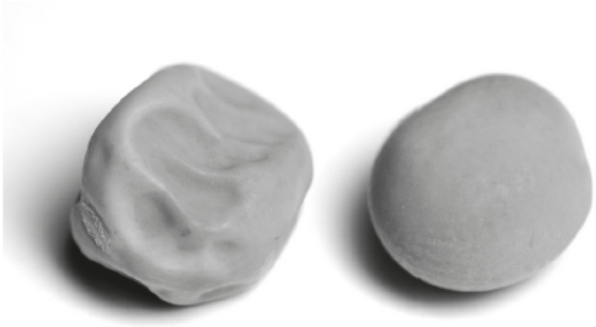
.....

.....

..... [2]

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(b) Some of the characteristics of pea plants are controlled by genes. An example of a characteristic of pea seeds is shown in Fig. 9.1. The allele for a smooth seed coat is dominant and is represented by the letter **R**. The allele for a wrinkled seed coat is recessive and is represented by the letter **r**.



wrinkled seed coat smooth seed coat

Fig. 9.1

The boxes on the left contain descriptions of genotypes.

The boxes on the right contain examples of the possible genotypes of the pea seeds shown in Fig. 9.1.

Draw a line to link **each** description to the correct genotype.

Draw **two** lines.

description of a genotype	**genotype**
	r
heterozygous genotype	**rr**
homozygous recessive genotype	**Rr**
	RR

[2]

(c) Complete the sentence.

A gene is a length of DNA that codes for a ..... . [1]

[Total: 5]

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16. Nov/2021/Paper_41/No.2

(a) Two tomato plants that produce red fruit were bred together.

This cross produced 71 offspring plants with red fruit and 26 offspring plants with yellow fruit.

Complete the genetic diagram to show this cross.

Select a suitable letter to represent the alleles and decide which allele will need a capital letter and which allele will need a lower case letter.

letter representing the allele for red fruit .....

letter representing the allele for yellow fruit .....

parental phenotypes	red fruit	×	red fruit
parental genotypes	.....	×	.....
gametes	....., ...	×	....., ...

offspring genotypes .....

expected phenotype ratio ..... red fruit : ..... yellow fruit

actual phenotype ratio 71 red fruit : 26 yellow fruit

[6]

(b) Researchers carried out some experiments on tomato plants that were homozygous for fruit colour.

State how the researchers could be sure that the fruit came from homozygous plants.

.....

.....

..... [1]

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(c) The researchers analysed two pigments, chlorophyll and lycopene, in homozygous red tomato fruit and homozygous yellow tomato fruit. Chlorophyll is found in unripe tomato fruit.

(i) Describe the function of chlorophyll.

.....

.....

.....

.....

..... [2]

(ii) State the name of **one** mineral required for the synthesis of chlorophyll.

..... [1]

(iii) The researchers analysed the concentration of the pigments in tomato fruits:

- before they were ready to eat (unripe)
- when they were ready to eat (ripe).

The results of the analysis are shown in Table 2.1.

Table 2.1

	chlorophyll concentration / mg per g of tomato fruit	lycopene concentration / mg per g of tomato fruit
unripe red fruit	10.0	0.0
ripe red fruit	1.2	105.7
unripe yellow fruit	6.2	0.0
ripe yellow fruit	0.4	0.7

Use the information in Table 2.1 to compare the changes in pigments in red fruit and yellow fruit as they ripen.

.....

.....

.....

.....

.....

.....

..... [3]

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(d) A gene is responsible for the production of lycopene in fruits. Geneticists have recently produced genetically modified pink pineapples using the gene associated with the production of lycopene.

(i) Genes are found at specific locations on an important biological molecule.

State the name of this biological molecule.

..... [1]

(ii) Describe the disadvantages of genetically modifying crops.

.....

.....

.....

.....

..... [2]

[Total: 16]

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17. Nov/2021/Paper_42/No.2

(a) A scientist investigated sexual reproduction in flowering plants.

Fig. 2.1 shows the procedure for crossing two plants of the same species.

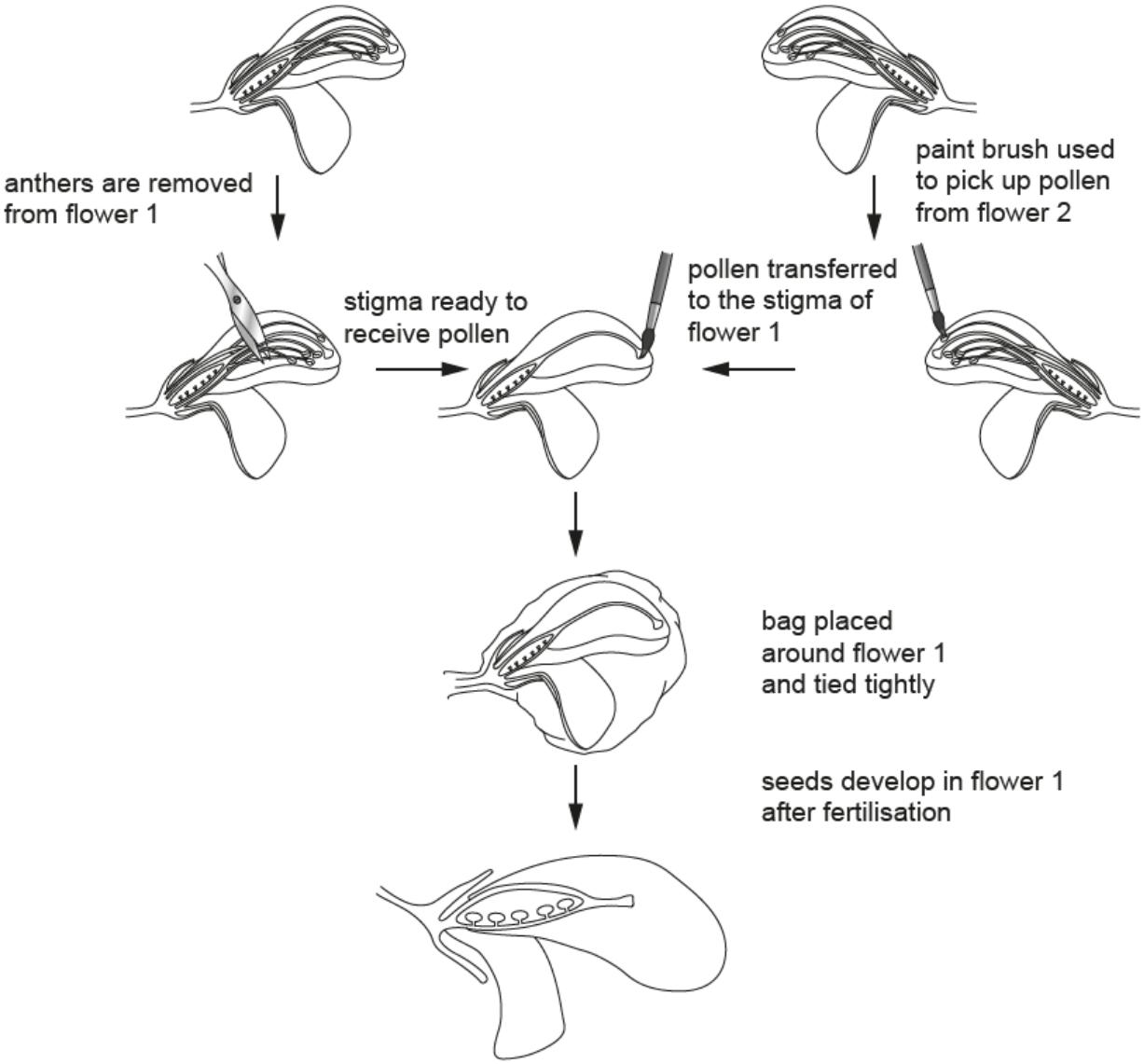


Fig. 2.1

The scientist collected the seeds and germinated them. The leaves and flowers of the offspring plants showed phenotypic variation as they were not all identical to the parent plants.

The scientist then investigated the chromosomes of all the offspring plants and found that they had exactly the same number of chromosomes as the parent plants.

(i) Define the term chromosome.

.....

.....

..... [2]

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(ii) Suggest why the scientist placed a bag around flower 1.

.....

.....

..... [1]

(iii) Explain how sexual reproduction results in the variation that the scientist discovered in the offspring plants.

.....

.....

.....

.....

..... [2]

(iv) The chromosome number of the offspring plants is the same as the chromosome number of the parent plants in this investigation.

Explain how the chromosome number is maintained from one generation to the next.

.....

.....

.....

.....

..... [2]

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(b) The plant *Camellia japonica* has flowers that can be white, red or a mixture of these two colours. When red-flowered plants are crossed with white-flowered plants, all the offspring plants have flowers with petals that are a mixture of red and white, as shown in Fig. 2.2.



Fig. 2.2

- The gene for petal colour in *C. japonica* is given the symbol **P**.
- The allele for white petals is given the symbol $\mathbf{P^W}$.
- The allele for red petals is given the symbol $\mathbf{P^R}$.

(i) Table 2.1 shows the phenotypes of three different pairs of parent plants.

Complete Table 2.1 by giving all the possible genotypes of the offspring plants that could be produced by these parent plants.

Space for working.

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Table 2.1

phenotype of male parent	phenotype of female parent	all the possible genotypes of offspring plants produced by this cross
red petals	red petals	
white petals	red petals	
petals that are both red and white	petals that are both red and white	

[3]

(ii) State the type of inheritance that is shown by petal colour in *C. japonica*.

..... [1]

[Total: 11]

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18. Nov/2021/Paper_43/No.3

A researcher investigated genetic variation in fruit flies, *Drosophila melanogaster*.

The bodies of fruit flies can be black or yellow. A yellow body colour is a recessive feature in fruit flies.

(a) Two heterozygous fruit flies with black bodies were bred together.

Predict the phenotypes of the offspring **and** the phenotypic ratio for this cross.

..... [1]

(b) In another fruit fly breeding experiment, researchers counted 124 offspring with black bodies and 121 offspring with yellow bodies.

Draw a genetic diagram to explain the results of this cross. Use the letter **B** to represent the allele for black body colour and the letter **b** to represent the allele for yellow body colour.

parental phenotypes ..... × .....

parental genotypes ..... × .....

gametes ..... , ... × ..... , ...

offspring genotypes .....

expected offspring phenotype ratio ..... black : ..... yellow

actual offspring phenotype ratio 124 black : 121 yellow

[5]

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(c) The crab, *Cerberusa caeca*, lives in dark caves and has no coloured pigment.

Fig. 3.1 is a photograph of *C. caeca*.



Fig. 3.1

(i) *C. caeca* and *D. melanogaster* are both arthropods.

State **one** feature present in all arthropods but **not** present in vertebrates.

..... [1]

(ii) *C. caeca* is a crustacean and *D. melanogaster* is an insect.

State **one** morphological feature of *C. caeca* that distinguishes it as a crustacean and **not** as an insect.

..... [1]

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(d) The ancestors of *C. caeca* had pigmented bodies.

The lack of a coloured pigment in *C. caeca* is called albinism and was caused by a mutation many thousands of years ago.

(i) Explain the mechanism that has resulted in the allele for albinism becoming common in recent generations in populations of *C. caeca*.

.....

.....

.....

.....

.....

.....

..... [3]

(ii) State **two** factors that can cause mutations.

1 .....

2 .....
[2]

[Total: 13]

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Inheritance – 2021 IGCSE 0610

1. March/2021/Paper_12/No.32

What is defined as 'a thread-like structure of DNA, carrying genetic information in the form of genes'?

A allele

B chromosome

C protein

D zygote

2. June/2021/Paper_11/No.33

What is the transmission of genetic information from generation to generation called?

A fertilisation

B inheritance

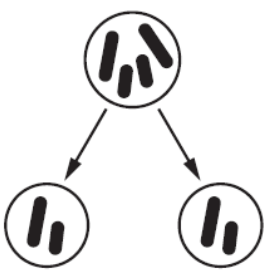
C meiosis

D reproduction

3. June/2021/Paper_11/No.34

Which diagram shows the results of the process of mitosis?

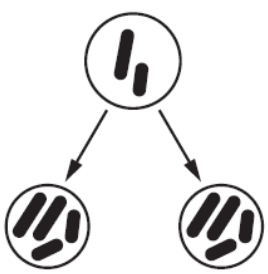
A



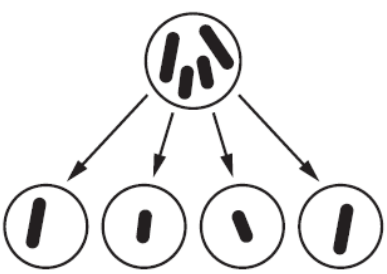
B



C

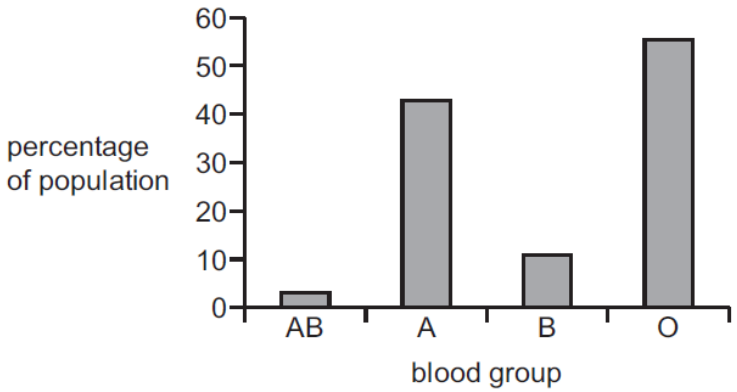


D



4. June/2021/Paper_11/No.35

The graph shows the distribution of blood groups in one area.



This is an example of discontinuous variation.

Which statement about discontinuous variation is correct?

A There is a range of genotypes between two extremes.

B There is a range of phenotypes between two extremes.

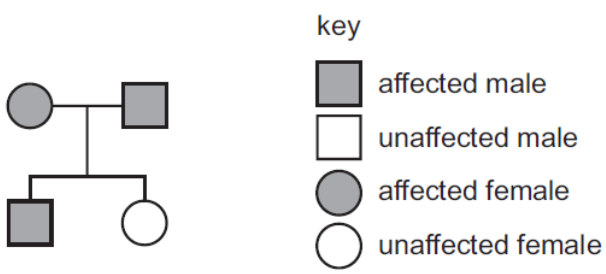
C There are intermediates between the phenotypes.

D There are no intermediates between the phenotypes.

5. June/2021/Paper_12/No.34

Both parents in a family have a characteristic caused by the dominant allele of a gene. They have two children.

The pedigree diagram of the family is shown.



Which row describes the genotypes of the parents in relation to this gene?

	female parent	male parent
A	heterozygous	heterozygous
B	heterozygous	homozygous
C	homozygous	heterozygous
D	homozygous	homozygous

6. June/2021/Paper_13/No.33

By which process is genetic information transmitted from generation to generation?

A inheritance

B mitosis

C meiosis

D variation

7. June/2021/Paper_13/No.34

Some reptiles can lose and regrow their tails to avoid predation.

Which process occurs to regrow the tail?

A digestion

B fertilisation

C meiosis

D mitosis

8. June/2021/Paper_21/No.32

What carries a copy of the gene to the cytoplasm to make a protein?

A alleles

B DNA molecules

C ribosomes

D mRNA molecules

9. June/2021/Paper_21/No.33

Which statement about meiosis is correct?

A Daughter cells are genetically identical.

B The chromosome number changes from haploid to diploid.

C It is used to produce body cells.

D It allows the formation of new combinations of chromosomes.

10. June/2021/Paper_21/No.34

Colour blindness is a characteristic that is sex-linked.

Which statement about colour blindness is correct?

A The gene for colour blindness is located on the Y chromosome and colour blindness is more common in males than in females.

B The gene for colour blindness is located on the X chromosome and colour blindness is more common in males than in females.

C The gene for colour blindness is located on the X chromosome and colour blindness is more common in females than in males.

D The gene for colour blindness is located on the Y chromosome and colour blindness is more common in females than in males.

11. June/2021/Paper_22/No.32

The Tasmanian devil is an animal with seven pairs of chromosomes in each body cell.

The diagram shows the chromosomes in a cell from a Tasmanian devil.



Which statement is correct?

A The cell is a haploid cell containing pairs of chromosomes.

B The cell is a diploid cell with no pairs of chromosomes.

C The cell is a haploid cell with no pairs of chromosomes.

D The cell is a diploid cell containing pairs of chromosomes.

12. June/2021/Paper_22/No.33

Some statements about mitosis are listed.

1 Cells divide and produce new cells to repair damaged tissues.

2 Chromosomes are duplicated and the cell separates to form gametes.

3 Chromosomes are duplicated and the cell separates to form genetically identical cells.

4 Mitosis is used in asexual reproduction.

Which statements are correct?

A 1, 2 and 3 **B** 1, 3 and 4 **C** 2 and 4 **D** 3 and 4 only

13. June/2021/Paper_23/No.33

Which definition of mitosis is correct?

A nuclear division giving rise to genetically different cells

B nuclear division giving rise to genetically identical cells

C fusion of nuclei giving rise to a genetically different cell

D fusion of nuclei giving rise to a genetically identical cell

14. June/2021/Paper_23/No.34

What happens during meiosis?

A A haploid cell produces haploid cells that are genetically identical.

B A haploid cell produces haploid cells that are genetically different.

C A diploid cell produces haploid cells that are genetically identical.

D A diploid cell produces haploid cells that are genetically different.

15. June2021/Paper_31/No.6

(a) Dimples are an indentation of the cheek visible when smiling.

Fig. 6.1 is a photograph showing a person with dimples.



Fig. 6.1

The number of male and female students in a class that had dimples was recorded.

The results are shown in Table 6.1.

Table 6.1

characteristic	sex	number of students
with dimples	male	4
	female	5
without dimples	male	13
	female	12

(i) Calculate the total number of male students in the class.

..... [1]

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16. June2021/Paper_32/No.4

(a) **(i)** Define the term genetic engineering.

.....

.....

.....

.....

..... [2]

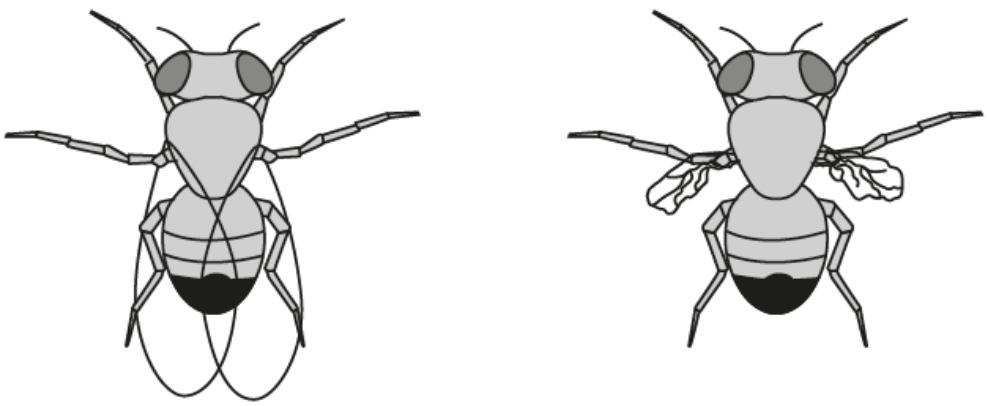
(ii) State **one** example of genetic engineering.

.....

.....

..... [1]

(b) Fig. 4.1 is a diagram of a fruit fly with normal wings and a fruit fly with vestigial wings.



normal wings **vestigial wings**

Fig. 4.1

A gene determines whether fruit flies have normal wings or vestigial wings.

There are two alleles for this gene:

- **A** is dominant and represents the allele for normal wings
- **a** is recessive and represents the allele for vestigial wings.

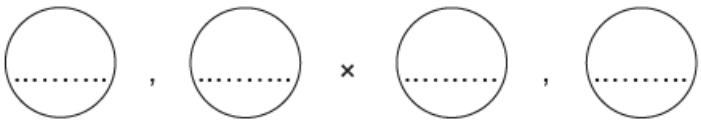
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(i) A homozygous dominant fruit fly was crossed with a heterozygous fruit fly.

Complete the genetic diagram to predict the probability of the offspring having vestigial wings.

parental phenotypes normal wings × normal wings

parental genotypes ..... × .....

gametes  , × ,

offspring genotypes ....

offspring phenotypes ....

probability of offspring having vestigial wings .....

[5]

(ii) State the genotype of a pure-breeding fruit fly that has normal wings.

..... [1]

(iii) The binomial name for a fruit fly is *Drosophila melanogaster*.

State the genus of this fruit fly.

..... [1]

[Total: 10]

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17. June2021/Paper_33/No.10

(b) Another plant with red flowers was crossed with a plant with white flowers.

Some of the offspring plants from this cross had red flowers and some of the offspring plants had white flowers.

Complete the genetic diagram to show the results of this cross.

	red-flowered plant	X	white-flowered plant
parental genotypes	.....	X	.....
parental gametes	....		....

offspring genotypes .....

offspring phenotypes .....

[5]

[Total: 7]

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18. June2021/Paper_41/No.5

Fig. 5.1 shows some of the stages in the reproduction of the bacterium *Escherichia coli*.

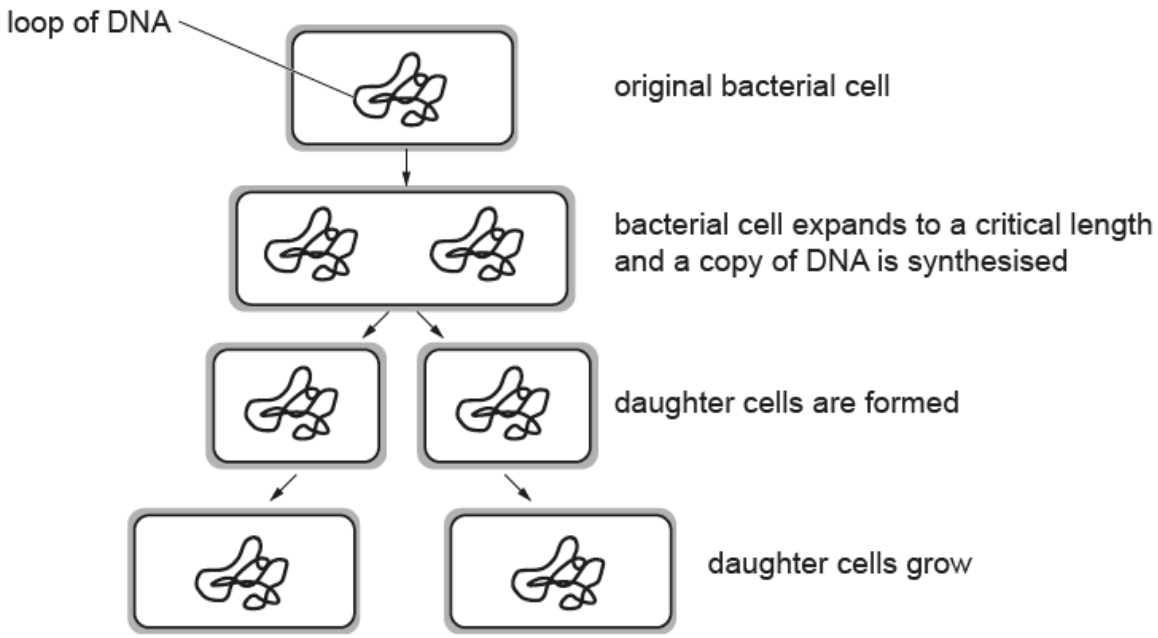


Fig. 5.1

(a) Complete the sentences about the cells in Fig. 5.1.

The DNA is in the form of a double ..... . The DNA is copied so that the number of loops of DNA after cell division is ..... in each daughter cell. The daughter cells are genetically ..... to the original cell.

[3]

(b) Students used a microscope and time-lapse photography to observe *E. coli* cells reproducing.

They used the series of photographs to identify which cells were dividing.

They measured the lengths of the dividing cells and put their data into two groups:

- cell lengths immediately before cell division
- cell lengths immediately after cell division.

Fig. 5.2 shows their results.

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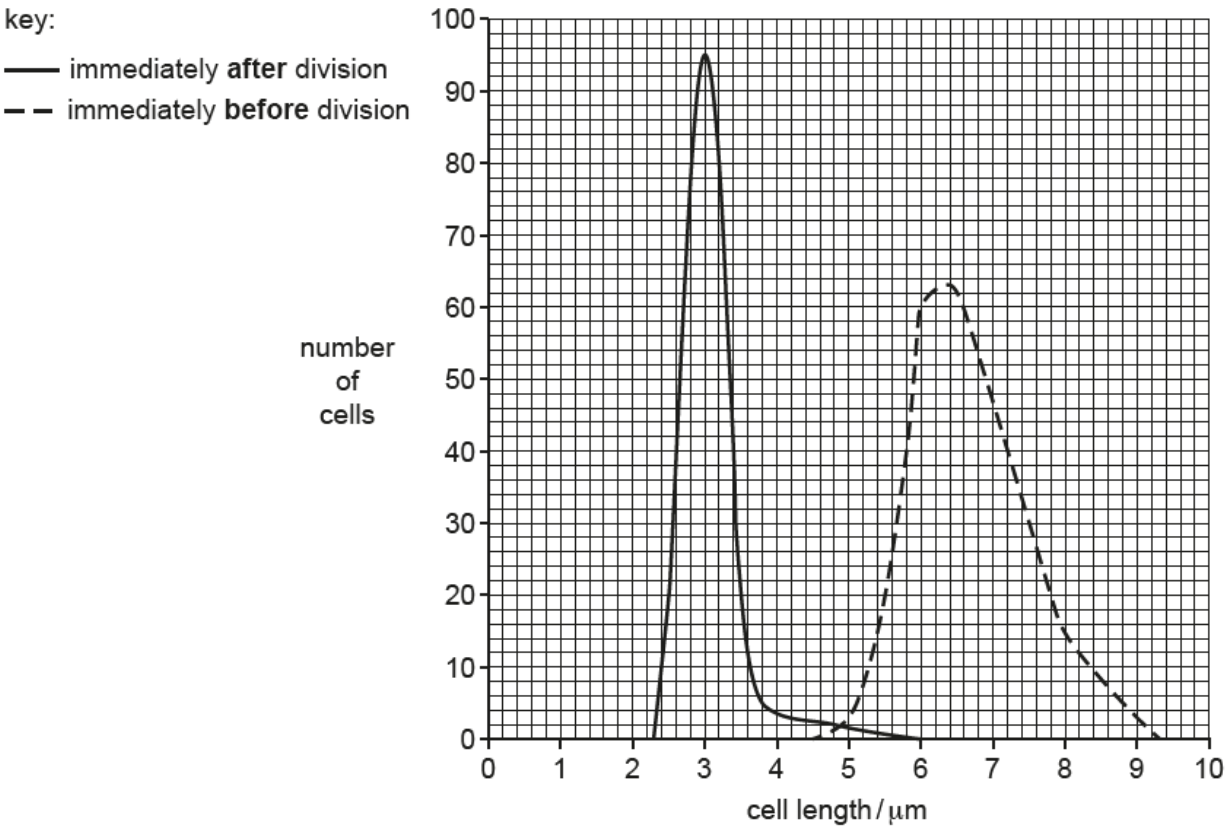


Fig. 5.2

(i) Use the information in Fig. 5.2 to state the most frequent cell length of the *E. coli* cells immediately **after** cell division.

Give your answer in **millimetres**.

..... mm
[2]

(ii) Some students concluded that the cells must be at least 6 μm in length before cell division can occur.

Describe the evidence **against** the students' conclusion. Use the information in Fig. 5.2 to support your answer.

.....

.....

.....

.....

..... [2]

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(i) Describe how a plasmid is cut so that a new gene can be inserted into the plasmid.

.....

.....

..... [2]

(ii) List **two** reasons, other than the presence of plasmids, that make bacteria and single-celled fungi useful to biotechnology industries.

1 .....

2 .....

[2]

[Total: 11]

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19. June2021/Paper_43/No.6

There are four blood groups in the ABO system in humans: A, B, AB and O.

The gene that determines blood group has three alleles: I^A, I^B and I^o.

(a) Parents with the genotypes I^AI^o and I^BI^o are planning to have more children.

Complete the genetic diagram to determine the probability that the next child will have blood group O.

parental blood groups A B

parental genotypes I^AI^o I^BI^o

Punnett square

phenotypes of the children .....

probability that the child will have blood group O .....

[4]

(b) Explain why the ABO blood group system is an example of co-dominance.

.....

.....

.....

.....

..... [2]

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(c) Fig. 6.1 shows the percentages of the global population with the four different blood groups in the ABO system.

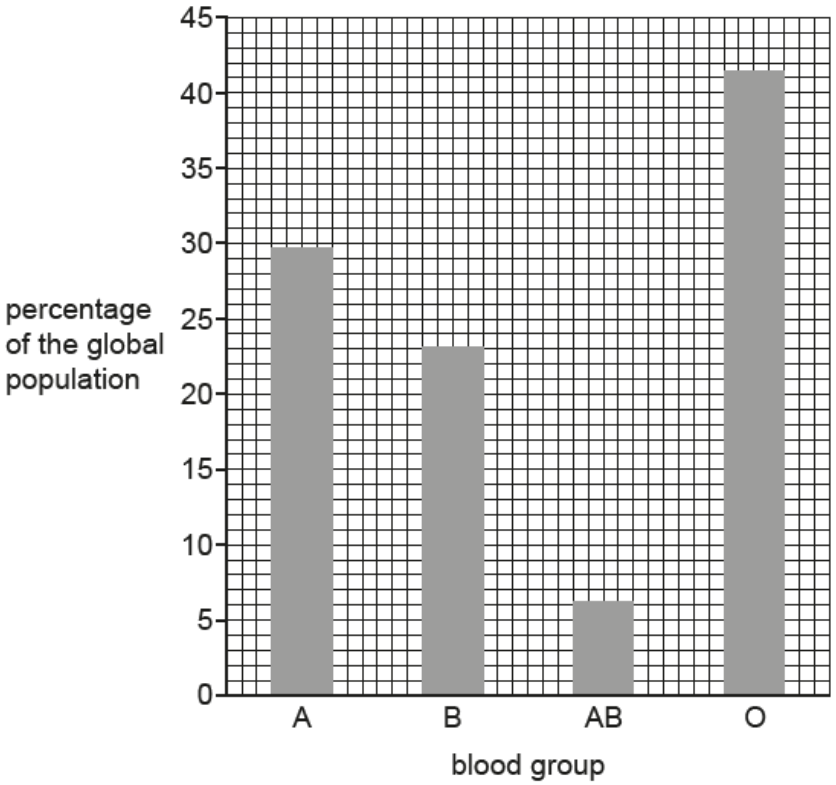


Fig. 6.1

With reference to Fig. 6.1, explain why the ABO blood group system is an example of discontinuous variation.

.....

.....

.....

.....

.....

..... [2]

[Total: 8]

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Inheritance – 2020 IGCSE 0610

1. Nov/2020/Paper_11/No.32

In humans, sex determination is controlled by the X and Y chromosomes.

A man and a woman have three children, two boys and a girl.

What is the probability that their next child will be a girl?

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

2. Nov/2020/Paper_12/No.32

Which is a correct description of mitosis?

A It produces genetically identical cells called gametes.

B It produces genetically identical cells for growth and repair.

C It produces genetically different cells for growth.

D It produces genetically different cells called gametes.

3. Nov/2020/Paper_12/No.33

Which term is used to describe alleles that are always expressed when they are present in the genotype?

A dominant

B heterozygous

C homozygous

D recessive

4. Nov/2020/Paper_12/No.34

Some human phenotypes are listed.

1 body mass

2 foot size

3 height

4 sex

Which features are examples of continuous variation?

A 1, 2 and 3 **B** 1, 3 and 4 **C** 1 and 4 only **D** 2 and 3 only

5. Nov/2020/Paper_13/No.32

Which word describes nuclear division to produce genetically identical cells?

A fertilisation

B inheritance

C meiosis

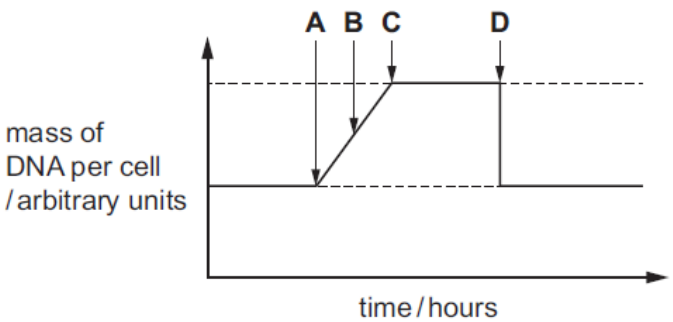
D mitosis

6. Nov/2020/Paper_13/No.33

7. Nov/2020/Paper_21/No.30

The graph shows how the mass of DNA changes during a mitotic cell division.

Where on the graph are two cells formed?



8. Nov/2020/Paper_21/No.31

What happens during meiosis?

A A diploid cell divides to form diploid cells.

B A diploid cell divides to form haploid cells.

C A haploid cell divides to form diploid cells.

D A haploid cell divides to form haploid cells.

9. Nov/2020/Paper_21/No.32

Red-green colour blindness is a condition that occurs more frequently in men than in women.

Which statement about this condition is correct?

A It can pass from father to son.

B It is a sex-linked characteristic.

C It shows co-dominance.

D The gene is on the Y chromosome.

10. Nov/2020/Paper_21/No.33

Which statement explains why the allele for sickle-cell anaemia is commonly found in human populations in certain parts of the world?

A It is transmitted by mosquitoes.

B It protects people against malaria.

C It prevents people being bitten by mosquitoes.

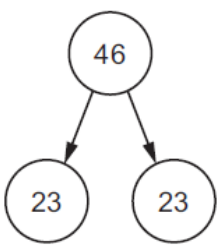
D It increases oxygen transport.

11. Nov/2020/Paper_22/No.30

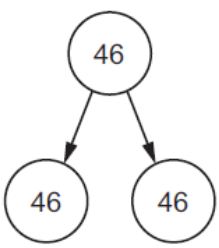
The diagrams show human nuclei and the number of chromosomes in each nucleus.

Which diagram represents nuclear division of skin cells for growth and repair?

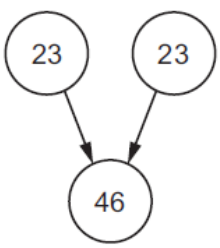
A



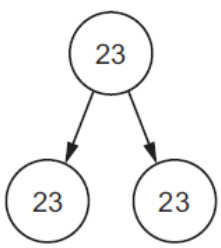
B



C



D



12. Nov/2020/Paper_22/No.31

Meiosis is sometimes called 'reduction division'.

What is reduced during meiosis?

A Body cells are reduced in size.

B Chromosomes are reduced in number.

C The number of gametes is reduced.

D The rate of cell division is reduced.

13. Nov/2020/Paper_22/No.32

In guinea pigs, the allele for black fur is dominant and the allele for white fur is recessive.

A test cross can be used to determine the genotype of a black guinea pig.

What would be the expected result of the test cross if the black guinea pig was heterozygous?

A 50% black, 50% white

B 25% black, 75% white

C 100% black

D 100% white

14. Nov/2020/Paper_22/No.33

Which substance is coded for by a length of DNA?

A base

B glucose

C glycerol

D lipase

15. Nov/2020/Paper_23/No.31

Some features of cell division are listed.

1 chromosome number is maintained

2 haploid cells are produced

3 new cells are genetically different

4 results in variation

Which features are involved in meiosis?

A 1, 2 and 3 only

B 1, 2 and 4 only

C 2, 3 and 4 only

D 2 and 3 only

16. Nov/2020/Paper_23/No.32

Which statement about the inheritance of red-green colour blindness is correct?

A The gene for red-green colour blindness is located on the X chromosome.

B Females are more likely to have red-green colour blindness than males.

C The allele for red-green colour blindness is the dominant allele.

D The gene for red-green colour blindness is located on the Y chromosome.

17. Nov/2020/Paper_23/No.33

18. Nov/2020/Paper_42/No.6

Fig. 6.1 is a diagram of DNA.

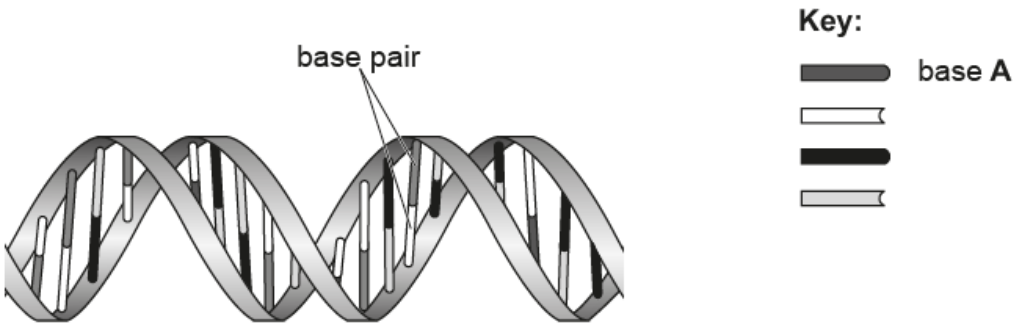


Fig. 6.1

(a) (i) State the letter of the base that pairs with **A**.

..... [1]

(ii) State the letters of the other bases in DNA.

..... [1]

(b) Outline the roles of DNA in a cell.

.....

.....

.....

.....

..... [2]

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(c) Fig. 6.2 shows a plant tissue in which cells are dividing by mitosis.

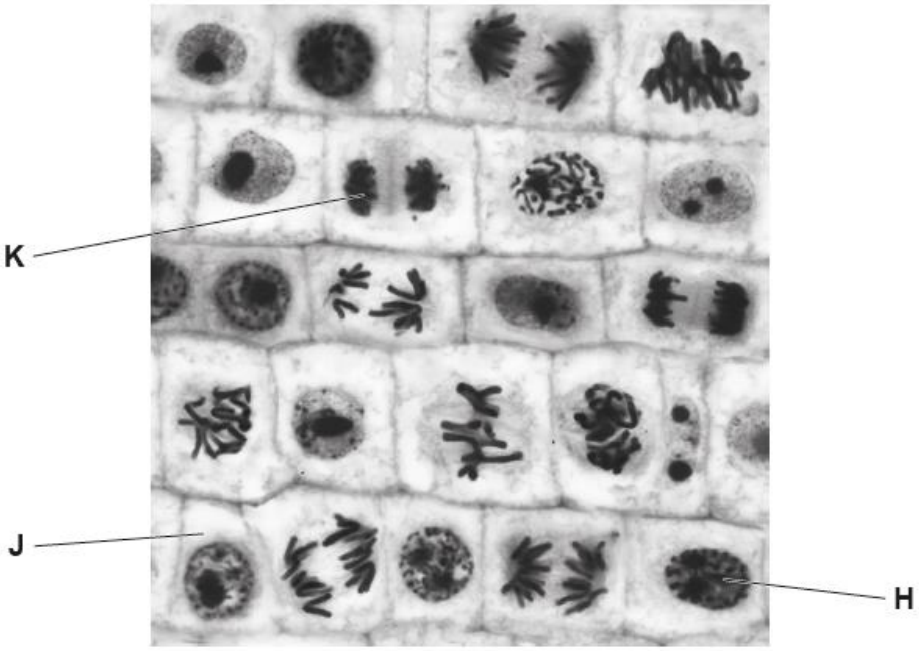


Fig. 6.2

(i) Cell **H** in Fig. 6.2 is about to divide by mitosis.

State what happens to the chromosomes in cell **H** before mitosis takes place **and** state why it is necessary.

.....

.....

.....

.....

..... [2]

(ii) Cell **K** is about to divide into two cells.

State the structures that will form between the nuclei so that the cell divides into two cells.

.....

..... [2]

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(iii) Cell **J** in Fig. 6.2 is an example of a diploid cell.

State what is meant by the term diploid.

.....

.....

..... [1]

[Total: 9]

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Inheritance – 2020 IGCSE 0610

1. March/2020/Paper_12/No.32

Some features of cell division are listed.

1 involved in making gametes

2 involved in replacing cells

3 makes genetically different cells

4 makes genetically identical cells

Which features are involved in meiosis?

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

2. March/2020/Paper_12/No.33

Which cross will be pure-breeding?

A a female homozygous individual and a male heterozygous individual bred together

B a male homozygous individual and a female heterozygous individual bred together

C two identical heterozygous individuals bred together

D two identical homozygous individuals bred together

3. March/2020/Paper_42/No.5

(a) Mitosis is a type of nuclear division.

Fig. 5.1 is a series of photomicrographs showing a cell dividing by mitosis.

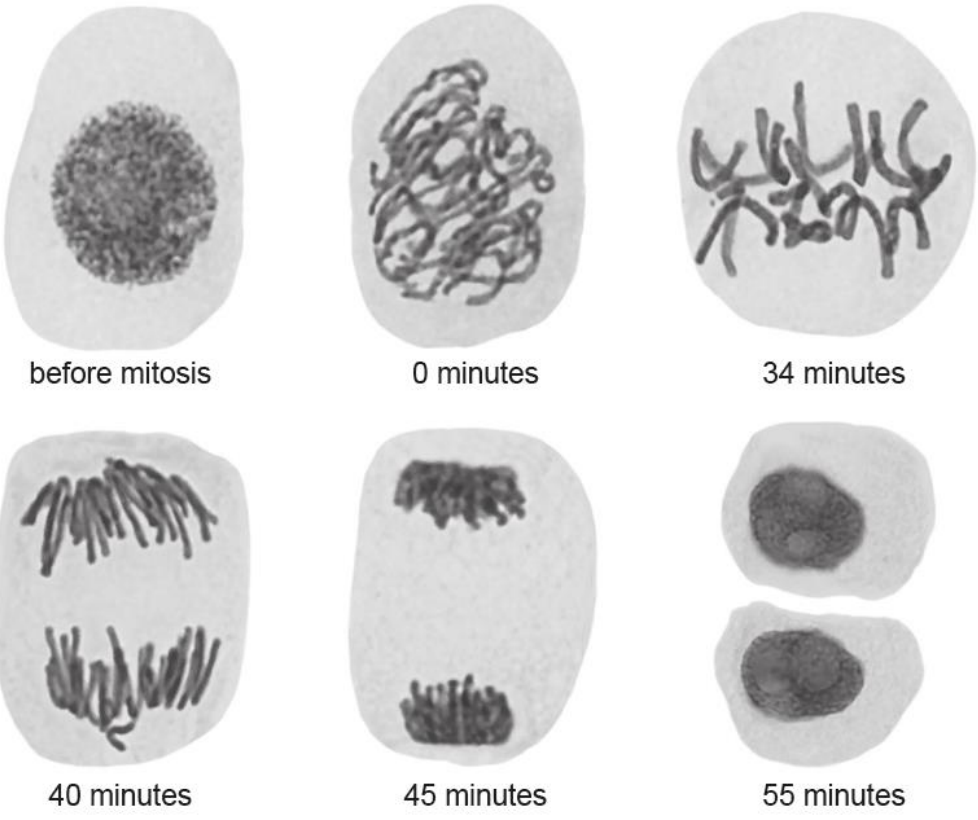


Fig. 5.1

(i) State the change that has occurred to the mass of DNA immediately before mitosis in Fig. 5.1.

..... [1]

(ii) Estimate the time when the chromosomes shown in Fig. 5.1 begin to separate.

..... [1]

(b) Meiosis is another type of nuclear division.

Describe how the nuclei in cells produced by meiosis differ from the nuclei in cells produced by mitosis.

.....

.....

.....

.....

.....

.....

..... [3]

(c) Stem cells divide by mitosis during the growth of an embryo.

Describe the role of stem cells in the growth of an embryo.

.....

.....

.....

.....

..... [2]

(d) An embryo develops into a fetus.

Outline the processes of labour and birth.

.....

.....

.....

.....

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.....

.....

.....

.....

.....

.....

..... [6]

[Total: 13]

4. June/2020/Paper_11/No.33

Pea plants produce either yellow or green seeds. Yellow (Y) is dominant to green (y).

What are the most likely phenotypes of the offspring of a cross between YY and Yy plants?

A 50% yellow and 50% green

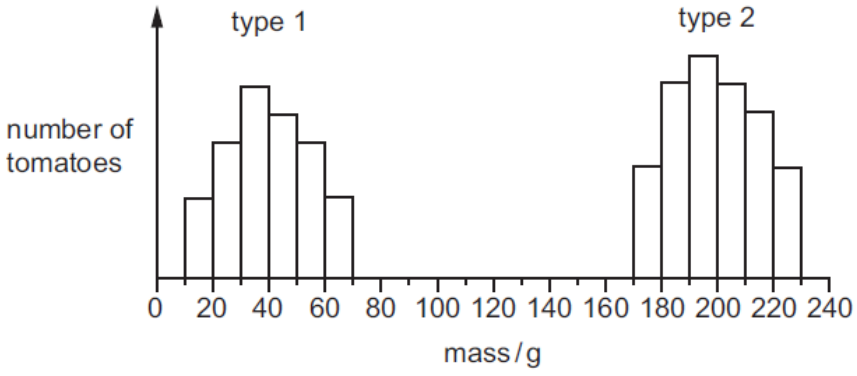
B 75% yellow and 25% green

C 100% yellow

D 100% green

5. June/2020/Paper_11/No.34

The graph shows the masses of two different types of tomato.



What can be concluded from the graph?

A Genes do not affect the mass of tomatoes.

B Type 1 tomatoes show continuous variation.

C Type 2 tomatoes are sometimes smaller than type 1 tomatoes.

D Type 2 tomatoes show discontinuous variation.

6. June/2020/Paper_13/No.31

Fur colour in cats is an observable feature.

Which word is used to describe an observable feature?

A allele

B genotype

C heterozygous

D phenotype

7. June/2020/Paper_13/No.32

Which row shows the sex chromosomes in the body cells and in the gametes of a woman?

	body cells	gametes
A	XX	all X
B	XX	all XX
C	XY	X or Y
D	XY	all XY

8. June/2020/Paper_13/No.33

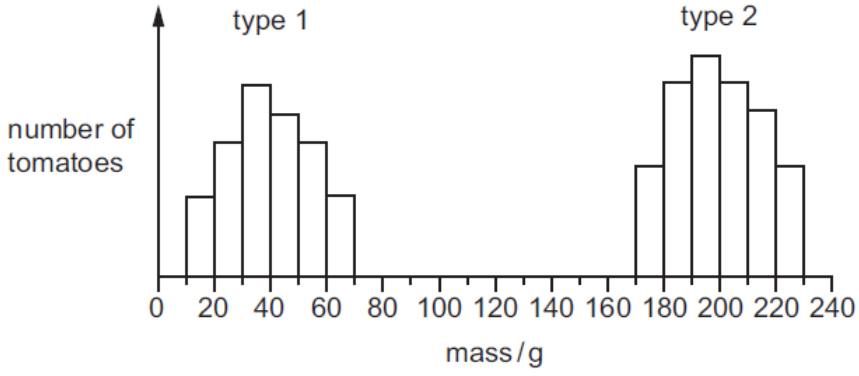
In mice, the allele for black hair is dominant to the allele for brown hair.

What proportion of offspring will have brown hair if a cross is made between a homozygous black mouse and a heterozygous black mouse?

A 0% **B** 25% **C** 50% **D** 100%

9. June/2020/Paper_13/No.34

The graph shows the masses of two different types of tomato.



What can be concluded from the graph?

A Genes do not affect the mass of tomatoes.

B Type 1 tomatoes show continuous variation.

C Type 2 tomatoes are sometimes smaller than type 1 tomatoes.

D Type 2 tomatoes show discontinuous variation.

10. June/2020/Paper_21/No.30

Which cell contains a haploid nucleus?

A neurone

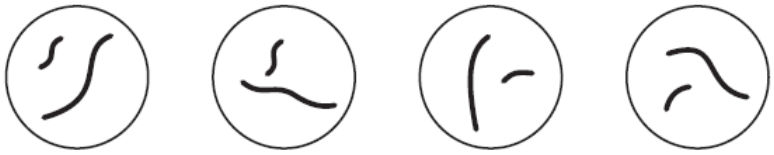
B sperm cell

C skin cell

D red blood cell

11. June/2020/Paper_21/No.31

The diagram shows the chromosomes of four daughter cells produced by meiosis.



Which parent cell produced these cells?

A



B



C



D



12. June/2020/Paper_21/No.32

When damaged tissues are repaired cells undergo division by

A meiosis to produce genetically identical cells.

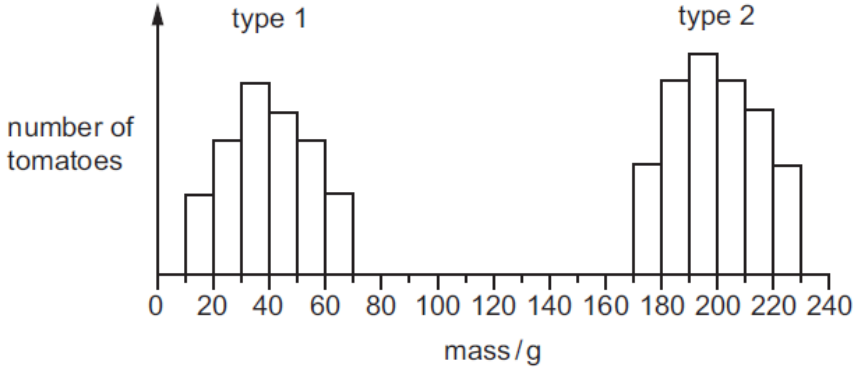
B meiosis to produce genetically different cells.

C mitosis to produce genetically identical cells.

D mitosis to produce genetically different cells.

13. June/2020/Paper_21/No.33

The graph shows the masses of two different types of tomato.



What can be concluded from the graph?

A Genes do not affect the mass of tomatoes.

B Type 1 tomatoes show continuous variation.

C Type 2 tomatoes are sometimes smaller than type 1 tomatoes.

D Type 2 tomatoes show discontinuous variation.

14. June/2020/Paper_32/No.6

(a) A student wrote an incorrect definition of the term *hormone*.

The student's incorrect definition is shown in Fig. 6.1.

> *A hormone is an electrical substance, produced by a gland and carried by the neurones, which alters the activity of one or more specific target organs.*

Fig. 6.1

Identify the **two** incorrect words in the student's definition.

1 .....

2 .....

[2]

(b) Table 6.1 shows the names of some hormones and the glands where they are secreted.

Complete Table 6.1.

Table 6.1

hormone	gland
	adrenal
insulin	
oestrogen	
	testes

[4]

(c) Fig. 6.2 shows the position of some of the organs and endocrine glands in the body.

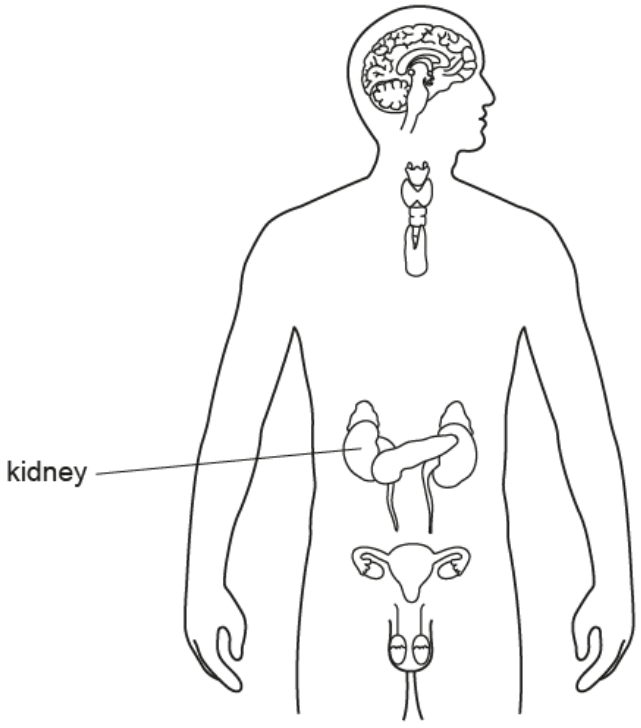


Fig. 6.2

Draw an **X on** Fig. 6.2 to identify an adrenal gland. [1]

(d) The list in Fig. 6.3 shows some of the changes that occur in boys and girls during puberty.

breasts grow	hair grows in armpits	pubic hair grows
hips widen	menstruation	testes grow

Fig. 6.3

(i) State **two** changes that occur in girls **only** from the list in Fig. 6.3.

1 .....

2 .....

[2]

(ii) State **one** change that occurs in **both** boys and girls from the list in Fig. 6.3.

..... [1]

[Total: 10]

15. June/2020/Paper_41/No.6

Colour blindness is a characteristic that is inherited. Colour blindness is more common in males than in females.

Fig. 6.1 is a pedigree diagram showing the inheritance of colour blindness in a family.

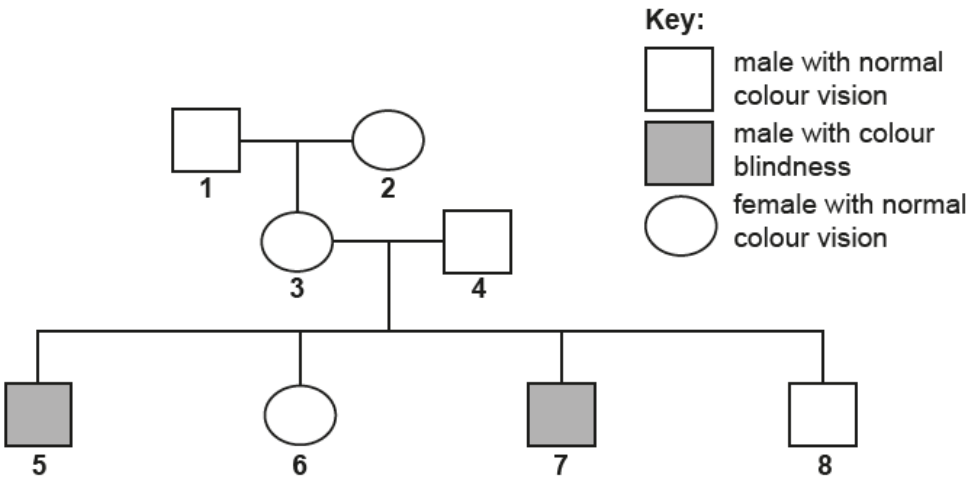


Fig. 6.1

(a) Define the term *inheritance*.

.....

.....

..... [1]

(b) **(i)** Using the symbols **B** and **b**, state the genotypes of individual **5** and individual **8** in the pedigree diagram.

5 .....

8 .....

[3]

(ii) Individual **3** is a carrier of colour blindness because she has one copy of the allele for colour blindness but has normal colour vision.

Describe the evidence from Fig. 6.1 that shows that individual **3** is a carrier.

.....

.....

.....

.....

.....

.....

..... [3]

(iii) There was no history of colour blindness in the parents and grandparents of individuals **1** and **2**.

Suggest how colour blindness first occurred in the family in Fig. 6.1.

.....

.....

.....

.....

..... [2]

[Total: 9]

16. June/2020/Paper_43/No.3

The American writer Ernest Hemingway lived on the island of Key West in Florida, USA in the 1930s. During this time he was given a male cat by a sea captain.

The cat had more toes than usual. This inherited condition is called polydactyly. The allele for polydactyly is dominant.

(a) Define the term inheritance.

.....

.....

..... [1]

(b) Fig. 3.1 is part of a pedigree diagram for Hemingway's cats.

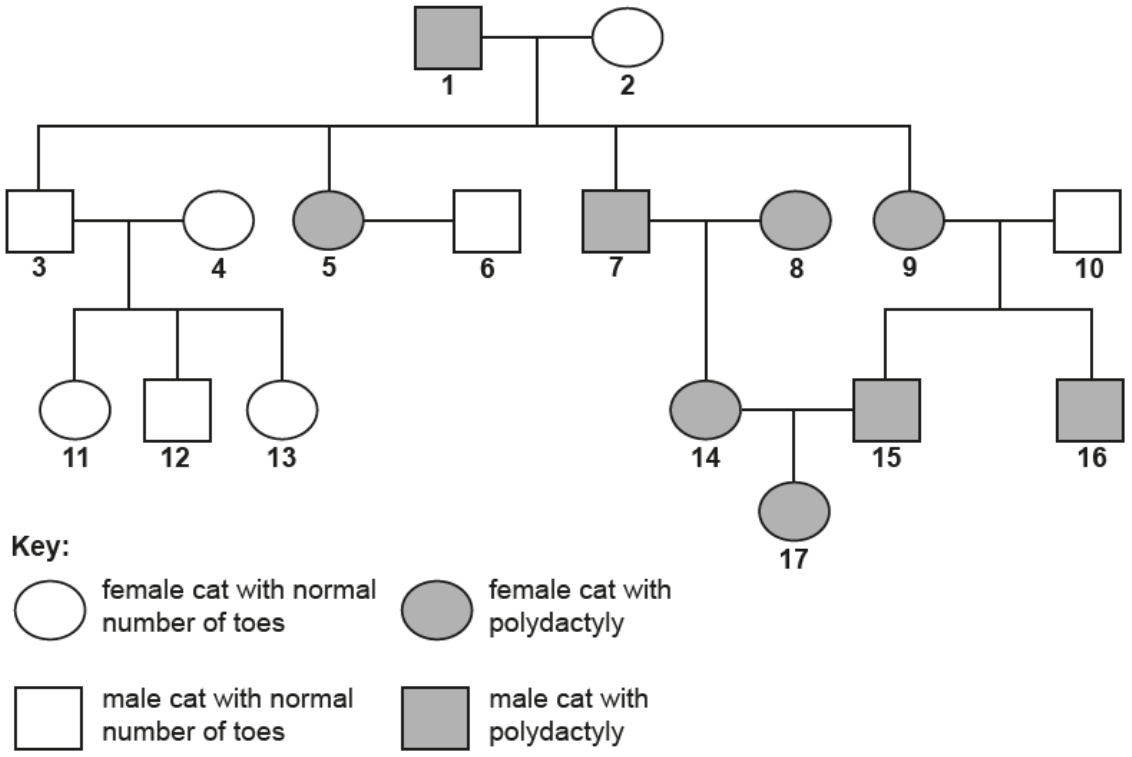


Fig. 3.1

(i) State the genotypes of cats **5**, **6** and **14** in the pedigree diagram in Fig. 3.1.

Use the letters **T** and **t**.

cat **5** .....

cat **6** .....

cat **14** .....

[3]

(ii) Explain why none of the offspring of cats **3** and **4** have inherited polydactyly.

Use the information in Fig. 3.1 in your answer.

.....

.....

..... [1]

(c) Scientists published the results of an investigation into the DNA of cats with and without polydactyly. They compared the base sequence from a particular region of DNA that controls the development of the limbs.

Table 3.1 shows the base sequences.

Table 3.1

cats without polydactyly	AGA CAC AGA AAT GAG
Hemingway's cats with polydactyly	AGA CAC GGA AAT GAG
cats with polydactyly from Oregon and Missouri in the USA	AGA CAC GGA AAT GAG
cats with polydactyly from the UK	AGA CAC AGT AAT GAG

(i) Describe how the base sequences of the cats with polydactyly differ from the base sequence of cats without polydactyly.

.....

.....

.....

.....

..... [2]

(ii) State the name of the process by which base sequences in DNA are changed.

..... [1]

(iii) The base sequences in Table 3.1 provide evidence that indicates which country the male cat given to Hemingway in the 1930s came from.

Suggest which country this cat came from **and** give a reason for your choice.

.....

.....

.....

.....

..... [2]

(d) Fig. 3.2 shows part of a DNA molecule from a chromosome of a cat.

Complete Fig. 3.2 by writing the letters for the base sequence of the other strand of the DNA molecule.

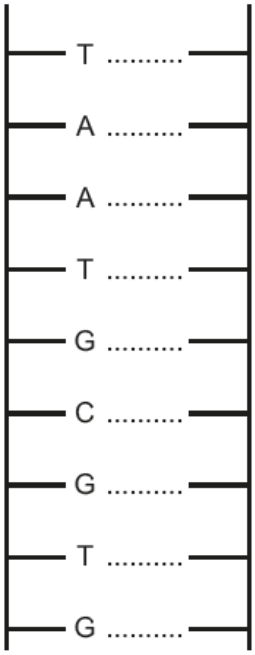


Fig. 3.2

[1]

(e) Explain why polydactyly is an example of discontinuous variation.

.....

.....

.....

.....

..... [2]

[Total: 13]

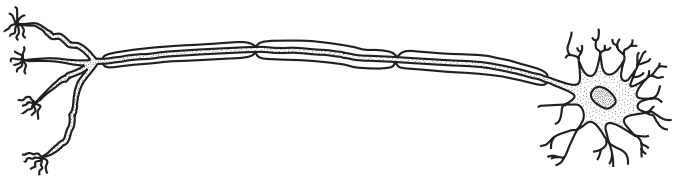
1 Cells are formed by the division of existing cells. Four different cells are shown.

Which cell is produced by meiosis?

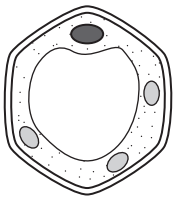
A



B



C



D



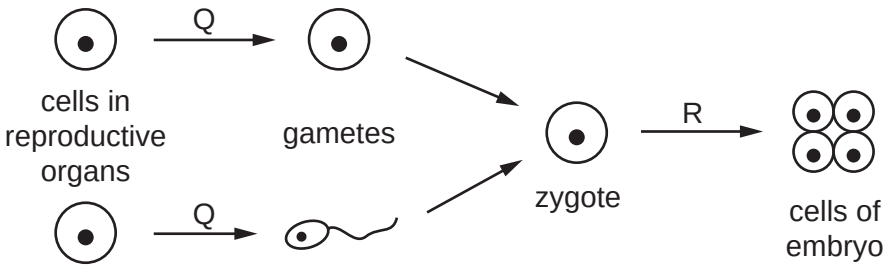
2 Albinism is an inherited condition in which pigment does not develop in the skin, hair and eyes.

The allele for albinism is recessive.

What are the chances of albino parents having an albino child?

A 0% **B** 25% **C** 75% **D** 100%

3 The diagram represents processes in sexual reproduction.



Which processes are represented by stages Q and R?

	Q	R
A	meiosis	meiosis
B	meiosis	mitosis
C	mitosis	meiosis
D	mitosis	mitosis

4 Which name is given to the observable features of an organism?

A alleles

B genes

C genotype

D phenotype

5 Which structure will be found in the nucleus of a body cell in a woman?

A X allele

B X chromosome

C Y allele

D Y chromosome

6 Owners of successful race horses hope that the horses' offspring will be like their parents.

How does a young race horse inherit its characteristics?

A equally from its mother and father

B mainly from its father

C mainly from its mother

D passed across the placenta

7 In pea plants the allele for tall, T, is dominant to the allele for dwarf, t. Which cross would produce plants in the proportion of 1 tall : 1 dwarf?

A TT × Tt **B** Tt × Tt **C** Tt × tt **D** tt × tt

8 In the inheritance of ABO blood groups, when two parents have the genotypes I^AI^A and I^AI^o, what is the blood group of their offspring?

A group A

B group AB

C group B

D group O

9 When a cell divides, these events occur.

1 The DNA inside the cell is duplicated exactly.

2 Daughter cells are produced with the same chromosome number as the parent cell. Which type of division has occurred?

A meiosis producing genetically different cells

B meiosis producing genetically identical cells

C mitosis producing genetically different cells

D mitosis producing genetically identical cells

10 Which structures in plant cells build protein molecules under the control of the nucleus?

A cell walls

B chloroplasts

C mitochondria

D ribosomes

11 Sickle cell anaemia is determined by the gene Hb. Hb^A is the allele for normal blood. Hb^S is the allele for sickle cell anaemia.

Which combination of parents could result in some children with resistance to malaria and some with all normal red blood cells?

A $Hb^A\ Hb^A$ $Hb^A\ Hb^A$

B $Hb^A\ Hb^A$ $Hb^A\ Hb^S$

C $Hb^A\ Hb^A$ $Hb^S\ Hb^S$

D $Hb^S\ Hb^S$ $Hb^S\ Hb^S$

12 Which substance is coded for by a length of DNA?

A fat

B fatty acid

C glycerol

D lipase

13 What are alleles?

A a pair of chromosomes

B different versions of the same gene

C the total number of genes on one chromosome

D two genes side by side on the same chromosome

14 A pure-breeding plant with smooth stems was crossed with a heterozygous plant with hairy stems.

What will be the ratio of hairy : smooth stems in the resulting plants?

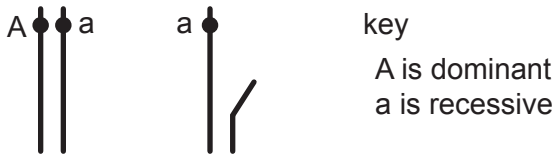
A 1 hairy : 1 smooth

B 1 hairy : 3 smooth

C 3 hairy : 1 smooth

D all hairy

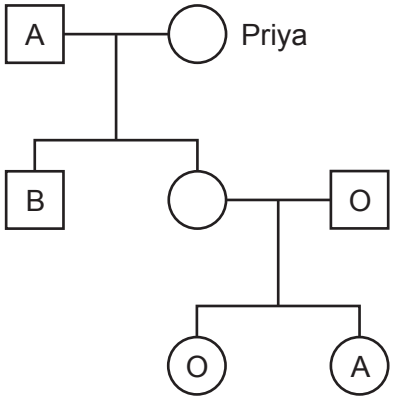
15 The diagram shows the sex chromosomes of a woman and of a man. Their genotypes for a recessive sex-linked condition are also shown.



What are the chances that their daughter will show the sex-linked condition?

A 0% **B** 25% **C** 50% **D** 75%

16 The diagram shows the inheritance of ABO blood groups. The blood groups of some of the individuals are given.



What could be Priya's genotype?

A I^AI^o **B** I^BI^B **C** I^BI^o **D** I^oI^o

17 Which statement about the human sex chromosomes is correct?

A All boys have two Y chromosomes.

B Everybody has at least one X chromosome.

C Girls have a Y chromosome and an X chromosome.

D Nobody has two X chromosomes.

18 What results from meiosis of a diploid cell?

A genetically different diploid cells

B genetically different haploid cells

C genetically identical diploid cells

D genetically identical haploid cells

19 What will be the genotypes of the offspring resulting from a genetic cross between two individuals, one of which is homozygous dominant, (TT), and the other heterozygous?

A all Tt

B 50% TT, 50% tt

C 50% TT, 50%Tt

D 25%TT, 50% Tt, 25% tt

20 Which of these cells is haploid?

A liver cell

B red blood cell

C sperm cell

D zygote

21 A genetic cross between two organisms may be shown as Gg × Gg.

What does g represent?

A a dominant allele

B a dominant chromosome

C a recessive allele

D a recessive chromosome

22 Some fruit flies have orange eyes and others have red eyes.

If two orange-eyed fruit flies are crossed, their offspring always have orange eyes.

If two red-eyed fruit flies are crossed, their offspring sometimes include both orange-eyed and red-eyed flies.

What can be concluded from these observations?

A Crossing an orange-eyed fly with a red-eyed fly will produce a 1 : 1 ratio in the offspring.

B The allele for orange eyes is dominant.

C The allele for red eyes is dominant.

D We could determine which allele is dominant only by doing a cross that produces a 3 : 1 ratio.

23 What are correct descriptions of mitosis and meiosis?

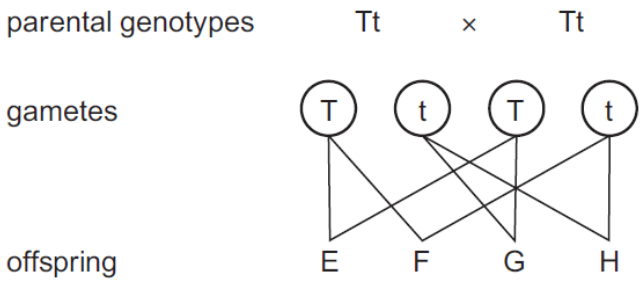
	mitosis	meiosis
A	cells produced are genetically identical	repairs damaged cells
B	halves the chromosome number	cells produced are genetically identical
C	involved in asexual reproduction	halves the chromosome number
D	involved in sexual reproduction	doubles the chromosome number

24 A man has three sons.

What is the chance of his next child being a son?

A 0% **B** 25% **C** 50% **D** 75%

25 The diagram shows a cross between heterozygous tall pea plants.



Which statement is **not** correct?

A Offspring E and H are both homozygous.

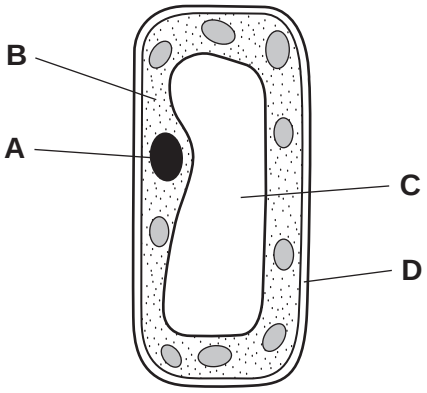
B Offspring F and G are both heterozygous.

C The phenotypes of offspring E, F and G are the same.

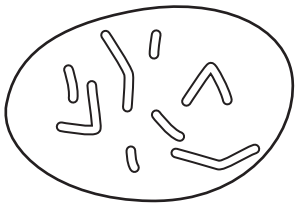
D The ratio of different phenotypes in the offspring is 1 : 1.

26 The diagram shows a plant cell.

Where is most of the DNA found?

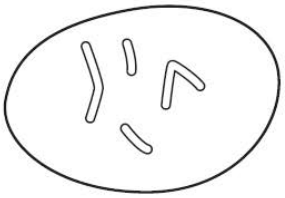


27 The diagram shows the chromosomes in the nucleus of a cell that divides by mitosis.

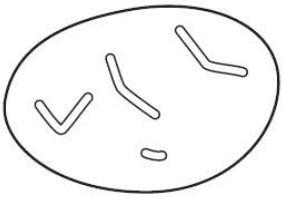


Which diagram shows the chromosomes in the nucleus of one of the daughter cells produced?

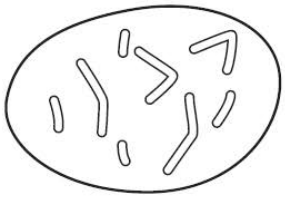
A



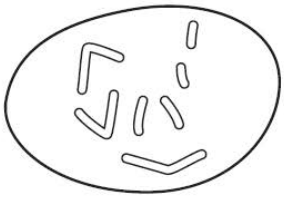
B



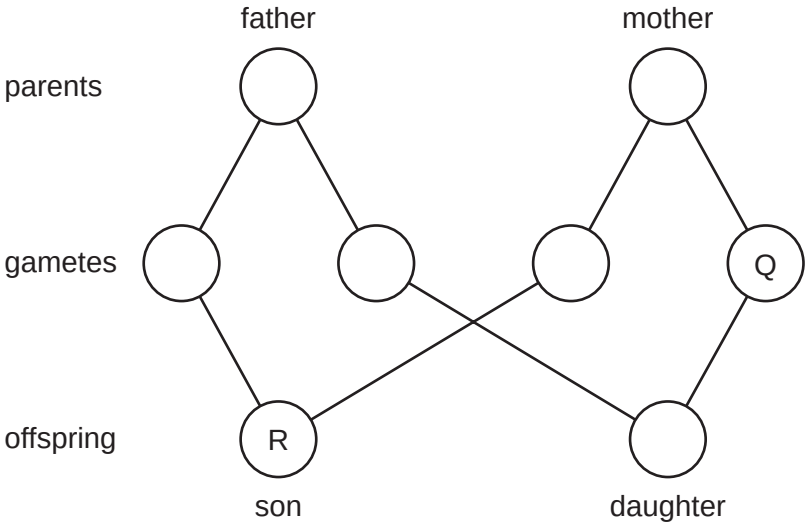
C



D



28 The diagram shows the fusion of gametes to produce a son and a daughter.



What are the sex chromosomes in gamete Q and son R?

	Q	R
A	X	XX
B	X	XY
C	Y	XX
D	Y	XY

29 What are the sex chromosomes for human females and males?

	female	male
A	XX	XY
B	XX	YY
C	XY	XX
D	YY	XY

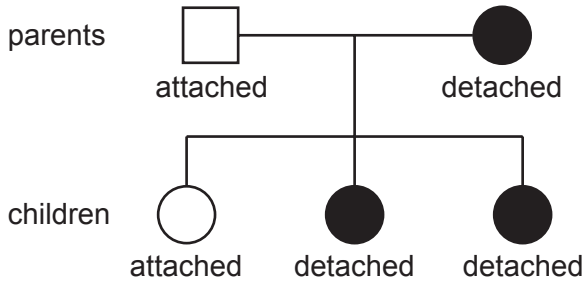
30 A plant has two different alleles of a gene resulting in it having a green seed.
Which row describes the phenotype and genotype of the seeds of this plant?

	phenotype	genotype
A	Gg	heterozygous
B	Gg	homozygous
C	green	heterozygous
D	green	homozygous

31 The shape of a person's earlobes is determined by a single gene. This gene has dominant and recessive alleles.

The allele for detached earlobes is dominant to the allele for attached earlobes.

The diagram shows the inheritance of earlobe shape in a family.



What is the probability of the next child from the same parents having detached earlobes?

A 0% **B** 25% **C** 50% **D** 75%

32 Which sex chromosomes are present in all mature human sperm cells?

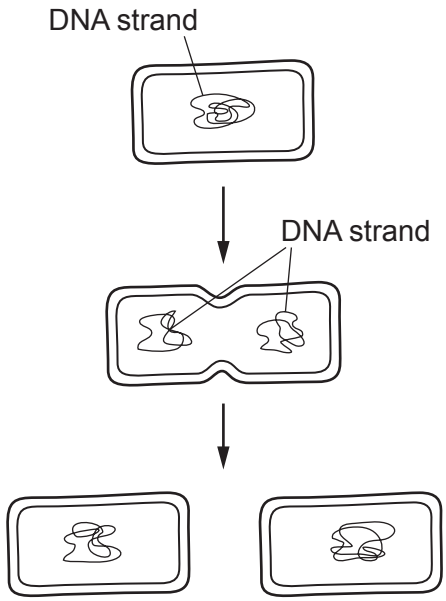
A both X and Y chromosomes

B either X or Y chromosomes

C only X chromosomes

D only Y chromosomes

33 The diagram shows a cell dividing into two.



Which process is shown in the diagram?

A asexual reproduction in a bacterium

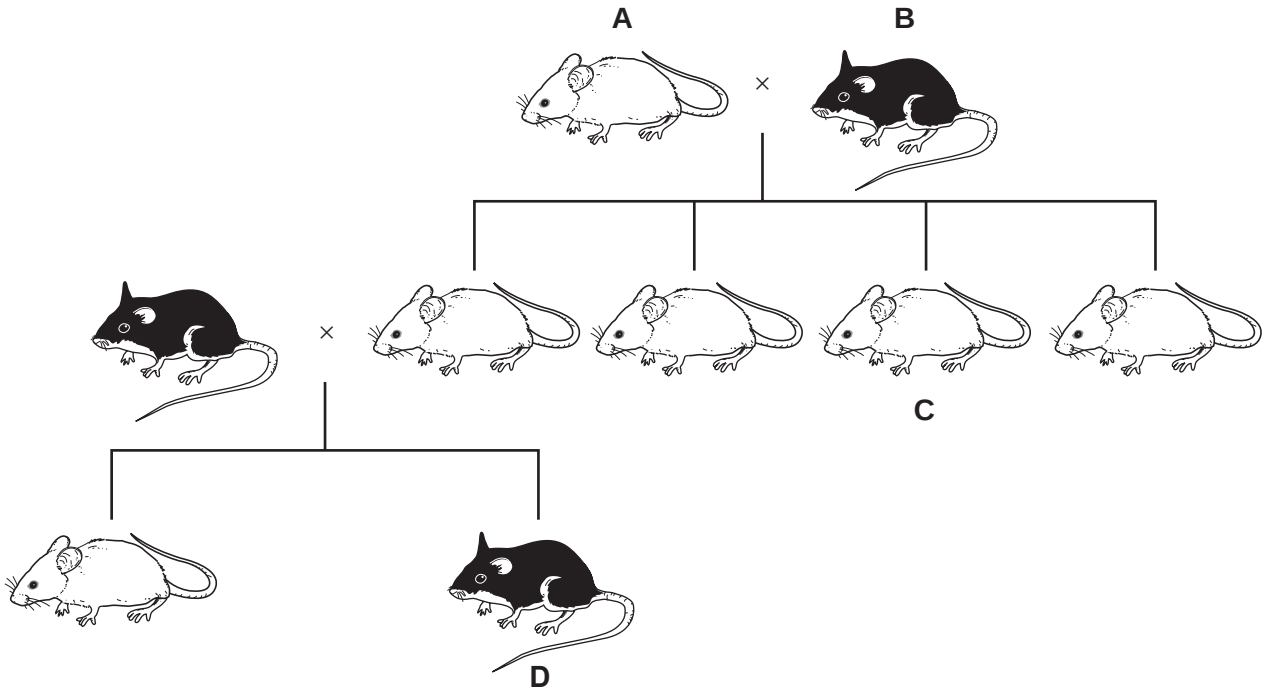
B asexual reproduction in a potato plant

C meiosis in a woman's ovary

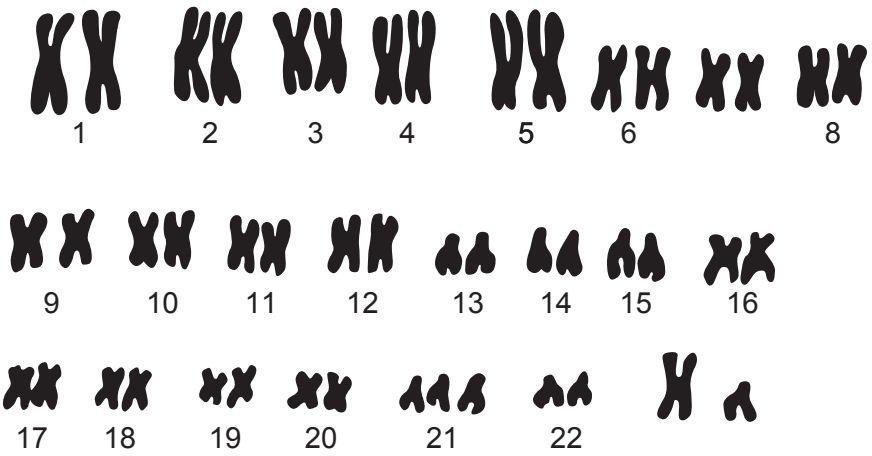
D mitosis in the root of a plant

34 The chart shows the inheritance of fur colour in a small mammal.

If the allele for white fur is dominant, which animal **must** be heterozygous for the gene controlling fur colour?



35 The diagram shows the chromosomes from one person.



What can be deduced about the person who has these chromosomes?

A a female with Down's syndrome

B a male with Down's syndrome

C a normal female

D a normal male

36 Genetics is the study of

A development of organisms.

B mechanisms of inheritance.

C nuclear division.

D variation between species.

37 What is **unlikely** to be affected by the environment?

A blood group

B body mass

C health

D height

38 Which statement is true of both chromosomes and genes?

A Each codes for a specific protein.

B Each may be copied and passed on in mitosis.

C Each may be either dominant or recessive.

D Each may exist as two or more alleles.

39 Most birds have a coloured pigment in their feathers, but in a few individuals, pigment is absent and the birds are albinos.

Albinism occurs when a bird is homozygous recessive for the gene which creates the coloured pigment.

If two albino birds mated, what describes the appearance of their offspring?

A all albino

B all coloured

C 50% coloured, 50% albino

D 75% coloured, 25% albino

40 In an animal, the allele for straight fur is dominant to the allele for curly fur.

A pair of these animals mate and have nine offspring with straight fur and three with curly fur.

F represents the allele for straight fur and f represents the allele for curly fur.

What are the most likely genotypes of the parents?

A F and f **B** FF and ff **C** FF and Ff **D** Ff and Ff

INHERITANCE QUESTIONS 5090 P2

O/N18/22/Q8

(a) Explain what is meant by each of the following terms and describe **one** example of each:

discontinuous variation, ...

.....

.....

.....

.....

.....

continuous variation. .....

.....

.....

.....

.....

.....

[7]

(b) Name the molecule that controls production of proteins in each body cell of a human and describe its importance in inheritance.

.....

.....

.....

.....[3]

[Total: 10]

M/J18/21/Q7

(a) Define the term *allele*.

.....

.....

.....[2]

(b) In mice, the allele for black fur (B) is dominant to the allele for white fur (b).

Two mice with black fur were mated to produce offspring, all of which were black.

One of these black offspring was then mated with a mouse with white fur. Equal numbers of mice with black fur and with white fur were produced.

Complete the genetic diagram to show the pattern of inheritance in each cross.

phenotypes of first parents	black fur	×	black fur
genotypes of first parents	.....	×	.....
gametes	....		....
genotypes	.....		.....
phenotype	all have black fur		
phenotypes of second parents	black fur	×	white fur
genotypes of second parents	.....	×	.....
gametes	....		....
genotypes	.....		.....
phenotypes	black fur		white fur

[8]

[Total: 10]

INHERITANCE QUESTIONS 5090 P2

M/J18/22/Q7

(a) Describe the cause of each of the following:

Down's syndrome,

.....

.....

.....

.....

sickle cell anaemia.

.....

.....

[3]

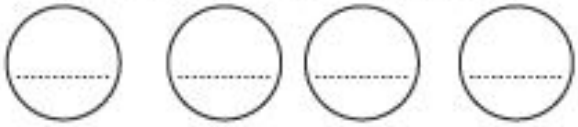
(b) (i) Parents, one with blood group B and the other with blood group A, have a child with blood group O.

The parents decide to have another child.

Complete the genetic diagram to show the possible blood groups for the second child of these parents.

genotypes of parents ..... x .....

gametes



possible genotypes of child ....

possible blood groups of child ....

[4]

(ii) State the probability of each of the following for the second child of these parents:

being the same sex as the first child .....

having the same blood group as the first child ..... [2]

(iii) Name the type of inheritance shown by the alleles that produce the blood group AB.

..... [1]

[Total: 10]

INHERITANCE QUESTIONS 5090 P2

O/N17/22/Q3

An experiment was carried out to investigate the inheritance of flower colour.

In cross 1, a plant with blue flowers (plant **G**) was pollinated by another plant with blue flowers (plant **H**). The resulting seeds were collected and labelled 'batch 1'.

In cross 2, plant **G** was pollinated by a plant with white flowers (plant **J**). The resulting seeds were collected and labelled 'batch 2'.

All the plants were of the same species.

Fifty seeds from each of batch 1 and batch 2 were grown and the number of plants with white flowers was counted.

The results are shown in Table 3.1.

Table 3.1

batch	number of plants with white flowers
1 (from cross 1)	12
2 (from cross 2)	27

(a) Name the dominant phenotype in this experiment .....[1]

The alleles controlling flower colour in this plant are **B** (dominant) and **b** (recessive).

(b) **(i)** State the genotypes of

plant **G** .....

plant **H** .....

plant **J** ..... [3]

(ii) State which of these plants is heterozygous .....[1]

(c) In the box below, draw a genetic diagram for cross 1 (between plants **G** and **H**).

[5]

[Total: 10]

M/J17/21/Q4

Fig. 4.1 shows a Bengal tiger.



Fig. 4.1

Fur colour in the Bengal tiger is controlled by a single gene. The dominant allele of the gene results in orange fur. A single change in this gene produces a recessive allele, which results in white fur in tigers with the homozygous recessive genotype.

(a) (i) Define the term *gene*.

.....

.....

.....

.....[3]

(ii) State the term used to describe a change in a gene.

..... [1]

(b) Using the letters T (orange) and t (white) to represent the alleles that control fur colour, draw a labelled genetic diagram to show how two tigers with orange fur may give rise to offspring with white fur.

[5]

(c) Bengal tigers have dark stripes on their fur.

Suggest why each of the following is true for the pattern of dark stripes:

it is not affected by whether the fur is orange or white

.....

.....

.....

it is unique to each individual

.....

.....

.....[3]

[Total: 12]

INHERITANCE QUESTIONS 5090 P2

O/N16/21/Q5

Complete the paragraph below by writing the most appropriate word in each of the spaces.

A ..... includes a long molecule of DNA that is divided into sections called genes. Genes may be copied and passed on to the next generation. Each gene may have two or more alternative forms called ..... . One of these forms may be ..... and the other recessive. A change in the structure of a gene or in the number of chromosomes is called a ..... . Chemicals and ..... may increase the rate at which these changes take place.

[5]

[Total: 5]

INHERITANCE QUESTIONS 5090 P2

M/J16/22/Q9

(a) With reference to the inheritance of blood groups, explain what is meant by each of the following terms:

(I) *dominance*

.....

.....

.....

.....

.....

.....

.....[3]

(II) *codominance*.

.....

.....

.....

.....

.....

.....

.....[3]

(b) Explain the difference between the number of chromosomes in a gamete and in a body cell.

.....

.....

.....

.....

.....

.....

.....

.....

.....[4]

[Total: 10]

O/N15/21/Q3

(a) Fig. 3.1 shows the distribution of blood groups in the population of a country.

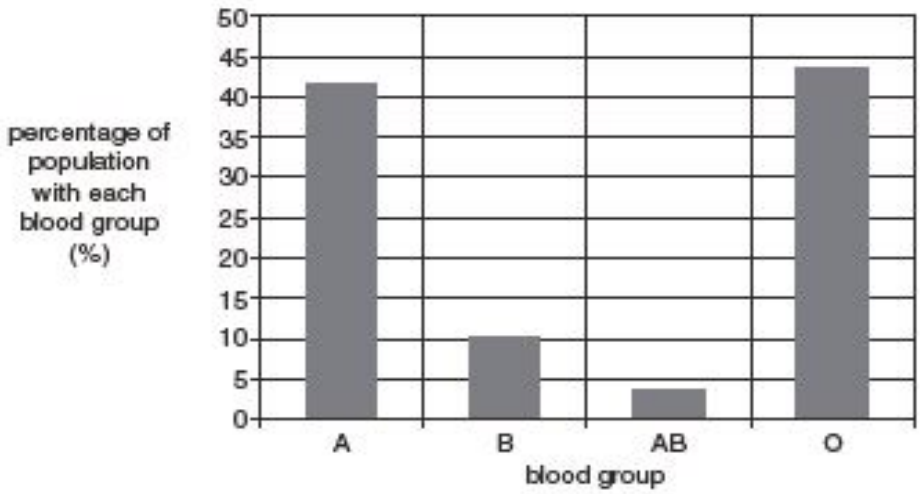


Fig. 3.1

(I) State the type of variation shown in Fig. 3.1.

..... [1]

(II) Give a reason for your answer to part **(a)(I)**.

.....

..... [1]

(III) The population of this country is approximately 63 million people. Use the information in Fig. 3.1 to calculate the approximate number of people in the country that have **blood group B**.

Show your working in the space below.

..... [2]

(b) Table 3.1 shows the distribution of blood groups in the populations of four countries.

Table 3.1

country	percentage of population with each blood group (%)			
	A	B	AB	O
S	23	38	10	29
T	42	10	4	44
U	26	18	.....	52
V	36	14	4	46

(I) Calculate the percentage of the population of country **U** that has blood group AB.

Write your answer in the space provided in Table 3.1. [1]

(II) Suggest why the percentage of the population with each blood group varies between the countries listed.

.....

.....

.....

.....

..... [2]

(c) Suggest why it might be necessary to know a person's blood group.

.....

.....

.....

.....

..... [2]

(d) A child's mother has blood group AB and the child's father has blood group O.

Draw a (ring) around each possible genotype and blood group of the child.

genotypes	I^AI^A	I^Ai^o	I^BI^B	I^Bi^o	I^AI^B	i^oi^o
blood groups	A	B	AB	O		

You may use the space below to work out your answer.

[2]

[Total: 11]

M/J15/22/Q4

The dominant allele for the ability to smell the scent of a particular flower is represented by **A**. The recessive allele, which does not allow a person to smell the scent of the flower, is represented by **a**.

(a) Using these letters, indicate each of the following:

(I) the genotype of a woman who is unable to smell the flower

..... [1]

(II) the possible alleles found in the gametes of a woman who can smell the flower.

..... and ..... [2]

(b) Fig. 4.1 represents some alleles on part of the sex chromosomes of a woman and of a man.

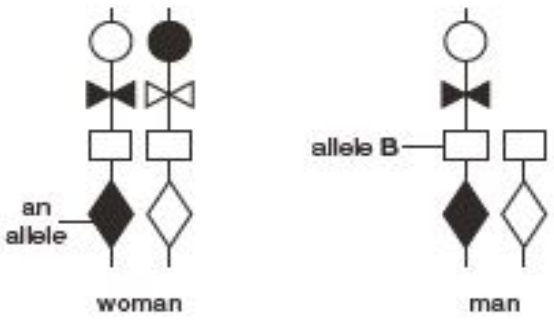


Fig. 4.1

In the space below, draw these alleles as they might appear in a sperm cell that carries the Y chromosome.

[2]

(c) Fig. 4.2 shows how the alleles on one of the chromosomes might appear in a cell taken from somewhere else in the man's body. Allele **B** shows a mutation.

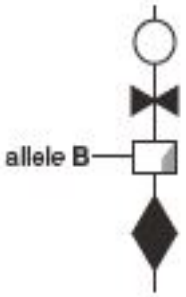


Fig. 4.2

Suggest **two** possible causes of the mutation.

1 .....

2 ..... [2]

(d) Mutated alleles such as that shown in Fig. 4.2 are usually recessive.

Use your knowledge of genetics to explain why society discourages marriage between closely-related people.

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 10]

INHERITANCE QUESTIONS 5090 P2

M/J14/21/Q6

(a) Describe the two forms of variation found within a natural population.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

(b) Explain how variation is important for the long-term survival of the species.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

M/J14/22/Q2

Two students performed an experiment to illustrate inheritance. They each made a 'spinner' similar to the one shown in Fig. 2.1. A result is recorded when a disc is spun and stops with one side nearest the surface.

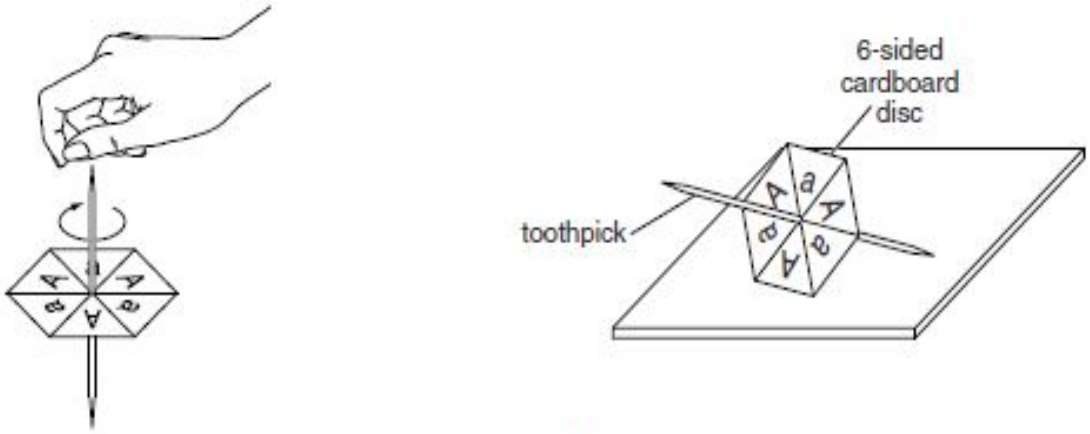


Fig. 2.1

(a) Complete Table 2.1, to show the expected results if the two students spin their discs, at the same time, on 80 separate occasions.

Table 2.1

combination of letters on each occasion	number of times each combination of letters is recorded
A and A	20
A and a	
a and a	

[1]

(b) Suggest **two** reasons why the results they obtained may have been different from the expected results.

.....

.....[2]

(c) Suggest the feature or stage in the process of inheritance represented by each of the following:

(i) the students .....

(ii) the spinning of the disc .....

(iii) the letters on the disc .....

[3]

(d) Describe how the students could modify their spinners and use them to illustrate the possible inheritance of blood groups by children of a father who has codominant blood group alleles and a mother who is heterozygous for blood group A.

.....

.....

.....

.....

.....

.....

.....

..... [5]

[Total: 11]

O/N13/22/Q5

Fig. 5.1(a) shows several members of the same species of small mammal. Some of these have white fur and some have black fur. They live in a region with very light-coloured soil.

Fig. 5.1(b) shows the effect of predation by a hawk (a carnivorous bird) after several years.

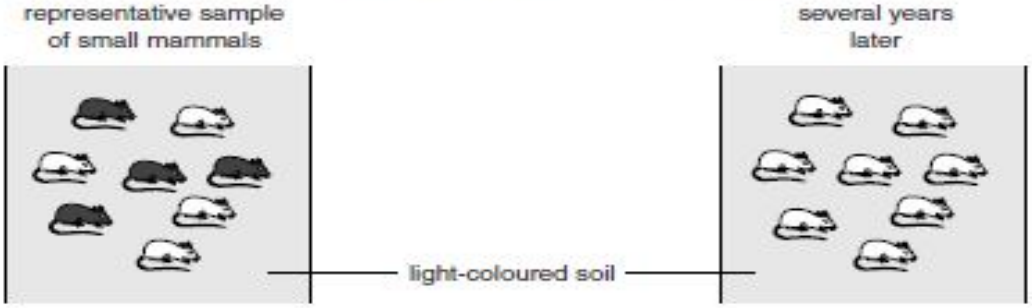


Fig. 5.1(a) **Fig. 5.1(b)**

(a) State the term for groups of animals and plants of different species linked together in a feeding relationship in the same environment.

.....[1]

(b) Explain what has happened to the small mammal population in the time between Fig. 5.1(a) and Fig. 5.1(b).

.....

.....

.....

.....[3]

(c) A change in agricultural practice caused the soil to become slightly darker.

(I) Suggest **two** genetic changes that might occur in this population of small mammals.

1 .....

2 .....[2]

(II) Explain how these genetic changes might help these small mammals to survive such an environmental change.

.....

.....[2]

[Total: 8]

INHERITANCE QUESTIONS 5090 P2

O/N12/22/Q2

Species **D** lives in a forest. Fig. 2.1 shows what can happen, over the same period of time, if some members of species **D** migrate from the forest to a desert region.

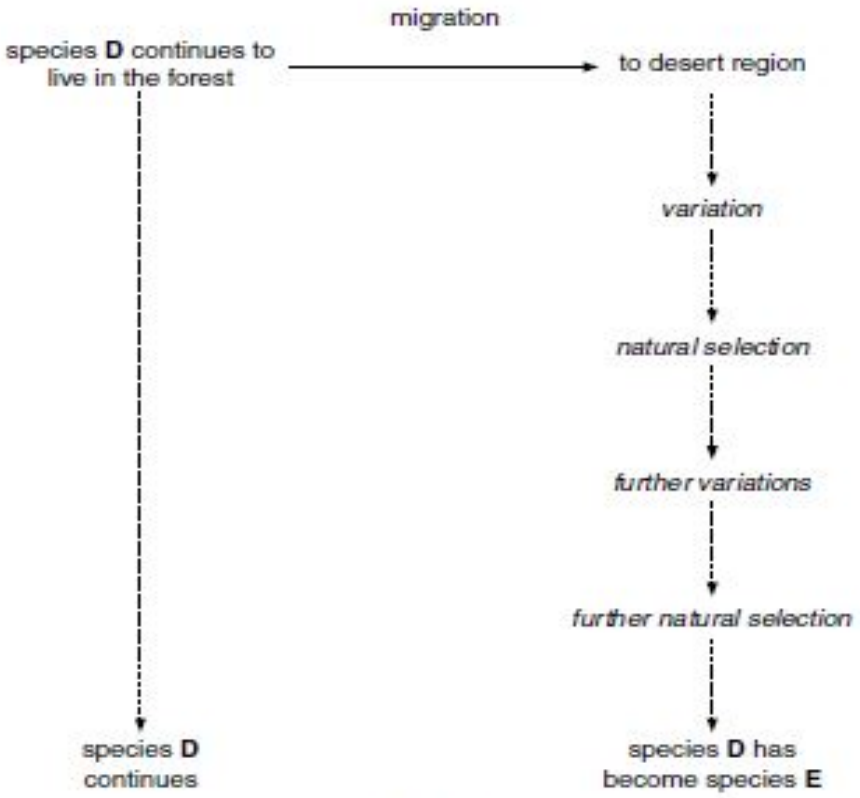


Fig. 2.1

(a) Name the **two** main causes of variation in organisms.

1. .....

2. ..... [2]

(b) Name the process involving variation and natural selection that has led to the development of species **E**.

..... [1]

INHERITANCE QUESTIONS 5090 P2

Mark Scheme (2018-2012) Both variants

O/N18/22/Q8

8(a) (discontinuous)

idea of few + phenotypes / categories AW OR no intermediates ;

inherited / passed to next generation ;

genes / genetic / genotype / alleles ;

correct example (e.g. blood group, eye colour, sex, ear lobes, tongue roll) ;

bar chart / bar graph ;

(continuous)

idea of many

+ phenotypes / categories AW OR intermediates / range ;

genes / genetic / genotype / alleles

+ environment ;

any named environmental factor (e.g. diet / sunlight exposure) ;

correct example (e.g. skin colour / hair colour / height / weight) ;

normal distribution ;

8(b) DNA / deoxyribonucleic acid ;

chromosomes / genes / alleles ;

copied / replicated ;

passed to next generation / from parents ;

gametes / egg / sperm

M/J18/22/Q7

7(a) form / version ;
gene ;
reference to codes for / specifies production of + protein ;
reference to dominant / codominant / recessive ;
2
7(b) BB ; x Bb ;
B + B + B + b ;
BB + Bb ;
Bb (black) ; x bb (white) ;
B + b + b + b ;
Bb + bb ;

INHERITANCE QUESTIONS 5090 P2

M/J18/22/Q7

7(a) **1** inherited / genetic **AW ;**
(Down's syndrome)
2 mutation **+** chromosome **;**
3 reference to chromosome 21 **;**
4 one extra **or** 3 instead of 2 **or** 47 not 46 **or** 24 not 23 in **+** gamete/egg/sperm **;**
(sickle cell anaemia)
5 mutation **+** gene **;**
6 homozygous recessive / two recessive alleles **;**
3
7(b)(i) **1** I^BI^O **+** I^AI^O **or** BO **+** AO **;**
2 I^B **+** I^O **+** I^A **+** I^O **or** B **+** O **+** A **+** O
or gametes correct for stated parent genotypes **;**
3 I^AI^B **+** I^BI^O **+** I^AI^O **+** I^OI^O **or** AB **+** BO **+** AO **+** OO
or possible genotypes of child correct for stated gametes **;**
4 AB **+** B **+** A **+** O
or possible blood groups of child correct for stated genotypes **;**
4 Allow any order within each marking point
7(b)(ii) *(same sex)*
50% / half / ½ / 0.5 / 2 in 4 / 1 in 2 / 1:1 **;**
(same blood group)
25% / quarter / ¼ / 0.25 / 1 in 4 / 1:3 **;**
2
7(b)(iii) codominance / codominant **;**

O/N17/22/Q3

3(a) blue **;**
3(b)(i) (**G**) Bb / heterozygous **;**
(**H**) Bb / heterozygous **;**
(**J**) bb / homozygous **+** recessive **;**
3(b)(ii) **G + H ;**
3(c) **1** parent genotypes / gametes correct from **G and H** in **(b)(i) ;**
2 offspring genotypes correct for parent genotypes / gametes **;**
3 offspring phenotypes correct for stated genotypes **;**
4 genotype / phenotype ratio correct **;**
5 correct use of the terms gamete **+** genotype / phenotype **;**

M/J17/21/Q4

4(a)(i) section of / made of / piece of **+** DNA / chromosome **;**
controls production of one protein **;**
may be copied **;**
unit of inheritance / passed on to next generation **;**

4(a)(ii) mutation **;**
4(b) Tt **+** Tt **;**
t **+** t **;**
tt **;**
tt offspring clearly indicated as white **;**
3 · labels on genetic diagram correct **;**
A parent / offspring / gamete / genotype / phenotype
4(c) *(unaffected by fur colour)*
(controlled by) different gene(s) **;**
(unique to each individual)
alleles **;**
(as a result of) mutation(s) **;**
meiosis AW **;**
different combinations (of alleles) **;**
reference to some may be homozygous / heterozygous **;**
reference to codominance **;**

O/N16/21/Q5

5 chromosome **;**
allele(s) **;**
dominant **;**
mutation **;**
radiation / named radiation / radioactivity **;**

M/J16/22/Q9

9 (a) (i) 1. allele(s) ;
2. responsible for a
character(istic) / trait ;
3. only one needs to be
present / reference to
heterozygote AW ;
4. for the character to appear / be
expressed (in phenotype) AW ;
5. e.g. $I^A I^O$ + group A / $I^B I^O$ + group
B / $I^A I^B$ + dominant to I^O ;
A A, B, O instead of I^A, I^B, I^O
[max 3]
(ii) 1. two alleles ;
2. neither being recessive / (equally)
dominant ;
3. both have an effect / are
expressed / phenotype
intermediate ;

4. reference to heterozygote AW ;
5. I
A
I
B
/ AB ;
[max 3]

(b) 1. number of chromosomes in a gamete is half those in a somatic or body cell ORA / one versus two sets of chromosomes ;
2. correct use of the terms haploid + diploid ;
3. 46 v. 23 ;
4. gametes / haploid cells are the result of meiosis / reduction division ;
5. somatic / body cells occur in / produced by mitosis ;
6. (diploid) number restored + at fertilisation ;
7. each parent has equal share in genotype of offspring AW ;
A sex cell = gamete / one named gamete
[max 4]

O/N15/21/Q3

3 (a) (i) discontinuous ; [1]

(ii) no intermediate values / distinct / separate categories ; [1]

(iii) (63 / 100) × 10 ;

6.3 million / 6 300 000 / 6.3 × 106 ;

[2]

award 2 marks for correct

answer alone

(b) (i) 4 (%) ; [1]

(ii) ref. alleles / genes ;

each person has two (for blood group) ;

different (allele / gene) frequency in different populations ;

ref. inbreeding (of separate groups) AW ;

[max. 2]

A example of inbreeding e.g.

geographical isolation / culture

(c) blood transfusion / tissue (A blood donor) / organ transplant ;

clotting with ref. to blood / prevent rejection ;

to check paternity ;

[max. 2]

A if ref. is to donor or recipient

A ORA

(d) IAIo + IBIo ;

A + B ;

[2]

M/J15/22/Q4

4 (a) (i)	aa ;		[1]
(ii)	a/A ; A ;		[2]
(b)	chromosome with 2 alleles drawn ; the same two alleles as in Fig. 4.1 ;		[2]
(c)	 radiation or type named ; chemicals or mutagenic chemical named ;	Ig ref. to inheritance e.g. uv, gamma, alpha e.g. mustard gas, benzene, tar, etc.	[2]

(d)
1. parents with normal
phenotype / appear normal / do not
have mutational condition ;
2. heterozygotes / carriers of
recessive allele ;
3. greater chance (correctly
qualified) ;
4. children + inheriting 2 recessive
alleles / being homozygous ;
5. suffering from mutational
condition ;

M/J14/21/Q6

6 (a) continuous variation ;
gradual change / range ;
between extremes ;
genes + environment ;
discontinuous variation ;
few and distinct differences ;
controlled by genes alone ;
any correct example of one or the other correctly linked ;

(b) some variations are advantageous ;
competition ;
in the organism's habitat / environment ;
organism survives / differential survival / ORA ;
breeds / reproduces ;
passes on the advantage / beneficial gene / allele ;
over many generations / ref. time ;
continuous adaptation to the changing environment ;
evolution / natural selection / AW ;
changes that result from the environment not so important ;

M/J14/22/Q2

2 (a)

combination of letters on each occasion	number of times each combination of letters is recorded
A and A	20
A and a	40
a and a	20

[1]
(b) expected are theoretical or statistical / spinning is random or
due to chance ;

disc poorly made / toothpick doesn't pass through middle / AW;
error in counting ;
[2]
Ig wind / force of spin
A 'it' is random
(c) (i)
(ii)
(iii)
parents (cells) / genotypes / gonads or both named ;
meiosis / reduction division / gamete (formation) / fertilisation ;
genes / alleles / chromosomes / gametes ;
[3]
R genotype

(d) Correct alleles, A, B and O (with or without I) ;
one disc with A and B and one disc with A and O ;
each disc with correct numbers of alleles, i.e. 3 for discs
given in question ;
representing father and mother ;
spin several / many times ;
results recorded / counted ;

O/N13/22/Q5

5 (a) biotechnology / fermentation / culturing; 1
(b) to control / lower / the temperature; 1 A maintain
(c) enzymes;
prevention of denaturation / destruction / prevents death of fungus / microorganism / bacterium;
optimum / best / better / + for growth / reproduction;
high(er) yield; 2
(d) any ref. sterile;
(H) for introduction of microorganism or named;
and food / nutrients / culture medium;
e.g. amino acids / protein / carbohydrates or named;
(J) for introduction of air / oxygen;
bubbles / large surface area (as O_2 passes through grille) / sparger;
for respiration;

O/N12/22/Q2

2 (a) genes / mutation / named common mutagen;
environment / habitat / named environmental factor; [2]
(b) evolution / speciation; [1]
(c) different/changed environment;
mutation(s);
variations + advantageous AW / better adapted;
survive;
reproduce / passed on;
cumulative effect / over many generations;
leading to change in phenotype / appearance / or e.g.; [Max 4]
(d) difference in genes/DNA;
difference in chromosomes;
ref to problems with fertilisation;
no sexual attraction / incompatible;
geographical separation; [Max 2]

1. The gene for the ABO blood group has three alleles, I^A, I^B and I^o.

(d) A person with blood group O has parents who have blood groups A and B. Complete the genetic diagram to show how this is possible.

Use the symbols, I^A, I^B and I^o, for the blood group alleles.

parental phenotypes	blood group A	×	blood group B
parental genotypes	.....	×	.....
gametes	....	+	....

offspring genotype	.....
offspring phenotype	blood group O

[3]

(e) Use your answer to **(d)** to give examples of the following. The first one has been completed for you.

term	example
a dominant allele	I^A
heterozygous genotype	.....
codominant alleles	.....
phenotype	.....

[3]

2. Fig. 11.1 shows a white sweet pea flower and a red sweet pea flower.



white red

Fig. 11.1

These colours in sweet pea are controlled by a single gene with two alleles.

(a) Define the term *allele*.

.....

.....[1]

(b) A homozygous sweet pea with white flowers was crossed with a homozygous sweet pea with red flowers. All of the offspring had red flowers.

State which allele of this gene is dominant.

.....[1]

(c) Two heterozygous sweet pea plants with red flowers were crossed as shown below.

parental phenotype	**red flowers**	**red flowers**
parental genotype	**Rr**	**Rr**
gametes	**R** **r**	**R** **r**

(i) Draw a Punnet square to show the genotypes that are produced in this cross.

[2]

(ii) State the phenotypic ratio produced in this cross.

..... [1]

[Total: 5]

3. **(a)** Describe the effect sickle cell anaemia has on red blood cells.

.....

.....

..... [2]

(b) **(i)** The allele for normal haemoglobin production is I^N. The allele for sickle cell haemoglobin production is I^S. Two parents who are heterozygous have a child. With the help of a genetic diagram, predict the probability that this child would be heterozygous.

[4]

(ii) Explain why, under some circumstances, people who are heterozygous for this condition have a greater chance of survival than homozygous people.

.....

.....

.....

..... [3]

[Total: 9]

4. **(a)** Four definitions of terms used in genetics are shown in Table 5.1.

Table 5.1

definitions	terms
the outward appearance of an organism	.....
a length of DNA that codes for a protein	.....
having one set of chromosomes	.....
type of nuclear division which gives daughter nuclei that are genetically identical	.....

For each of the definitions, select an appropriate term from the list and write it in the box provided.

chromosome	genotype	mitosis
diploid	haploid	mutation
dominant	heterozygous	phenotype
gene	homozygous	recessive

[4]

(b) A couple who have blood groups **A** and **B** have four children. Each child has a different blood group.

Use the space below to draw a genetic diagram to show how this is possible. Use the symbols, I^A, I^B and I^o, for the alleles.

parental blood groups		**A**	×	**B**
parental genotypes		.....	×	.....
gamete genotypes		.....		.....
children's genotypes	.....	.....	.....	.....
children's blood groups	.....	.....	.....	.....

[4]

(c) Explain what is meant by *codominance*. You may refer to the genetic diagram in **(b)** to help you with your answer.

.....

.....

.....

.....

.....

.....

..... [3]

(d) Insulin produced by genetically engineered bacteria first became available in 1982. Before 1982, insulin had been prepared from dead animal tissues.

Explain the **advantages** of using insulin produced by genetically engineered bacteria rather than insulin from dead animal tissues.

.....

.....

.....

.....

.....

..... [3]

5. **(a)** Define the term *self-pollination*.

.....

.....

.....

..... [2]

Snapdragon plants have flowers with three colours: red, pink and white.

Some students investigated the inheritance of flower colour in snapdragons.

In **cross 1** they cross-pollinated plants that were homozygous for red flowers with plants that were homozygous for white flowers. They collected and planted the seeds from cross 1. All of the resulting plants had pink flowers.

In **cross 2** they self-pollinated all the pink-flowered plants and found that in the next generation there were red-flowered plants, white-flowered plants and pink-flowered plants.

(b) Complete the genetic diagrams to show how flower colour is inherited in snapdragon plants.

Use the symbol I^R for the allele for red flowers and I^W for the allele for white flowers.

cross 1

parental phenotypes	red flowers	×	white flowers
parental genotypes	.....	×	.....
gametes	.....		.....
offspring genotypes	.....		
offspring phenotypes	pink flowers		

cross 2

parental phenotypes	pink flowers	×	pink flowers
parental genotypes	.....	×	.....
gametes	....		....

offspring genotypes .....

ratio of offspring phenotypes ..... [4]

(c) Another student cross-pollinated pink-flowered plants with white-flowered plants.

Complete the genetic diagram to show the results that the student would expect.

phenotypes	pink flowers	×	white flowers
genotypes	.....	×	.....
gametes	....		.....

offspring genotypes .....

ratio of offspring phenotypes ..... [3]

(d) Explain the advantages of sexual reproduction to a species of flowering plant, such as the snapdragon.

.....

.....

.....

.....

.....

.....

..... [4]

[Total: 13]

6 Haemoglobin is a protein that is made inside developing red blood cells in the bone marrow.

(a) (i) State the function of haemoglobin.

.....

[1]

(ii) Name the small molecules that are combined to make haemoglobin.

.....

[1]

(iii) Name the mineral ion provided in the diet that is needed to make haemoglobin.

.....

[1]

There are many different varieties of haemoglobin. The gene for haemoglobin exists as two alleles, $\mathbf{Hb^A}$ and $\mathbf{Hb^S}$.

People with the genotype $\mathbf{Hb^SHb^S}$ have a condition called sickle cell anaemia.

(b) Describe the features of sickle cell anaemia.

.....

.....

.....

.....

.....

.....

[3]

(c) The allele for $\mathbf{Hb^S}$ is rare in many parts of the world, but it is more common in parts of tropical Africa.

Explain why $\mathbf{Hb^S}$ is more common in parts of tropical Africa.

.....

.....

.....

.....

.....

.....

[3]

(d) The parents of people with sickle cell anaemia rarely have this condition.

Explain, using a genetic diagram, how two parents who do not have sickle cell anaemia may have a child with the condition.

.....

.....

.....

parental genotypes ..... × .....

gametes .... + ...

genotype of child with sickle cell anaemia .....

[3]

(e) Sickle cell anaemia is an example of variation in humans. There are many causes of variation, including nuclear fall-out.

Suggest how nuclear fall-out could cause variation in humans.

.....

.....

.....

.....

.....

[2]

[Total: 14]

7. The gene for haemoglobin exists in two alternative forms:

H^A codes for the normal form of haemoglobin;
H^S codes for the abnormal form of haemoglobin.

(i) State the name for the alternative forms of a gene.

..... [1]

(ii) A child has sickle cell anaemia. The parents do not have this disorder.

Complete the genetic diagram to show how the child inherited the disorder.

Use the symbols H^A and H^S in your answer.

parental phenotypes	normal	×	normal
parental genotypes	H^AH^S	×	H^AH^S
gametes	◯ ◯	+	◯ ◯

child's genotype .....

child's phenotype sickle cell anaemia

[2]

(iii) The parents are about to have another child.

What is the probability that this child will have sickle cell anaemia?

..... [1]

(c) The maps in Fig. 4.2 show the distribution of sickle cell anaemia and malaria in some parts of the world.

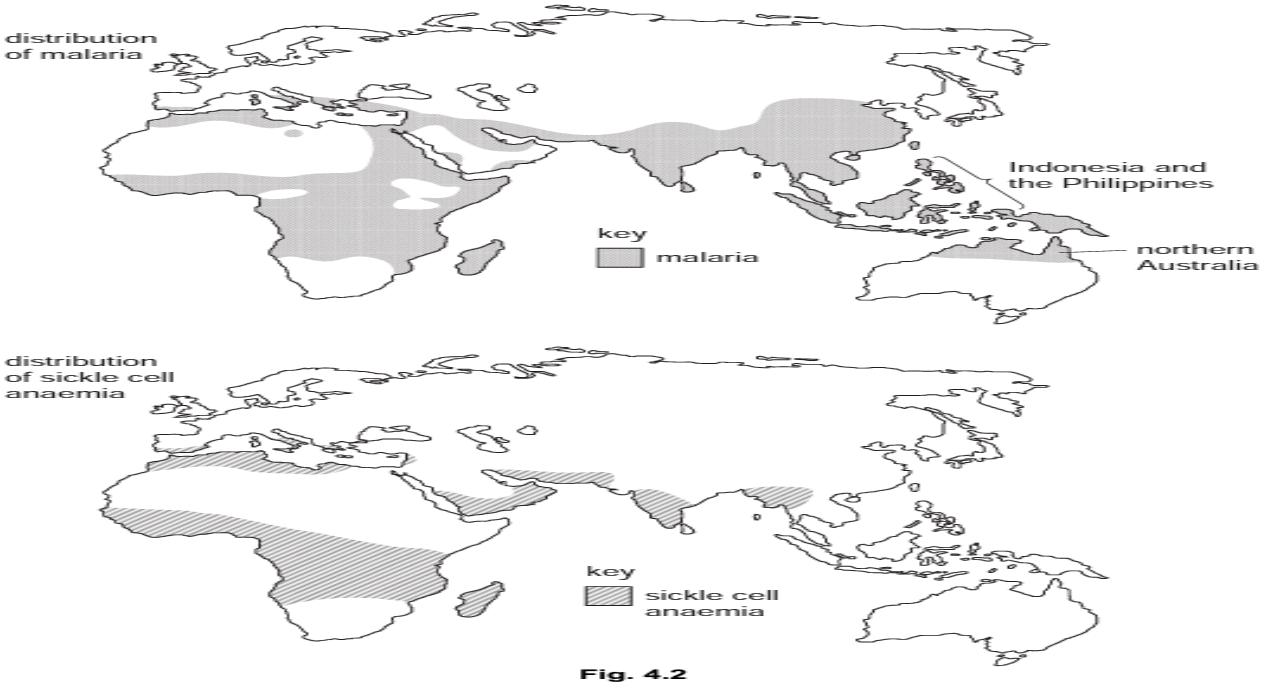


Fig. 4.2

(i) Explain why sickle cell anaemia is common in people who live in areas where malaria occurs.

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

(ii) Suggest why sickle cell anaemia is very rare among people who live in Indonesia and northern Australia.

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

[Total: 14]

8. Haemoglobin is a large protein molecule. The structure of each haemoglobin molecule is controlled by a gene that has two alleles:

- Hb^A codes for the normal form of haemoglobin,
- Hb^S codes for an abnormal form of haemoglobin.

Red blood cells containing only the abnormal form of haemoglobin become a stiff, sickle shape in conditions of low oxygen concentration. This gives rise to sickle cell anaemia.

(a) Describe the harmful effects on the body of having red blood cells which become sickle-shaped.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

People who are heterozygous for the gene for haemoglobin produce both the normal and abnormal forms of haemoglobin. These people show no symptoms or have very mild symptoms known as sickle cell trait.

(b) (i) Complete the genetic diagram to show how a couple who are both heterozygous may have a child with sickle cell anaemia.

parental phenotypes	sickle cell trait	×	sickle cell trait
parental genotypes	.....	×	.....
gametes	....	+	....

offspring genotypes	.....	.....	.....	.....
offspring phenotypes	.....	.....	.....	.....

[3]

(ii) What is the chance of a child born to this couple having sickle cell anaemia?

..... [1]

In some parts of the world, up to 25% of the population have sickle cell trait.

(c) State the advantage of having sickle cell trait.

.....

..... [1]

(d) Discuss whether sickle cell trait is an example of codominance.

.....

.....

.....

.....

..... [2]

[Total: 12]

9. One of the genes that controls the ability of blood to clot is found **only** on the X chromosome.

X^H represents an X chromosome with the dominant allele for normal blood clotting.

X^h represents an X chromosome with the recessive allele which causes the blood to clot slowly.

The Y chromosome is small and does not have the gene for blood clotting.

Here is a list of four genotypes.

X^HX^H, X^HX^h, X^HY, X^hY

Choose the genotype from the list that matches each of the following:

- gives a phenotype of long clotting time; .....
- is heterozygous; .....
- is homozygous. ..... [3]

(e) Haemophilia is a rare genetic condition in which the blood clots very slowly.

In the USA, haemophilia affects 1 in 5000 male births each year. In some cases these births occur in families where the condition has not occurred before.

Explain how boys can have haemophilia when the condition has not previously existed in their family.

.....

.....

.....

.....

..... [2]

[Total: 13]

10. In tulip plants, the petals can have markings called flecks.
There are two alleles for flecks in tulip plants: with flecks **F**; and without flecks **f**.

(a) Explain the meaning of the term *dominant* allele.

.....

..... [1]

(b) A tulip grower crosses two tulip plants.

He finds that 76 of the offspring have petals with flecks and 23 of the offspring have petals without flecks.

(i) Complete the genetic diagram to explain this result.

parental genotypes ..... X .....

parental phenotypes ..... X .....

gametes (....) (....) X (....) (....)

offspring genotypes ....

offspring phenotypes petals with flecks present petals without flecks

[5]

(ii) The tulip grower wants to produce a pure-breeding variety of tulips with petals without flecks.

State the genotypes of the parent plants he should use to produce tulip plants without flecks. Explain your answer.

parental genotypes ..... X .....

explanation .....

.....

..... [2]

[Total: 8]

11. The four o'clock plant, *Mirabilis jalapa*, can have flowers of three different colours as shown in Fig. 4.1.



Fig. 4.1

(a) A student crossed some crimson-flowered plants with some yellow-flowered plants (cross 1). She collected the seeds and grew them. All of the plants that grew from these seeds had orange-red flowers.

Complete the genetic diagram to explain the result of cross 1.

parental phenotypes	crimson flowers	×	yellow flowers
parental genotypes	A^CA^C	×	A^YA^Y
gametes	.....	+	.....
offspring genotype	.....		
offspring phenotype	.....		

[3]

(b) The student then carried out three further crosses as shown in Table 4.1.

Table 4.1

	cross	genotypes of offspring
2	offspring of cross 1 × offspring of cross	
3	offspring of cross 1 × crimson-flowered plant	
4	offspring of cross 1 × yellow-flowered plant	

Complete Table 4.1 by writing the genotypes of the offspring of crosses **2**, **3** and **4**, using the same symbols as in the genetic diagram in **(a)**.

Write the genotypes in Table 4.1.

You may use the space below for any working.

[3]

(c) Flower colour in *M. jalapa* is not an example of the inheritance of dominant and recessive alleles.

Explain how the results of the crosses show that these alleles for flower colour are **not** dominant or recessive.

.....

.....

.....

.....

.....

..... [3]

Flowers from *M. jalapa* were cross-pollinated.

(d) Explain the difference between self-pollination and cross-pollination.

.....

.....

.....

..... [2]

(e) Some species of plants are self-pollinated.

Discuss the long-term effects of self-pollination on the evolution of these plants.

.....

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