

Week 23

IGCSE Biology

Homework bundle for this week

本周作业合集

exercises.lol

Contents 目录

Topic 17 quiz	2
Exercise sheet 17.1	5
Past-paper questions 17.1	10
Exercise sheet 17.2	15
Past-paper questions 17.2	19
Exercise sheet 17.3	21
Past-paper questions 17.3	24
Exercise sheet 17.4	28
Past-paper questions 17.4	32

17. Inheritance

Starter Quiz · 课前小测

IGCSE Biology

Name: _____ Score: _____

- A gene is:
 - ☐ a section of DNA that codes for a protein
 - ☐ a whole chromosome
 - ☐ a type of cell
 - ☐ a sugar
- The shape of a DNA molecule is a:
 - ☐ double helix
 - ☐ single straight line
 - ☐ circle
 - ☐ square
- Mitosis produces daughter cells that are:
 - ☐ genetically identical to the parent
 - ☐ all different
 - ☐ gametes
 - ☐ half the chromosome number
- Meiosis produces how many cells from one parent cell?
 - ☐ four
 - ☐ two
 - ☐ one
 - ☐ eight
- An allele is:
 - ☐ a version of a gene
 - ☐ a whole chromosome
 - ☐ a protein
 - ☐ a cell
- How many chromosomes are in a human body cell?

7. How many chromosomes are in a human gamete?

8. Mitosis is used for: (Select all that apply.)

- ☐ growth
- ☐ repair of tissue
- ☐ asexual reproduction
- ☐ making gametes

Tick every correct option.

9. In a Bb x Bb cross, out of 4 offspring, how many show the recessive trait?

10. The order of bases in a gene determines the protein made.

- ☐ True ☐ False

17. Inheritance

Answers · 答案

IGCSE Biology

1. **a section of DNA that codes for a protein**

A gene codes for one protein.

2. **double helix**

DNA is a double helix — two twisted strands.

3. **genetically identical to the parent**

Mitosis makes identical copies.

4. **four**

Meiosis makes four gametes.

5. **a version of a gene**

Alleles are different versions of a gene.

6. **46**

Body cells have 46 chromosomes (23 pairs).

7. **23**

Gametes have half — 23 — so fertilisation restores 46.

8. **growth; repair of tissue; asexual reproduction**

Gametes are made by meiosis, not mitosis.

9. **1**

Only bb (1 in 4) shows the recessive trait.

10. **True**

Base order sets the amino acid order, hence the protein.

17.1 Chromosomes, genes and proteins

Name: _____ Class: _____ Date: _____ Total: 29 marks

KEY WORDS proteins 蛋白质 • codes 编码 • ribosome 核糖体 • gene 基因 • amino acids 氨基酸

Objective

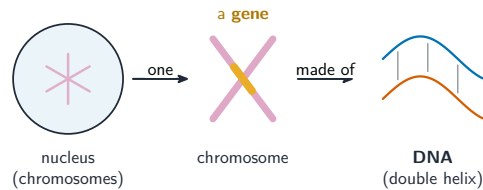
Build the skills to answer exam questions on **chromosomes, genes and proteins** 染色体、基因与蛋白质 — the terms, sex chromosomes, and how DNA controls a cell.

You must be able to:

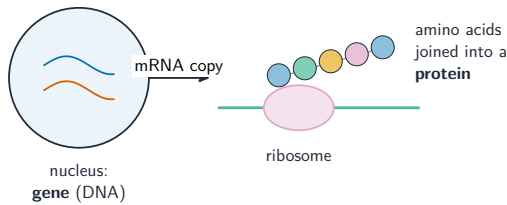
- define chromosome, gene and allele
- explain sex determination (XX/XY)
- describe how a gene's base sequence codes for a protein

1 Worked examples

■ Genes and protein synthesis



A gene is a length of DNA that codes for one protein; an allele is one form of a gene



The base sequence sets the order of amino acids → the protein's shape → its job

- **sex:** XX female, XY male; sperm (X or Y) decides the sex → 1:1 ratio.

■ The words, in the order they nest

A **chromosome** 染色体 is a thread of DNA carrying many genes. A **gene** 基因 is a length of DNA that codes for one protein. An **allele** 等位基因 is one of the alternative forms of a gene — for example the allele for a round seed and the allele for a wrinkled seed sit at the same place on the chromosome.

Genotype and phenotype. The **genotype** 基因型 is the alleles an organism carries (TT, Tt or tt); the **phenotype** 表现型 is the observable feature (tall or short). Two alleles the same is **homozygous** 纯合的; two different is **heterozygous** 杂合的. A **dominant** 显性 allele shows in the phenotype whenever it is present; a **recessive** 隐性 allele only shows when both alleles are recessive.

Sex determination. A human has 23 pairs of chromosomes, one pair of which is the sex chromosomes: a female is **XX** and a male is **XY**. Every egg carries an X. A sperm carries either an X or a Y, and it is the sperm that decides: X sperm + X egg gives a girl, Y sperm + X egg gives a boy. Because the two kinds of sperm are made in equal numbers, the chance of each is $\frac{1}{2}$, or 50%.

Worked example (a monohybrid cross). Two plants heterozygous for height (Tt) are crossed. Give the phenotype ratio.

1. Parents: Tt × Tt.
2. Gametes: T and t from each.
3. Offspring genotypes: TT, Tt, Tt, tt.
4. T is dominant, so TT, Tt and Tt are all tall and tt is short.
5. Phenotype ratio **3 tall : 1 short**; genotype ratio 1 : 2 : 1.

Every layer of that working carries a mark, so write all five lines even when you can see the answer.

2 Practice

2.1 Define a gene. [1]

2.2 State the sex chromosomes of a human female. [1]

2.3 State the difference between a genotype and a phenotype. [2]

2.4 State what is meant by homozygous recessive, and give an example using the symbols T and t. [2]

2.5 Give the probability that a child is male, and explain your answer. [2]

3 Exam-style questions

3.1 An allele is: [1]

- A a whole chromosome
- B an alternative form of a gene
- C a protein
- D a ribosome

3.2 The sex of a baby is determined at fertilisation.

(a) Explain why the sperm, not the egg, determines the sex. [2]

(b) State the ratio of males to females this produces. [1]

3.3 Explain how the base sequence of a gene determines the protein made. [2]

3.4 In a species of mouse, black fur (B) is dominant to brown fur (b).

(a) State the genotypes of a homozygous black mouse and of a brown mouse. [2]

(b) A homozygous black mouse is crossed with a brown mouse. Draw the genetic diagram and give the genotypes and phenotypes of the offspring. [4]

(c) Two of the offspring from part (b) are crossed with each other. Give the expected phenotype ratio, showing your working. [4]

(d) A black mouse is crossed with a brown mouse and produces some brown offspring. Deduce the genotype of the black parent, and explain your reasoning. [3]

(e) Explain why the sperm, and not the egg, determines the sex of a human baby. [2]

Solutions

2.1 a length of DNA that codes for one protein.

2.2 XX.

2.3 The genotype is the alleles an organism carries; the phenotype is the observable characteristic those alleles produce.

2.4 Both alleles are the recessive form; for example tt, which would give a short plant.

2.5 $\frac{1}{2}$ or 50%; a sperm carries either an X or a Y chromosome and the two kinds are made in equal numbers, so either is equally likely to fertilise the egg.

3.1 B. An allele is an alternative form of a gene.

3.2 (a) the egg always carries an X; the sperm carries either an X or a Y; so whether it is XX or XY depends on the sperm.

(b) 1:1.

3.3 the base sequence sets the order of amino acids in the protein; this gives the protein its shape, which decides its job.

3.4 (a) Homozygous black: BB; brown: bb.

(b) Parents BB $\times$ bb; gametes all B from one parent and all b from the other; all offspring are Bb; all are black, because B is dominant.

(c) Parents Bb $\times$ Bb; gametes B and b from each; offspring BB, Bb, Bb, bb; phenotype ratio 3 black : 1 brown.

(d) The black parent must be Bb, heterozygous; a brown offspring is bb and must have received a b allele from each parent; so the black parent carries a b allele as well as the B that makes it black.

(e) Every egg carries an X chromosome, so the egg cannot vary; a sperm carries either an X or a Y, and which one fertilises the egg decides whether the child is XX or XY.

Name: _____

IGCSE Biology: w25 22

30 Why are lymphocytes the only cells that produce antibody proteins?

- A** Lymphocytes express all the genes in the nucleus.
- B** Lymphocytes have twice as many genes as other cells.
- C** Other cells do **not** have the genes for antibodies.
- D** The genes for antibodies are only expressed in lymphocytes.

31 During protein synthesis, what is the function of the ribosome?

- A** It assembles amino acids in a chain.
- B** It carries a copy of a gene to the cytoplasm.
- C** It contains the code for the synthesis of a protein.
- D** It determines the order of bases in the protein.

6 Fig. 6.1 is a diagram of a cell that shows how DNA is involved in protein synthesis.

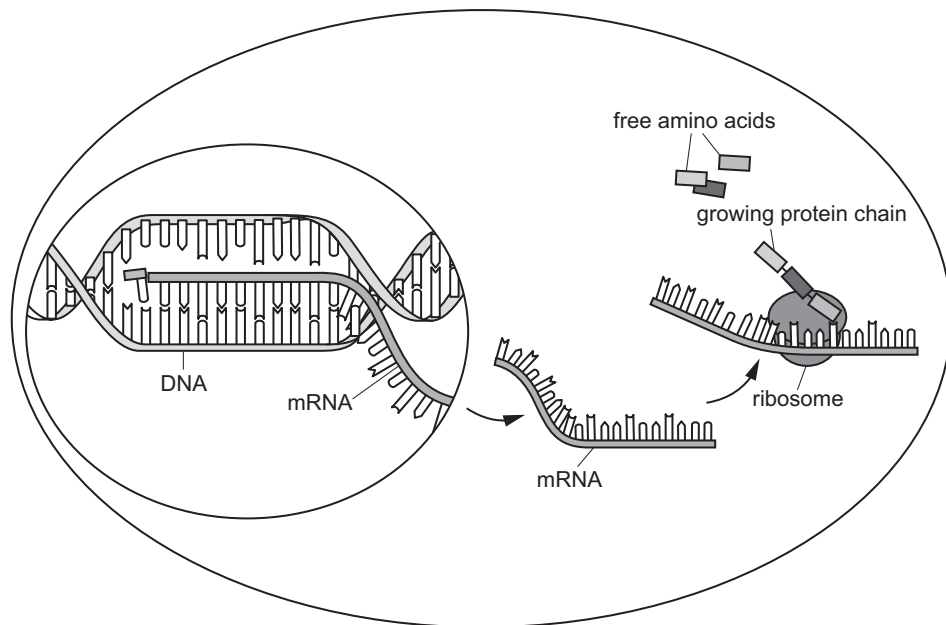


Fig. 6.1

(a) State the name of the part of the cell that contains DNA.

..... [1]

(b) DNA controls cell function by controlling the production of proteins.

State the name of **one** type of protein.

..... [1]

(c) Using Fig. 6.1, explain how mRNA is involved in protein synthesis.

.....

 [3]

4 In a DNA molecule, bonds between pairs of bases hold two strands together. High temperatures can break these bonds to form two single strands of DNA.

The base pair C and G is held together more strongly than the base pair A and T.

Two DNA molecules containing the same number of bases were studied.

- In DNA molecule 1, 20% of bases are T.
- In DNA molecule 2, 20% of bases are C.

Which DNA molecule would require the lowest temperature to break into single strands?

- A** DNA molecule 1, because there are more A bases present.
- B** DNA molecule 1, because there are more G bases present.
- C** DNA molecule 2, because there are more A bases present.
- D** DNA molecule 2, because there are more G bases present.

- 5 (a) Organisms can be classified by their features and by studying the sequence of bases in their DNA.

Fig. 5.1 is a diagram showing the evolutionary relationships between some different groups of organisms.

Each branch shows the point at which organisms developed new features that classify them as a new group.

The point where the branch starts also indicates a common ancestor shared by the new groups.

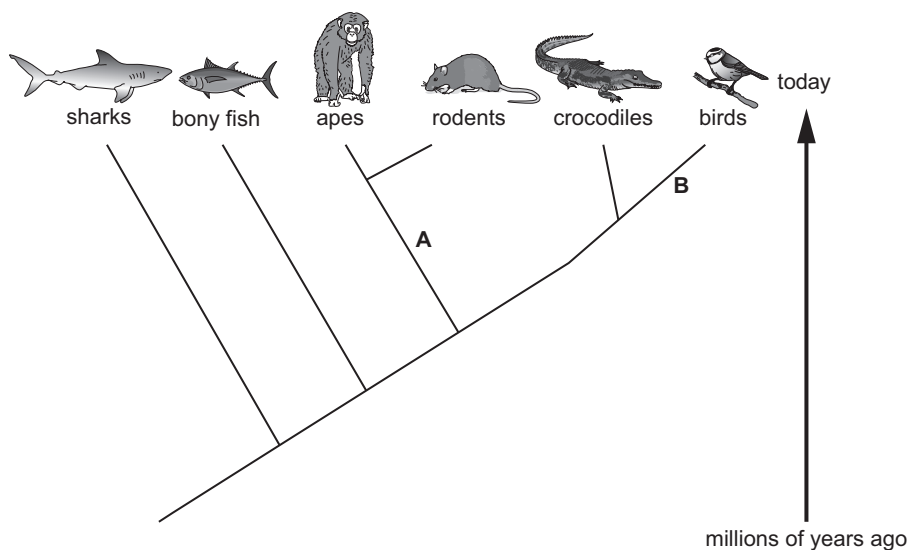


Fig. 5.1

- (i) Suggest which visible features have developed at **A** and **B** in Fig. 5.1.

A

B

[2]

- (ii) Identify the names of the **two** groups that share the most recent common ancestor in Fig. 5.1.

..... and [1]

- (iii) Suggest the groups with the most similar and least similar DNA base sequences to crocodiles in Fig. 5.1.

most similar

least similar

[2]

- (b) Describe the structure of a DNA molecule.

.....

 [4]

- (c) Outline how the base sequences in DNA control cell function.

.....

 [3]

[Total: 12]

- 29 Which term is defined as a length of DNA that codes for a protein?

- A** amino acid
B chromosome
C gene
D mutation

17.2 Mitosis

Name: _____ Class: _____ Date: _____

Total: 6 marks

KEY WORDS mitosis 有丝分裂 • daughter cell 子细胞 • haploid 单倍体 • diploid 二倍体
• stem cells 干细胞

Objective

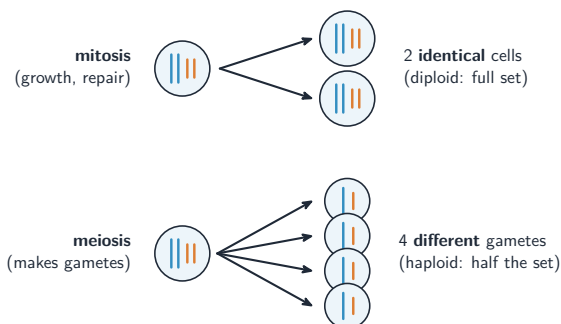
Build the skills to answer exam questions on **mitosis** 有丝分裂 — what it produces, when it is used, and **stem cells** 干细胞.

You must be able to:

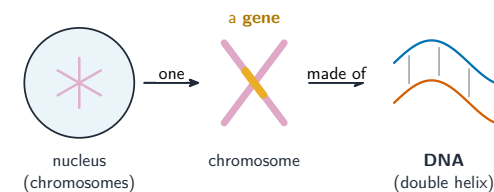
- describe mitosis (two genetically identical diploid cells)
- state where mitosis is used
- describe stem cells

1 Worked examples

■ Mitosis



Mitosis makes two genetically identical diploid daughter cells



Chromosomes carry the genes copied in mitosis

- chromosomes are copied (replication) first, so each daughter keeps the full number.
- used for **growth, repair, replacing cells and asexual reproduction**.
- **stem cells** are unspecialised cells that divide by mitosis.

2 Practice

2.1 State how the daughter cells of mitosis compare with the parent. [1]

2.2 State one use of mitosis in the body. [1]

3 Exam-style questions

3.1 Mitosis produces cells that are: [1]

- A haploid and different
- B diploid and identical
- C haploid and identical
- D diploid and different

3.2 Mitosis is important for growth and repair.

(a) Explain why the chromosomes are copied before mitosis.

[2]

(b) State what a stem cell is.

[1]

Solutions

2.1 they are genetically identical to the parent.

2.2 any of: growth; repair; replacing cells; asexual reproduction.

3.1 B. Mitosis produces diploid, genetically identical cells.

3.2 (a) so each daughter cell receives a full, identical set of chromosomes; keeping the diploid number.

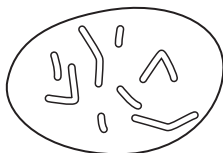
(b) an unspecialised cell that divides by mitosis (and can become specialised).

33 What are stem cells?

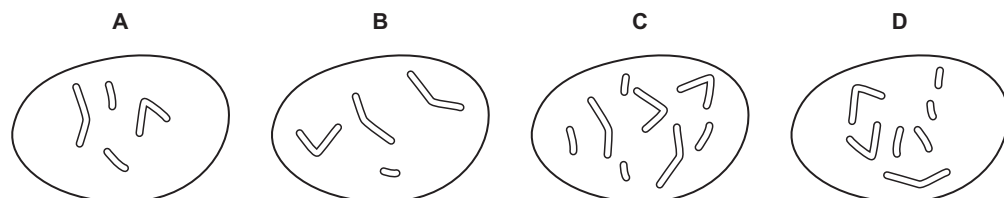
- A** specialised cells that divide by meiosis to produce daughter cells
- B** specialised cells that divide by mitosis to produce daughter cells
- C** unspecialised cells that divide by meiosis to produce daughter cells
- D** unspecialised cells that divide by mitosis to produce daughter cells

IGCSE Biology: **s25 21**

29 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?



IGCSE Biology: **s25 23**

31 The diagram shows the cells of a mammalian embryo shortly after fertilisation.

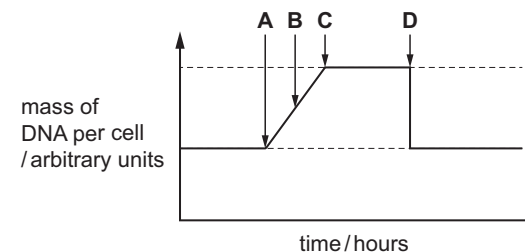


What is the correct description of these cells?

- A** embryo cells undergoing meiosis
- B** gametes undergoing mitosis
- C** stem cells undergoing mitosis
- D** zygote undergoing meiosis

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

Where on the graph are **two** cells formed?



17.3 Meiosis

Name: _____ Class: _____ Date: _____ **Total: 7 marks**

KEY WORDS meiosis 减数分裂 • gametes 配子 • haploid 单倍体 • mitosis 有丝分裂
• division 分裂

Objective

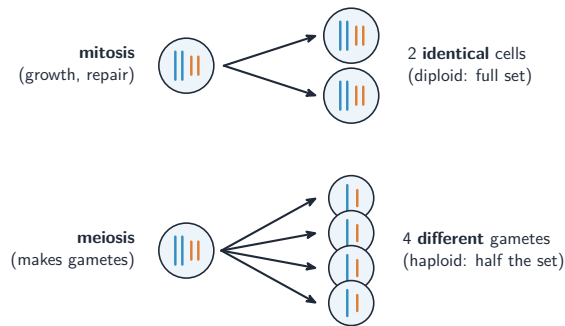
Build the skills to answer exam questions on **meiosis** 减数分裂 — what it produces, and how it differs from mitosis.

You must be able to:

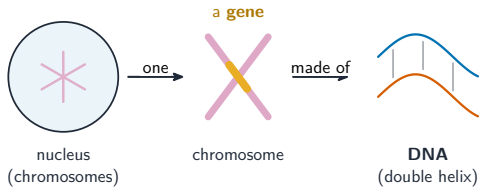
- describe meiosis (a reduction division making gametes)
- state that the gametes are haploid and genetically different
- contrast meiosis with mitosis

1 Worked examples

■ Meiosis



Meiosis halves the chromosome number (diploid → haploid) and makes four genetically different gametes



Meiosis halves the chromosome number

2 Practice

2.1 State what cells meiosis produces. [1]

2.2 State why meiosis is called a reduction division. [1]

3 Exam-style questions

3.1 The gametes made by meiosis are: [1]

- **A** diploid and identical
- **B** haploid and genetically different
- **C** diploid and different
- **D** haploid and identical

3.2 Meiosis differs from mitosis.

(a) State two differences between meiosis and mitosis. [2]

(b) Explain why making genetically different gametes is useful. [2]

Solutions

2.1 gametes (sex cells).

2.2 it halves the chromosome number (diploid → haploid).

3.1 B. Gametes are haploid and genetically different.

3.2 (a) any two of: meiosis halves the chromosome number (mitosis keeps it); meiosis makes 4 cells (mitosis 2); meiosis makes different cells (mitosis identical).

(b) it produces variation in the offspring, which helps the species survive if the environment changes.

Name:

IGCSE Biology: **w25 21**

28 Which statement describes the effect of meiosis on chromosome number?

- A** A diploid parent cell produces diploid daughter cells.
- B** A diploid parent cell produces haploid daughter cells.
- C** A haploid parent cell produces diploid daughter cells.
- D** A haploid parent cell produces haploid daughter cells.

IGCSE Biology: **w25 23**

33 Four features of cell division are listed.

- 1 Haploid cells are produced.
- 2 New cells are genetically identical.
- 3 It is a reduction division.
- 4 It results in variation.

Which features would be associated with meiosis?

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

3 (a) Fig. 3.1 shows one stage involved in plant reproduction after pollination.

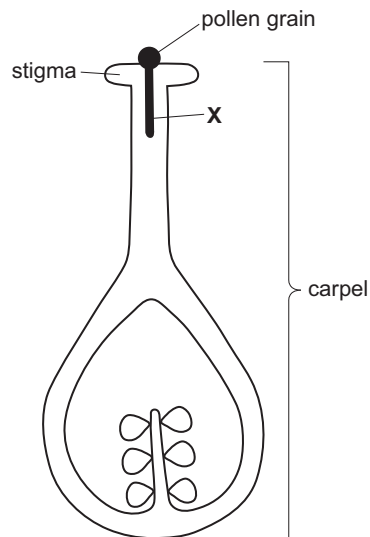


Fig. 3.1

(i) State the name of the part labelled X in Fig. 3.1.
 [1]

(ii) Describe the events that occur after the stage shown in Fig. 3.1 that result in fertilisation.

 [3]

(b) A species of plant can use self-pollination and cross-pollination.

(i) Suggest reasons for this species of plant to use self-pollination rather than cross-pollination.

.....

 [3]

(ii) Discuss the potential effects of only using self-pollination in a population of plants.

 [3]

(c) Meiosis produces gametes and is a source of genetic variation.

State **two other** sources of genetic variation in populations.

1
 2 [2]

[4]

[1]

24

Total: 7 marks

Objective

You must be able to:

- use genotype/phenotype, dominant/recessive, homo-/heterozygous
- complete a Punnett square and predict ratios
- interpret a test cross / pedigree

1 Worked examples

- A monohybrid cross

Bb × **Bb** (both parents)

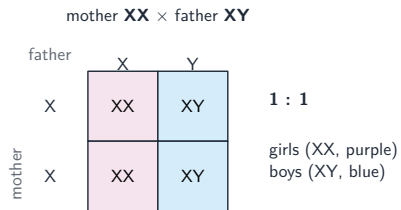
gametes

	B	b
B	BB	Bb
b	Bb	bb

3 : 1

3 dominant (blue)
1 recessive (orange)

$Bb \times Bb \rightarrow BB, Bb, Bb, bb \rightarrow$ a 3:1 ratio of dominant to recessive



A Punnett square also predicts sex determination

- **dominant** shows with one copy (capital); **recessive** needs two copies (lower-case).
- **homozygous** = two same alleles; **heterozygous** = two different.

2 Practice

2.1 Define a recessive allele. [1]

2.2 State the genotype of a heterozygous organism for a gene with alleles B and b. [1]

3 Exam-style questions

3.1 Crossing two heterozygous parents (Bb × Bb) gives a phenotype ratio of: [1]

- A 1:1
 - B 3:1
 - C 1:2:1
 - D all dominant
-

3.2 In rabbits, black fur (B) is dominant to white (b). A heterozygous black rabbit is crossed with a white rabbit.

(a) Complete a Punnett square for this cross. [3]

(b) State the ratio of black to white offspring expected. [1]

Solutions

2.1 an allele shown in the phenotype only when no dominant allele is present.

2.2 Bb.

3.1 B. Bb $\times$ Bb gives a 3:1 ratio.

3.2 (a) parents Bb $\times$ bb; gametes B,b and b,b; offspring Bb, Bb, bb, bb.
(b) 1:1 (black : white).

Name:

IGCSE Biology: w25 21

27 Which statements describe the sex chromosomes in human gametes?

- 1 Egg cells contain either an X or a Y chromosome.
- 2 Egg cells contain only X chromosomes.
- 3 Sperm cells contain either an X or a Y chromosome.
- 4 Sperm cells contain only Y chromosomes.

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

29 A female with red-green colour blindness has a child with a male who does **not** have red-green colour blindness. The child is male.

What is the chance of this child having red-green colour blindness?

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

32 The photograph shows a speckled chicken.

Speckled chickens have white feathers and black feathers.



When a chicken with only white feathers and a chicken with only black feathers are crossed, all of the offspring are speckled.

What would be the expected phenotypic ratio if a speckled chicken was crossed with a chicken with only white feathers?

- A** all offspring have only white feathers
- B** all offspring are speckled
- C** 1 white feathers only : 1 speckled
- D** 3 white feathers only : 1 speckled

30 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

31 Polydactyly in cats is a dominant condition that causes affected cats to be born with extra toes.

What is the probability of two cats that are heterozygous for polydactyly having an offspring with **no** extra toes?

- A** 0.125
- B** 0.25
- C** 0.50
- D** 0.75

32 Which statement describes red-green colour blindness?

- A** It is an example of codominance.
- B** It is more common in females than in males.
- C** It only occurs in males.
- D** The recessive allele is located on an X chromosome.

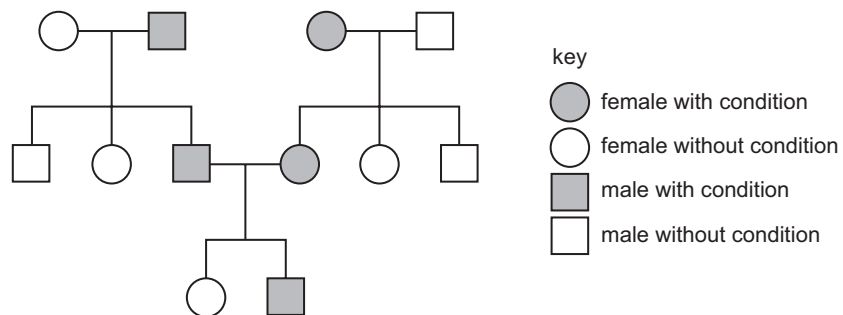
30 A farmer bred together male cattle with white hair and female cattle with red hair. All the offspring produced had roan hair (a mixture of red and white).

He then repeatedly bred together two roan cattle, and the offspring were in the ratio of 1 red : 2 roan : 1 white.

What explains why the farmer obtained this ratio?

- A** The red phenotype is dominant to the white phenotype.
- B** The roan phenotype is an example of codominance.
- C** The roan phenotype is dominant to the red phenotype and the white phenotype.
- D** The white phenotype is dominant to the red phenotype.

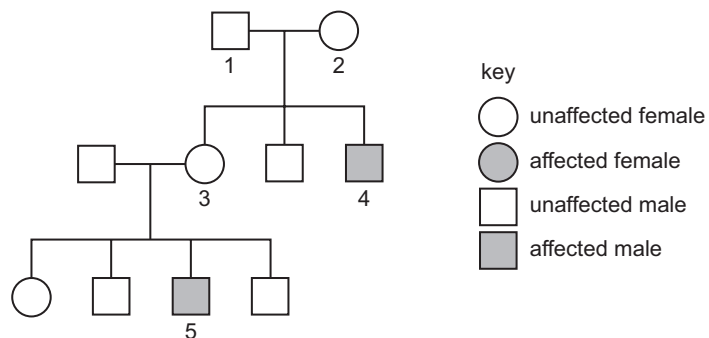
31 The diagram shows the inheritance of a genetic condition in one family.



What can be concluded about this genetic condition?

- A The alleles for the condition must be codominant.
- B It is caused by a dominant allele.
- C It is caused by recessive alleles.
- D The alleles for the condition must be sex-linked.

32 The diagram shows the inheritance, in one family, of a sex-linked recessive disease.



Which individuals in the diagram are heterozygous for this disease?

- A 1 and 2
- B 1 only
- C 2 and 3
- D 4 and 5

32 A man with blood group A and genotype $I^A I^o$ has a child with a woman who has blood group B and genotype $I^B I^o$.

What is the probability of the child having blood group O?

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