

Genetics practice questions

28 questions • 82 marks • mark scheme at the back

For Edexcel GCSE Biology 1BI0 and Combined Science 1SC0. **Triple only** is not in Combined Science. **Higher tier** is only on the Higher paper.

Name

Total / 82

Reproduction and meiosis **Spec 3.1B-3.3**

1 **Triple only** [1 mark]

Which of these is an advantage of asexual reproduction?

- A. ☐ It produces variation in the population
- B. ☐ It does not need a mate
- C. ☐ It makes gametes by meiosis
- D. ☐ It makes offspring that are different from the parent

2 **Triple only** [2 marks]

Explain one advantage of sexual reproduction for a population of organisms.

3 **Triple only** [2 marks]

A farmer grows a large field of plants that were all produced by asexual reproduction. A new disease spreads through the field and every plant dies. Explain why.

4 [4 marks]

A human body cell has 46 chromosomes. (a) State the number of chromosomes in a human egg cell. (1) (b) One cell divides by meiosis. State the number of daughter cells produced. (1) (c) Explain why the number of chromosomes in a human cell does not double each generation. (2)

10 Describe how DNA can be extracted from a strawberry.

[4 marks]

Protein synthesis and gene variants

Spec 3.7B-3.10B

Triple only

Higher tier

11 Triple only Higher tier

[1 mark]

What decides the order of amino acids in a protein?

- A. ☐ The shape of the ribosome
- B. ☐ The order of bases in a gene
- C. ☐ The number of chromosomes in the cell
- D. ☐ The type of enzyme in the nucleus

12 Triple only Higher tier

[3 marks]

Explain how the order of bases in a gene decides the shape of an enzyme.

13 Triple only Higher tier

[4 marks]

Describe how a gene is used to make a polypeptide.

14 Triple only Higher tier [3 marks]

A variant in the non-coding DNA in front of a gene alters the phenotype of an organism. The protein made from the gene has the same sequence of amino acids. Explain how the variant can affect the phenotype.

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15 Triple only Higher tier [3 marks]

A variant in the coding DNA of a gene for an enzyme stops the enzyme working. Explain how.

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Inheritance Spec 3.11B–3.18B

16 Triple only [3 marks]

Describe the work of Gregor Mendel, and suggest why his work could not be explained at the time.

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17 [3 marks]

Explain the meaning of the terms allele, dominant and genotype.

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- 18** In pea plants, the allele for tall (T) is dominant to the allele for short (t). Two heterozygous tall plants are crossed. Use a genetic diagram to work out the ratio of tall plants to short plants in the offspring. **[3 marks]**

Answer =

- 19** Use a genetic diagram to show that the probability of a baby being a girl is 50%. **[3 marks]**

- 20** A genetic disorder is caused by a recessive allele. Two parents do not have the disorder, but they have a daughter who does. (a) Explain what this shows about the parents. (2) (b) The parents have another child. Calculate the probability that this child has the disorder. (1) **[3 marks]**

Answer =

- 21** **Triple only** A mother has blood group A and a father has blood group B. Their child has blood group O. Explain how this is possible. **[3 marks]**

25 Identical twins have the same genes. One twin has a scar on her arm and is heavier than her sister. (a) Name the type of variation shown by the scar. (1) (b) Suggest two reasons why the twins have different masses. (2) (c) State one cause of genetic variation between non-identical siblings. (1) **[4 marks]**

26 The masses of five pea seeds were 0.42 g, 0.38 g, 0.45 g, 0.40 g and 0.35 g. Calculate the mean mass. **[2 marks]**

Answer =

27 (a) State how extensive genetic variation arises in a population. (1) (b) Describe the effects mutations can have on the phenotype. (2) **[3 marks]**

28 Discuss the outcomes of the Human Genome Project and its potential applications within medicine. **[3 marks]**

Mark scheme

One mark for each point unless a maximum is given. Words in brackets are not needed for the mark.

1. [1] Triple only

B B: It does not need a mate (1)

2. [2] Triple only

- it produces variation in the population (1)
- so some individuals are likely to survive a change in the environment or a new disease (1) allow 'some are resistant to the disease'

3. [2] Triple only

- the plants are genetically identical / there is no variation in the population (1)
- so none of the plants has resistance to the disease / if one is susceptible, all are (1)

4. [4]

- (a) 23 (1)
- (b) 4 (1)
- (c) gametes have half the number of chromosomes (1)
- fertilisation restores the full number (46) / the zygote gets 23 from each parent (1)

5. [6] Triple only

Level 3 5-6	A detailed, balanced evaluation of both types of reproduction. Advantages and disadvantages are linked to their consequences for survival of the population, with a reasoned judgement.
Level 2 3-4	Some advantages and disadvantages of both types are given, with some linking of ideas, but the evaluation may be unbalanced or lack a conclusion.
Level 1 1-2	Simple statements about one or both types of reproduction, with little or no linking of ideas.

Indicative content

- asexual: only one parent, so no need to find a mate
- asexual: rapid reproductive cycle, so many offspring quickly
- asexual: offspring are genetically identical so there is no variation in the population
- asexual: if the environment changes or a disease appears, all individuals may be affected
- sexual: two parents are needed so a mate must be found, which takes time and energy
- sexual: variation in the population
- sexual: some individuals more likely to survive and reproduce when conditions change
- judgement: asexual is better in a stable environment where speed matters; sexual is better when the environment is likely to change

6. [1]

B B: Weak hydrogen bonds between bases (1)

7. [3]

- two strands coiled to form a double helix (1)
- strands linked by complementary base pairs joined by (weak) hydrogen bonds (1)
- made of nucleotides, each consisting of a sugar and phosphate group (1)
- with one of four different bases attached to the sugar (1)
- Max 3

8. [2]

- (a) T A C G G T (1)
- (b) hydrogen (bonds) (1)

9. [2]

- (a) the entire DNA of an organism (1)
- (b) a section of a DNA molecule that codes for a specific protein (1)

10. [4]

- mash / crush the strawberry (1)
- add detergent (and salt) to break down cell membranes / release DNA (1)
- filter to remove solid pieces (1)
- add ice-cold ethanol (1)
- DNA appears as white stringy strands / precipitate (1)
- Max 4

11. [1] Triple only Higher tier

B B: The order of bases in a gene (1)

12. [3] Triple only Higher tier

- the order of bases decides the order of amino acids (1)
- the chain of amino acids folds (1)
- to produce a specifically shaped protein / active site (1)

13. [4] Triple only Higher tier

- RNA polymerase binds to non-coding DNA in front of the gene (1)
- RNA polymerase produces a complementary mRNA strand (1)
- from the coding DNA of the gene (1)
- mRNA attaches to a ribosome (1)
- codons / triplets of bases in the mRNA code for specific amino acids (1)
- tRNA transfers amino acids to the ribosome (1)
- amino acids are linked to form a polypeptide (1)
- Max 4

14. [3] Triple only Higher tier

- the variant affects the binding of RNA polymerase (1)
- so a different amount of mRNA is made (1)
- so the quantity of protein produced is altered (1)

15. [3] Triple only Higher tier

- the sequence of amino acids is altered (1)
- so the protein folds into a different shape / the active site changes shape (1)
- the substrate no longer fits so the enzyme activity is reduced or lost (1)

16. [3] Triple only

- bred pea plants and counted the characteristics of the offspring (1)
- showed characteristics are inherited as separate factors / some are dominant and some recessive (1)
- genes, chromosomes and DNA were not known, so there was no mechanism to explain the results (1)

17. [3]

- allele: a different version of the same gene (1)
- dominant: an allele that is expressed in the phenotype even when only one copy is present (1)
- genotype: the alleles an organism has (for a gene) (1)

18. [3]

- gametes from both parents T and t (1)
- offspring genotypes TT, Tt, Tt, tt (1)
- 3 tall : 1 short (1) allow 3:1

19. [3]

- mother's gametes X and X, father's gametes X and Y (1)
- offspring XX, XX, XY, XY (1)
- two out of four are XX / female so probability is 50% (1)

20. [3]

- (a) both parents are carriers / heterozygous (1)
- each has one recessive allele, which is masked by the dominant allele (1) allow: the daughter is homozygous recessive so must have inherited a recessive allele from each parent
- (b) 1/4 or 0.25 or 25% (1)

21. [3] Triple only

- the mother's genotype is IA IO and the father's is IB IO (1)
- each parent passes on the IO allele (1)
- the child is IO IO, which is blood group O (1)

22. [4] Triple only Higher tier

- (a) males have only one X chromosome (1)
- so one copy of the recessive allele causes the disorder / females need two copies (1)
- (b) 50% or 1/2 (1)
- (c) 0 / 0% / none (1) ignore reasons, e.g. the father passes on an X with the normal allele

23. [6]

Level 3 5-6	A clear, logical explanation using correct terms, a correct genetic diagram, and a correct prediction of the proportions with the idea of probability.
Level 2 3-4	Some explanation using some correct terms, a mostly correct genetic diagram, and a prediction with minor errors or omissions.
Level 1 1-2	Simple statements with limited use of terms. The diagram may be missing or incorrect.

Indicative content

- both parents have genotype Pp (heterozygous)
- each parent produces gametes P and p
- gametes combine at random at fertilisation
- offspring genotypes PP, Pp, Pp and pp
- P is dominant so PP and Pp have purple flowers
- pp is homozygous recessive so has white flowers
- ratio 3 purple : 1 white
- probability of purple 75%, of white 25%

24. [1]

B B: multiple genes (1)

25. [4]

- (a) environmental variation / acquired characteristic (1)
- (b) different diet (1)
- different amount of exercise (1) allow other suitable environmental factors
- (c) sexual reproduction / mutation (1)

26. [2]

- $0.42 + 0.38 + 0.45 + 0.40 + 0.35 = 2.00$ (1)
- $2.00 \div 5 = 0.40$ g (1)

27. [3]

- (a) through mutations (1)
- (b) most have no effect (1)
- some have a small effect, and rarely a single mutation significantly affects the phenotype (1)

28. [3]

- the human genome has been mapped / the sequence of bases in human DNA identified (1)
- genes linked to inherited disorders can be identified so people can be tested / their risk predicted (1)
- treatments or drugs can be developed or matched to a person's genes (1)
- concern: genetic information could be used unfairly or cause worry (1)
- Max 3