

Inheritance, variation and evolution practice questions

25 questions • 80 marks • mark scheme at the back

For AQA GCSE Biology 8461 and Combined Science: Trilogy 8464. **Triple only** is not in Combined Science. **Higher tier** is only on the Higher paper.

Name

Total / 80

Reproduction **Spec 4.6.1**

- 1** Which statement about asexual reproduction is correct? [1 mark]
- A. ☐ Gametes fuse to form the offspring.
 - B. ☐ The offspring are genetically identical to the parent.
 - C. ☐ Meiosis is used to form the offspring.
 - D. ☐ Two parents are needed.

- 2** A human body cell has 46 chromosomes. Explain how meiosis and fertilisation make sure [3 marks]
that a baby has 46 chromosomes in its body cells.

- 3** **Triple only** [4 marks]
- A strawberry plant can reproduce sexually by making seeds, and asexually by making runners. Explain one advantage of each type of reproduction for the strawberry plant.

- 4** (a) What is meant by the genome of an organism? (1) (b) Give one reason why it is important to understand the human genome. (1) [2 marks]

- 5** Triple only [3 marks]
- DNA is a polymer made up of repeating nucleotide units. Describe the structure of one nucleotide.

- 6** Triple only Higher tier [4 marks]
- A mutation changes one base in the DNA sequence of a gene that codes for an enzyme. The enzyme made from the changed gene does not work. Explain why.

7 In mice, the allele for black fur (B) is dominant to the allele for brown fur (b). A heterozygous black mouse (Bb) is crossed with a brown mouse (bb). The table shows an incomplete Punnett square. (a) Give the genotypes that go in boxes (i) and (ii). (1) (b) Give the expected ratio of black to brown offspring. (1) (c) The mice have 12 offspring. How many would you expect to be brown? (1) (d) Explain why the parent with genotype Bb is described as heterozygous. (1)

Punnett square for Bb × bb		
Gametes	B	b
b	Bb	(i)
b	(ii)	bb

Answer =

[illegible]

8 **Higher tier** **[4 marks]**

Cystic fibrosis is caused by a recessive allele (f). Two parents do not have cystic fibrosis, but both are carriers (Ff). Construct a Punnett square to work out the probability that their child has cystic fibrosis. (4)

Answer =

[illegible]

- 9** A couple are both carriers of the recessive allele that causes cystic fibrosis. They are offered embryo screening. Embryos are made outside the body and tested for the faulty allele. Only embryos without two copies of the faulty allele are placed in the mother's womb. Embryos that are not used are destroyed. The process is expensive. Discuss the economic, social and ethical issues of embryo screening for this couple. **[6 marks]**

[illegible]

- 10** Use a genetic cross to show how the sex of a human baby is inherited. Give the ratio of female to male babies. **[3 marks]**

[illegible]

Variation and evolution Spec 4.6.2

- 11** Two identical twins are brought up in different houses. At age 16 they have different body masses. Explain why their body masses are different. **[2 marks]**

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- 12** A population of grasshoppers living in grass contains green grasshoppers and brown grasshoppers. The grass dries out and turns brown. Birds eat the grasshoppers that they can see. Explain how the population of grasshoppers changes over many generations. **[4 marks]**

- 13** (a) Describe how a farmer could use selective breeding to produce cattle that give more milk. (3) (b) Give one risk of selective breeding in animals. (1) **[4 marks]**

- 14** **Higher tier** Human insulin can be made by genetically engineered bacteria. Describe the main steps in the process of genetic engineering. **[4 marks]**

- 15** Many crops are genetically modified (GM). Give one benefit of GM crops and one concern about them. **[2 marks]**

16 Triple only [4 marks]

A sheep can be cloned using a skin cell from an adult sheep. Describe how a cloned embryo is made and used.

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The development of understanding of genetics and evolution Spec 4.6.3

17 Triple only [2 marks]

Darwin published his theory of evolution by natural selection in 1859, but it was only gradually accepted. Give two reasons why.

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18 Triple only [4 marks]

A new mountain range separates one population of a species of bird into two populations that cannot meet. Describe the steps that could lead to the formation of two new species.

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19 Triple only [3 marks]

Gregor Mendel carried out breeding experiments on plants in the mid-19th century. (a) State one observation Mendel made. (1) (b) Explain why the importance of his discovery was not recognised until after his death. (2)

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- 20** (a) Describe two ways in which fossils may form. (2) (b) Give one reason why the fossil record is incomplete. (1) **[3 marks]**

[illegible]

- 21** Define extinction and describe one factor that could cause a species to become extinct. [2 marks]

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- 22** Some bacteria have become resistant to antibiotics. MRSA is an example. Explain how antibiotic-resistant strains of bacteria develop and spread, and describe how the rate of their development can be reduced. **[6 marks]**

[illegible]

Classification of living organisms Spec 4.6.4

- 23** The scientific name of the domestic dog is *Canis familiaris*. The scientific name of the wolf is *Canis lupus*. (a) What does the first word in both names tell you? (1) (b) Name the group in the Linnaean system that comes just above genus. (1) **[2 marks]**

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- 24** Carl Woese developed the three-domain system of classification. (a) Name the three domains. (1) (b) Give one development in biology that led scientists to propose new models of classification. (1) **[2 marks]**

- 25** An evolutionary tree shows that species P and species Q split from a common ancestor 10 million years ago. Species R split from the line leading to P and Q 40 million years ago. Which species is more closely related to P: Q or R? Explain your answer. **[2 marks]**

Mark scheme

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

1. [1]

B B: the offspring are genetically identical to the parent (1)

2. [3]

- meiosis halves the number of chromosomes / gametes have a single set of chromosomes (1)
- so each gamete (sperm or egg) has 23 chromosomes (1)
- at fertilisation two gametes join / fuse, restoring the full number of 46 (1) ignore 'meet' without joining

3. [4] **Triple only**

- asexual: only one parent needed / no need for pollination or to find a mate (1)
- so it is faster / more time and energy efficient / many identical offspring can be produced when conditions are favourable (1)
- sexual: produces variation in the offspring (1)
- so if the environment changes some offspring may survive / variation gives a survival advantage by natural selection (1)

4. [2]

- (a) the entire genetic material of that organism (1) allow all of the DNA of an organism
- (b) any one from: search for genes linked to (different types of) disease / understanding and treatment of inherited disorders / tracing human migration patterns from the past (1)

5. [3] **Triple only**

- a (common) sugar (1)
- a phosphate group (1)
- one of four different bases / A, C, G or T attached to the sugar (1)

6. [4] **Triple only** **Higher tier**

- the order / sequence of bases is changed (1)
- so the order of amino acids is changed / a different amino acid is added (1)
- so the protein folds into a different shape (1)
- the substrate no longer fits the (active / binding) site of the enzyme (1) allow active site changes shape; ignore enzyme is killed

7. [4]

- (a) (i) bb and (ii) Bb, both needed (1)
- (b) 1 : 1 (1) allow 2 : 2
- (c) 6 (1) allow correct answer from their ratio in (b)
- (d) it has two different alleles (for the gene) (1)

8. [4] **Higher tier**

- gametes from each parent shown as F and f (1)
- offspring genotypes FF, Ff, Ff, ff shown in a Punnett square (1)
- only ff has cystic fibrosis (two recessive alleles) (1)
- probability = 1 in 4 / 0.25 / 25% / 1/4 (1) do not accept 1 : 3 or 1 : 4

9. [6]

Level 3 5-6	Discusses economic, social and ethical issues, giving points for and against, linked to the information given, and reaches a reasoned conclusion.
Level 2 3-4	Discusses at least two types of issue with some explanation. The answer may be one-sided or have no conclusion.
Level 1 1-2	Simple statements about one or two issues, with little explanation or link to the information given.

Indicative content

- ethical: prevents suffering for the child and family
- ethical: embryos are destroyed, which some people think is wrong
- social: couple can have a child without cystic fibrosis
- social: may lead to pressure to choose other characteristics, or to people with the disorder feeling devalued
- economic: screening and the process is expensive for the family or health service
- economic: may save the long-term cost of treating cystic fibrosis
- a conclusion that weighs up the issues

10. [3]

- gametes: mother X and X, father X and Y (1)
- offspring XX, XX, XY, XY (1) allow a correct Punnett square for both marks
- ratio female : male = 1 : 1 (1) allow 50% / 1 in 2 chance of each

11. [2]

- they have the same genes / genome, so the difference is not genetic (1)
- different environmental conditions, for example diet or exercise (1)

12. [4]

- there is variation in colour (caused by different alleles) (1)
- brown grasshoppers are better camouflaged / less likely to be seen and eaten (1)
- so more brown grasshoppers survive and breed (1)
- they pass on the allele for brown to offspring, so the proportion of brown grasshoppers increases over generations (1)

13. [4]

- choose / select parents (cows and bulls) with the desired characteristic / high milk yield (1)
- breed them together (1)
- choose the best offspring and breed them together, repeating over many generations (1)
- inbreeding / breeds prone to disease or inherited defects (1) allow reduced genetic variation

14. [4] **Higher tier**

- enzymes are used to isolate / cut out the human insulin gene (1)
- the gene is inserted into a vector, for example a bacterial plasmid (or virus) (1)
- the vector is used to insert the gene into the bacterial cells (1)
- the bacteria multiply and make insulin / develop with the desired characteristic (1)

15. [2]

- benefit: increased yields / resistant to insects, herbicides or disease / bigger, better fruits (1)
- concern: effect on populations of wild flowers or insects / effects of eating GM crops on human health have not been fully explored (1) ignore 'unnatural' unqualified

16. [4] Triple only

- the nucleus is removed from an unfertilised egg cell (1)
- the nucleus from the adult body (skin) cell is inserted into the egg cell (1)
- an electric shock stimulates the egg cell to divide to form an embryo (1)
- when it is a ball of cells, the embryo is inserted into the womb of an adult female (1)

17. [2] Triple only

- it challenged the idea that God made all the animals and plants that live on Earth (1)
- there was insufficient evidence at the time to convince many scientists (1)
- the mechanism of inheritance and variation was not known (until 50 years later) (1)
- Max 2

18. [4] Triple only

- the populations are isolated / cannot interbreed (1)
- there is variation / mutations in each population (1)
- the environments are different, so natural selection acts differently / different characteristics are best suited (1)
- over many generations the populations become so different that they can no longer interbreed to produce fertile offspring (1)

19. [3] Triple only

- (a) the inheritance of each characteristic is determined by 'units' that are passed on to descendants unchanged (1)
- (b) when he published, chromosomes / the behaviour of chromosomes in cell division had not been observed (1)
- (b) so scientists could not link his 'units' to any structure in cells / could not explain how they were inherited (1)
- (b) allow for 1 mark: few scientists read or understood his work
- Max 3 (max 2 for part b)

20. [3]

- (a) parts of organisms have not decayed because one or more conditions needed for decay are absent (1)
- (a) parts of the organism are replaced by minerals as they decay (1)
- (a) preserved traces, such as footprints, burrows or rootlet traces (1)
- (b) early forms of life were soft-bodied, so left few traces / traces were destroyed by geological activity (1)
- Max 3 (max 2 for part a)

21. [2]

- no remaining individuals of a species are still alive (1)
- any one from: new predator / new disease / new, more successful competitor / change in the environment / a catastrophic event such as a volcanic eruption or asteroid collision (1)

22. [6]

Level 3 5-6	A clear, logical explanation of how resistance arises and spreads, with at least two ways to reduce the rate of development, explained.
Level 2 3-4	Explains some of how resistance arises or spreads, and gives at least one way to reduce the rate.
Level 1 1-2	Simple statements, for example that bacteria become resistant or that antibiotics should be used carefully.

Indicative content

- bacteria reproduce at a fast rate, so can evolve rapidly
- mutations produce new strains, some of which are resistant to antibiotics
- antibiotics kill non-resistant bacteria but the resistant ones survive and reproduce
- the population of the resistant strain rises
- the strain spreads because people are not immune and there is no effective treatment
- doctors should not prescribe antibiotics inappropriately, such as for viral infections or non-serious infections
- patients should complete the course of antibiotics so that all bacteria are killed
- restrict agricultural use of antibiotics

23. [2]

- (a) they are in the same genus (1)
- (b) family (1)

24. [2]

- (a) archaea, bacteria and eukaryota, all three needed (1)
- (b) any one from: improvements in microscopes gave evidence of internal structures / understanding of biochemical processes progressed / evidence from chemical analysis (1)

25. [2]

- Q (1)
- P and Q share a more recent common ancestor / split more recently (10 million years ago rather than 40 million years ago) (1)