

This is the **Foundation Combined Science** version. Only Foundation-level content is included. Higher Tier and Separate-only questions have been removed.

DNA and Chromosomes (4.6.2)

Specification reference: 4.6.2

Q1. Describe the structure of a DNA molecule.

[3 marks]

Q2. Explain the relationship between DNA, genes and chromosomes.

[3 marks]

Meiosis and Reproduction (4.6.1)

Specification reference: 4.6.1

Q3. Explain why meiosis produces cells that are genetically different from each other.

[3 marks]

Q4. Compare sexual and asexual reproduction in terms of the number of parents, genetic variation and type of cell division.

[3 marks]

Genetic Inheritance and Punnett Squares (4.6.3)

Q5. Define the following terms: (a) dominant allele, (b) recessive allele, (c) genotype, (d) phenotype.

[4 marks]

Q6. Brown eye colour (B) is dominant over blue (b). Two parents both have genotype Bb. Use a Punnett square to calculate the probability their child has blue eyes.

[3 marks]

Q7. Polydactyly is caused by a dominant allele (D). Cystic fibrosis is caused by a recessive allele (f). Explain why someone with one copy of the polydactyly allele (Dd) will have extra digits, but a cystic fibrosis carrier (Ff) will appear unaffected.

[3 marks]

Natural Selection and Evolution (4.6.5)

Specification reference: 4.6.5

Q8. Describe how natural selection can lead to changes in a species over many generations. Use all of the following terms: variation, competition, survival, inheritance.

[5 marks]

Q9. State THREE pieces of evidence that support the theory of evolution.

[3 marks]

Total: 30 marks

DNA and Chromosomes (4.6.2)

Q1 (3 marks)

Describe the structure of a DNA molecule.

- Double helix — two strands twisted together [1]
- Made of nucleotides, each containing a sugar, phosphate and one of four bases (A, T, C, G) [1]
- Complementary base pairing: A-T and C-G hold the two strands together [1]

Q2 (3 marks)

Explain the relationship between DNA, genes and chromosomes.

- DNA is a long molecule carrying genetic information [1]
- A gene is a section of DNA that codes for a specific protein/characteristic [1]
- Chromosomes are long strands of DNA coiled up and carrying many genes — humans have 46 in 23 pairs [1]

Meiosis and Reproduction (4.6.1)

Q3 (3 marks)

Explain why meiosis produces cells that are genetically different from each other.

- During meiosis, homologous chromosomes pair up and sections of DNA are exchanged (crossing over) — creating new allele combinations [1]
- Chromosomes then separate randomly (independent assortment) — each gamete receives a random mix of maternal and paternal chromosomes [1]
- Fertilisation combines two gametes — the combination of alleles in offspring is unique [1]

Q4 (3 marks)

Compare sexual and asexual reproduction in terms of the number of parents, genetic diversity and the number of offspring.

- Asexual: one parent; sexual: two parents [1]
- Asexual: offspring are genetically identical (clones); sexual: offspring are genetically different [1]
- Asexual: uses mitosis; sexual: uses meiosis (to produce gametes) [1]

Genetic Inheritance and Punnett Squares (4.6.3)

Q5 (4 marks)

Define the following terms: (a) dominant allele, (b) recessive allele, (c) genotype.

- (a) An allele that is expressed when only one copy is present — masks recessive [1]
- (b) An allele that is only expressed when two copies are present [1]
- (c) The alleles an individual carries (e.g. Bb) [1]
- (d) The observable characteristic produced by the genotype (e.g. brown eyes) [1]

Q6 (3 marks)

Brown eye colour (B) is dominant over blue (b). Two parents both have genotype Bb.

- Correct Punnett square: BB, Bb, Bb, bb [1]
- 1 in 4 / 25% probability of blue eyes (bb genotype) [1]
- Phenotype ratio: 3 brown : 1 blue [1]

Q7 (3 marks)

Polydactyly is caused by a dominant allele (D). Cystic fibrosis is caused by a recessive allele (ff).

- Polydactyly allele is dominant — expressed whenever present, even with only one copy [1]
- Cystic fibrosis allele is recessive — only expressed when two copies present (ff) [1]
- Carrier (Ff) has one dominant normal allele that masks the recessive cystic fibrosis allele [1]

Natural Selection and Evolution (4.6.5)

Q8 (5 marks)

Describe how natural selection can lead to changes in a species over many genera...

- Variation exists within a population due to mutations and sexual reproduction [1]
- Individuals compete for limited resources (food, water, mates, space) [1]
- Individuals with advantageous characteristics are more likely to survive and reproduce [1]
- Survivors pass on the alleles for their advantageous characteristics to offspring (inheritance) [1]
- Over many generations, the frequency of advantageous alleles increases — the population changes [1]

Q9 (3 marks)

State THREE pieces of evidence that support the theory of evolution.

- Fossil record — shows gradual changes in species over millions of years [1]
- DNA evidence — closely related species share more similar DNA sequences [1]
- Observable examples of natural selection today (e.g. antibiotic resistance in bacteria) [1] — accept: comparative anatomy