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SPECA

GCSE Combined Science (AQA Trilogy) · Biology

Inheritance, Variation and Evolution · Mark Scheme

For use with the Tiered Worksheet. Marking points are indicative, not exhaustive: award equivalent correct answers.

Section A: Foundation (Q1 to 16)

1) Sexual reproduction involves two parents and produces genetically varied offspring (1); asexual reproduction involves one parent and produces genetically identical offspring/clones (1) [2]

2) Meiosis (1); mitosis (1) [2]

3) Meiosis halves the chromosome number when gametes form (1); fertilisation fuses two gametes, restoring the full chromosome number (1) [2]

4) A gene is a section of DNA that codes for a specific sequence of amino acids, to build a particular protein (1); a genome is an organism's entire genetic material (1) [2]

5) Allele: a different version of a gene (1); dominant: an allele that is expressed even when only one copy is present (1); recessive: an allele that is only expressed when two copies are present (1); genotype: the combination of alleles an organism has for a gene (1) [4]

6) Cc × Cc gives offspring genotypes CC, Cc, Cc, cc (2 for correctly completed square); predicted ratio 3 black : 1 brown (2) [4]

7) A child can only inherit polydactyly if at least one parent carries and passes on the dominant allele, and would very likely show the condition themselves if a parent has it (1); a child can only inherit cystic fibrosis if they receive a recessive allele from both parents (1), meaning two unaffected carrier parents can still have an affected child (1) [3]

8) 23 pairs (46 in total) (1); one pair determines sex: XX in females, XY in males (1): the sex chromosome contributed by the father's sperm determines the baby's sex (1) [3]

9) Genetic variation is the differences in genotype/phenotype between individuals of the same species (1); all variants ultimately arise from mutation (1) [2]

10) Individuals show variation in phenotype (1); those with characteristics best suited to the environment are more likely to survive and reproduce (1); passing those characteristics on to the next generation, so the population changes over time (1) [3]

11) Selective breeding (artificial selection) is humans choosing organisms with desired characteristics and breeding them together over many generations (1); example, e.g. breeding disease-resistant crops or higher-yield livestock (1); risk: inbreeding can make some bred lines more prone to disease or inherited defects (1) [3]

12) Genetic engineering modifies an organism's genome by inserting a gene from another organism to produce a desired characteristic (1); example, e.g. bacteria engineered to produce human insulin, or disease-resistant crops (1); this differs from selective breeding because the DNA is changed directly rather than through breeding over generations (1) [3]

13) Any three of: the genetic basis for inheritance, now understood at a molecular level; the fossil record; the observed evolution of antibiotic resistance in bacteria (1 mark each, max 3) [3]

14) Many early life forms were soft-bodied and left few traces (1); much of what did survive has since been destroyed by geological activity (1); as a result, scientists cannot be certain exactly how life on Earth began (1) [3]

15) Bacteria reproduce very rapidly (1), so a resistant strain arising by mutation can spread through a population quickly as non-resistant strains are killed by the antibiotic (1); measure,

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e.g. patients completing the full course of antibiotics, or doctors not prescribing antibiotics for viral infections (1) [3]

16) Kingdom, phylum, class, order, family, genus, species (1 mark for at least 5 in correct order, 2 marks for all 7 in correct order: award up to 3 for full accuracy and completeness) [3]

Section B: Higher (Q17 to 19)

17) Correctly drawn Punnett square showing TT × tt → all offspring Tt (2 for a correctly constructed square with parent genotypes labelled); phenotype ratio: all offspring tall, i.e. 4 tall : 0 short (2) [4]

18) Correctly constructed square showing TT, Tt, Tt, tt (2); ratio 3 tall : 1 short (1) [3]

19) Enzymes are used to isolate the required gene (1); the gene is inserted into a vector, typically a bacterial plasmid or a virus (1); the vector is used to insert the gene into the target plant cells (1); this is done at an early developmental stage, so the desired characteristic develops as the plant grows (1) [4]

Total: 45 marks (Section A) + 11 marks (Section B) = 56 marks

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