1.6 Inheritance, Variation and Evolution: Test Pack

AQA 8461 · Calculator allowed · about 55 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A normal human body cell contains chromosomes arranged in pairs. State how many pairs of chromosomes this is, and the total number of chromosomes.

(Total for Question 1 is 2 marks)

2 Give one example of a human characteristic that is caused mainly by genes, one that is caused mainly by the environment, and one that is caused by a combination of genes and environment.

(Total for Question 2 is 3 marks)

3 Scientists name organisms using a two-part (binomial) naming system, and group organisms using a classification system with several levels.

(a) State the two parts of an organism's scientific (binomial) name.
(b) Give one advantage of classifying organisms into groups.

(Total for Question 3 is 2 marks)

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4 Complete the sentences about human sex chromosomes.

(Total for Question 4 is 2 marks)

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5 Mutations are changes to the DNA of an organism.

(a) Define the term 'mutation'. **(1)**

(b) Explain why most mutations do not have a noticeable effect on the phenotype of an organism. **(2)**

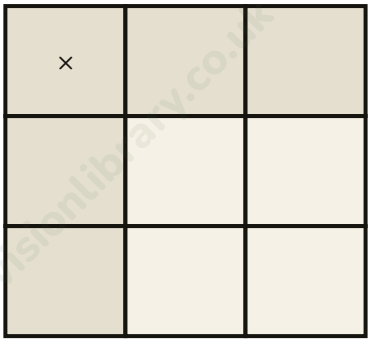
(Total for Question 5 is 3 marks)

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6 Cystic fibrosis is a genetic disorder caused by a recessive allele, f. The dominant allele, F, does not cause cystic fibrosis. Two parents, both unaffected carriers with genotype Ff, are expecting a baby.

(a) Complete a genetic cross diagram to show the possible genotypes of their children. **(2)**

Cross: Ff × Ff



(b) Calculate the probability, as a percentage, that a child of these two parents will be born with cystic fibrosis. **(1)**

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(c) Explain why two parents who do not have cystic fibrosis can have a child with cystic fibrosis. **(1)**

(Total for Question 6 is 4 marks)

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7 Polydactyly (having extra fingers or toes) is caused by a dominant allele, D. The recessive allele, d, gives the usual number of digits. A man with genotype Dd (polydactyly) and a woman with genotype dd (usual number of digits) plan to have children.

Draw a Punnett square for this cross and calculate the percentage of their children expected to have polydactyly.

(Total for Question 7 is 3 marks)

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8 Selective breeding is used by farmers to produce plants and animals with desirable characteristics. A farmer in Norfolk wants to breed wheat plants that are more resistant to a fungal disease.

(a) Describe the process the farmer could use to selectively breed wheat plants with increased disease resistance. **(4)**

(b) State one advantage of selectively breeding wheat in this way. **(1)**

(c) State one disadvantage of selectively breeding wheat in this way. **(1)**

(Total for Question 8 is 6 marks)

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9 Human insulin can be manufactured using genetic engineering, by inserting the human insulin gene into bacteria.

Describe the main stages of this process, from isolating the human insulin gene to bacteria producing insulin.

(Total for Question 9 is 4 marks)

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10 An evolutionary tree is a diagram used by scientists to show how species are related through evolution. It is described in words below.

Species A and species B share a common ancestor that lived more recently than the common ancestor shared by species A, B and species C. Species D branched off earlier still, from an ancestor common to all four species.

Use this description to answer:

(a) State which two species, A/B/C/D, are most closely related to each other.
(b) State which species is the most distantly related to species A.

(Total for Question 10 is 2 marks)

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11 Selective breeding can quickly produce animals or plants with desirable characteristics, but it also has disadvantages.

Evaluate the impact of repeated selective breeding on the genetic variation of a population, and explain one risk this creates.

(Total for Question 11 is 3 marks)

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12 Explain how meiosis produces gametes that are genetically different from each other and from the parent cell.

(Total for Question 12 is 3 marks)

13 Modern classification uses a three-domain system, first proposed by Carl Woese, which groups all living organisms into Archaea, Bacteria and Eukarya, above the traditional kingdom level.

State the type of evidence that allowed scientists to develop the three-domain system, and explain why this evidence gave more detailed information than looking at an organism's physical (visible) features alone.

(Total for Question 13 is 3 marks)

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Mark scheme · 1.6 Inheritance, Variation and Evolution: Test Pack

Question 1

23 pairs cao **B1**

46 chromosomes in total cao **B1**

Answer: 23 pairs of chromosomes, 46 chromosomes in total.

Question 2

genes: e.g. eye colour or blood group or ability to roll tongue **B1**

environment: e.g. a scar, or an accent/language learned, or a pierced ear **B1**

combination of genes and environment: e.g. body height or body mass or skin colour (with sun exposure), oe **B1**

Answer: Genes: eye colour. Environment: a scar. Both: body height.

Question 3

genus name and species name cao **B1**

makes it easier to identify, compare or study relationships between organisms (or avoids confusion between common names in different languages), oe **B1**

Answer: The genus name and the species name. Classification makes it easier to identify and compare organisms and study how they are related.

Question 4

a human female usually has the sex chromosomes XX cao **B1**

a human male usually has the sex chromosomes XY cao **B1**

Answer: Females usually have XX; males usually have XY.

Question 5

(a) a change in the DNA base sequence of a gene (oe) **B1**

(a) Answer: A change in the DNA base sequence of a gene.

(b) most mutations occur in regions of DNA that do not code for a characteristic, or do not change the protein produced enough to affect its function (oe) **B1**

(b) so the protein made still works normally/the same characteristic is still produced, meaning the phenotype is unaffected **B1**

(b) Answer: Most mutations do not significantly change the protein produced, so the protein still functions normally and the phenotype is not noticeably affected.

Question 6

(a) correct gametes shown for each parent: F and f **M1**

(a) correct offspring genotypes shown: FF, Ff, Ff, ff **A1**

(a) Answer: Gametes F and f from each parent; offspring genotypes FF, Ff, Ff, ff.

(b) 25% (1 in 4) cao, ft from (a) **B1**

(b) Answer: 25% (1 in 4)

(c) both parents are heterozygous carriers; the recessive allele (f) is masked by the dominant allele (F) in the parents, but a child can inherit the recessive allele from both parents (oe) **B1**

(c) Answer: Both parents are unaffected carriers (Ff); the recessive allele is hidden by the dominant allele in them, but a child can inherit a recessive allele from each parent.

Question 7

correctly combines gametes D, d from the father with d, d from the mother to give genotypes Dd, Dd, dd, dd **M1**

identifies 2 out of 4 offspring have genotype Dd (polydactyly) **M1**

50 % cao **A1**

Answer: 50 % of their children are expected to have polydactyly.

Question 8

(a) select existing wheat plants that show the most disease resistance **B1**

(a) breed these selected plants together **B1**

(a) from the offspring, select those showing the greatest disease resistance and breed these together **B1**

(a) repeat this process over many generations, so that disease resistance gradually increases in the population **B1**

(a) Answer: Select the most disease-resistant plants, breed them together, then select and breed the most resistant offspring; repeat over many generations to increase resistance.

(b) e.g. increases crop yield/reduces crop losses caused by disease, reducing costs for the farmer (or improves food security) **B1**

(b) Answer: It reduces crop losses to disease, increasing yield and reducing costs for the farmer.

(c) reduces the gene pool/genetic variation in the wheat population, which can increase the risk of a different disease or environmental change affecting the whole crop (inbreeding depression) (oe) **B1**

(c) Answer: It reduces genetic variation in the population, making the whole crop more vulnerable to a new disease or environmental change.

Question 9

the gene for human insulin is identified and cut out of human DNA (isolated), usually using restriction enzymes **B1**

a vector, such as a bacterial plasmid, is cut open using the same restriction enzyme so the cut ends are complementary **B1**

the insulin gene is inserted into the plasmid and joined using an enzyme called ligase, forming recombinant DNA **B1**

the recombinant plasmid is inserted into a bacterium, which then multiplies (replicates) and expresses the gene to produce (large quantities of) human insulin **B1**

Answer: Isolate the human insulin gene using restriction enzymes; cut open a plasmid vector with the same enzyme; insert and join the gene into the plasmid using ligase; insert the recombinant plasmid into bacteria, which multiply and produce human insulin.

Question 10

(a) species A and species B cao **B1**

(b) species D cao **B1**

Answer: (a) Species A and B are most closely related. (b) Species D is most distantly related to species A.

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Question 11

selective breeding reduces the gene pool / genetic variation of the population, because only individuals with the desired allele(s) are bred, oe **B1**

over many generations this can lead to inbreeding, where closely related individuals are bred together **B1**

reduced genetic variation makes the population more vulnerable to a new disease or environmental change, because there may be no individuals with alleles that give resistance/tolerance, so the whole population could be affected, oe **B1**

Answer: Selective breeding reduces genetic variation because only individuals with the desired traits are bred, which can lead to inbreeding. With less variation, if a new disease or environmental change occurs there may be no resistant individuals, putting the whole population at risk.

Question 12

before meiosis begins, the DNA is copied, so each chromosome consists of two identical strands (sister chromatids) **B1**

during meiosis, chromosomes are randomly distributed (independent assortment) into the four daughter cells, so each gamete receives a different mixture of the mother's and father's chromosomes **B1**

two divisions occur, halving the chromosome number, so each of the four gametes produced is genetically different from the others and from the original parent cell, oe **B1**

Answer: DNA is copied before meiosis, then chromosomes are randomly distributed between the four gametes produced (independent assortment) across two cell divisions, so each gamete gets a different genetic mixture and the chromosome number is halved.

Question 13

evidence from chemical/molecular analysis, in particular comparing the base sequences of genetic material (DNA/RNA), oe **B1**

this evidence let scientists compare organisms at the molecular level, revealing relationships between organisms that look very different, or separating organisms that look similar but are genetically very different, oe **B1**

this is more objective/precise than comparing visible features alone, because organisms can evolve similar features independently (or physical features can be affected by environment), oe **B1**

Answer: Comparing DNA/RNA base sequences let scientists see genetic relationships that are not visible from physical features alone, revealing that some organisms once grouped together are genetically very different.

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