



B6F Inheritance, Variation and Evolution: Foundation Tier Practice

AQA 8461 · Calculator allowed · about 80 minutes

Total Marks

Name: _____ Date: ____ / ____ / ____

Answer ALL questions. Show all your working.

- 1** State what is meant by the term 'gene'.

(Total for Question 1 is 1 mark)

- 2** A normal human body cell contains chromosomes arranged in pairs.

(Total for Question 2 is 2 marks)

- 3** State the two chromosomes that determine the biological sex of a human.

(Total for Question 3 is 1 mark)

- 4** Complete the sentences about human sex chromosomes.

(Total for Question 4 is 2 marks)

- 5** Define the terms 'dominant allele' and 'recessive allele'.

(Total for Question 5 is 2 marks)

- 6** In pea plants, purple flower colour is controlled by a dominant allele B. White flower colour is controlled by the recessive allele b. A pea plant with genotype Bb (purple, heterozygous) is crossed with a pea plant with genotype bb (white).

Complete a Punnett square for this cross: parent 1 gametes are B and b; parent 2 gametes are b and b. Use the square to find the possible genotypes of the offspring.

(Total for Question 6 is 2 marks)

- 7** Using your answer to question 6, give the ratio of purple-flowered offspring to white-flowered offspring, and state this as a percentage chance of a white-flowered offspring.

(Total for Question 7 is 2 marks)

- 8** Cystic fibrosis is caused by a recessive allele, f. Two parents who are both unaffected carriers have the genotype Ff.

Draw a Punnett square for the cross Ff x Ff and use it to calculate the percentage chance that a child of these two parents has cystic fibrosis (genotype ff).

(Total for Question 8 is 3 marks)

- 9** State why body cells produced by mitosis contain the full number of chromosomes, while gametes (sex cells) produced by meiosis contain only half the number of chromosomes.

(Total for Question 9 is 2 marks)

- 10** 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 10 is 3 marks)

- 11** State what a mutation is, and state what is true about the effect of most mutations on an organism's phenotype.

(Total for Question 11 is 2 marks)

- 12** A dairy farmer wants to breed cows that produce more milk. The table shows the mean milk yield of the farmer's herd over four generations of selective breeding.

Generation 1: 18 litres per day

Generation 2: 21 litres per day

Generation 3: 25 litres per day

Generation 4: 30 litres per day

(a) Describe the trend shown by the data.

(b) Calculate the percentage increase in mean milk yield from Generation 1 to Generation 4.

(Total for Question 12 is 3 marks)

- 13** State the process the farmer in question 12 is using, and describe how this process is carried out over several generations.

(Total for Question 13 is 3 marks)

14 Extended response (6 marks).

A hospital ward has a population of bacteria. A patient is treated with an antibiotic. A few days later, doctors find that most of the bacteria on the ward are now resistant to that antibiotic.

Explain how the bacteria on the ward evolved to become resistant to the antibiotic. Refer to variation, natural selection and reproduction in your answer.

(Total for Question 14 is 6 marks)

15 State three different ways that a fossil can form.

(Total for Question 15 is 3 marks)

16 State two reasons why a species might become extinct.

(Total for Question 16 is 2 marks)

17 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 17 is 2 marks)

18 Genetic engineering can be used to produce crop plants with useful new characteristics, such as resistance to insect pests.

Give one potential benefit and one potential concern of growing genetically modified (GM) crops.

(Total for Question 18 is 2 marks)

Mark scheme • B6F Inheritance, Variation and Evolution: Foundation Tier Practice

Question 1

- **B1** a small section of DNA (found on a chromosome) that codes for (controls) a particular characteristic or protein, oe
- **Answer: A small section of DNA that codes for a particular characteristic or protein.**

Question 2

- **B1** 23 pairs cao
- **B1** 46 chromosomes in total cao
- **Answer: 23 pairs of chromosomes, 46 chromosomes in total.**

Question 3

- **B1** X and Y chromosomes cao
- **Answer: The X chromosome and the Y chromosome.**

Question 4

- **B1** a human female usually has the sex chromosomes XX cao
- **B1** a human male usually has the sex chromosomes XY cao
- **Answer: Females usually have XX; males usually have XY.**

Question 5

- **B1** dominant allele: an allele whose characteristic appears in the phenotype even if only one copy is present (e.g. present in a heterozygote), oe
- **B1** recessive allele: an allele whose characteristic only appears in the phenotype if two copies are present (homozygous recessive), oe
- **Answer: Dominant allele: its characteristic shows even with only one copy present. Recessive allele: its characteristic only shows if two copies are present.**

Question 6

- **M1** correctly combines gametes to give offspring genotypes Bb, Bb, bb, bb (in any 2x2 arrangement)
- **A1** identifies genotypes as 2 x Bb and 2 x bb cao
- **Answer: Offspring genotypes: Bb, Bb, bb, bb.**

Question 7

- **B1** ratio 1 : 1 (purple : white) cao
- **B1** 50 % chance of a white-flowered offspring cao
- **Answer: Ratio 1 : 1 purple to white; 50 % chance of white.**

Question 8

- **M1** correctly combines gametes F and f from each parent to give genotypes FF, Ff, Ff, ff
- **M1** identifies that 1 out of 4 offspring has genotype ff
- **A1** 25 % cao
- **Answer: 25 % chance of a child having cystic fibrosis.**

Question 9

- **B1** mitosis produces two genetically identical cells with the full number of chromosomes, for growth and repair, oe
- **B1** meiosis halves the chromosome number so that when two gametes fuse at fertilisation the normal (full) chromosome number is restored in the offspring, oe
- **Answer: Mitosis keeps the full chromosome number for growth and repair. Meiosis halves the chromosome number so fertilisation (fusion of two gametes) restores the normal number in the offspring.**

Question 10

- **B1** 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
- **Answer: Genes: eye colour. Environment: a scar. Both: body height.**

Question 11

- **B1** a mutation is a change to the DNA base sequence (of a gene), oe
- **B1** most mutations have no effect on the phenotype (they are neither harmful nor helpful), cao
- **Answer: A mutation is a change in the DNA base sequence. Most mutations have no effect on the phenotype.**

Question 12

- **B1** mean milk yield increases steadily (each generation) from 18 to 30 litres per day, oe
- **M1** substitutes into percentage increase = (increase / original) x 100: $(30 - 18) / 18 \times 100$
- **A1** approximately 67 % (66.7 %) cao
- **Answer: The mean yield rises steadily each generation, an increase of approximately 67 % from Generation 1 to Generation 4.**

Question 13

- **B1** selective breeding (artificial selection) cao
- **B1** the organisms with the desired characteristic (highest milk yield) are chosen and bred together
- **B1** this is repeated over many generations so the desired characteristic becomes more common (more pronounced) in the population, oe
- **Answer: Selective breeding: parents with the desired characteristic are chosen and bred together, repeated over many generations so the characteristic becomes more common.**

Question 14

- **Level 3** (5-6): A clear, logically sequenced explanation linking random mutation, variation in resistance, survival advantage of resistant bacteria, and their preferential reproduction, leading to a resistant population. Uses scientific terms accurately throughout.
- **Level 2** (3-4): A mostly correct explanation covering variation and survival of resistant bacteria, with some detail missing or not fully linked, e.g. reproduction of survivors not clearly explained.
- **Level 1** (1-2): Simple or partial statements, e.g. 'the strong bacteria survived', with little reference to variation, mutation or reproduction.
- **Indicative content:**
 - Within the bacterial population there is variation: due to random mutation, a small number of bacteria already happen to carry a gene (allele) that makes them resistant to the antibiotic, before the antibiotic is given.
 - When the antibiotic is used, the non-resistant bacteria are killed or cannot reproduce, but the resistant bacteria survive because they are not affected by the antibiotic.
 - The surviving resistant bacteria have a survival advantage and go on to reproduce (bacteria reproduce very rapidly by simple cell division).
 - The resistance allele is passed on to the offspring of the resistant bacteria, so more of the next generation are resistant.
 - Over repeated rounds of antibiotic use and reproduction, the proportion of resistant bacteria in the population increases until most or all of the population is resistant.
 - This is an example of natural selection: the environment (presence of the antibiotic) selects for bacteria best suited to survive it, and this characteristic becomes more common over time.

Question 15

- **B1** from the hard parts of an organism (bones, shells, teeth) that do not decay easily, oe
- **B1** from parts of an organism that have not decayed because the conditions needed for decay are absent, e.g. in ice, peat bogs or amber, oe
- **B1** when parts of the organism are replaced by minerals as they decay, forming a rock-like substance (mineralisation), oe
- **Answer: Fossils can form from hard body parts that resist decay, from remains preserved where decay cannot occur (e.g. in ice or amber), or by minerals gradually replacing the original material.**

Question 16

- **B1** the environment changes too quickly for the species to adapt/evolve, oe
- **B1** a new predator, new disease, or a new, more successful competitor for resources appears, oe
- **Answer: For example: the environment changes too rapidly for the species to adapt; a new disease or predator, or a more successful competitor, appears.**

Question 17

- **B1** genus name and species name
- **B1** makes it easier to identify, compare or study relationships between organisms (or avoids confusion between common names in different languages), oe
- **Answer: The genus name and the species name. Classification makes it easier to identify and compare organisms and study how they are related.**

Question 18

- **B1** benefit: e.g. higher crop yield, resistance to pests/disease so less pesticide is needed, or crops can grow in difficult conditions, oe
- **B1** concern: e.g. possible unknown long-term effects on human health, reduction in biodiversity if only GM varieties are grown, or GM genes spreading to wild plant populations, oe
- **Answer: Benefit: e.g. higher crop yield or less pesticide needed. Concern: e.g. possible long-term effects on health or on biodiversity are not yet fully known.**