

AS Level Biology

Topic 6: Genetic Information, Variation and Biodiversity

AQA Biology (7401)

Question Paper

100 marks

Instructions

- Answer **all** questions.
- In calculations show your working and give your answer to an appropriate number of significant figures.
- In extended-response questions you should write in clear, well-organised continuous prose.
- There are 18 questions in this paper. The total mark is **100**.

Name: _____

Class: _____

Date: _____

Teacher: _____

1. This question is about genes and the genetic code.

(a) Define the term *gene*. (2)

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(b) State what is meant by a *codon*. (1)

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(c) The genetic code is described as degenerate. Explain what this means. (1)

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(d) The genetic code is also described as non-overlapping and universal. Explain what each term means. (2)

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2. This question is about the structure of a gene and a chromosome.

(a) State what is meant by an *allele*. (1)

(b) In eukaryotes, a gene contains coding and non-coding sequences. Name the parts that code for the polypeptide and the parts that do not. (2)

(c) State what is meant by the term *genome*. (1)

(d) State what is meant by the term *proteome*. (1)

3. This question is about transcription, the first stage of protein synthesis.

(a) State where in a eukaryotic cell transcription takes place. (1)

(b) Describe the process of transcription to produce pre-mRNA. (4)

(c) In eukaryotes, the pre-mRNA is modified before leaving the nucleus. Describe this process of splicing. (2)

4. This question is about translation, the second stage of protein synthesis.

(a) State where in the cell translation takes place. (1)

(b) Describe the role of transfer RNA (tRNA) in translation. (3)

(c) Describe how a polypeptide is assembled during translation. (3)

5. A short section of the template (antisense) strand of DNA has the base sequence: TAC GGA TTC.

(a) Write the base sequence of the mRNA transcribed from this template strand. (2)

(b) State the anticodon of the tRNA molecule that would pair with the first mRNA codon (AUG). (1)

(c) State how many amino acids would be coded for by this section of mRNA. (1)

6. This question is about gene mutation.

(a) State what is meant by a *gene mutation*.

(1)

(b) A substitution mutation changes one base for another. Explain why a substitution mutation may have no effect on the polypeptide produced.

(2)

(c) Explain why a deletion mutation usually has a greater effect on the polypeptide than a substitution mutation.

(3)

7. This question is about meiosis and genetic variation.

(a) State the type of cells produced by meiosis and their chromosome number compared to the parent cell.

(2)

(b) Describe how independent segregation of homologous chromosomes during meiosis produces genetic variation.

(3)

(c) Describe how crossing over during meiosis increases genetic variation.

(2)

8. A diploid organism has a diploid number of 8 (4 homologous pairs).

- (a) Calculate the number of different combinations of chromosomes possible in the gametes due to independent segregation alone. Show your working. **(2)**

- (b) State two further sources of genetic variation in sexually reproducing organisms, in addition to independent segregation. **(2)**

9. This question is about variation within and between species.

- (a) Explain how genetic factors can cause variation within a species. **(2)**

- (b) Explain how the environment can cause variation within a species. **(1)**

- (c) A student wanted to investigate the variation in leaf length of a species of plant in a field. Explain why the student should take a large, random sample. **(3)**

10. This question is about the principles of classification.

(a) State what is meant by a *species*.

(2)

(b) Name the system of naming species using two names, and state what the two names represent.

(2)

(c) List the eight taxonomic groups (taxa) used in classification, in order from the largest to the smallest.

(2)

11. This question is about how scientists classify organisms and clarify evolutionary relationships.

(a) Explain what is meant by a *phylogenetic* classification.

(2)

(b) Scientists now compare the DNA base sequences and amino acid sequences of different species to study their evolutionary relationships. Explain how comparing DNA base sequences can show how closely related two species are.

(3)

(c) Suggest why comparing amino acid sequences of a protein can also be used to investigate evolutionary relationships.

(2)

12. This question is about biodiversity and species diversity.

(a) State what is meant by the term *biodiversity*.

(1)

(b) Explain why species diversity is a better measure of biodiversity than simply counting the number of species present.

(2)

(c) Explain why an ecosystem with a higher species diversity is generally more stable.

(2)

13. The index of diversity (d) can be calculated using the formula $d = N(N - 1) / \sum n(n - 1)$, where N is the total number of organisms of all species and n is the number of organisms of each species.

(a) In a sample, there are 3 species. Species A has 5 organisms, species B has 3 organisms and species C has 2 organisms. Calculate the total number of organisms, N .

(1)

(b) Calculate the value of $\sum n(n - 1)$ for this sample. Show your working.

(2)

(c) Hence calculate the index of diversity, d , for this sample. Give your answer to 2 decimal places.

(2)

14. This question is about the effect of farming and human activity on biodiversity.

(a) Explain how clearing land to grow a single crop (monoculture) reduces biodiversity. **(2)**

(b) Suggest two farming practices that could help to conserve biodiversity. **(2)**

(c) Explain why there is often a conflict between conservation of biodiversity and the need to produce enough food. **(2)**

15. This question is about genetic diversity and natural selection.

(a) State what is meant by the term *genetic diversity*. **(1)**

(b) Explain how natural selection can lead to a change in the allele frequency in a population over time, using the example of antibiotic resistance in bacteria. **(4)**

(c) Explain why a population with a greater genetic diversity is more likely to survive a change in the environment. **(2)**

16. This question is about types of natural selection.

(a) Describe the effect of *directional* selection on a characteristic in a population. (2)

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(b) Describe the effect of *stabilising* selection on a characteristic in a population. (2)

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17. This question is about courtship behaviour as an adaptation.

(a) Explain how courtship behaviour increases the probability of successful mating and reproduction. (2)

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(b) Adaptations of organisms can be anatomical, physiological or behavioural. State which type of adaptation courtship behaviour is, and give one example of a physiological adaptation. (2)

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18. A student used the mark-release-recapture method to estimate the population size of a species of beetle in a field. The estimate is given by: $\text{population} = (\text{number in first sample} \times \text{number in second sample}) / \text{number marked in second sample}$.

(a) In the first sample, 40 beetles were caught and marked. In the second sample, 50 beetles were caught, of which 8 were marked. Calculate the estimated population size. Show your working. (2)

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(b) State two assumptions that must be made for this estimate to be valid. (2)

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