



Mutation and gene editing: practice questions

5 questions • 15 marks • mark scheme at the back

For IB Diploma Biology SL undefined. **HL only** is additional higher level content, for HL students only.

Name

Total / 15

1 PAPER 1A STYLE [1 mark]

Which mutation is most likely to cause a frameshift?

- A. ☐ Substitution of one base
- B. ☐ Deletion of three adjacent bases
- C. ☐ Insertion of one base
- D. ☐ Insertion of six adjacent bases

2 PAPER 1A STYLE [1 mark]

A base substitution changes the codon GAA to GAG, but the polypeptide is unchanged. What explains this?

- A. ☐ The genetic code is universal.
- B. ☐ The genetic code is degenerate.
- C. ☐ The mutation occurred in an intron.
- D. ☐ Proofreading removed the change.

3 PAPER 1B STYLE**[6 marks]**

Samples of the same bacterial culture were exposed to ultraviolet (UV) light for different times. After exposure, the frequency of mutants unable to make a particular amino acid was measured (practice data). (a) Describe the relationship between exposure time and mutant frequency. [2] (b) Calculate how many times greater the mutant frequency is at 40 s than at 0 s. [1] (c) Suggest why mutants occur in the sample with no UV exposure. [1] (d) Explain how UV light increases the frequency of mutation. [2]

Mutant frequency after UV exposure	
Exposure time / s	Mutants per 10 ⁶ surviving cells
0	2
10	15
20	38
30	61
40	80

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4 PAPER 2A STYLE**[2 marks]**

Distinguish between the consequences of a mutation in a germ cell and in a somatic cell.

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Explain the role of gene mutation in evolution by natural selection.

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Mark scheme

One mark for each point unless a maximum is given. Words in brackets are not needed for the mark.

1. [1]

C C;

2. [1]

B B;

3. [6]

- (a) mutant frequency increases as exposure time increases / positive correlation;
- (a) increase is roughly linear / steady between 10 and 40 s / rises from 2 to 80 per 10^6 cells; Accept use of data
- (b) $80 \div 2 = 40$ (times);
- (c) spontaneous mutations / errors in DNA replication or repair (not caused by UV);
- (d) UV is a mutagen / mutagenic radiation;
- (d) UV changes the structure of DNA / causes adjacent bases to bond together;
- (d) leading to incorrect base pairing / changed base sequence when DNA is replicated or repaired;
- (d) longer exposure causes more DNA damage, so more mutations;
- max 6

4. [2]

- germ-cell mutation can be inherited / passed to offspring, whereas somatic mutation is not inherited;
- germ-cell mutation will be in every cell of the offspring, whereas a somatic mutation is only in cells descended from the mutated cell;
- somatic mutation can cause cancer (in the individual);
- max 2

5. [5]

- mutation is the original source of all genetic variation;
- mutation creates new alleles;
- meiosis/sexual reproduction only recombines existing alleles;
- mutations occur at random / not in response to need;
- most mutations are harmful or neutral (for an individual);
- some mutations give an advantage in a particular environment;
- individuals with advantageous alleles are more likely to survive and reproduce;
- so these alleles increase in frequency in the population over generations;
- without mutation there would be no (new) variation for selection to act on;
- max 5