BIOLOGY 2016

Unit 4
Key Topic Test 2 – Mutations

Recommended writing time*: 45 minutes
Total number of marks available: 45 marks

SOLUTIONS

SECTION A: Multiple-choice questions (1 mark each)

Question 1

Answer: B

Explanation:

The rate of mutations within a population is generally consistent when there are no other factors implicating changes. They do, however, give rise to new genetic variation.

Question 2

Answer: D

Explanation:

Sickle cell anaemia is the only example given that is a substitution. The others indicate an addition or a deletion has occurred.

Question 3

Answer: A

Explanation:

The chance of the mutation occurring in the offspring is reduced by mating with a non-affected individual.

Question 4

Answer: A

Explanation:

Biologists often refer to the term single nucleotide polymorphism to explain a point mutation that has led to a variation with two different phenotypic outcomes.

Question 5

Answer: D

Explanation:

D demonstrates a repeat in the segments FGH and is known as a duplication.

Question 6

Answer: C

Explanation:

B and C both demonstrate missing segments and this is known as a deletion.

Question 7

Answer: B

Explanation:

Whilst mutations give rise to new variation within the population, they are not always favourable and thus most mutations do not give rise to offspring and are detrimental to cellular functions.

Question 8

Answer: A

Explanation:

Bacteria have the quickest rate of reproduction of those listed, therefore they would be the easiest to study within a population. They also have DNA that is currently easier to manipulate and work with in a laboratory.

Question 9

Answer: C

Explanation:

Each codon consists of three bases. If two codons were deleted a total of 6 bases would be removed.

Question 10

Answer: D

Explanation:

The start of the intron would be the most detrimental as it results in incorrect removal during transcription and could result in incomplete pre-mRNA splicing

Question 11

Answer: B

Explanation:

Trinucleotide repeats involve the repetition of three bases, they occur naturally in DNA sequences, however, tandem repeats above an acceptable threshold often lead to other abnormalities.

Question 12

Answer: A

Explanation:

Mendel's inheritance of recessive genes would indicate that it would be more likely for two individuals that are affected to produce offspring that are also affected.

Question 13

Answer: C

Explanation:

C indicates a translocation that is not specified to be due to an external factor such as a mutagenic agent.

SECTION B – Short-answer solutions

Question 1

a. UAC- CAC- GUG- GAC – GGA – GGA – CUC – CUC – UUC – AGA – CGG – CAA – UGA

1 mark

Tyr- his – val – asp - gly – gly – leu – leu – phe – arg – arg – gln – stop

1 mark

UAC- CAC- GUG- GAC – GGA – GGA – **CAC** – CUC – UUC – AGA – CGG – CAA – UGA

1 mark

Tyr- his – val – asp - gly – gly – **his** – leu – phe – arg – arg – gln – stop

1 mark

b. Point mutation / substitution mutation.

1 mark

c. The DNA code for amino acids is redundant.

1 mark

AND
The change that may occur when a substitution is present may not change the actual amino acid that is coded for.

1 mark

d. A silent mutation.

1 mark

e. As they cannot acquire the malaria disease due to the shape of the red blood cell as a result of the abnormal protein produced. This could lead to a selective advantage and result in greater chance of survival.

1 mark

f. Mutations increase the variation that exists within a population.

1 mark

AND
If the variation is a selective advantage then they would have greater chance of survival and this may result in an evolutionary change for the species.

1 mark

g. Germline cells.

1 mark

Total 12 marks

Question 2

a. Chromosomal deletion

1 mark

b. The sequence of amino acids that determine protein production is determined by the genetic material found within the chromosome.

1 mark

AND
If the series of nucleotide bases that start the production of amino acids are partially missing by the deletion, then they would be unable to produce the necessary proteins.

1 mark

c. Down syndrome

1 mark

AND
The repeat of chromosome number 21due to translocation of the chromosome.
OR
Any other reasonable answer

1 mark

d. As the mutation is only found on only of the chromosome number 5's, then there is a 50% chance of offspring obtaining this mutated chromosome.

1 mark

e. Karyotyping of the individual identifies the genetic disorder and there is less chance for a miss or error in diagnosis.

1 mark

AND
The individual can develop a care plan to assist their life requirements and assign appropriate therapy's if needed.

1 mark

OR
Any other reasonable response

Total 8 marks

Question 3

a.

i. 60. Each codon codes for one amino acid

1 mark

ii. 180 (60 codons x 3 bases)

1 mark

b. UCU, UCC, UCA, UCG, AGU, AGC

1 mark

c.

i. Substitution

1 mark

ii. The mutation would be silent and have no effect on the protein produced

1 mark

AND

Or the protein would not be correctly produced or not formed at all due to incorrect amino acids present

1 mark

iii. insertion and deletion

1 mark

d.

i. germline

1 mark

ii. radiation

OR

Any other reasonable response

1 mark

iii. Mitosis

1 mark

Total 10 marks

Question 4

As they can be caused by a single dominant gene it would be likely that many members of the population may be carrying the gene if others are also carrying the same gene.

1 mark

AND

A genetic test that indicates if they have the dominant gene present would assist in investigating if there is a mutagenic agent or just chance that this population has a large number of individuals with the dominant gene.

1 mark

Or any other reasonable answer

Total 2 marks