BIOLOGY 2016

Unit 4
Key Topic Test 1 – DNA Replication and Protein Synthesis

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

SOLUTIONS

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

Question 1

Answer: B

Explanation:

III is mRNA as it is single stranded and contains uracil, which is the first step in protein synthesis, then IV is tRNA that carries the amino acid to the ribosome, I is an amino acid, which is then built to make II the polypeptide.

Question 2

Answer: D

Explanation:

When a polypeptide is built, condensation polymerisation allows for amino acids to be brought together into a chain. A bond forms between the amine group of one amino acid and the carboxyl group of the next amino acid, releasing water.

Question 3

Answer: B

Explanation:

TATA boxes are a series of nucleotide repeats that indicate that a promoter region will start and transcription and translation should begin.

Question 4

Answer: A

Explanation:

The outline of sickle cell anaemia in this scenario indicates that it is caused by a point mutation with a single based involved. Whilst B is true in other cases of protein formation, it is not correct for this particular situation. The protein formed is abnormal and thus is caused by the different amino acid being coded for.

Question 5

Answer: B

Explanation:

If 600 bases are indicated to be utilised for translation, the only possible solution would be B. 200 amino acids, would require 200 codons, each being three bases long, giving the 600 total bases.

Question 6

Answer: A

Explanation:

C and D indicate a reference to the number of genes found in organisms, B indicates the known genes from every organism. A correctly identifies the genome.

Question 7

Answer: D

Explanation:

The structure of a nucleotide consists of a phosphate, sugar and nitrogenous base. These are the building blocks of DNA and the number of phosphates and nitrogenous bases must remain constant in regards to the nucleotide structure.

Question 8

Answer: C

Explanation:

Introns are found in pre-messenger RNA at the initial phases of transcription, they are not found in the final mRNA product that will undergo translation as they are cleaved out.

Question 9

Answer: A

Explanation:

Uracil is not a component of DNA.

Question 10

Answer: C

Explanation:

Okazaki fragments are short newly made DNA lengths that form during the lagging stage of DNA replication which is indicated in figure 2. They are not required for a non-replicating DNA strand as seen in figure 1.

Question 11

Answer: B

Explanation:

An oncogene is a gene that has the potential to cause cancer, it interferes with transcription and translation to mutate the cells function.

Question 12

Answer: D

Explanation:

Anticodons are located on tRNA within the cytoplasm of the cell in order for translation to occur at the ribosome. They are not directly found on the ribosome unless 'docking' is being undertaken to remove the amino acid.

SECTION B – Short-answer solutions

Question 1

a.

i. Allowing the addition of nucleotides onto strands in part B during the formation of the new DNA strand as depicted in part C

1 mark

ii. A Replication fork would be apparent in part A that would open the double stranded molecule to form part B as unwound DNA strands

1 mark

iii. DNA helicase is the enzyme that would assist in the formation of the replication fork by opening up the double stranded molecule from part A

1 mark

iv. Free nucleotides would be added to the single strands in part B to form the new double stranded molecule in part C

1 mark

b. It has produced two new complete double stranded DNA molecules from a single double stranded molecule.

1 mark

Total 5 marks

Question 2

a. CAU CAU GAC UAA UAU AUC GGA CCC AU

1 mark

b. RNA polymerase carries out this process.

1 mark

AND
The leading strand of DNA is being read by RNA polymerase and a complementary strand of pre-mRNA is produced.

1 mark

AND
Introns are removed, exons are spliced together and a polyA tail and methylated cap are added to the molecule before it leaves the nucleus.

1 mark

c.

1 mark for both correctly positioned

d. Transcription

1 mark

e. His-his-asp-stop

1 mark

f. mRNA enters the ribosome and codons are read

1 mark

AND

Appropriate tRNA with the correct anticodon move to the ribosome

1 mark

AND

The amino acid on the tRNA is deposited and joined to other amino acids to form a polypeptide.

1 mark

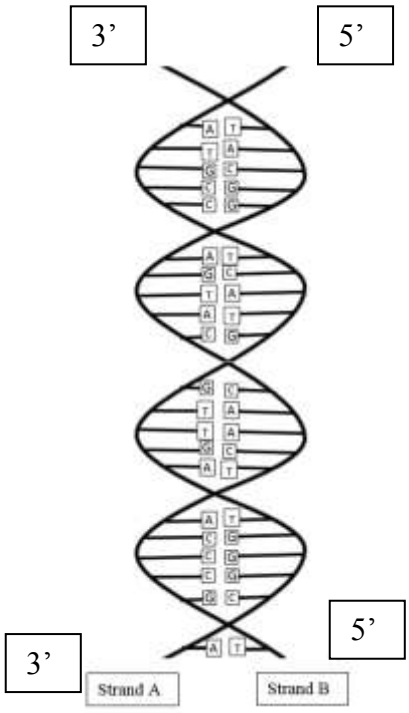
g. Translation

1 mark

Total 11 marks

Question 3

a.



1 mark

b. Complementary strand or non-coding strand

1 mark

c. If the A was replaced with a C then the complementary strand would have a G present.

1 mark

AND

If this underwent transcription and translation then the final amino acid code may be changed and thus the protein may not correctly form.

1 mark

d. Point mutation, substitution.

1 mark

e. Disassociation

1 mark

Total 6 marks

Question 4

a. It is the cells ability to alter the rate of production of specific gene products based on cellular needs

1 mark

AND
This alters the function of the cell that is evident as the genes specific role

1 mark

b.

i. RNA splicing occurs during transcription

1 mark

AND
It removes introns from the pre-messenger RNA and joins exons together to form the messenger RNA

1 mark

Introns are non-coding regions of DNA and Exons are the coding regions of DNA

ii.

1 mark

AND
The segment produced will be shorter

1 mark

c. A TATA box

1 mark

Total 7 marks

Question 5

a. The promoter sequence acts as starting initiation site for transcription to occur allowing the operator sequence to be functional

1 mark

b. The operator sequence allows the transcription factor to bind to the region if the repressor binding protein is absent. This allows the function of the lactose utilization genes.

1 mark

c. Lactose

1 mark

d. The repressor protein stops the unnecessary utilization of the lactose utilization genes when lactose is not present within the cell.

1 mark

Total 4 marks