

BIOLOGY

Unit 3 – Written examination



2024 Trial Examination

SOLUTIONS

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

Question 1

Answer: B

Explanation:

As trp is only coded for by one codon, it is ambiguous, not degenerate. Exons are coding regions of a gene and introns are the non-coding regions.

Question 2

Answer: D

Explanation:

As the monomer is RNA, the sugar is a ribose sugar. Thymine is a nitrogenous base found in DNA whereas uracil is found in RNA.

Question 3

Answer: C

Explanation:

The bonds between nucleotides are phosphodiester bonds, which endonucleases and DNA ligase acts upon. Hydrogen bonds are found between complementary nitrogenous bases. Disulphide and peptide bonds are both found within polypeptides.

Question 4

Answer: C

Explanation:

Transport vesicles move proteins within the cell from the rough endoplasmic reticulum to the Golgi. Secretory vesicles move molecules out of the cell by fusing with the plasma membrane.

Question 5

Answer: B

Explanation

Attenuation occurs when the trp codons in the leader region of the operon are quickly expressed, causing a terminator hairpin loop to form, preventing transcription of the structural genes from occurring.

Question 6

Answer: A

Explanation

The proteome is the complete set of proteins expressed by an organism. Not all proteins in the genome will be expressed, therefore B cannot be correct.

Question 7

Answer: D

Explanation

In PCR, denaturation occurs at 95°C to separate the strands. Primers anneal at 55°C and Taq polymerase elongates the strands at 72°C.

Question 8

Answer: A

Explanation

Viral DNA is stored as a spacer, with the repeats separating the sequences stored from different pathogenic genomes.

Question 9

Answer: B

Explanation

The anticodon UUA binds to the codon AAU. The DNA triplet to produce a AAU codon is TTA.

Question 10

D

The two adjacent trp codons regulate the rate of translation, that creates hairpin loops in the mRNA depending on the speed of translation. Prokaryotes do not undergo RNA processing so pre-mRNA is not an option.

Question 11

Answer: A

Explanation

Non-competitive inhibitors bind to the allosteric site, causing a conformation change in shape of the active site, which prevents the substrate from binding. This means that regardless of how much substrate is added, the rate of reaction cannot increase.

Question 12

Answer: A

Explanation

The final electron acceptor in aerobic respiration is oxygen, forming water molecules. The other molecules are co-enzymes.

Question 13

Answer: C

Explanation

PCR uses Taq or DNA polymerase not RNA polymerase. Primers are required as they are the binding site for Taq polymerase and free nucleotides are needed to extend the strand.

Question 14

Answer: A

Explanation

At a pH level above and below the optimum, and a temperature above the optimum, the rate of reaction decreased as the enzyme denatures, therefore the rate of reaction will decrease.

Question 15

Answer: A

Explanation

Each glucose molecule produces 4 ATP, with 2 of these ATP molecules used within glycolysis. Overall, a net output of 2 ATP.

Question 16

Answer: D

Explanation

The optimal temperature to insert a plasmid into *E. coli* is 40°C as this allows the membrane to become more fluid without causing too much damage to enzymes.

Question 17

Answer: B

Explanation

Proteins are produced at the ribosome and folding occurs at the rough endoplasmic reticulum. The smooth endoplasmic reticulum is where lipids are produced.

Question 18

Answer: C

Explanation

Monomers of glucose are an input into anaerobic respiration. Hydrolysis used a water molecule to break bonds between polymers.

Question 19

Answer: B

Explanation

The graph shows saturation of an enzyme, as such it is an enzyme-concentration graph.

Question 20

Answer: D

Explanation

Cas9 binds to the PAM sequence and cuts upstream of this sequence. This prevents cutting self-DNA.

Question 21

Answer: A

Explanation

RNA processing removes introns and splices exons together with a methyl cap added to the 5' end and the poly A tail is added to the 3' end. A is the only correct option.

Question 22

Answer: D

Explanation

As the environment has the lid on, it is anaerobic. As such, ethanol would be produced and no oxygen would be consumed.

Question 23

Answer: D

Explanation

Due to the lack of oxygen entering the solution, anaerobic respiration would be occurring.

Question 24

Answer: A

Explanation

As anaerobic respiration is occurring, the Krebs cycle is not occurring. As such, all carbon dioxide produced is from glycolysis.

Question 25

Answer: A

Explanation

The same amount of yeast should be used in each trial, therefore this is a controlled variable.

SECTION B Short-answer questions

Question 1 (6 marks)

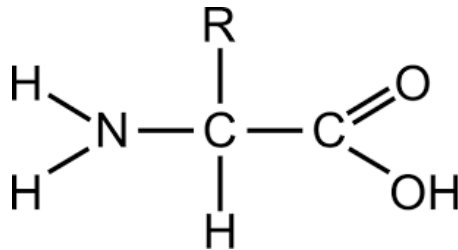
a. Ribosomes (1)

1 mark

b. Introns are removed and exons are spliced together (1). A methyl cap is added to the 5' end (1) and a poly A tail is added to the 3' end (1)

3 marks

c.



2 marks – all correct

1 mark – 1 error

0 marks – more than 2 errors

Question 2 (6 marks)

a. The trp regulatory gene produces the repressor protein that binds to the operator region (1) controlling expression of the structural genes (1)

2 marks

b. Regulation of trp through repression cannot occur (1), as the operator is no longer complementary to the repressor protein (1). As such, the trp will continually be produced (1) leading to the wastage of energy (1)

4 marks

Question 3 (6 marks)

a. It provides a binding site for Cas9 (1) and it prevents Cas9 from cutting self DNA (1)

2 marks

b. The scientist may not have added the slow ripening gene that is to be inserted (1). As such, whilst Cas9 could cut at the target sequence, the specific sequence of nucleotides to be inserted was not there (1).

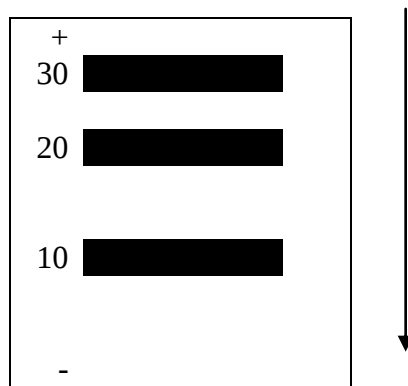
2 marks

- c. Consequence based (1) as the benefits of the actions outweigh the negative consequences (1)
2 marks

Question 4 (6 marks)

- a. Two (1)
1 mark

- b. When it is cut, it creates an overhang of nucleotide bases (1) which allows fragments to join via complementary base pairing (1)
2 marks



1 mark for correct sizes and bands
1 mark for positive and negative
1 mark for arrow to indicate direction

Question 5 (15 marks)

- a. Photorespiration occurs when oxygen binds to Rubisco (1) producing carbon dioxide as a product (1)
2 marks

- b. C₄ (1) as the Calvin cycle/light independent stage is separated by location (1) starting in the mesophyll and moving to the bundle sheath (1)
3 marks

- c. Tropical (1).
If part C was incorrectly identified as CAM, dry/arid conditions (1)
1 mark

d. (i) NADP⁺/NADPH (1) and ADP + Pi/ATP (1)

2 marks

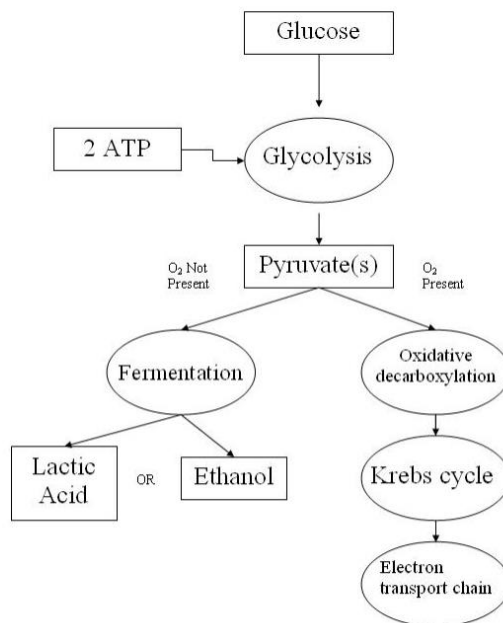
(ii) They do not catalyse reactions/lower the activation energy of reactions (1) and they change in a reaction, whereas enzymes do not (1)

2 marks

e. Carbon fixation is the conversion of inorganic carbon products into organic carbon products (1). In C₃ plants, carbon fixation only occurs in the presence of Rubisco (1). C₄ and CAM plants use PEP carboxylase for initial carbon fixation (1). C₄ plants separate carbon fixation by space (1) and CAM plants separate carbon fixation by time (1)

5 marks

Question 6 (11 marks)



a.

5 marks

b. Oxygen binds with H^+ ions that have passed through ATP synthase (1) maintaining a concentration gradient (1) allowing the electron transport chain to continue (1).

If there is no oxygen, co-enzymes can not be unloaded (1) and the cell will revert to anaerobic respiration (1) producing 2 ATP instead of 30 or 32 (1)

6 marks