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Level: HL IB in Biology
Subject: Biology
Topic: IB HL Biology
Type: Mark Scheme

All International Baccalaureate IB Topic Questions HL Biology

BIOLOGY

HL - IB

Key skills

Answer 1

The correct answer is D.

The DNA double helix unwinds and the hydrogen bonds between complementary base pairs are broken (step 4).

When the hydrogen bonds break, it allows the two strands to separate (step 1)

Free DNA nucleotides are paired with complementary nucleotides by DNA polymerase (step 2) and hydrogen bonds form between them (step 3)

Lastly, the nucleotides are joined together by covalent bonds that form between the phosphate group of one nucleotide and the sugar of the adjacent nucleotide (step 5)

Answer 2

The correct answer is C.

Each amino acid is coded for by three bases. That means that the 10th base will affect the 4th amino acid, which is lysine. The 10th amino acid will represent the first base of lysine and change it to a T. This will change the DNA base sequence for this amino acid from AAA to TAA. Using the table provided, we can see that TAA codes for a STOP codon, which will end translation after the third amino acid.

None of the base sequences after the STOP codon will be translated and the new polypeptide will only consist of the first three amino acids of the original polypeptide.

Answer 3

The correct answer is D.

Both DNA and RNA are involved in the processes of transcription and protein synthesis. During transcription, DNA serves as a template and RNA polymerase synthesises a complementary mRNA molecule using free RNA nucleotides. Protein synthesis is the complete process of creating a polypeptide from DNA and includes both transcription and translation which involves both DNA and RNA.

I. is incorrect as only DNA is involved in replication since two molecules of DNA is created from the original DNA molecule.

III. is incorrect as only RNA is involved in the process of translation, where the codons on messenger RNA are translated by ribosomes (made of ribosomal RNA) into a sequence of amino acids brought to the ribosomes by transfer RNA.

Answer 4

The correct answer is D.

The first step is to split the mRNA sequence into triplets:

AAA CUU CUC AUA GAA CGG

Use the table to find the amino acid that corresponds with each codon:

AAA	CUU	CUC	AUA	GAA	CGG
Lys	Leu	Leu	Ile	Glu	Arg

Answer 5

The correct answer is C.

The tRNA anticodons have the same sequence as the template DNA strand, except that it contains uracil (U) instead of thymine (T).

If the 18th base is deleted, it will affect the 6th amino acid, since each amino acid is coded for by three bases. The 6th amino acid is histidine, and the 18th base would refer to the 3rd base of histidine.

If this base was deleted, then the first base of the next amino acid, in this case, valine, would take the place of the deleted base during translation.

It means that the base sequence for the 6th amino acid would change from CAT to CAG, which means that the amino acid would change from histidine to glutamine.

Answer 6

The correct answer is C. LexA is a repressor protein since it is bound to the SOS box that codes for genes involved with DNA repair in cells without DNA damage. This means that LexA will prevent these genes from being transcribed when they are not needed. RecA will be an activator protein, since it breaks down LexA to activate the expression of the genes controlled by the SOS box. The SOS box will be the promoter region to which RNA polymerase can bind to transcribe the SOS genes.

Answer 7

The correct answer is B. The exons of pre-mRNA can be spliced in many different ways to produce mature mRNA molecules. This is called alternative splicing and will lead to the translation of different polypeptides from the same gene, as is the case for the different forms of titin.

A is incorrect as there are multiple post-transcriptional events that could take place and not all of them will result in the translation of different polypeptides.

C is incorrect as introns are removed from pre-mRNA and will not be joined together to form mature mRNA.

D is incorrect as poly-A tails are added to mRNA to prevent degradation by exonucleases, not to form different mature mRNA molecules.

Answer 8

The correct answer is C. Transcription and translation in prokaryotes can occur almost simultaneously due to the lack of a nuclear membrane. This gives the ribosomes access to the mRNA as it is being transcribed; therefore, no post-transcriptional changes will occur. Prokaryotic DNA does not contain introns, which decreases the need for modification of mRNA after transcription occurs.

A is incorrect since the complexity of mRNA does not rely on whether the DNA molecule is arranged in a circular or linear form. Prokaryotic mRNA is not necessarily less complex than eukaryotic mRNA.

B is incorrect as the size of the ribosomes does not determine whether post-transcriptional changes occur. Note that post-transcriptional modifications occur in the nucleus in eukaryotic cells.

D is incorrect as the complexity of mRNA does not rely on the shape of the DNA molecule. mRNA is transcribed as a single-stranded molecule in both prokaryotes and eukaryotes and does not determine whether post-transcriptional changes need to happen.

Answer 9

The correct answer is A. The complementary shape of the enzyme active site, created by the 3D folding of the polypeptide, and the shape of the tRNA molecule and its specific amino acid enables them to be linked together with the help of ATP.

B is incorrect as the enzyme active site and the shape of the tRNA molecule and its specific amino acid must be complementary to each other like puzzle pieces, not the same.

C is incorrect as the active site of an enzyme is defined by the tertiary level of protein structure, not the quaternary. If the enzyme active site had more than one polypeptide associated with each other, then you would refer to the quaternary structure.

D is incorrect since tRNA is a nucleic acid and not a protein, therefore the levels of protein structure does not apply to it.

Answer 10

The correct answer is B. Ribosomes are responsible for catalysing the formation of peptide bonds between amino acids during translation. This is made possible by the binding sites that allows tRNA to bind to the correct part of the mRNA molecule to bring specific amino acids into close contact for a peptide bond to form. They have three binding sites for tRNA and one binding site for mRNA to allow this to happen.

Statement I only applies to free ribosomes that produces polypeptides that are mainly used inside the cell.

Statement II applies to bound ribosomes only. The process of translation will be paused once the signalling sequence on the growing polypeptide is reached. The sequence will signal the ribosome to move to the ER and bind to a receptor protein before translation is re-initiated.

Statement III applies mainly to free ribosomes. 80S ribosomes are found in the cytoplasm of all eukaryotic cells, while 70S ribosomes can be located inside chloroplasts and mitochondria. It is however, only the 80S ribosomes in the cytoplasm that will bind to ER.

Answer 11

The correct answer is B. It can be seen from the graph that even low levels of added leucine led to a significant increase in protein synthesis compared to the diet that had no added leucine. However, when comparing the effect of different levels of leucine on protein breakdown, it is clear that low levels of leucine will lead to a breakdown rate which is similar to that of a diet with no added leucine.

A is incorrect as this conclusion is too vague. High levels of leucine did seem to increase the rate of protein breakdown significantly however, low levels of leucine had the same breakdown rate as the diet with no added leucine.

C is incorrect as protein synthesis will still be occurring at a higher rate than protein breakdown.

D is incorrect as the change in protein synthesis seen in the no leucine diet is still a positive one, and a protein deficiency will only develop if there is a lack of most essential amino acids in the diet.

Answer 12

The correct answer is C.

Statement I is incorrect since the tRNA molecule will bind to its corresponding amino acid at its attachment site, not at the anticodon. The anticodon is complementary to the corresponding codon on the mRNA molecule.

Statement III is incorrect as the initiator tRNA will be released once it reaches the "E" site, it will not initiate translation at this point.

Statement IV is incorrect because the amino acid is linked to the polypeptide chain when the tRNA occupies the "A" site, not the "P" site.