HL Paper 1

What does a nucleosome consist of ?

A. DNA and histones
B. DNA and chromatin
C. Chromatin and nucleotides
D. Mature RNA and histones

Markscheme

A

Examiners report

While one comment on the G2 correctly stated that candidates do not need to know histones according to AS 4.1.1, that is the depth of detail for SL;

however, for HL it is required as per AS 7.1.2.

How does DNA replicate?

A. The deoxyribose of a free nucleotide is linked to the phosphate of the last nucleotide in the chain.
B. The phosphate of a free nucleotide is linked to the deoxyribose of the last nucleotide in the chain.
C. Nucleotides are linked in a 3′ to 5′ direction and the new strands are anti-parallel to the template strands.
D. Nucleotides are linked in a 5′ to 3′ direction and the new strands are parallel to the template strands.

Markscheme

B

Examiners report

N/A

The sequence of nucleotides in a section of RNA is: GCCAUACGAUCG

What is the base sequence of the DNA sense strand?

A. CGGUAUGCUAGC
B. GCCATACGATCG
C. CGGTATGCTAGC
D. GCCAUACGAUCG

Markscheme

B

Examiners report

There still seems to be some confusion in the topic of transcription as to which is the sense or antisense strand of DNA. The syllabus specifies how this should be treated in 7.3.2.

Which of the following forms the nucleosome?

A. DNA and histone molecules
B. DNA only
C. RNA and histone molecules
D. Histone molecules only

Markscheme

A

Examiners report

N/A

The antisense strand on the DNA molecule coding for three codons of a gene is

TATCGCACG

What are the anticodons of the three tRNA molecules that correspond to this sequence?

A. UAU, CGC and ACG
B. ATA, GCG and TGC
C. AUA, GCG and UGC
D. TAT, CGC and ACG

Markscheme

A

Examiners report

Most candidates had the incorrect answer C, showing poor understanding of the process of translation. It was a good discriminator, so good candidates did understand this question.

Some regions of DNA do not code for the production of proteins. What are these regions of DNA used as?

A. They have no known function and are recycled to provide nucleotides

B. Gene regulation and coding for production of enzymes used in translation

C. Telomeres and coding for production of tRNA

D. Introns and coding for production of structural proteins

Markscheme

C

Examiners report

[N/A]

Variations in the types of antibodies are produced by mRNA splicing. What is an advantage of this process?

A. Reduces the size of mRNA required for the translation of antibodies
B. Increases the number of different antibodies that can be synthesized
C. Ensures that one gene codes for one antibody
D. Speeds up transcription of antibodies

Markscheme

B

Examiners report

[N/A]

Which types of interactions are found in a part of a protein with secondary but not tertiary structure?

I. Hydrogen bonds

II. Disulphide bridges

III. Ionic bonds

A. I only

B. I and II only

C. II and III only

D. I, II and III

Markscheme

A

Examiners report

[N/A]

Which cell component synthesizes actin and myosin?

A. Free ribosomes

B. Rough endoplasmic reticulum

C. Smooth endoplasmic reticulum

D. Nuclear membrane

Markscheme

A

Examiners report

[N/A]

What is a nucleosome?

A. A region in a prokaryotic cell where DNA is found
B. A DNA molecule wrapped around histone proteins
C. A ribosome of a prokaryotic cell
D. A molecule consisting of a sugar, a base and a phosphate

Markscheme

B

Examiners report

N/A

What does post-transcriptional modification of eukaryotic mRNA include?

I. Introns are removed from mRNA.
II. Exons are joined together to form mature mRNA.
III. A 5' cap and 3' poly-A tail are added to mRNA.

A. I only
B. I and III only
C. II and III only
D. I, II and III

Markscheme

D

Examiners report

[N/A]

Which best describes the tertiary structure of a protein?

A. The interaction of polypeptide subunits and prosthetic groups
B. Interactions forming hydrogen bonds between the amino acids
C. The sequence of amino acids in the polypeptide chain
D. The structure formed from interactions between the amino acid side groups

Markscheme

D

Examiners report

This question had a high discrimination index, showing that it did not show difficulty for good candidates. Even if hydrogen bonds are very important in the tertiary structure of proteins, it is the interactions between the side groups of amino acids that determines the tertiary structure.

Which of the following chemicals is a component of eukaryotic chromosomes?

A. Protein
B. Triglyceride
C. Fatty acid
D. RNA

Markscheme

A

Examiners report

N/A

After which process are introns removed?

A. Replication
B. Transcription
C. Translation
D. Translocation

Markscheme

B

Examiners report

N/A

What makes up eukaryotic RNA immediately after transcription?

A. Exons, introns and primers

B. Exons and introns

C. Introns only

D. Exons only

Markscheme

B

Examiners report

[N/A]

What are Okazaki fragments?

A. Short lengths of RNA primase attached to the DNA during replication
B. Short sections of DNA formed during DNA replication
C. Nucleotides added by DNA polymerase I in the same direction as the replication fork
D. Sections of RNA removed by DNA polymerase III and replaced with DNA

Markscheme

B

Examiners report

This question was a good discriminator. Some candidates confused primase with primer and thus chose the incorrect response. Okazaki fragments are expected knowledge as per AS 7.2.2.

What is the distinction between highly repetitive DNA sequences and single-copy genes?

A. The highly repetitive sequences have greater amounts of guanine.
B. The highly repetitive sequences have greater amounts of cytosine.
C. The highly repetitive sequences are not transcribed.
D. The highly repetitive sequences are not replicated.

Markscheme

D

Examiners report

Almost 84% of the candidates recognized that highly repetitive DNA sequences are not transcribed.

The antisense strand of a DNA molecule has the sequence TACCCGATC. What would be the resulting mRNA strand sequence?

A. TACCCGATC
B. ATGGGCTAG
C. UACCCGAUC
D. AUGGGCUAG

Markscheme

D

Examiners report

Some teachers felt that the 3’ and 5’ terminals should have been indicated, but this was not needed for candidates to answer the question. The most common incorrect answer was chosen by candidates who were confused about the difference between sense and anti-sense strands.

What is the reason for Okazaki fragments being formed during DNA replication?

A. To enable replication of the 3′ → 5′ (lagging) strand
B. To form the template for the RNA primers
C. To initiate replication on the 5′ → 3′ (leading) strand
D. To help the DNA helicase unwinding the DNA helix 27

Markscheme

A

Examiners report

N/A

Which statement applies to transcription in eukaryotic cells but not to prokaryotic cells?

A. RNA polymerase transcribes the antisense strand of DNA to produce a strand of RNA.
B. During transcription, uracil replaces thymine in RNA.
C. Transcription takes place in the cell nucleus.
D. Initiation of transcription requires a promoter sequence of DNA.

Markscheme

C

Examiners report

N/A

What happens during transcription in eukaryotes?

A. Polysomes move.

B. Nucleosomes are phosphorylated.

C. RNA polymerase separates DNA strands.

D. Okazaki fragments are produced.

Markscheme

C

Examiners report

[N/A]

What are introns?

A. Sequences of nucleotides that are removed to form mature RNA in eukaryotes
B. Sequences of nucleotides that are removed to form mature RNA in prokaryotes
C. Sequences that remain in mature RNA after exons have been removed
D. Small pieces of circular DNA that are found in prokaryotes

Markscheme

A

Examiners report

N/A

What is a feature of transcription?

A. Both strands of a DNA molecule act as a template for mRNA.

B. Nucleoside triphosphates become nucleotides by losing three phosphates.

C. RNA polymerase binds to the promoter region.

D. The sense strand acts as a template for mRNA.

Markscheme

C

Examiners report

[N/A]

What happens during the formation of Okazaki fragments?

A. DNA polymerase III adds nucleotides in the 3′→ 5′ direction.
B. DNA polymerase III adds nucleotides in the 5′→ 3′ direction.
C. DNA polymerase I adds nucleotides in the 5′→ 3′ direction.
D. RNA polymerase adds nucleotides in the 3′→ 5′ direction.

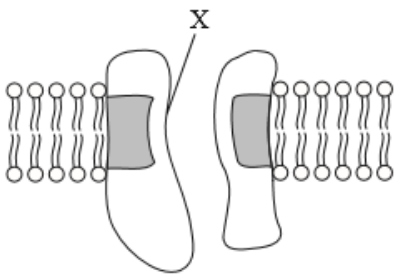
Markscheme

B

Examiners report

N/A

The diagram shows the cross section of a plasma membrane.



What is found in area X?

A. Glycolipid
B. Glycoprotein
C. Polar amino acid
D. Non-polar amino acid

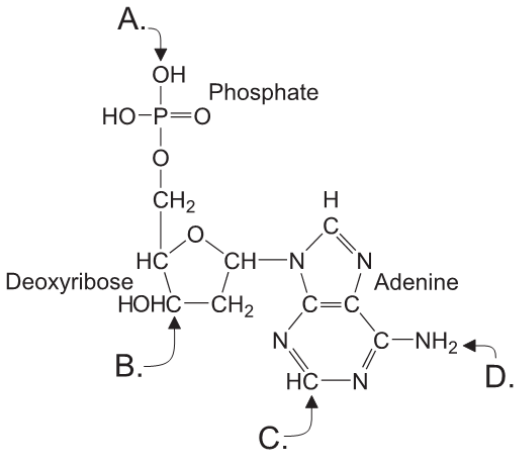
Markscheme

C

Examiners report

This was the third hardest on the paper and an excellent discriminator. Candidates were expected to identify the structure as a channel protein and deduce that polar amino acids would line the pore.

Which letter (A–D) indicates where a new nucleotide would attach?



Markscheme

B

Examiners report

[N/A]

What are the fundamental packaging units of eukaryotic chromosomes?

A. Nucleosomes
B. Centromeres
C. Histones
D. Nucleoids

Markscheme

A

Examiners report

This question seemed to be a bit complicated as many candidates confused the term packing units, considering they were the histones instead of the nucleosome. The discrimination index was quite good, showing that it did not prove that difficult to good candidates.

In which process(es) do nucleosomes play a role in eukaryotes?

I. tRNA activation

II. Transcription regulation

III. DNA supercoiling

A. I only

B. II only

C. II and III only

D. I, II and III

Markscheme

C

Examiners report

[N/A]

What is removed during the formation of mature RNA in eukaryotes?

A. Exons
B. Introns
C. Codons
D. Nucleosomes

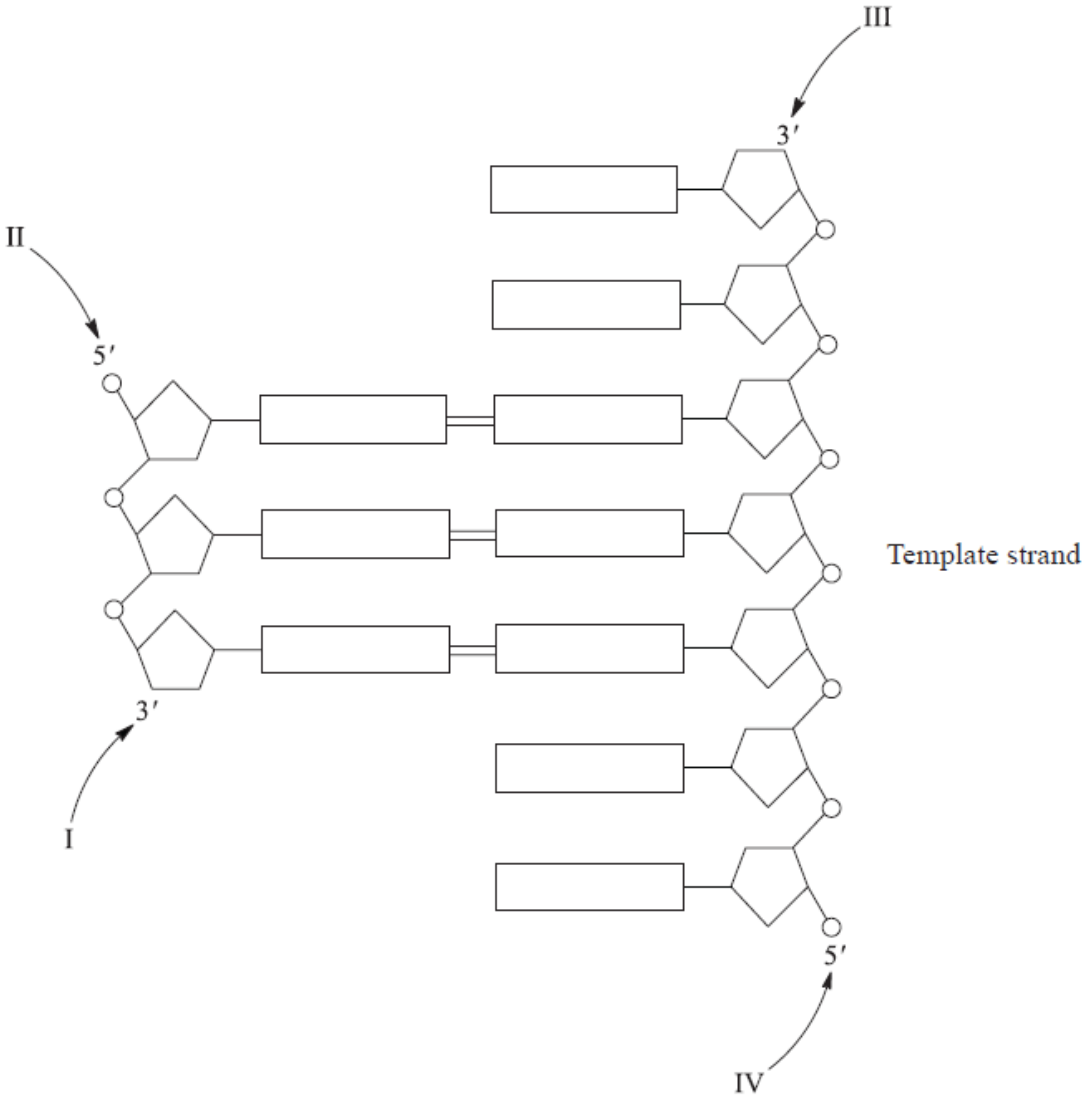
Markscheme

B

Examiners report

N/A

The diagram below shows part of a DNA molecule that is being replicated.



Where would DNA polymerase link the next nucleotide during replication?
A. I
B. II
C. III
D. IV

Markscheme

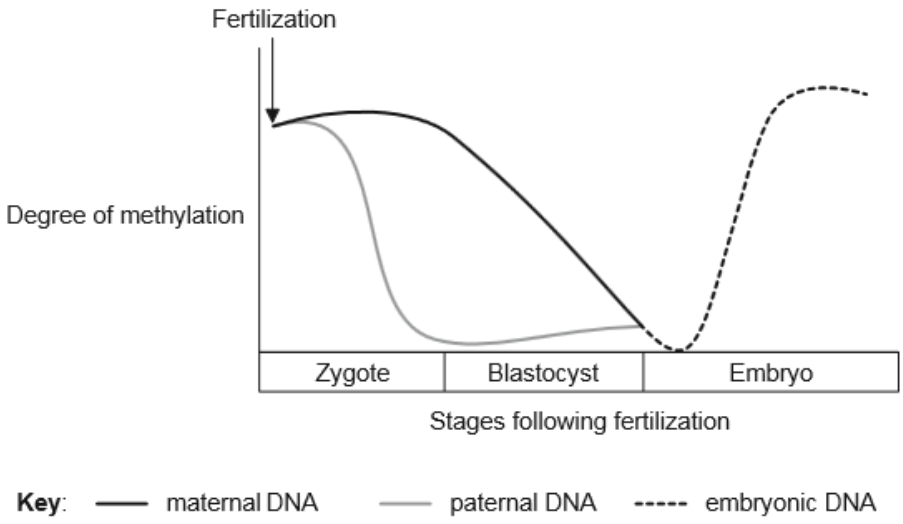
A

Examiners report

[N/A]

Very soon after fertilization, parental epigenetic methylation is reversed in the DNA.

Later, tissue-specific epigenetic modifications are made to the embryonic DNA. The graph follows the degree of methylation from different sources during embryonic development.



[Source: Sandra Rodriguez-Rodero, "Epigenetic regulation of ageing" *Discovery Medicine* 10 (52), 225–233, September 2010. Reprinted with permission.]

According to the graph, what are the changes in DNA methylation during embryonic development?

A. Only the paternal DNA becomes demethylated.
B. The maternal DNA becomes demethylated first.
C. The methylation patterns of the parents' DNA are erased before fertilization.
D. The methylation patterns of both parents are erased after fertilization.

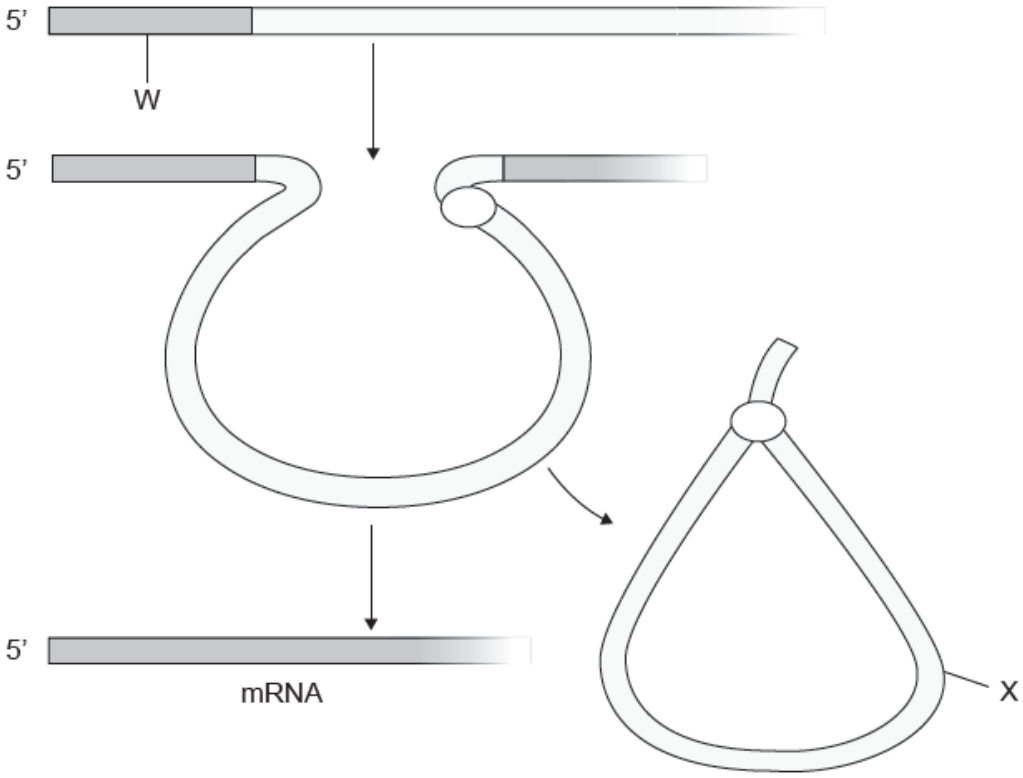
Markscheme

D

Examiners report

There were many comments on the G2 forms about this question. The teachers were concerned that candidates would confuse embryonic development with embryo, but this did not seem to happen. The question was too wordy and rather confusing, but the answer was obtained out of common sense. Most candidates went for the correct answer D. This was the only possible answer, as when located in a gene promoter, DNA methylation acts to repress gene transcription. DNA methylation is typically removed during zygote formation and re-established through successive cell divisions during development.

The diagram shows how pre-mRNA is processed into mature mRNA. Which structures are indicated by the letters W and X?



	W	X
A.	Exon	Poly-A tail
B.	Poly-A tail	Exon
C.	Intron	Exon
D.	Exon	Intron

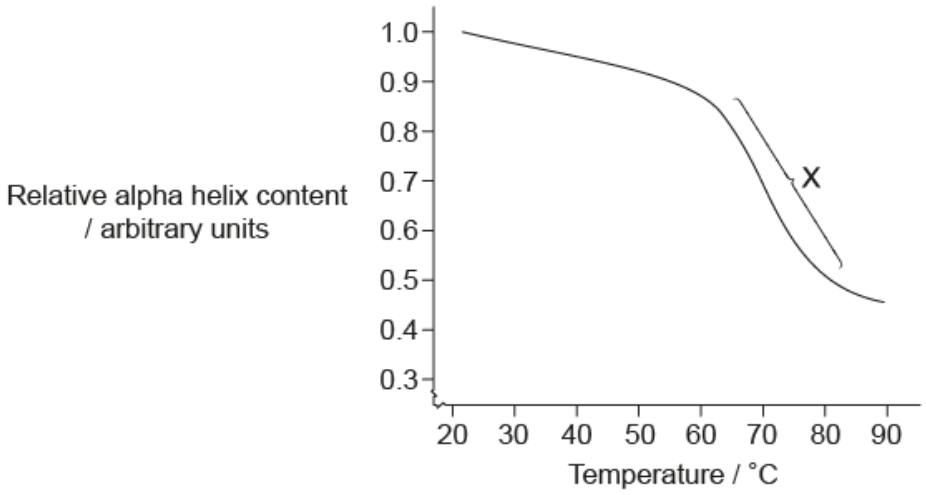
Markscheme

D

Examiners report

[N/A]

Scientists have heated a solution containing the protein albumin and measured its relative alpha helix content, shown on the graph.



[Source: adapted from R Wetzel, *et al.*, (1980), *European Journal of Biochemistry*, **104** (2), Wiley, page 471]

What does the zone labelled X indicate?

A. Rapid increase in beta pleated sheets

B. Rapid formation of hydrogen bonds

C. Rapid increase in denatured protein molecules

D. Rapid decrease in peptide bonds

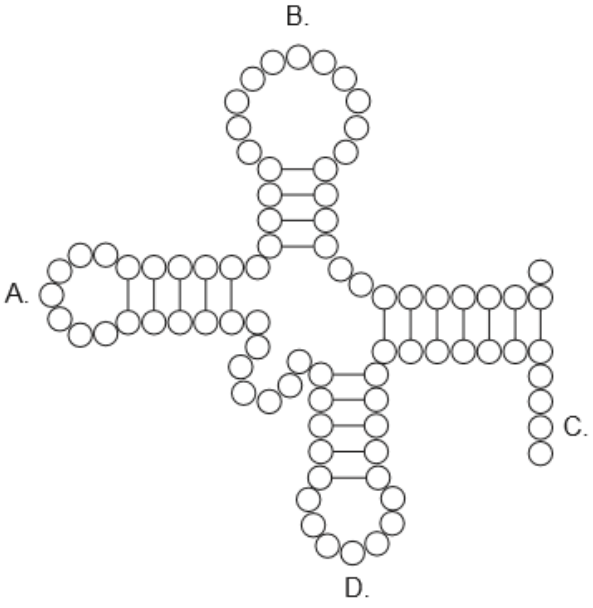
Markscheme

C

Examiners report

[N/A]

Where does a tRNA-activating enzyme attach the appropriate amino acid to the tRNA molecule?



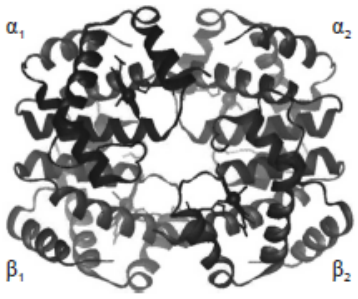
Markscheme

C

Examiners report

[N/A]

The image shows the structure of hemoglobin.



[Source: adapted from http://upload.wikimedia.org]

What determines the primary structure of hemoglobin?

A. Genetic information

B. Hydrogen bonding

C. Four polypeptide chains

D. Side chain interactions

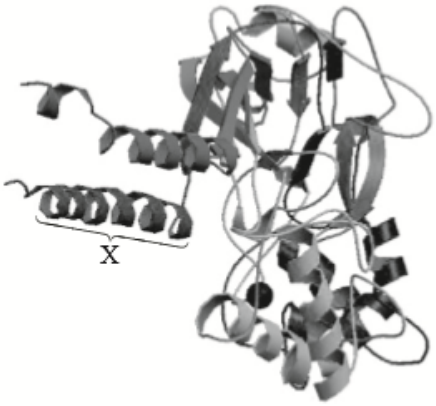
Markscheme

A

Examiners report

The image was not needed to answer the question, but seemed to have misled some candidates to answer four polypeptide chains instead of genetic information determining the primary structure.

The diagram is a three-dimensional molecular model of a protein.



[Source: Reprinted by permission from Macmillan Publishers Ltd: Nature, Toshimitsu Kawate, Jennifer Carlisle Michel, William T. Birdsong & Eric Gouaux, 'Crystal structure of the ATP-gated P2X4 ion channel in the closed state', 460, pp 592–598, © 2009. www.nature.com.]

Which bonds stabilize the shape of the area labelled X?

A. Covalent bonds between adjacent amino acids
B. Hydrogen bonds between N–H and C=O groups of amino acids
C. Hydrophobic interactions between R groups of amino acids
D. Disulphide bridges between cysteine molecules

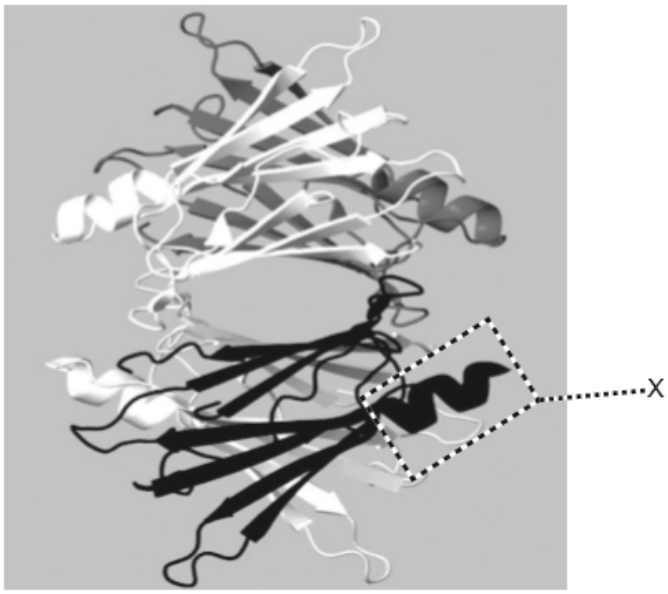
Markscheme

B

Examiners report

N/A

The image represents a model of the protein transthyretin.



[Source: adapted from http://en.wikipedia.org]

Which level of structure is indicated by X on the image?

A. Primary
B. Secondary
C. Tertiary
D. Quaternary

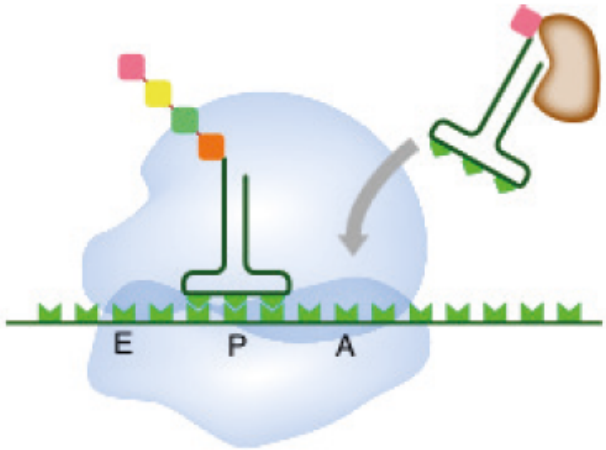
Markscheme

B

Examiners report

This question proved to be a very good discriminator. Some teachers complained that the structure was showing a bit of a loop, therefore they believed the answer should have been tertiary structure instead of secondary structure. In the diagram it is clear that the entire model is of a tertiary structure of a protein and that the box is only showing a bit of an alpha helix, therefore the secondary structure is being shown.

The following diagram shows a ribosome during translation.



[Source: http://upload.wikimedia.org/wikipedia/commons/d/d1/ProteinTranslation.svg]

What describes the specific stage of translation?
A. Initiation
B. Elongation
C. Termination
D. Translocation

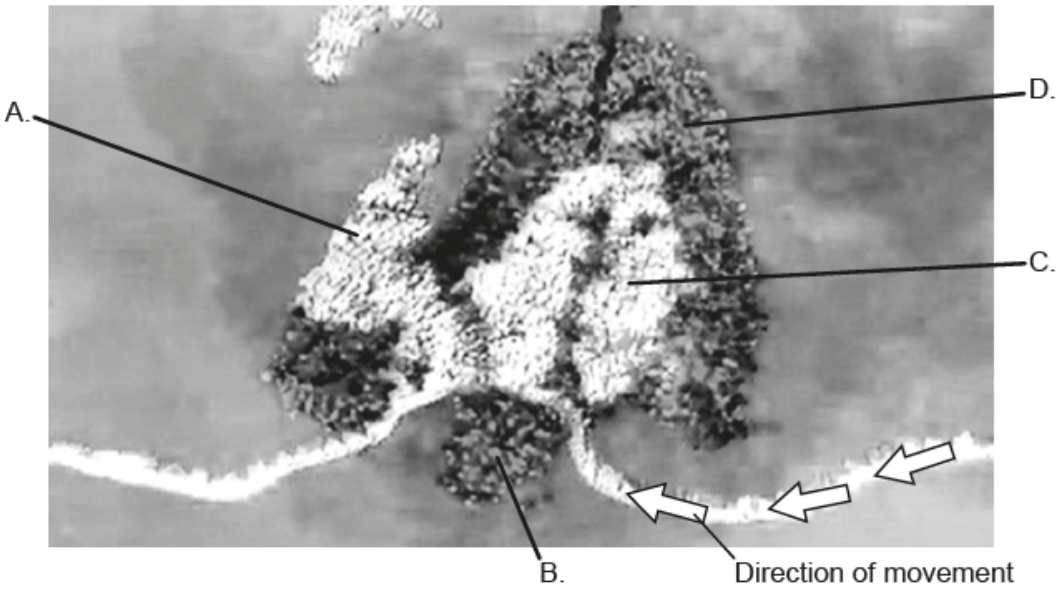
Markscheme

B

Examiners report

There was a comment that the diagram was not clear. However this did not seem to have affected the students who generally gave the correct answer of B.

This image is taken from a visualization of a eukaryotic ribosome. The arrows show the direction of movement of mRNA. Which letter represents a tRNA exiting from the E site?



[Source: Adapted from Cold Spring Harbor Laboratory DNA Learning Center (www.dnalc.org)]

Markscheme

A

Examiners report

[N/A]
