

7.2 Transcription & Gene Expression

Question Paper

Course	DP IB Biology
Section	7. Nucleic Acids (HL Only)
Topic	7.2 Transcription & Gene Expression
Difficulty	Medium

Time allowed: 20
Score: /10
Percentage: /100

Question 1

Which of the following statements describes the promoter?

- I. The first part of a gene to be transcribed.
- II. Acts as a binding site for RNA polymerase.
- III. A non-coding sequence located near the gene.
- IV. Only found in eukaryotes.

- A. I and II
- B. I and III
- C. II and III
- D. All the above

[1 mark]

Question 2

In humans, during periods of hypoxia (low oxygen in tissues) the transcription factor HIF (Hypoxia-Inducible Factor) binds to the Hypoxia Response Element (HRE) sequence and increases transcription of the EPO gene. This stimulates the production of red blood cells. The diagram shows the EPO gene and regulatory elements.



Which kind of regulatory elements are HIF and HRE?

	HIF	HRE
A	Activator protein	Enhancer sequence
B	Repressor protein	Silencer sequence
C	Enhancer sequence	Activator protein
D	General transcription factor	Enhancer sequence

[1 mark]

Question 3

Which of the following occur in the bacterium *Escherichia coli* if **no** lactose is present?

- A. LAC repressor protein is deactivated.
- B. Lactose binds to the LAC repressor protein preventing it from binding near the promoter.
- C. Gene that codes for the LAC repressor protein is silenced.
- D. LAC repressor protein binds near the promoter blocking RNA polymerase from transcribing genes involved in lactose metabolism.

[1 mark]

Question 4

Identical twins have the same DNA (genotype) but often display many observable physical differences (phenotype). Studies on twins have shown that one twin can be more susceptible to diseases like cancer or diabetes.

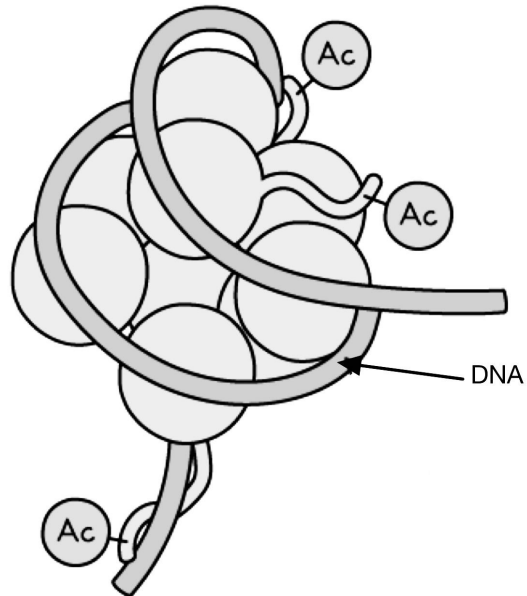
Which of the following statements best explains these differences between identical twins?

- A. One twin is more prone to random mutations of DNA.
- B. Epigenetic changes can affect the structure of proteins.
- C. One twin inherited epigenetic modifications from a parent.
- D. An organism's environment can influence gene expression patterns.

[1 mark]

Question 5

The diagram below shows a nucleosome where the histone tails have had an acetyl group added.



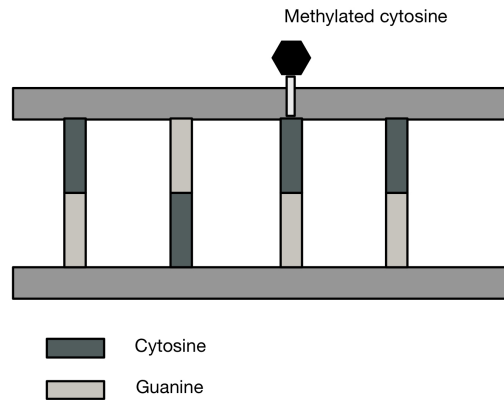
Which statement best describes the effect of acetylation of histone tails?

- A. Adding an acetyl group causes the DNA to be less tightly wrapped
- B. Adding an acetyl group deactivates the gene
- C. Adding an acetyl group causes the DNA to be more tightly wrapped
- D. Adding an acetyl group helps maintain a positive charge

[1 mark]

Question 6

The simplified diagram below shows a section of DNA where a methyl ($-CH_3$) group has been added to a cytosine base.



Which of the following best describes the outcome of direct methylation of DNA?

- A. It stimulates the expression of the gene.
- B. It prevents guanine from forming hydrogen bonds.
- C. It inhibits the binding of transcription factors.
- D. It causes breaks in the phosphate deoxyribose backbone.

[1 mark]

Question 7

Which of the following statements about transcription are correct?

- I. RNA polymerase synthesises mRNA in a 5' to 3' direction.
- II. RNA polymerase binds near the promoter.
- III. RNA polymerase uses the sense strand of DNA as a template.
- IV. RNA polymerase synthesises mRNA in a 3' to 5' direction.

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

[1 mark]

Question 8

It is estimated that the human genome contains between 20 000 and 25 000 genes. However, the proteome is estimated to contain up to 400 000 proteins. This large difference in numbers is due to alternative splicing.

Which of the following best describes alternative splicing in eukaryotes?

- A. Different combinations of introns can be incorporated into the mature mRNA.
- B. Some exons are duplicated.
- C. Different combinations of exons can be incorporated into the mature mRNA.
- D. Different genes can be fused together.

[1 mark]

Question 9

Which of the following accurately describes the sequence of steps that happen following production of a pre-mRNA in eukaryotes?

A	Addition of a 5' methylated cap	Removal of a 3' poly-A tail	Removal of non-coding sequences	Transport to the cytoplasm
B	Binding of RNA polymerase	Addition of a 5' methylated cap	Removal of non-coding sequences	Transport to the cytoplasm
C	Addition of a 5' methylated cap	Addition of a 3' poly-A tail	Transport to the cytoplasm	Binding to ribosome
D	Addition of a 5' methylated cap	Addition of a 3' poly-A tail	Removal of non-coding sequences	Transport to the cytoplasm

[1 mark]

Question 10

Which of the following statements about DNA methylation are correct?

- I. DNA methylation varies throughout a lifetime.
- II. DNA methylation can be affected by environmental factors.
- III. Analysis of DNA methylation patterns can be used in the early detection of disease.
- IV. DNA methylation can cause changes in the DNA sequence.

- A. I only
- B. I and II
- C. I, II and III
- D. All the above

[1 mark]