

# 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:** 60  
**Score:** /47  
**Percentage:** /100

### Question 1a

a)  
The compact structure of a nucleosome makes it impossible for transcription of DNA to occur.

Describe the mechanism that needs to occur in order to initiate transcription.

[3 marks]

### Question 1b

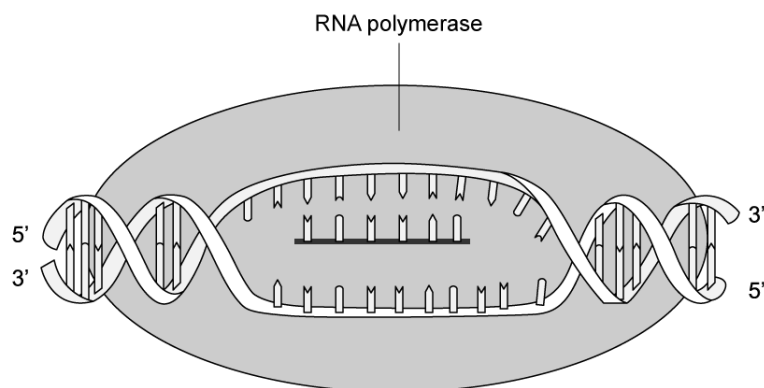
b)  
During transcription, the DNA strand unwinds into two strands. One is named the sense strand and the other one the antisense strand.

Distinguish between the sense and antisense strands of DNA during transcription.

[1 mark]

### Question 1c

c)  
The diagram below shows the process of transcription.



- Label the sense and antisense strands.
- Draw an arrow on the diagram to show where the promoter region is located.

**[2 marks]****Question 1d**

d)

Transcription occurs in three stages: initiation, elongation and termination.

Describe what events occur during the elongation stage of transcription.

**[1 mark]****Question 2a**

a)

Nucleosomes help regulate transcription in eukaryotic cells.

State three chemical modifications of a nucleosome that could alter gene expression.

**[3 marks]****Question 2b**

b)

Regulation of gene expression occurs in both eukaryotes and prokaryotes.

Describe two differences of this process in eukaryotes and prokaryotes.

**[2 marks]**

**Question 2c**

c)

The following sections of a gene are important in regulating gene expression and transcription: promoter, coding sequence, terminator.

State the role of each of these components.

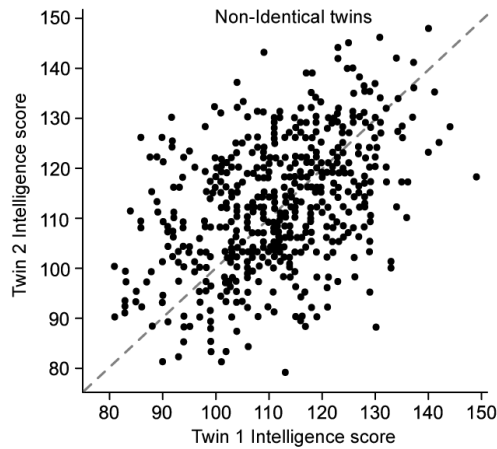
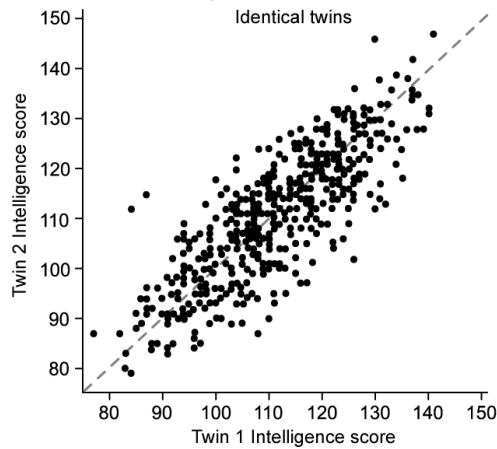
**[3 marks]**

### Question 3a

a)

Environmental factors, internal and external, can influence gene expression by affecting levels of regulatory proteins or transcription factors. Environmental factors explain the differences observed between identical twins, even though they have the same DNA.

Scientists have investigated a range of phenotypic traits, such as intelligence, in twins. Data has been compared between identical and non-identical twins to help determine whether these characteristics are genetic or more greatly influenced by the environment. The graphs below shows data comparing identical and non-identical twins and their IQ.



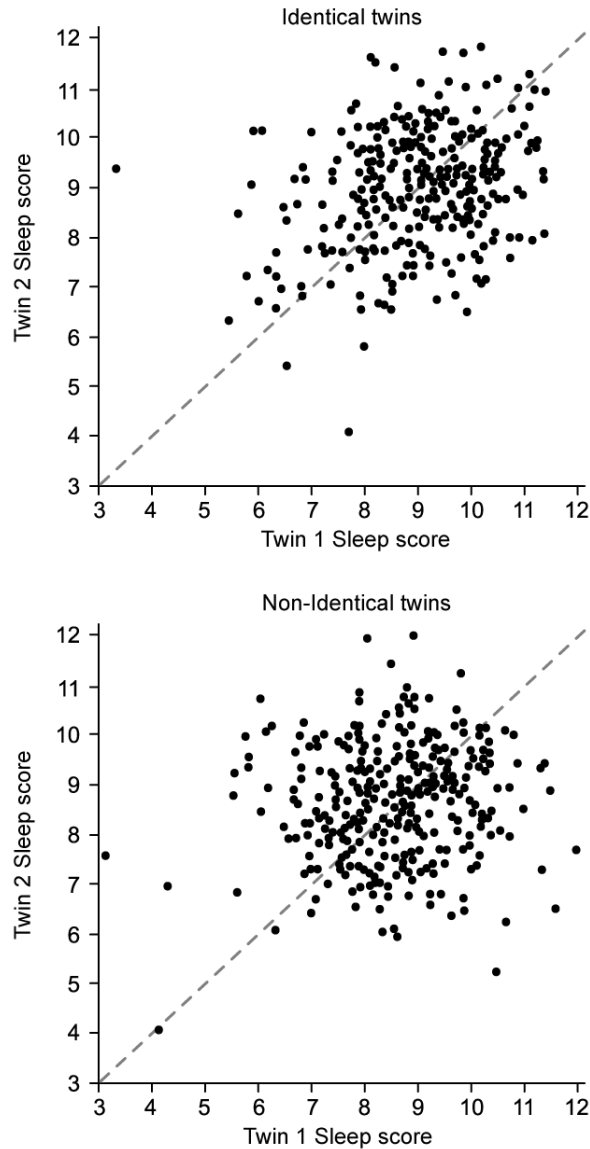
Suggest conclusions that could be drawn from the data shown in the graphs.

[3 marks]

**Question 3b**

b)

The scientists also investigated how many hours per night identical and non-identical twins typically sleep. The results are shown in the graph below. The scientists concluded that sleep was not a heritable factor and environmental factors caused differences in sleep time.



Evaluate the scientists' conclusion.

[2 marks]

### Question 3c

c)  
The environment has been shown to contribute to heritable changes in gene function. One such factor is epigenetics.  
Outline what is meant by the epigenome.

[3 marks]

### Question 3d

d)  
DNA methylation involves the direct addition of a methyl group ( $-\text{CH}_3$ ) to cytosine bases which can influence gene expression.

Explain the impact of methylation of DNA bases on gene expression.

[2 marks]

### Question 4a

a)  
Gene expression can be regulated after an mRNA transcript has been produced, this is called post-transcriptional modification of mRNA.

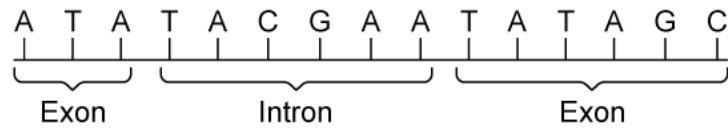
Outline the mechanisms involved in post-transcriptional modification.

[3 marks]

### Question 4b

b)

The diagram below shows the base sequence on part of a template DNA strand.



Deduce, with a reason, the sequence of bases on the mRNA transcribed from this strand.

[2 marks]

### Question 4c

c)

Mature mRNA is transcribed from a gene and then translated into a protein. One single gene can give rise to different polypeptide chains.

Explain how a single gene can give rise to different amino acid sequences.

[1 mark]

### Question 4d

d)

A piece of mRNA is 972 nucleotides long but the DNA coding strand from which it was transcribed is 1215 nucleotides long.

Explain why there is a difference in the number of nucleotides.

[1 mark]

### Question 5a

*One mark is available for clarity of communication throughout this question.*

a)

Messenger RNA (mRNA) is used during translation to form polypeptides.

Describe how mRNA is produced in the nucleus of a cell.



[7 marks]

### Question 5b

b)

Explain the events of mRNA splicing.

[4 marks]

**Question 5c**

c)

Outline the role of protein-protein interactions in the regulation of transcription.

**[4 marks]**