A+ ACADEMY

Biomedical Science

Molecular Genetics

Quiz 2

DNA Transcription

سلسلة الامتحان بالجيب

WEBSITE

aplusacademyedu.com

Visit →

WHATSAPP

Join the Community

Join →

PART ONE

I Multiple Choice

Choose the one best answer for each question

QUESTIONS 1 – 50

01 Which of the following is NOT listed as a main component of transcription?

A The gene that is to be transcribed
B The mRNA resulting from transcription
C The enzymes that carry out transcription
D The ribosome that reads the codons

02 The core RNA polymerase of E. coli is made of which subunits?

A One α, two β, one β′ and one σ
B Two α, one β, one β′ and one σ
C Two α, one β, one β′ and one ω
D Two α, two β, one ω and one σ

03 The sigma subunit joins the core enzyme:

A Only during the elongation of the RNA
B Only at the initiation of transcription
C Only at the termination of transcription
D Throughout every stage of transcription

04 An example of a promoter consensus sequence in eukaryotes is the:

A TATA box
B Pribnow box
C -35 region
D Lac operon

05 What is the correct order of the steps of transcription?

A Elongation → initiation → termination
B Initiation → termination → elongation
C Termination → initiation → elongation
D Initiation → elongation → termination

06 What is the effect of a palindromic DNA sequence on transcription?

A The RNA becomes stably double-stranded with DNA
B Sigma rebinds the core and restarts initiation
C The new RNA forms a hairpin, ending elongation
D The promoter becomes stronger and fires faster

07 **Rho-dependent termination differs from rho-independent termination because it:**

- A Needs no protein to end transcription
- B Needs a protein to end transcription
- C Occurs only in eukaryotic cells
- D Occurs at the promoter, not the gene end

08 **Transcription is best defined as the process in which:**

- A Information in RNA is copied into DNA
- B Information in DNA is copied into RNA
- C RNA is translated into a polypeptide
- D DNA is copied into a new DNA strand

09 **The patterns of similarity found between promoter sequences are called:**

- A Palindromic sequences
- B Termination sequences
- C Consensus sequences
- D Enhancer sequences

10 **Which subunit acts as the scaffold for assembly of the other subunits?**

- A Beta (β)
- B Alpha (α)
- C Omega (ω)
- D Sigma (σ)

11 **Counting every polypeptide chain, how many subunits make up the E. coli RNA polymerase holoenzyme?**

- A 4
- B 6
- C 5
- D 7

12 **The enzymes needed to metabolise lactose in E. coli lie side by side under one promoter. This unit is called:**

- A The lac operon
- B The TATA box
- C The Pribnow box
- D The rho terminator

13 **Which feature adds an extra level of transcriptional control in eukaryotes that is absent in prokaryotes?**

- A A single RNA polymerase
- B Operons under one promoter
- C DNA packaged into chromatin
- D A sigma factor at the promoter

14 **Which eukaryotic RNA polymerase produces mRNA from protein-coding genes?**

- A RNA polymerase I
- B RNA polymerase III
- C Core polymerase
- D RNA polymerase II

15 **Elongation is best described as:**

A Separating the RNA from the DNA template
B Adding nucleotides to the growing RNA
C Recognising the -10 and -35 regions
D Adding a cap to the 5′ end of mRNA

16 **Which pair of subunits together forms the active site of E. coli RNA polymerase?**

A α and ω
B α and σ
C β′ and ω
D β and β′

17 **Which statement about mRNA is correct?**

A It is the most abundant and most stable RNA
B It is a small, unstable fraction of total RNA
C It is more stable in prokaryotes than eukaryotes
D It is synthesised in the cytoplasm of eukaryotes

18 **The elongation complex pauses at certain sites before termination because these regions are:**

A A/T-rich, with bonds that are easy to break
B G/C-rich, with bonds that are hard to break
C Bound very tightly by the sigma subunit
D Lacking any bases on the template strand

19 **During initiation, the strand positioned at the polymerisation site of RNA polymerase is the:**

A Coding strand
B Lagging strand
C Leading strand
D Template strand

20 **Enhancers and silencers can affect a gene even when they are far from its promoter because:**

A They are transcribed into regulatory RNAs
B They migrate along the DNA towards the promoter
C They bind sigma and carry it over to the gene
D DNA looping brings them close to the promoter

21 **In negative regulation, the ligand that removes the repressor and allows transcription is called:**

A An inducer
B A co-repressor
C An activator
D A silencer

22 **The E. coli RNA polymerase becomes a holoenzyme when:**

- A The sigma subunit binds to the core enzyme
- B The omega subunit leaves the core enzyme
- C Two alpha subunits bind to the promoter
- D The beta subunit binds the template strand

23 **A template region contains 12 G–C pairs and 4 A–T pairs. How many hydrogen bonds must be broken to open it, and would it favour pausing?**

- A 32 — no, an A/T-rich region
- B 44 — yes, a G/C-rich pause site
- C 44 — no, an A/T-rich region
- D 40 — yes, a G/C-rich pause site

24 **Which statement about promoters is correct?**

- A Several prokaryotic genes can share one
- B Several eukaryotic genes always share one
- C Each prokaryotic gene must have its own
- D Promoters are found only in eukaryotes

25 **A gene is called a housekeeping gene when it:**

- A Is expressed only at a single developmental stage
- B Is switched on only by one specific inducer
- C Encodes products essential to all living cells
- D Is found only in the genomes of prokaryotes

26 **A cell is making large amounts of tRNA. Which enzyme carries out this transcription?**

- A RNA polymerase II
- B RNA polymerase I
- C DNA polymerase III
- D RNA polymerase III

27 **The movement of the transcription complex away from the promoter along the DNA is called:**

- A Promoter clearance
- B Rho-dependent termination
- C Hairpin formation
- D Bubble formation

28 **Transcriptional regulation is described as positive when:**

- A A repressor must bind to switch the gene on
- B An activator is needed to switch the gene on
- C A co-repressor helps to block transcription
- D A silencer lowers the rate of the transcription

29 Eukaryotic transcription initiation differs from that in prokaryotes because it requires:

- A A single sigma factor to find the promoter
- B The rho protein to recognise the promoter
- C Multiple general transcription factors
- D An operon shared by several genes

30 NusA is a protein that:

- A Recognises the Pribnow box in the promoter
- B Terminates transcription at rho-dependent sites
- C Removes the repressor from the operator
- D Helps the change from initiation to elongation

31 Which of the following is a cis-acting regulator?

- A A repressor
- B An enhancer
- C An activator
- D A co-repressor

32 The first bond formed during initiation is a phosphodiester linkage between two:

- A Deoxyribonucleoside triphosphates
- B Ribonucleoside monophosphates
- C Ribonucleoside triphosphates
- D Amino acids on charged tRNAs

33 If transcription starts at position +1, the E. coli consensus regions lie, respectively, about how many bases upstream?

- A 10 and 25 bases
- B 35 and 70 bases
- C 5 and 10 bases
- D 10 and 35 bases

34 A co-repressor is a ligand that:

- A Removes the repressor so that transcription can begin
- B Helps the repressor bind DNA and block transcription
- C Binds the activator and switches the gene on
- D Brings a distant enhancer close to the promoter

35 In E. coli, the '-10 region' (Pribnow box) has the sequence:

- A 5′-TATAAT-3′
- B 5′-GAATTC-3′
- C 5′-AATTAA-3′
- D 5′-GCGCGC-3′

36 In prokaryotes, transcription and translation both take place in the:

- A Nucleus
- B Cytoplasm
- C Nucleolus
- D Mitochondria

37 The enzyme that catalyses DNA-directed RNA synthesis is:

- A RNA polymerase
- B DNA polymerase
- C Telomerase
- D RNA primase

38 Why does eukaryotic mRNA undergo post-transcriptional modifications?

- A To allow it to be translated inside the nucleus
- B To let it bind directly to the sigma factor
- C To convert it into a double-stranded DNA copy
- D To protect it on its way out to the cytoplasm

39 Promoters are:

- A DNA regions where transcription initiates
- B RNA regions where translation initiates
- C Proteins that bring transcription to an end
- D Sequences that fold into RNA hairpins

40 An operon is:

- A A single gene controlled by several promoters
- B A eukaryotic enhancer lying far from a gene
- C Several genes transcribed from one promoter
- D A sequence that terminates transcription

41 Which DNA sequence (top strand, 5′→3′) is palindromic?

- A GAATTG
- B GATTAC
- C GCATTC
- D GAATTC

42 Which eukaryotic RNA polymerase transcribes genes encoding ribosomal RNA?

- A RNA polymerase II
- B RNA polymerase III
- C RNA polymerase I
- D Sigma holoenzyme

43 Which description of initiation is correct?

- A A fast step that needs no strand separation
- B A step in which an RNA hairpin is formed
- C A slow step forming a transcription bubble
- D A step in which rho releases the new RNA

44 In the lecture, a gene is defined as:

- A A sequence of DNA that can be transcribed
- B A sequence of RNA that can be translated
- C A protein that binds tightly to the promoter
- D A sugar–phosphate unit of the DNA backbone

45 In E. coli, the -10 and -35 promoter sequences are recognised by the:

- A Omega (ω) subunit
- B Rho protein
- C Sigma (σ) subunit
- D NusA protein

46 The DNA strand binds to which RNA polymerase subunit?

- A Alpha (α)
- B Omega (ω)
- C Beta prime (β′)
- D Sigma factor (σ)

47 Which of the following is a palindromic number, as described in the lecture?

- A 13677631
- B 13677613
- C 13676731
- D 31677631

48 A gene whose -10 and -35 regions closely match the consensus sequences is likely to:

- A Have a weak promoter and very rare transcription
- B Need the rho protein to start transcription
- C Lack any binding site for the RNA polymerase
- D Have a strong promoter and high transcription

49 RNA polymerase switches from initiation to elongation mode when the RNA is about how long?

- A Ten nucleotides
- B Two nucleotides
- C Thirty-five nucleotides
- D One hundred nucleotides

50 The function of which RNA polymerase subunit is described as 'not well understood'?

- A Omega (ω)
- B Alpha (α)
- C Beta (β)
- D Sigma (σ)

Join the A+ community
Get updates, new quizzes and study support — scan to join our WhatsApp community
SCAN · WHATSAPP

PART TWO

II True or False

Tick one box for each statement

STATEMENTS 1 – 15

NO.	STATEMENT	T	F
01	In bacteria, transcription complexes disassemble at termination sequences at the end of genes.	☐	☐
02	Pausing usually happens in regions that are palindromic.	☐	☐
03	Operons are found in both prokaryotes and eukaryotes.	☐	☐
04	Prokaryotic mRNA transcripts undergo post-transcriptional modifications.	☐	☐
05	Trans-acting regulators are DNA sequences located on the same DNA as the gene.	☐	☐
06	Eukaryotic RNA polymerases are simpler than prokaryotic RNA polymerase.	☐	☐
07	Weak promoters are found in genes that are transcribed less frequently.	☐	☐
08	Unwinding of the DNA double helix occurs during initiation.	☐	☐
09	Housekeeping genes are constitutively expressed.	☐	☐
10	Some scientists define the gene as the unit of heredity.	☐	☐
11	Prokaryotes have three main RNA polymerases.	☐	☐
12	RNA polymerase works as part of a transcription complex.	☐	☐
13	A prokaryote is a cell with a true, membrane-bound nucleus.	☐	☐
14	mRNA in eukaryotes is more stable than mRNA in prokaryotes.	☐	☐
15	Enhancers can be located only upstream of the initiation site.	☐	☐

Want the full designed notes?
This chapter is available as premium A⁺ Notes — visit aplusacademyedu.com

SCAN · WEBSITE

III

PART THREE

Matching

Match each term (Column A) with its description (Column B). Two options in Column B are not used.

ITEMS 1 – 8

COLUMN A		COLUMN B	
1	Holoenzyme	A	Genes sharing one promoter, transcribed together
2	Pribnow box	B	Polymerase that transcribes rRNA genes
3	Operon	C	Ligand that removes the repressor
4	Promoter clearance	D	Protein needed for one type of termination
5	Rho	E	Core RNA polymerase joined by sigma
6	Repressor	F	Cis-acting sequence that reduces transcription
7	Inducer	G	Protein that prevents transcription
8	Silencer	H	The -10 region of the E. coli promoter
		I	Enzyme that copies RNA back into DNA
		J	Complex moving away from the promoter

A+ is more than just a platform

Exam banks, mock exams and quizzes for every chapter — designed for an A+

SCAN · WHATSAPP

IV

PART FOUR

Short Answer

Answer each question in the space provided

QUESTIONS 1 – 5

S1 E. coli RNA polymerase — 5 MARKS

(a) Name the subunits of the core enzyme, with their number of copies.

(b) State the function of each subunit and explain what a holoenzyme is.

S2 Promoters — 5 MARKS

(a) Define a promoter and an operon, giving the lecture's example.

(b) Describe the E. coli consensus sequences and explain strong versus weak promoters.

S3 Initiation and elongation — 5 MARKS

(a) Describe the events of initiation.

(b) Describe elongation, including promoter clearance and NusA.

S4 Termination — 6 MARKS

(a) Compare rho-dependent and rho-independent termination.

(b) Explain why pause sites and palindromic sequences lead to termination, and show that GAATTC is palindromic.

S5 Prokaryotes versus eukaryotes and regulation — 6 MARKS

(a) List the five differences between prokaryotic and eukaryotic transcription.

(b) Distinguish trans-acting from cis-acting regulators with two examples of each.

SOLUTIONS

Answer Key

Check your work, then review the model answers

TOTAL MARKS
100

PART I · MULTIPLE CHOICE

01	02	03	04	05	06	07	08	09	10
D	C	B	A	D	C	B	B	C	B
11	12	13	14	15	16	17	18	19	20
B	A	C	D	B	D	B	B	D	D
21	22	23	24	25	26	27	28	29	30
A	A	B	A	C	D	A	B	C	D
31	32	33	34	35	36	37	38	39	40
B	C	D	B	A	B	A	D	A	C
41	42	43	44	45	46	47	48	49	50
D	C	C	A	C	C	A	D	A	A

PART II · TRUE OR FALSE

01	02	03	04	05	06	07	08	09	10
TRUE	TRUE	FALSE	FALSE	FALSE	FALSE	TRUE	TRUE	TRUE	TRUE
11	12	13	14	15					
FALSE	TRUE	FALSE	TRUE	FALSE					

PART III · MATCHING

1 → E	2 → H	3 → A	4 → J	5 → D	6 → G	7 → C	8 → F

PART IV · MODEL ANSWERS

S1 E. coli RNA polymerase

(a) Two α, one β, one β′ and one ω (four types, five chains). (b) α — scaffold for assembly of the other subunits; β — forms the active site; β′ — forms the active site with β and is where the DNA strand binds; ω — not well understood; σ — not part of the core; it joins the core only at initiation to form the holoenzyme.

S2 Promoters

(a) Promoters are DNA regions where transcription initiates; in eukaryotes each gene has its own, in prokaryotes several genes can share one. Genes sharing one promoter and transcribed together form an operon (prokaryotes only), e.g. the lac operon for lactose metabolism in E. coli. (b) The -10 region (Pribnow box, 5′-TATAAT-3′) and the -35 region, recognised by σ; the TATA box is a eukaryotic example. Strong promoters closely match the consensus and are transcribed at high rate; weak promoters match less and are transcribed less often.

S3 Initiation and elongation

(a) A slow process: the holoenzyme searches for and binds the promoter; the DNA unwinds and a transcription bubble forms; the template strand sits at the polymerisation site; a phosphodiester bond forms between two ribonucleoside triphosphates base-paired with the template. (b) Nucleotides are added to the growing RNA in an RNA–DNA helix; at about ten nucleotides the enzyme switches from initiation to elongation mode and moves away from the promoter (promoter clearance); proteins such as NusA help this transition.

S4 Termination

(a) Rho-dependent sequences need the protein rho to end transcription; rho-independent sequences destabilise the elongation complex and stop it without a protein. (b) Pause sites are G/C-rich (three H-bonds per pair), so the complex slows or stops. At palindromic sites the new RNA forms a hairpin that destabilises the RNA–DNA hybrid, partly disrupting the bubble so elongation ceases. Top strand 5′-GAATTC-3′; complement 3′-CTTAAG-5′, read 5′→3′ = GAATTC — identical, so palindromic.

S5 Prokaryotes versus eukaryotes and regulation

(a) Chromatin structure (eukaryotic DNA packaged, less accessible); RNA polymerases (eukaryotes have I, II, III; prokaryotes one); transcription factors (eukaryotes need multiple general factors; prokaryotes use σ); gene organisation (eukaryotic genes have their own promoters; prokaryotic genes form operons); post-transcriptional modifications (eukaryotes only). (b) Trans-acting regulators act from outside the DNA: transcription factors, activators, repressors, co-repressors. Cis-acting regulators are DNA sequences on the same DNA: enhancers (increase RNA polymerase II activity) and silencers (reduce transcription); DNA looping brings them near the promoter.

A+ ACADEMY

Thank you for studying with us

WEBSITE

aplusacademyedu.com

WHATSAPP

Join the Community

A+ is more than just a platform ♥