Biochemistry 2000 Sample Question Transcription, Translation and Lipids

(1) Give brief definitions or unique descriptions of the following terms:

(a) exon (b) holoenzyme
(c) anticodon (d) trans fatty acid
(e) poly A tail (f) open complex
(g) Fluid Mosaic Model (h) embedded protein

(2) What are the four distinct steps in bacterial transcription?

(3) How does bacterial RNA Polymerase locate the promoter?

(4) Bacterial transcription is error prone. Explain why this is not always a problem.

(5) Fill in the blanks in the following statements.

(a) RNA is synthesized in the _____ direction and the template DNA strand is read in the _____ direction.

(b) Bacterial transcription rates are directly proportional to the _____ of RNA polymerase for the _____.

(c) The two most common mechanisms for transcription termination are _____ and _____.

(6) What is the "Wobble Hypothesis"?

(7) List at least four features of the genetic code.

(8) What are the reactions required to generate an aminoacyl tRNA?

(9) What identifies the site at which bacterial translation is initiated?

(10) Consider the following mRNA sequence:

5'-GAGAAUAACAAUGCAAACAUUU ...

(a) What is the sequence of the corresponding "coding" strand?

(b) What is the primary sequence of the translation product?

(11) Identify each of the tRNA binding sites on the ribosome and the type of tRNA present in the site.

(12) Describe each of the steps of the translation elongation cycle.

(13) Draw a stick diagram for each of the following:

(a) an 18:1(Δ^9) fatty acid (b) any simple triacylglycerol
(c) any glycerophospholipid (d) uridylyl-2',5'-guanylic acid

(14) Above the critical micelle concentration, what structures are formed by

(a) sphingolipids (b) fatty acids (c) diacylglycerols

(15) In biological membranes, how does the ratio of saturated/unsaturated fatty acid tails change as a function of temperature?

(16) How do nonmediated and mediated transport differ?

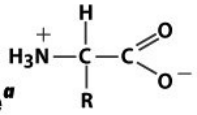

Table 26-1. Key to Function. The "Standard" Genetic Code[a]

First position (5′ end)	Second position U	Second position C	Second position A	Second position G	Third position (3′ end)
U	UUU Phe	UCU	UAU Tyr	UGU Cys	U
	UUC Phe	UCC	UAC Tyr	UGC Cys	C
	UUA Leu	UCA Ser	UAA STOP	UGA STOP	A
	UUG Leu	UCG Ser	UAG STOP	UGG Trp	G
C	CUU Leu	CCU Pro	CAU His	CGU Arg	U
	CUC Leu	CCC Pro	CAC His	CGC Arg	C
	CUA Leu	CCA Pro	CAA Gln	CGA Arg	A
	CUG Leu	CCG Pro	CAG Gln	CGG Arg	G
A	AUU Ile	ACU Thr	AAU Asn	AGU Ser	U
	AUC Ile	ACC Thr	AAC Asn	AGC Ser	C
	AUA Ile	ACA Thr	AAA Lys	AGA Arg	A
	AUG Met[b]	ACG Thr	AAG Lys	AGG Arg	G
G	GUU Val	GCU Ala	GAU Asp	GGU Gly	U
	GUC Val	GCC Ala	GAC Asp	GGC Gly	C
	GUA Val	GCA Ala	GAA Glu	GGA Gly	A
	GUG Val	GCG Ala	GAG Glu	GGG Gly	G

[a]Nonpolar amino acid residues are tan, basic residues are blue, acidic residues are red, and polar uncharged residues are purple

[b]AUG forms part of the initiation signal as well as coding for internal Met residues.

Table 26-1 Fundamentals of Biochemistry, 2/e

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Answers

1 –
a – The coding sequence that is retained in mature mRNA and directs eucaryotic protein synthesis.
b – The complete or active enzyme including all subunits.
c – The ribonucleotide triplet of tRNA that is complementary to the mRNA codon.
d – An unsaturated fatty acid with a trans conformation about the double bond.
e – A stretch of 10s to 100s of adenylic acid nucleotides added to the 3' terminii of eucaryotic mRNA.
f – The transcription initiation complex in which the DNA strands of the bacterial promoter (-10 - +4) are single stranded.
g – Biological membranes are dynamic structures in which the lipids and proteins are free to move in 2D.
h – An integral membrane protein that is only exposed on a specific side of the membrane.

2 – The steps in bacterial transcription are
(1) Template binding,
(2) Initiation,
(3) Elongation
(4) Termination.

3 – The RNA polymerase holoenzyme ($\alpha\beta\beta'\omega\sigma$) binds dsDNA and 'scans' along the dsDNA searching for a promoter. When a promoter is located, the holoenzyme binds tightly to the promoter. Once transcription has initiated the σ subunit is released.

4 – Transcription errors are not necessarily a problem as (1) multiple transcripts are produced from a single gene, (2) redundancy in the genetic code means the resulting codon may encode the same amino acid residue and (3) many mutations in protein sequence do affect function. In the case of eucaryotic genes, mutations in introns may not appear in the mature mRNA.

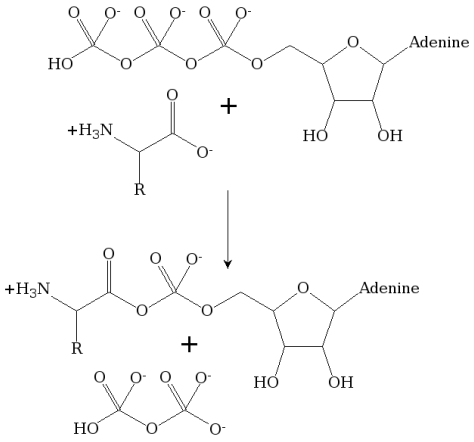
5 –
a – 5' to 3'
3' to 5'
b – affinity
promoter
c – ρ dependent
ρ independent

6 – There are many more codons than tRNA molecules. Some tRNAs can recognize more than one codon that differ in the third position of the codon by forming non Watson-Crick base pairs.

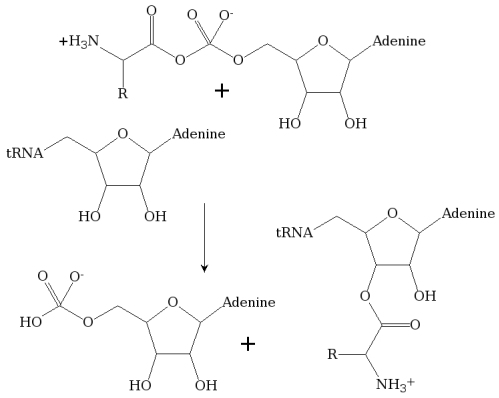
7 – Features of the genetic code include
(1) codons or base triplet specify an amino acid residue,
(2) base triplets are read in a particular frame,

(3) an amino acid can be specified by more than one codon (code is degenerate)
(4) related codons specify amino acids with similar physiochemical properties (code is non-random)
(5) virtually identical in all organisms (code is universal)

8 – Amino Acid + ATP → Aminoacyl adenylate + PP_i (Reaction 1)



Aminoacyl adenylate + tRNA → Aminoacyl tRNA + Adenosine-5'-monophosphate (Reaction 2)



9 – Translation initiation depends upon an AUG codon and the presence of a Shine-Dalgarno sequence a few nucleotides upstream that base pairs with 16S rRNA terminii.

10 –
a – The coding sequence is identical to the mRNA sequence
5'-GAGAATAACAATGCAAACATTT ...
b – Translation starts at the AUG codon and produces: Met^f – Gln – Thr – Phe ...

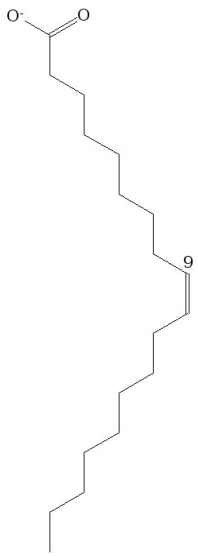
11 –

A site	contains aminoacyl tRNA
P site	contains peptidyl tRNA
E site	contains tRNA (deacylated tRNA)

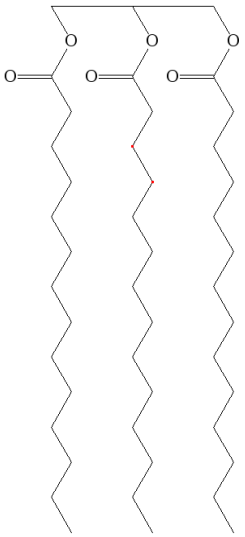
12 – The translation elongation cycle involves three steps:
(i) aminoacyl tRNA binding to the A site of the ribosome (catalyzed by EF-Tu)
(ii) peptide bond formation between P site tRNA and the A site tRNA
(iii) translocation of the A site tRNA to the P site and the P site tRNA to the E site (catalyzed by EF-G)
In order for the cycle to continue, EF-Tu is converted from the GDP to the GTP form by EF-Ts

13 –

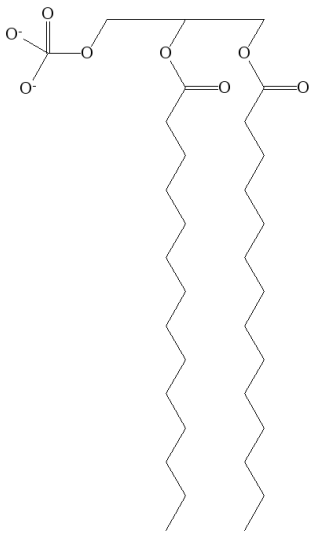
a –



b –



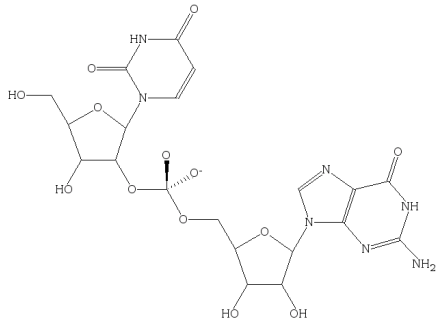
c-



Note: Each fatty acid must be the same (In this figure they are 14:0 fatty acids)

Phosphatidic acid (14:0 fatty acids) (the simplest glycerophospholipid)

d –



14 –

a – sphingolipids have two long alkyl chains and form bilayers
b – fatty acids contain a single long alkyl chain and form micelles
c – diacylglycerols have two long alkyl chains and form bilayers

15 – Unsaturated fatty acids decrease the temperature of the order-disorder transition. Consequently, the

ratio of unsaturated to saturated fatty acids increases as the temperature is lowered.

16 – Mediated transport requires a specific carrier protein and is
(1) much faster
(2) more specific
(3) can be saturated
(4) can be competitively inhibited
(5) can be chemical inactivated