

Chapter 17 From Gene to Protein

Multiple-Choice Questions

- 1) Garrod hypothesized that "inborn errors of metabolism" such as alkaptonuria occur because
- A) genes dictate the production of specific enzymes, and affected individuals have genetic defects that cause them to lack certain enzymes.
 - B) enzymes are made of DNA, and affected individuals lack DNA polymerase.
 - C) many metabolic enzymes use DNA as a cofactor, and affected individuals have mutations that prevent their enzymes from interacting efficiently with DNA.
 - D) certain metabolic reactions are carried out by ribozymes, and affected individuals lack key splicing factors.
 - E) metabolic enzymes require vitamin cofactors, and affected individuals have significant nutritional deficiencies.

Answer: A

Topic: Concept 17.1

Skill: Knowledge/Comprehension

The following questions refer to Figure 17.1, a simple metabolic pathway:

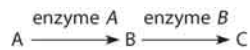


Figure 17.1

- 2) According to Beadle and Tatum's hypothesis, how many genes are necessary for this pathway?
- A) 0
 - B) 1
 - C) 2
 - D) 3
 - E) It cannot be determined from the pathway.

Answer: C

Topic: Concept 17.1

Skill: Application/Analysis

- 3) A mutation results in a defective enzyme A. Which of the following would be a consequence of that mutation?
- A) an accumulation of A and no production of B and C
 - B) an accumulation of A and B and no production of C
 - C) an accumulation of B and no production of A and C
 - D) an accumulation of B and C and no production of A
 - E) an accumulation of C and no production of A and B

Answer: A

Topic: Concept 17.1

Skill: Application/Analysis

- 4) If A, B, and C are all required for growth, a strain that is mutant for the gene encoding enzyme A would be able to grow on which of the following media?
- A) minimal medium
 - B) minimal medium supplemented with nutrient "A" only
 - C) minimal medium supplemented with nutrient "B" only
 - D) minimal medium supplemented with nutrient "C" only
 - E) minimal medium supplemented with nutrients "A" and "C"

Answer: C

Topic: Concept 17.1

Skill: Application/Analysis

- 5) If A, B, and C are all required for growth, a strain mutant for the gene encoding enzyme *B* would be capable of growing on which of the following media?
- A) minimal medium
 - B) minimal medium supplemented with "A" only
 - C) minimal medium supplemented with "B" only
 - D) minimal medium supplemented with "C" only
 - E) minimal medium supplemented with nutrients "A" and "B"

Answer: D

Topic: Concept 17.1

Skill: Application/Analysis

- 6) The nitrogenous base adenine is found in all members of which group?
- A) proteins, triglycerides, and testosterone
 - B) proteins, ATP, and DNA
 - C) ATP, RNA, and DNA
 - D) alpha glucose, ATP, and DNA
 - E) proteins, carbohydrates, and ATP

Answer: C

Topic: Concept 17.1

Skill: Knowledge/Comprehension

- 7) Using RNA as a template for protein synthesis instead of translating proteins directly from the DNA is advantageous for the cell because
- A) RNA is much more stable than DNA.
 - B) RNA acts as an expendable copy of the genetic material.
 - C) only one mRNA molecule can be transcribed from a single gene, lowering the potential rate of gene expression.
 - D) tRNA, rRNA and others are not transcribed.
 - E) mRNA molecules are subject to mutation but DNA is not.

Answer: B

Topic: Concept 17.1

Skill: Knowledge/Comprehension

- 8) If proteins were composed of only 12 different kinds of amino acids, what would be the smallest possible codon size in a genetic system with four different nucleotides?
- A) 1
 - B) 2
 - C) 3
 - D) 4
 - E) 12

Answer: B

Topic: Concept 17.1

Skill: Application/Analysis

- 9) The enzyme polynucleotide phosphorylase randomly assembles nucleotides into a polynucleotide polymer. You add polynucleotide phosphorylase to a solution of adenosine triphosphate and guanosine triphosphate. How many artificial mRNA 3 nucleotide codons would be possible?
- A) 3
 - B) 4
 - C) 8
 - D) 16
 - E) 64

Answer: C

Topic: Concept 17.1

Skill: Application/Analysis

- 10) A particular triplet of bases in the template strand of DNA is 5' AGT 3'. The corresponding codon for the mRNA transcribed is
- A) 3' UCA 5'.
 - B) 3' UGA 5'.
 - C) 5' TCA 3'.
 - D) 3'ACU 5'.
 - E) either UCA or TCA, depending on wobble in the first base.

Answer: A

Topic: Concept 17.1

Skill: Application/Analysis

The following questions refer to Figure 17.2, a table of codons.

| | | Second Base | | | | | | |
|------------|---|--------------------|-----------|------------|------------|---|------------|---|
| | | U | C | A | G | | | |
| First Base | U | UUU } Phe | UCU } Ser | UAU } Tyr | UGU } Cys | U | Third Base | |
| | | UUC } Leu | UCC } Ser | 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 | Third Base | |
| | | CUC } Leu | CCC } Pro | CAC } His | CGC } Arg | C | | |
| | | CUA } Leu | CCA } Pro | CAA } Gin | CGA } Arg | A | | |
| | | CUG } Leu | CCG } Pro | CAG } Gin | CGG } Arg | G | | |
| | A | AUU } Ile | ACU } Thr | AAU } Asn | AGU } Ser | U | Third Base | |
| | | AUC } Ile | ACC } Thr | AAC } Asn | AGC } Ser | C | | |
| | | AUA } Ile | ACA } Thr | AAA } Lys | AGA } Arg | A | | |
| | | AUG } Met or Start | ACG } Thr | AAG } Lys | AGG } Arg | G | | |
| | G | GUU } Val | GCU } Ala | GAU } Asp | GGU } Gly | U | Third Base | |
| | | 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 | | |

Figure 17.2

- 11) A possible sequence of nucleotides in the template strand of DNA that would code for the polypeptide sequence phe-leu-ile-val would be
- A) 5' TTG-CTA-CAG-TAG 3'.
 - B) 3' AAC-GAC-GUC-AUA 5'.
 - C) 5' AUG-CTG-CAG-TAT 3'.
 - D) 3' AAA-AAT-ATA-ACA 5'.
 - E) 3' AAA-GAA-TAA-CAA 5'.

Answer: E

Topic: Concept 17.1

Skill: Application/Analysis

- 12) What amino acid sequence will be generated, based on the following mRNA codon sequence?

5' AUG-UCU-UCC-UUA-UCC-UUG 3'

- A) met-arg-glu-arg-glu-arg
- B) met-glu-arg-arg-gln-leu
- C) met-ser-leu-ser-leu-ser
- D) met-ser-ser-leu-ser-leu
- E) met-leu-phe-arg-glu-glu

Answer: D

Topic: Concept 17.1

Skill: Application/Analysis

- 13) A peptide has the sequence NH₂-phe-pro-lys-gly-phe-pro-COOH. Which of the following sequences in the coding strand of the DNA could code for this peptide?

- A) 3' UUU-CCC-AAA-GGG-UUU-CCC
- B) 3' AUG-AAA-GGG-TTT-CCC-AAA-GGG
- C) 5' TTT-CCC-AAA-GGG-TTT-CCC
- D) 5' GGG-AAA-TTT-AAA-CCC-ACT-GGG
- E) 5' ACT-TAC-CAT-AAA-CAT-TAC-UGA

Answer: C

Topic: Concept 17.1

Skill: Application/Analysis

- 14) What is the sequence of a peptide based on the following mRNA sequence?

5' . . . UUUUCUUAUUGUCUU 3'

- A) leu-cys-tyr-ser-phe
- B) cyc-phe-tyr-cys-leu
- C) phe-leu-ile-met-val
- D) leu-pro-asp-lys-gly
- E) phe-ser-tyr-cys-leu

Answer: E

Topic: Concept 17.1

Skill: Application/Analysis

15) The genetic code is essentially the same for all organisms. From this, one can logically assume all of the following *except*

- A) a gene from an organism could theoretically be expressed by any other organism.
- B) all organisms have a common ancestor.
- C) DNA was the first genetic material.
- D) the same codons in different organisms usually translate into the same amino acids.
- E) different organisms have the same number of different types of amino acids.

Answer: C

Topic: Concept 17.1

Skill: Synthesis/Evaluation

16) The "universal" genetic code is now known to have exceptions. Evidence for this could be found if which of the following is true?

- A) If UGA, usually a stop codon, is found to code for an amino acid such as tryptophan (usually coded for by UGG only).
- B) If one stop codon, such as UGA, is found to have a different effect on translation than another stop codon, such as UAA.
- C) If prokaryotic organisms are able to translate a eukaryotic mRNA and produce the same polypeptide.
- D) If several codons are found to translate to the same amino acid, such as serine.
- E) If a single mRNA molecule is found to translate to more than one polypeptide when there are two or more AUG sites.

Answer: A

Topic: Concept 17.1

Skill: Synthesis/Evaluation

17) Which of the following nucleotide triplets best represents a codon?

- A) a triplet separated spatially from other triplets
- B) a triplet that has no corresponding amino acid
- C) a triplet at the opposite end of tRNA from the attachment site of the amino acid
- D) a triplet in the same reading frame as an upstream AUG
- E) a sequence in tRNA at the 3' end

Answer: D

Topic: Concept 17.1

Skill: Application/Analysis

18) Which of the following is *true* for both prokaryotic and eukaryotic gene expression?

- A) After transcription, a 3' poly-A tail and a 5' cap are added to mRNA.
- B) Translation of mRNA can begin before transcription is complete.
- C) RNA polymerase binds to the promoter region to begin transcription.
- D) mRNA is synthesized in the 3' → 5' direction.
- E) The mRNA transcript is the exact complement of the gene from which it was copied.

Answer: C

Topic: Concept 17.2

Skill: Knowledge/Comprehension

- 19) In which of the following actions does RNA polymerase differ from DNA polymerase?
- A) RNA polymerase uses RNA as a template, and DNA polymerase uses a DNA template.
 - B) RNA polymerase binds to single-stranded DNA, and DNA polymerase binds to double-stranded DNA.
 - C) RNA polymerase is much more accurate than DNA polymerase.
 - D) RNA polymerase can initiate RNA synthesis, but DNA polymerase requires a primer to initiate DNA synthesis.
 - E) RNA polymerase does not need to separate the two strands of DNA in order to synthesize an RNA copy, whereas DNA polymerase must unwind the double helix before it can replicate the DNA.

Answer: D

Topic: Concept 17.2

Skill: Knowledge/Comprehension

- 20) Which of the following statements best describes the termination of transcription in prokaryotes?
- A) RNA polymerase transcribes through the polyadenylation signal, causing proteins to associate with the transcript and cut it free from the polymerase.
 - B) RNA polymerase transcribes through the terminator sequence, causing the polymerase to fall off the DNA and release the transcript.
 - C) RNA polymerase transcribes through an intron, and the snRNPs cause the polymerase to let go of the transcript.
 - D) Once transcription has initiated, RNA polymerase transcribes until it reaches the end of the chromosome.
 - E) RNA polymerase transcribes through a stop codon, causing the polymerase to stop advancing through the gene and release the mRNA.

Answer: B

Topic: Concept 17.2

Skill: Knowledge/Comprehension

- 21) RNA polymerase moves in which direction along the DNA?
- A) 3' → 5' along the template strand
 - B) 3' → 5' along the coding (sense) strand
 - C) 5' → 3' along the template strand
 - D) 3' → 5' along the coding strand
 - E) 5' → 3' along the double-stranded DNA

Answer: A

Topic: Concept 17.2

Skill: Knowledge/Comprehension

- 22) RNA polymerase in a prokaryote is composed of several subunits. Most of these subunits are the same for the transcription of any gene, but one, known as sigma, varies considerably. Which of the following is the most probable advantage for the organism of such sigma switching?
- A) It might allow the transcription process to vary from one cell to another.
 - B) It might allow the polymerase to recognize different promoters under certain environmental conditions.
 - C) It could allow the polymerase to react differently to each stop codon.
 - D) It could allow ribosomal subunits to assemble at faster rates.
 - E) It could alter the rate of translation and of exon splicing.

Answer: B

Topic: Concept 17.2

Skill: Synthesis/Evaluation

- 23) Which of these is the function of a poly (A) signal sequence?
- A) It adds the poly (A) tail to the 3' end of the mRNA.
 - B) It codes for a sequence in eukaryotic transcripts that signals enzymatic cleavage ~10–35 nucleotides away.
 - C) It allows the 3' end of the mRNA to attach to the ribosome.
 - D) It is a sequence that codes for the hydrolysis of the RNA polymerase.
 - E) It adds a 7-methylguanosine cap to the 3' end of the mRNA.

Answer: B

Topic: Concept 17.2

Skill: Knowledge/Comprehension

- 24) In eukaryotes there are several different types of RNA polymerase. Which type is involved in transcription of mRNA for a globin protein?
- A) ligase
 - B) RNA polymerase I
 - C) RNA polymerase II
 - D) RNA polymerase III
 - E) primase

Answer: C

Topic: Concept 17.2

Skill: Knowledge/Comprehension

- 25) Transcription in eukaryotes requires which of the following in addition to RNA polymerase?
- A) the protein product of the promoter
 - B) start and stop codons
 - C) ribosomes and tRNA
 - D) several transcription factors (TFs)
 - E) aminoacyl synthetase

Answer: D

Topic: Concept 17.2

Skill: Knowledge/Comprehension

- 26) A part of the promoter, called the TATA box, is said to be highly conserved in evolution. Which might this illustrate?
- A) The sequence evolves very rapidly.
 - B) The sequence does not mutate.
 - C) Any mutation in the sequence is selected against.
 - D) The sequence is found in many but not all promoters.
 - E) The sequence is transcribed at the start of every gene.

Answer: C

Topic: Concept 17.2

Skill: Synthesis/Evaluation

- 27) The TATA sequence is found only several nucleotides away from the start site of transcription. This most probably relates to which of the following?
- A) the number of hydrogen bonds between A and T in DNA
 - B) the triplet nature of the codon
 - C) the ability of this sequence to bind to the start site
 - D) the supercoiling of the DNA near the start site
 - E) the 3-dimensional shape of a DNA molecule

Answer: A

Topic: Concept 17.2

Skill: Synthesis/Evaluation

28) Which of the following help(s) to stabilize mRNA by inhibiting its degradation?

- A) TATA box
- B) spliceosomes
- C) 5' cap and poly (A) tail
- D) introns
- E) RNA polymerase

Answer: C

Topic: Concept 17.3

Skill: Knowledge/Comprehension

29) What is a ribozyme?

- A) an enzyme that uses RNA as a substrate
- B) an RNA with enzymatic activity
- C) an enzyme that catalyzes the association between the large and small ribosomal subunits
- D) an enzyme that synthesizes RNA as part of the transcription process
- E) an enzyme that synthesizes RNA primers during DNA replication

Answer: B

Topic: Concept 17.3

Skill: Knowledge/Comprehension

30) What are the coding segments of a stretch of eukaryotic DNA called?

- A) introns
- B) exons
- C) codons
- D) replicons
- E) transposons

Answer: B

Topic: Concept 17.3

Skill: Knowledge/Comprehension

31) A transcription unit that is 8,000 nucleotides long may use 1,200 nucleotides to make a protein consisting of approximately 400 amino acids. This is best explained by the fact that

- A) many noncoding stretches of nucleotides are present in mRNA.
- B) there is redundancy and ambiguity in the genetic code.
- C) many nucleotides are needed to code for each amino acid.
- D) nucleotides break off and are lost during the transcription process.
- E) there are termination exons near the beginning of mRNA.

Answer: A

Topic: Concept 17.3

Skill: Knowledge/Comprehension

32) Once transcribed, eukaryotic mRNA typically undergoes substantial alteration that includes

- A) union with ribosomes.
- B) fusion into circular forms known as plasmids.
- C) linkage to histone molecules.
- D) excision of introns.
- E) fusion with other newly transcribed mRNA.

Answer: D

Topic: Concept 17.3

Skill: Knowledge/Comprehension

- 33) Introns are significant to biological evolution because
- A) their presence allows exons to be shuffled.
 - B) they protect the mRNA from degeneration.
 - C) they are translated into essential amino acids.
 - D) they maintain the genetic code by preventing incorrect DNA base pairings.
 - E) they correct enzymatic alterations of DNA bases.

Answer: A

Topic: Concept 17.3

Skill: Knowledge/Comprehension

- 34) A mutation in which of the following parts of a gene is likely to be most damaging to a cell?
- A) intron
 - B) exon
 - C) 5' UTR
 - D) 3' UTR
 - E) All would be equally damaging.

Answer: B

Topic: Concept 17.3

Skill: Knowledge/Comprehension

- 35) Which of the following is (are) true of snRNPs?
- A) They are made up of both DNA and RNA.
 - B) They bind to splice sites at each end of the exon.
 - C) They join together to form a large structure called the spliceosome.
 - D) They act only in the cytosol.
 - E) They attach introns to exons in the correct order.

Answer: C

Topic: Concept 17.3

Skill: Knowledge/Comprehension

- 36) During splicing, which molecular component of the spliceosome catalyzes the excision reaction?
- A) protein
 - B) DNA
 - C) RNA
 - D) lipid
 - E) sugar

Answer: C

Topic: Concept 17.3

Skill: Knowledge/Comprehension

- 37) Alternative RNA splicing
- A) is a mechanism for increasing the rate of transcription.
 - B) can allow the production of proteins of different sizes from a single mRNA.
 - C) can allow the production of similar proteins from different RNAs.
 - D) increases the rate of transcription.
 - E) is due to the presence or absence of particular snRNPs.

Answer: B

Topic: Concept 17.3

Skill: Knowledge/Comprehension

38) In the structural organization of many eukaryotic genes, individual exons may be related to which of the following?

- A) the sequence of the intron that immediately precedes each exon
- B) the number of polypeptides making up the functional protein
- C) the various domains of the polypeptide product
- D) the number of restriction enzyme cutting sites
- E) the number of start sites for transcription

Answer: C

Topic: Concept 17.3

Skill: Knowledge/Comprehension

39) Each eukaryotic mRNA, even after post-transcriptional modification, includes 5' and 3' UTRs. Which are these?

- A) the cap and tail at each end of the mRNA
- B) the untranslated regions at either end of the coding sequence
- C) the U attachment sites for the tRNAs
- D) the U translation sites that signal the beginning of translation
- E) the U — A pairs that are found in high frequency at the ends

Answer: B

Topic: Concept 17.3

Skill: Knowledge/Comprehension

40) In an experimental situation, a student researcher inserts an mRNA molecule into a eukaryotic cell after he has removed its 5' cap and poly(A) tail. Which of the following would you expect him to find?

- A) The mRNA could not exit the nucleus to be translated.
- B) The cell recognizes the absence of the tail and polyadenylates the mRNA.
- C) The molecule is digested by restriction enzymes in the nucleus.
- D) The molecule is digested by exonucleases since it is no longer protected at the 5' end.
- E) The molecule attaches to a ribosome and is translated, but more slowly.

Answer: D

Topic: Concept 17.3

Skill: Synthesis/Evaluation

41) A particular triplet of bases in the coding sequence of DNA is AAA. The anticodon on the tRNA that binds the mRNA codon is

- A) TTT.
- B) UUA.
- C) UUU.
- D) AAA.
- E) either UAA or TAA, depending on first base wobble.

Answer: C

Topic: Concept 17.4

Skill: Application/Analysis

42) Accuracy in the translation of mRNA into the primary structure of a polypeptide depends on specificity in the

- A) binding of ribosomes to mRNA.
- B) shape of the A and P sites of ribosomes.
- C) bonding of the anticodon to the codon.
- D) attachment of amino acids to tRNAs.
- E) both C and D

Answer: E

Topic: Concept 17.4

Skill: Knowledge/Comprehension

- 43) A part of an mRNA molecule with the following sequence is being read by a ribosome: 5' CCG - ACG 3' (mRNA). The following charged transfer RNA molecules (with their anticodons shown in the 3' to 5' direction) are available. Two of them can correctly match the mRNA so that a dipeptide can form.

| tRNA Anticodon | Amino Acid |
|----------------|------------|
| GGC | Proline |
| CGU | Alanine |
| UGC | Threonine |
| CCG | Glycine |
| ACG | Cysteine |
| CGG | Alanine |

Figure 17.3

The dipeptide that will form will be

- A) cysteine-alanine.
- B) proline-threonine.
- C) glycine-cysteine.
- D) alanine-alanine.
- E) threonine-glycine.

Answer: B

Topic: Concept 17.4

Skill: Application/Analysis

- 44) What type of bonding is responsible for maintaining the shape of the tRNA molecule?
- A) covalent bonding between sulfur atoms
 - B) ionic bonding between phosphates
 - C) hydrogen bonding between base pairs
 - D) van der Waals interactions between hydrogen atoms
 - E) peptide bonding between amino acids

Answer: C

Topic: Concept 17.4

Skill: Knowledge/Comprehension

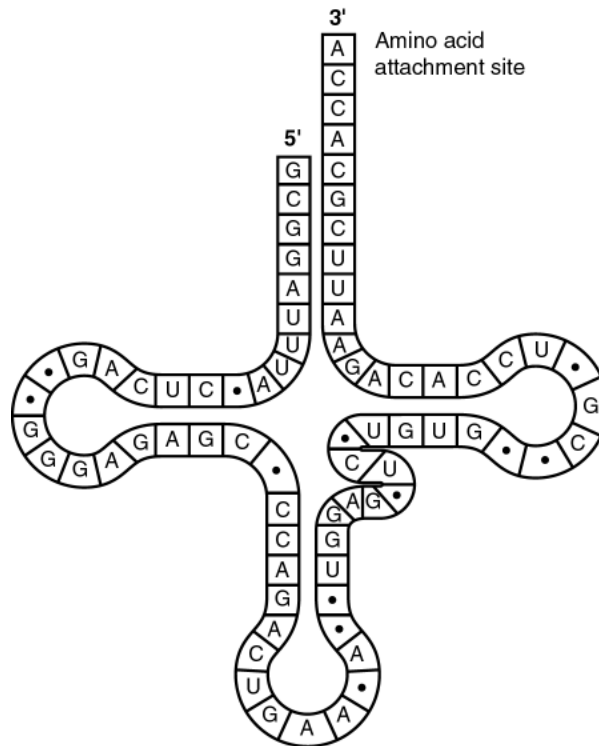


Figure 17.4

- 45) Figure 17.4 represents tRNA that recognizes and binds a particular amino acid (in this instance, phenylalanine). Which codon on the mRNA strand codes for this amino acid?

A) UGG
 B) GUG
 C) GUA
 D) UUC
 E) CAU

Answer: D

Topic: Concept 17.4

Skill: Application/Analysis

- 46) The tRNA shown in Figure 17.4 has its 3' end projecting beyond its 5' end. What will occur at this 3' end?

A) The codon and anticodon complement one another.
 B) The amino acid binds covalently.
 C) The excess nucleotides (ACCA) will be cleaved off at the ribosome.
 D) The small and large subunits of the ribosome will attach to it.
 E) The 5' cap of the mRNA will become covalently bound.

Answer: B

Topic: Concept 17.3

Skill: Knowledge/Comprehension

- 47) A mutant bacterial cell has a defective aminoacyl synthetase that attaches a lysine to tRNAs with the anticodon AAA instead of a phenylalanine. The consequence of this for the cell will be that
- A) none of the proteins in the cell will contain phenylalanine.
 - B) proteins in the cell will include lysine instead of phenylalanine at amino acid positions specified by the codon UUU.
 - C) the cell will compensate for the defect by attaching phenylalanine to tRNAs with lysine-specifying anticodons.
 - D) the ribosome will skip a codon every time a UUU is encountered.
 - E) None of the above will occur; the cell will recognize the error and destroy the tRNA.

Answer: B

Topic: Concept 17.4

Skill: Application/Analysis

- 48) There are 61 mRNA codons that specify an amino acid, but only 45 tRNAs. This is best explained by the fact that
- A) some tRNAs have anticodons that recognize four or more different codons.
 - B) the rules for base pairing between the third base of a codon and tRNA are flexible.
 - C) many codons are never used, so the tRNAs that recognize them are dispensable.
 - D) the DNA codes for all 61 tRNAs but some are then destroyed.
 - E) competitive exclusion forces some tRNAs to be destroyed by nucleases.

Answer: B

Topic: Concept 17.4

Skill: Knowledge/Comprehension

- 49) What is the most abundant type of RNA?
- A) mRNA
 - B) tRNA
 - C) rRNA
 - D) pre-mRNA
 - E) hnRNA

Answer: C

Topic: Concept 17.4

Skill: Knowledge/Comprehension

- 50) From the following list, which is the first event in translation in eukaryotes?
- A) elongation of the polypeptide
 - B) base pairing of activated methionine-tRNA to AUG of the messenger RNA
 - C) the larger ribosomal subunit binds to smaller ribosomal subunits
 - D) covalent bonding between the first two amino acids
 - E) the small subunit of the ribosome recognizes and attaches to the 5' cap of mRNA

Answer: E

Topic: Concept 17.4

Skill: Knowledge/Comprehension

51) Choose the answer that has these events of protein synthesis in the proper sequence.

1. An aminoacyl-tRNA binds to the A site.
2. A peptide bond forms between the new amino acid and a polypeptide chain.
3. tRNA leaves the P site, and the P site remains vacant.
4. A small ribosomal subunit binds with mRNA.
5. tRNA translocates to the P site.

- A) 1, 3, 2, 4, 5
- B) 4, 1, 2, 5, 3
- C) 5, 4, 3, 2, 1
- D) 4, 1, 3, 2, 5
- E) 2, 4, 5, 1, 3

Answer: B

Topic: Concept 17.4

Skill: Knowledge/Comprehension

52) As a ribosome translocates along an mRNA molecule by one codon, which of the following occurs?

- A) The tRNA that was in the A site moves into the P site.
- B) The tRNA that was in the P site moves into the A site.
- C) The tRNA that was in the A site moves to the E site and is released.
- D) The tRNA that was in the A site departs from the ribosome via a tunnel.
- E) The polypeptide enters the E site.

Answer: A

Topic: Concept 17.4

Skill: Knowledge/Comprehension

53) What are polyribosomes?

- A) groups of ribosomes reading a single mRNA simultaneously
- B) ribosomes containing more than two subunits
- C) multiple copies of ribosomes associated with giant chromosomes
- D) aggregations of vesicles containing ribosomal RNA
- E) ribosomes associated with more than one tRNA

Answer: A

Topic: Concept 17.4

Skill: Knowledge/Comprehension

54) Which of the following is a function of a signal peptide?

- A) to direct an mRNA molecule into the cisternal space of the ER
- B) to bind RNA polymerase to DNA and initiate transcription
- C) to terminate translation of the messenger RNA
- D) to translocate polypeptides across the ER membrane
- E) to signal the initiation of transcription

Answer: D

Topic: Concept 17.4

Skill: Knowledge/Comprehension

55) When translating secretory or membrane proteins, ribosomes are directed to the ER membrane by

- A) a specific characteristic of the ribosome itself, which distinguishes free ribosomes from bound ribosomes.
- B) a signal-recognition particle that brings ribosomes to a receptor protein in the ER membrane.
- C) moving through a specialized channel of the nucleus.
- D) a chemical signal given off by the ER.
- E) a signal sequence of RNA that precedes the start codon of the message.

Answer: B

Topic: Concept 17.4

Skill: Knowledge/Comprehension

- 56) When does translation begin in prokaryotic cells?
- A) after a transcription initiation complex has been formed
 - B) as soon as transcription has begun
 - C) after the 5' caps are converted to mRNA
 - D) once the pre-mRNA has been converted to mRNA
 - E) as soon as the DNA introns are removed from the template

Answer: B

Topic: Concept 17.4

Skill: Knowledge/Comprehension

- 57) When a tRNA molecule is shown twisted into an L shape, the form represented is
- A) its linear sequence.
 - B) its 2-dimensional shape.
 - C) its 3-dimensional shape.
 - D) its microscopic image.

Answer: C

Topic: Concept 17.4

Skill: Knowledge/Comprehension

- 58) An experimenter has altered the 3' end of the tRNA corresponding to the amino acid methionine in such a way as to remove the 3' AC. Which of the following hypotheses describes the most likely result?
- A) tRNA will not form a cloverleaf.
 - B) The nearby stem end will pair improperly.
 - C) The amino acid methionine will not bind.
 - D) The anticodon will not bind with the mRNA codon.
 - E) The aminoacylsynthetase will not be formed.

Answer: C

Topic: Concept 17.4

Skill: Synthesis/Evaluation

Use the following information to answer the following questions.

A transfer RNA (#1) attached to the amino acid lysine enters the ribosome. The lysine binds to the growing polypeptide on the other tRNA (#2) in the ribosome already.

- 59) Which enzyme causes a covalent bond to attach lysine to the polypeptide?
- A) ATPase
 - B) lysine synthetase
 - C) RNA polymerase
 - D) ligase
 - E) peptidyl transferase

Answer: E

Topic: Concept 17.4

Skill: Knowledge/Comprehension

- 60) Where does tRNA #2 move to after this bonding of lysine to the polypeptide?
- A) A site
 - B) P site
 - C) E site
 - D) Exit tunnel
 - E) Directly to the cytosol

Answer: D

Topic: Concept 17.4

Skill: Application/Analysis

- 61) Which component of the complex described enters the exit tunnel through the large subunit of the ribosome?
- A) tRNA with attached lysine (#1)
 - B) tRNA with polypeptide (#2)
 - C) tRNA that no longer has attached amino acid
 - D) newly formed polypeptide
 - E) initiation and elongation factors

Answer: D

Topic: Concept 17.4

Skill: Application/Analysis

- 62) The process of translation, whether in prokaryotes or eukaryotes, requires tRNAs, amino acids, ribosomal subunits, and which of the following?
- A) polypeptide factors plus ATP
 - B) polypeptide factors plus GTP
 - C) polymerases plus GTP
 - D) SRP plus chaperones
 - E) signal peptides plus release factor

Answer: B

Topic: Concept 17.4

Skill: Knowledge/Comprehension

- 63) When the ribosome reaches a stop codon on the mRNA, no corresponding tRNA enters the A site. If the translation reaction were to be experimentally stopped at this point, which of the following would you be able to isolate?
- A) an assembled ribosome with a polypeptide attached to the tRNA in the P site
 - B) separated ribosomal subunits, a polypeptide, and free tRNA
 - C) an assembled ribosome with a separated polypeptide
 - D) separated ribosomal subunits with a polypeptide attached to the tRNA
 - E) a cell with fewer ribosomes

Answer: A

Topic: Concept 17.4

Skill: Synthesis/Evaluation

- 64) Why might a point mutation in DNA make a difference in the level of protein's activity?
- A) It might result in a chromosomal translocation.
 - B) It might exchange one stop codon for another stop codon.
 - C) It might exchange one serine codon for a different serine codon.
 - D) It might substitute an amino acid in the active site.
 - E) It might substitute the N terminus of the polypeptide for the C terminus.

Answer: D

Topic: Concept 17.5

Skill: Synthesis/Evaluation

- 65) In the 1920s Muller discovered that X-rays caused mutation in *Drosophila*. In a related series of experiments, in the 1940s, Charlotte Auerbach discovered that chemicals—she used nitrogen mustards—have a similar effect. A new chemical food additive is developed by a cereal manufacturer. Why do we test for its ability to induce mutation?
- A) We worry that it might cause mutation in cereal grain plants.
 - B) We want to make sure that it does not emit radiation.
 - C) We want to be sure that it increases the rate of mutation sufficiently.
 - D) We want to prevent any increase in mutation frequency.
 - E) We worry about its ability to cause infection.

Answer: D

Topic: Concept 17.5

Skill: Synthesis/Evaluation

- 66) Which of the following types of mutation, resulting in an error in the mRNA just after the AUG start of translation, is likely to have the most serious effect on the polypeptide product?
- A) a deletion of a codon
 - B) a deletion of 2 nucleotides
 - C) a substitution of the third nucleotide in an ACC codon
 - D) a substitution of the first nucleotide of a GGG codon
 - E) an insertion of a codon

Answer: B

Topic: Concept 17.5

Skill: Application/Analysis

- 67) What is the effect of a nonsense mutation in a gene?
- A) It changes an amino acid in the encoded protein.
 - B) It has no effect on the amino acid sequence of the encoded protein.
 - C) It introduces a premature stop codon into the mRNA.
 - D) It alters the reading frame of the mRNA.
 - E) It prevents introns from being excised.

Answer: C

Topic: Concept 17.5

Skill: Knowledge/Comprehension

- 68) Each of the following options is a modification of the sentence THECATATETHERAT. Which of the following is analogous to a frameshift mutation?
- A) THERATATETHECAT
 - B) THETACATETHERAT
 - C) THECATARETHERAT
 - D) THECATATTHERAT
 - E) CATATETHERAT

Answer: D

Topic: Concept 17.5

Skill: Application/Analysis

- 69) Each of the following options is a modification of the sentence THECATATETHERAT. Which of the following is analogous to a single substitution mutation?
- A) THERATATETHECAT
 - B) THETACATETHERAT
 - C) THECATARETHERAT
 - D) THECATATTHERAT
 - E) CATATETHERAT

Answer: C

Topic: Concept 17.5

Skill: Application/Analysis

- 70) Sickle-cell disease is probably the result of which kind of mutation?
- A) point
 - B) frameshift
 - C) nonsense
 - D) nondisjunction
 - E) both B and D

Answer: A

Topic: Concept 17.5

Skill: Application/Analysis

- 71) A frameshift mutation could result from
- A) a base insertion only.
 - B) a base deletion only.
 - C) a base substitution only.
 - D) deletion of three consecutive bases.
 - E) either an insertion or a deletion of a base.

Answer: E

Topic: Concept 17.5

Skill: Knowledge/Comprehension

- 72) Which of the following DNA mutations is the most likely to be damaging to the protein it specifies?
- A) a base-pair deletion
 - B) a codon substitution
 - C) a substitution in the last base of a codon
 - D) a codon deletion
 - E) a point mutation

Answer: A

Topic: Concept 17.5

Skill: Knowledge/Comprehension

- 73) Which point mutation would be most likely to have a catastrophic effect on the functioning of a protein?
- A) a base substitution
 - B) a base deletion near the start of a gene
 - C) a base deletion near the end of the coding sequence, but not in the terminator codon
 - D) deletion of three bases near the start of the coding sequence, but not in the initiator codon
 - E) a base insertion near the end of the coding sequence, but not in the terminator codon

Answer: B

Topic: Concept 17.5

Skill: Knowledge/Comprehension

- 74) Which of the following statements are true about protein synthesis in prokaryotes?
- A) Extensive RNA processing is required before prokaryotic transcripts can be translated.
 - B) Translation can begin while transcription is still in progress.
 - C) Prokaryotic cells have complicated mechanisms for targeting proteins to the appropriate cellular organelles.
 - D) Translation requires antibiotic activity.
 - E) Unlike eukaryotes, prokaryotes require no initiation or elongation factors.

Answer: B

Topic: Concept 17.6

Skill: Knowledge/Comprehension

- 75) Gene expression in Archaea differs from that in other prokaryotes. It shares features with which of the following?
- A) eubacteria only
 - B) eukaryotes only
 - C) protists only
 - D) fungi only
 - E) bacteria and eukaryotes

Answer: E

Topic: Concept 17.6

Skill: Knowledge/Comprehension

- 76) Of the following, which is the most current description of a gene?
- A) a unit of heredity that causes formation of a phenotypic characteristic
 - B) a DNA subunit that codes for a single complete protein
 - C) a DNA sequence that is expressed to form a functional product: either RNA or polypeptide
 - D) a DNA–RNA sequence combination that results in an enzymatic product
 - E) a discrete unit of hereditary information that consists of a sequence of amino acids

Answer: C

Topic: Concept 17.6

Skill: Knowledge/Comprehension

Self-Quiz Questions

- 1) In eukaryotic cells, transcription cannot begin until
- A) the two DNA strands have completely separated and exposed the promoter.
 - B) several transcription factors have bound to the promoter.
 - C) the 5' caps are removed from the mRNA.
 - D) the DNA introns are removed from the template.
 - E) DNA nucleases have isolated the transcription unit.

Answer: B

Topic:

Skill:

- 2) Which of the following is *not* true of a codon?
- A) It consists of three nucleotides.
 - B) It may code for the same amino acid as another codon.
 - C) It never codes for more than one amino acid.
 - D) It extends from one end of a tRNA molecule.
 - E) It is the basic unit of the genetic code.

Answer: D

Topic:

Skill:

- 3) The anticodon of a particular tRNA molecule is
- A) complementary to the corresponding mRNA codon.
 - B) complementary to the corresponding triplet in rRNA.
 - C) the part of tRNA that bonds to a specific amino acid.
 - D) changeable, depending on the amino acid that attaches to the tRNA.
 - E) catalytic, making the tRNA a ribozyme.

Answer: A

Topic:

Skill:

- 4) Which of the following is *not* true of RNA processing?
- A) Exons are cut out before mRNA leaves the nucleus.
 - B) Nucleotides may be added at both ends of the RNA.
 - C) Ribozymes may function in RNA splicing.
 - D) RNA splicing can be catalyzed by spliceosomes.
 - E) A primary transcript is often much longer than the final RNA molecule that leaves the nucleus.

Answer: A

Topic:

Skill:

The following questions refer to Figure 17.5, a table of codons.

| | | Second Base | | | | | | |
|------------|---|--------------------|-----------|------------|------------|---|------------|---|
| | | U | C | A | G | | | |
| First Base | U | UUU } Phe | UCU } Ser | UAU } Tyr | UGU } Cys | U | Third Base | |
| | | UUC } Phe | UCC } Ser | 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 | C | |
| | | CUC } Leu | CCC } Pro | CAC } His | CGC } Arg | C | | |
| | | CUA } Leu | CCA } Pro | CAA } Gin | CGA } Arg | A | | |
| | | CUG } Leu | CCG } Pro | CAG } Gin | CGG } Arg | G | | |
| | A | AUU } Ile | ACU } Thr | AAU } Asn | AGU } Ser | U | C | |
| | | AUC } Ile | ACC } Thr | AAC } Asn | AGC } Ser | C | | |
| | | AUA } Ile | ACA } Thr | AAA } Lys | AGA } Arg | A | | |
| | | AUG } Met or Start | ACG } Thr | AAG } Lys | AGG } Arg | G | | |
| | G | GUU } Val | GCU } Ala | GAU } Asp | GGU } Gly | U | C | |
| | | 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 | | |

Figure 17.5

- 5) Using Figure 17.5, identify a 5' → 3' sequence of nucleotides in the DNA template strand for an mRNA coding for the polypeptide sequence Phe-Pro-Lys.

- A) 5'-UUUGGGAAA-3'
- B) 5'-GAACCCCTT-3'
- C) 5'-AAAACCTTT-3'
- D) 5'-CTTCGGGAA-3'
- E) 5'-AAACCCUUU-3'

Answer: D

Topic:

Skill:

- 6) Which of the following mutations would be *most* likely to have a harmful effect on an organism?
- A) a base-pair substitution
 - B) a deletion of three nucleotides near the middle of a gene
 - C) a single nucleotide deletion in the middle of an intron
 - D) a single nucleotide deletion near the end of the coding sequence
 - E) a single nucleotide insertion downstream of, and close to, the start of the coding sequence

Answer: E

Topic:

Skill:

- 7) Which component is *not* directly involved in translation?
- A) mRNA
 - B) DNA
 - C) tRNA
 - D) ribosomes
 - E) GTP

Answer: B

Topic:

Skill:

8) Review the roles of RNA by filling in the following table:

| Type of RNA | Functions |
|---------------------------|--|
| Messenger RNA (mRNA) | |
| Transfer RNA (tRNA) | |
| | Plays catalytic (ribozyme) roles and structural roles in ribosomes |
| Primary transcript | |
| Small nuclear RNA (snRNA) | |

Answer:

| Type of RNA | Functions |
|---------------------------|---|
| Messenger RNA (mRNA) | Carries information specifying amino acid sequences of proteins from DNA to ribosomes. |
| Transfer RNA (tRNA) | Serves as adapter molecule in protein synthesis; translates mRNA codons into amino acids. |
| Ribosomal RNA (rRNA) | Plays catalytic (ribozyme) roles and structural roles in ribosomes. |
| Primary transcript | Is a precursor to mRNA, rRNA, or tRNA, before being processed. Some intron RNA acts as a ribozyme, catalyzing its own splicing. |
| Small nuclear RNA (snRNA) | Plays structural and catalytic roles in spliceosomes, the complexes of protein and RNA that splice pre-mRNA. |

Topic:

Skill: