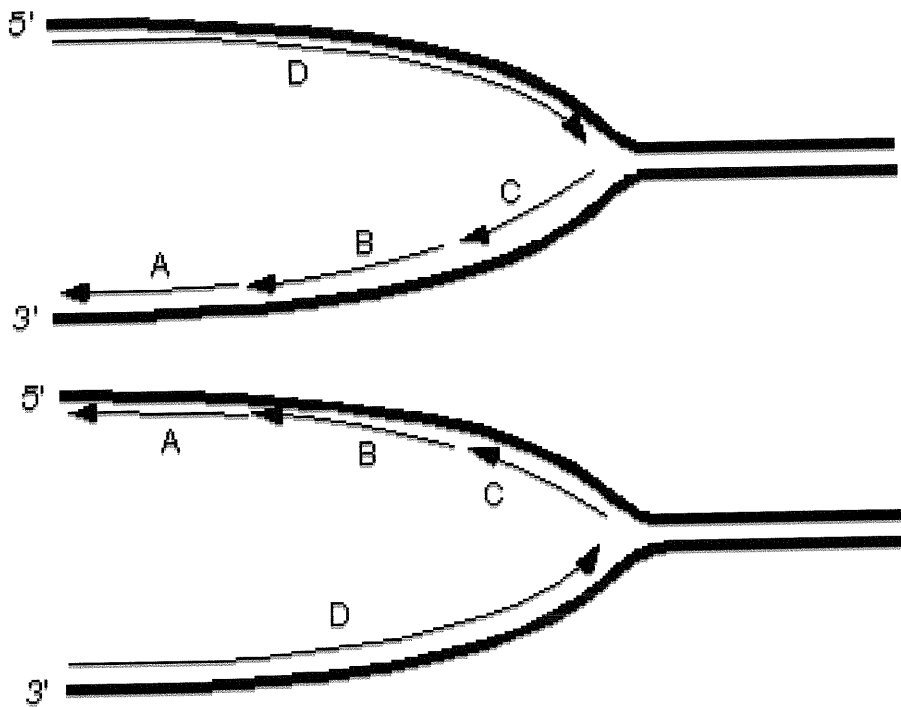


1. Since DNA synthesis is bidirectional from the origin, the number of new strands are being made simultaneously in *E. coli* is:
 - (A) one
 - (B) two
 - (C) three
 - (D) four
 - (E) the answer cannot be determined from this information.
2. When the synthesis of new DNA is directed by an original template DNA molecule
 - (A) the DNA produced has two newly formed strands (no change in the original DNA)
 - (B) two DNA molecules are formed, each with one new strand and one strand from the original DNA
 - (C) there is random arrangement of newly formed and original DNA on the two strands of the DNA produced
 - (D) no information is available on this subject
3. The primer for *in vivo* DNA replication is:
 - (A) The 3' hydroxyl of the preceding Okazaki fragment.
 - (B) A short piece of RNA.
 - (C) A nick made in the DNA template.
 - (D) A primer is not always required for DNA replication.
 - (E) All of these are true.
4. Which of the following is not a function of DNA polymerase I from *E. coli*?
 - (A) adding nucleotides to the primer strand
 - (B) 3' → 5' exonuclease activity
 - (C) 5' → 3' exonuclease activity
 - (D) proofreading
5. *E. coli* replication on the lagging strand
 - (A) is carried out by DNA polymerase I
 - (B) is initially synthesized as Okazaki fragments
 - (C) is synthesized continuously
 - (D) has this DNA strand synthesized in a 3'-5' direction

Exhibit 1A: Consider the following diagrams showing a replication fork moving from left to right. The thick lines represent the template/parental strands. The 5' and 3' represent the ends of those template/parental strands.



6. **Refer to exhibit 1A:** Which diagram correctly depicts the orientation of the lagging and leading strands on the parentals?
- (A) The top
 - (B) The bottom
 - (C) Neither is fully accurate.
 - (D) Either would be accurate dependent on the organism being studied.
7. **Refer to exhibit 1A:** Which Okazaki fragment was synthesized earliest?
- (A) A
 - (B) B
 - (C) C
 - (D) D
8. Which of the following activities does *E. coli* DNA polymerase III **lack**?
- (A) 5'→3' polymerase
 - (B) 5'→3' exonuclease
 - (C) 3'→5' exonuclease
 - (D) *E. coli* DNA polymerase III has ALL of the above activities.
9. Single strand binding proteins are important for this activity:
- (A) Prevent single-stranded DNA from rewinding.
 - (B) Protect single-stranded DNA from enzymatic degradation.
 - (C) Prevent double helical DNA from unwinding.
 - (D) Prevent double helical DNA from becoming a triple helix.

- (E) Prevent single-stranded DNA from rewinding and protect it from degradation.
10. Ultra-violet light principally causes which of the following damages to DNA?
- (A) mismatches between stands
 - (B) breaks in the phosphodiester backbone of the DNA strand
 - (C) thymine dimerization
 - (D) methylation of specific bases
11. Replication of eukaryotic DNA
- (A) must occur faster than replication of prokaryotic DNA
 - (B) must be controlled to coordinate with the cell cycle
 - (C) takes place during mitosis
 - (D) takes place twice during each cell cycle
12. Chain termination occurs, *in vivo*, when:
- (A) RNA Pol gets to the end of the DNA.
 - (B) The factor called rho (ρ) binds to the DNA.
 - (C) A hairpin loop forms in the template.
 - (D) Either a hairpin loop forms or rho is involved.
 - (E) All of these.
13. Which of the following correctly describes a difference between RNA & DNA polymerases?
- (A) RNA polymerases usually do not need a template, while DNA polymerases do.
 - (B) DNA polymerases usually require a primer (i.e., they can only continue a strand, not start one), while most RNA polymerases do not.
 - (C) RNA polymerases usually synthesize introns, while DNA polymerases synthesize cistrons.
 - (D) RNA polymerases polymerize 5' \rightarrow 3', while DNA polymerases polymerize 3' \rightarrow 5'.
14. The promoter site is
- (A) the start site for transcription in DNA
 - (B) the binding site for regulatory proteins that stimulate transcription
 - (C) the general region of DNA downstream from the start site
 - (D) the site on DNA at which RNA polymerase binds to initiate transcription
15. Which of the conditions would result in the **greatest** amount of transcription of the *lac* operon?
- | | [glucose] | [lactose] |
|-----|-----------|-----------|
| (A) | high | high |
| (B) | low | low |
| (C) | high | low |

(D) low high

16. The following are all key steps in activation of mRNA synthesis in eukaryotes, **except**:

- (A) Binding of TBP to the DNA.
- (B) Binding of other transcription factors.
- (C) Binding of RNA Pol I.
- (D) Phosphorylation of the RNA Pol.
- (E) All of these are necessary to initiate RNA synthesis in eukaryotes.

17. Which of the following is not a structural motif encountered in DNA-binding proteins?

- (A) helix-turn-helix
- (B) leucine zipper
- (C) zinc finger
- (D) β barrel

18. Ribozymes, the catalytic activity of RNA, were first discovered as part of the snRNA group.

- (A) True
- (B) False

19. Inosine or hypoxanthine can wobble with all the following bases, **except**:

- (A) A
- (B) C
- (C) T
- (D) U
- (E) Inosine can wobble with all of these bases.

20. Which amino acids have unique codons?

- (A) gly
- (B) met
- (C) tyr
- (D) stop

21. A tRNA was determined to have the following anticodon sequence:

3'-GAI-5' (I represents the base hypoxanthine). Indicate which of the following codons can form base pairs with this anticodon

- (A) 5'-CUA-3'
- (B) 5'-CUC-3'
- (C) 5'-CUU-3'
- (D) all of the above

22. A Shine-Dalgarno Sequence is a

- (A) sequence of nucleotides in the DNA that interacts with the σ -subunit of RNA polymerase to begin transcription.
- (B) sequence of nucleotides in an mRNA that interacts with the small subunit of a ribosome to begin translation.
- (C) sequence of nucleotides in the DNA that interacts with ρ -protein to terminate transcription.
- (D) sequence of nucleotides in an mRNA that functions to terminate translation.
23. The ribosome is actually a ribozyme.
- (A) True
- (B) False
24. The final form of mRNA in eukaryotes has all these features, **except**:
- (A) There will be a special nucleotide cap on the 5' end of the mRNA.
- (B) There is usually a poly A tail on the 3' end of the mRNA.
- (C) The mature, active mRNA contains introns.
- (D) Only a single protein is made from any mature mRNA molecule.
25. All of these are true. The protein which marks proteins for degradation is called:
- (A) Chaperonin
- (B) Ubiquitin
- (C) Proteasomin
- (D) Apoptosin
- (E) None of these names is correct.
26. In a typical eukaryotic cell the pH is usually around 7.4. What is the $[H^+]$ in a typical eukaryotic cell?
- (A) 0.00000074 M (B) 6.6 μ M (C) 4×10^{-8} M (D) 7.4×10^{-5} M
27. You mix 100 ml of solution of pH 1 with 100 ml of a solution of pH 3. The pH of the new 200 ml solution will be:
- (A) pH 2.0 (B) pH 3.0 (C) between pH 1.0 and pH 2.0 (D) between pH 2.0 and pH 3.0
28. The only amino acid having an R group with a pK_a near 7; important in the active site of some enzymes is:
- (A) aspartate (B) histidine (C) lysine. (D) tyrosine.
29. The only amino acid with a substituted α -amino group; influences protein folding by forcing a bend in the chain is:
- (A) phenylalaine (B) glycine (C) proline (D) cysteine
30. Calculate the net charge on the tetrapeptide: Asp-Ser-Lys-Gly at pH 7.0. And estimate the pI for this peptide.
- (A) 0 ; 6.6 (B) +1 ; 4.5 (C) -1 ; 10.0 (D) -1 ; 5.6

31. Which of the following tripeptides will be retained the longest on a cation-exchange chromatographic column in a pH 7.0 buffer?
(A) Asp-Glu-Ser (B) Ser-Gly-Thr (C) Gly-Lys-Arg (D) Tyr-Leu-His
- 32.. Cellular agents that assist in protein folding at elevated temperatures are called:
(A) isomerases (B) proteases (C) chaperones (D) polymerases
33. Which of the following bonds or interactions is/are possible contributors to the stability of the tertiary structure of a globular protein?
(A) peptide bonds between a metal ion cofactor and a histidine residue
(B) hydrophobic interactions between histidine and tryptophan R groups
(C) covalent disulfide cross-links between two methionine residues
(D) hydrogen bonds between serine residues and the aqueous surroundings
34. An enzyme facilitates chemical reaction by:
(A) decreasing the free-energy difference between reactants and products.
(B) increasing the free-energy difference between reactants and products.
(C) lowering the activation energy of the reaction.
(D) raising the activation energy of the reaction.
35. Which of the following statements is *false* regarding Michaelis-Menten kinetics?
(A) At very high substrate concentration, the velocity of the reaction is independent of substrate concentration.
(B) The concentration of the enzyme-substrate complex stays constant throughout the reaction.
(C) Enzyme concentration is much lower than substrate concentration.
(D) K_m is equal to the substrate concentration that will bring the reaction to maximal velocity
36. In a Lineweaver-Burk plot for an enzyme-catalyzed reaction, the presence of a competitive inhibitor will alter the:
(A) intercept on the $1/V$ axis. (B) intercept on the $1/[S]$ axis. (C) V_{max}
(D) curvature of the plot.
37. In glycoproteins, the carbohydrate moiety is always attached through the amino acid residues:
(A) glutamine or arginine. (B) tryptophan, aspartate, or cysteine. (C) asparagine, serine, or threonine. (D) aspartate or glutamate.
38. A quantitative amino acid analysis reveals that bovine serum albumin (BSA) contains 0.60% tryptophan (M_r 204) by weight. (1) Calculate the *minimum* molecular weight of BSA (assuming there is only one tryptophan residue per protein molecule) (2) Gel filtration of BSA gives a molecular weight estimate of 70,000. How many tryptophan residues are present in a molecule of BSA?
(A) 34,000 ; 2 (B) 68,000 ; 1 (C) 340 ; 200 (D) 3,400 ; 20

39. Which of the following methods cannot be used for molecular weight estimation of a protein?
(A) SDS-PAGE (B) Isoelectric focusing (IEF) (C) Gel filtration column chromatography (D) Mass spectrometry
40. Which of the following techniques is not a major subject applied in proteomic studies?
(A) Two dimensional gel electrophoresis (B) Mass spectrometry (C) DNA microarray (D) Bioinformatics
41. Following digestion of a DNA sample with restriction enzyme and separation of the resulting fragments by electrophoresis, one often uses RNA probes and a blotting procedures to identify the fragment containing the gene of interest. The process is known as?
(A) Southern blotting
(B) Northern blotting
(C) Eastern blotting
(D) Western blotting
42. Using Southern blotting technique for analysis of chromosomal DNA involving following five major steps:
1. Autoradiography
2. Blotting
3. Cleavage
4. Electrophoresis
5. Hybridization
Which of the following sequences of steps best illustrates this technique?
(A) 1 2 3 4 5
(B) 3 4 2 5 1
(C) 2 5 3 4 1
(D) 3 1 2 5 4
43. Plasmids containing antibiotics resistance genes are widely used in gene cloning. What is the major benefit of using plasmids containing genes for antibiotic resistance?
(A) Protection against natural antibiotics produced by other bacteria in culture
(B) Allowing cells to grow in the presence of antibiotics to kill competing bacteria
(C) As a means of selection of those bacteria which have picked up the plasmid
(D) Contamination prevention
44. Which of the following four fatty acids has the lowest melting point?
(A) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{COOH}$
(B) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{COOH}$
(C) $\text{CH}_3\text{CH}=\text{CH}_2\text{CH}_2\text{CH}_2\text{COOH}$
(D) None of above

45. Which of the following base is “not” coenzyme
- (A) Biotin
 - (B) pyridoxal phosphate
 - (C) Coenzyme A
 - (D) None of above
46. In polymerization of nucleotides, the hydroxyl groups to which the phosphoric acid is esterified are those bounded to the 3' and 5' carbons on adjacent residues. The resulting repeated linkage is
- (A) 3',5'-phosphodiester bond
 - (B) 5',3'-phosphodiester bond
 - (C) Hydrogen bond
 - (D) Glycosidic bond
47. In polymerization of nucleotides, the hydroxyl groups to which the phosphoric acid is esterified are those bounded to the 3' and 5' carbons on adjacent residues. The resulting repeated linkage is
- (A) 3',5'-phosphodiester bond
 - (B) 5',3'-phosphodiester bond
 - (C) Hydrogen bond
 - (D) Glycosidic bond
48. Which protein could promote unwinding DNA replication fork?
- (A) single-strand binding protein
 - (B) helicase
 - (C) DNA gyrase
 - (D) primase
49. Which response element is responsive to CREB?
- (A) heat-shock element
 - (B) glucocorticoid-response element
 - (C) metal-response element
 - (D) cyclin-AMP-response element
50. A buffer solution at pH 10 has a ratio of $[HA]/[A^-]$ of 0.01. What is the pKa of the acid?
- (A) 1
 - (B) 5
 - (C) 8
 - (D) 9