

※ 注意：請於答案卷上依序作答，並應註明作答之題號。

1. 5'-CAU-3' is a codon in mRNA that specifies the amino acid histidine in the position 58 of human hemoglobin alpha. (6 points)
  - (a) What is the corresponding anticodon in tRNA?
  - (b) What is the corresponding triplet in the coding DNA strand?
  - (c) What is the corresponding triplet in the template DNA strand?

Use the following to answer questions 2-13. (1 point/ question)

Regulation in bacteria and phages includes a number of terms. Twelve terms are given below (a-l), followed by twelve statements. Write letter of the correct term. A single letter is sufficient. Not all letters need to be used, and a particular letter may be used more than once.

- a. Temporal control
- b. Positive control
- c. Negative control
- d. Inducible
- e. Noninducible
- f. Repressible
- g. Constitutive
- h. Operator
- i. Repressor
- j. Effector molecule
- k. Feedback inhibition
- l. Suppressor mutation

2. Phenotype with respect to beta-galactosidase synthesis for the partial diploid  
 $I^+ O^+ Z^+ / I^+ O^c Z^-$
3. Phenotype of  $I^+ O^+ Z^- / I^+ O^c Z^+$
4. Phenotype of  $I^+ O^+ Z^- / I^+ O^c Z^-$
5. Phenotype with respect to the synthesis of tryptophan enzymes in the *trp* operon  
 $trp R^+ O^c S^+$  (*trp R* codes for repressor; *S* = structural gene).
6. Phenotype of  $trp R^+ O^+ S^+$  in the presence of tryptophan.
7. Regulatory molecule must be present at site in DNA so that transcription occurs.
8. Small molecules that bind to regulatory molecule, such as repressor.
9. During lytic cycle of lambda phage, genes concerned with DNA replication are transcribed before genes specifying head proteins, which are transcribed before tail proteins.
10. Mutation that reverses effect of another mutation at a different site
11. Type of operons responding to catabolites repression.
12. Post-translational control of biosynthetic pathway.
13. Regulatory molecule that binds to operator region in DNA

For questions 14-18: match each of the numbered words with the following cell components in mammalian cells. Again, each cell component may be used once, more than once, or not at all. (1 point/ question)

- a. Nuclear envelope
- b. Nucleolus
- c. Euchromatin
- d. Heterochromatin
- e. Nuclear lamina

14. Site of synthesis of histone mRNA
15. Site of transcriptionally inactive DNA
16. Site of protein synthesis
17. Site of transcription by RNA polymerase II
18. Site of 45S rRNA processing

接背面

Question 19-23: match each of the numbered words with the following enzymes. Again, each enzyme may be used once, more than once, or not at all. (1 point/ question)

- a. Helicase
- b. 3' to 5' exonuclease
- c. Ligase
- d. Topoisomerase II
- e. Primase

- 19. Catalyzes double-strand cuts to facilitate unwinding of DNA
- 20. Enhances separation of DNA strands during replication
- 21. Covalently connects segments of DNA
- 22. Synthesizes short segments of RNA
- 23. Resolves catenated DNA

24. Which of the following is true for both prokaryotic and eukaryotic gene expression? (2 points)

- (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 may bind at a promoter region upstream from the gene
- (D) mRNA is synthesized in its 3' to 5' direction
- (E) mRNA is always collinear with the gene from which it was copied.

Please choose the most appropriate terms/phrases/statements that complete or answer the questions 25-39. Attention: More than one of the choices provided may be correct in some cases. (3 points for each question)

25. Which of the following statement(s) is (are) true about the protein?

- A) Three-dimensional structure is specified by amino acid sequence.
- B) Secondary structures are the core elements of protein architecture.
- C) Motifs are regular combinations of tertiary structures.
- D) Structure and functional domains are modules of tertiary structure.
- E) Folding of proteins in vivo is promoted by Ubiquitin.

26. Which of the following statement(s) is (are) true about the protein?

- A) Turns composed of nine of ten residues.
- B) Turns are located on the surface of a protein.
- C) Turns are forming smooth ends that redirect the polypeptide backbone back toward the interior.
- D) Turns are short, U-shaped tertiary structure.
- E) Turns are stabilized by a hydrogen bond between their end residues.

27. Which of the following statement(s) is (are) true about the motor proteins?

- A) The ability to transduce a source of energy, either UTP, or GTP.
- B) The ability to bind a cytoskeletal filament and protein complex.
- C) The ability to bind a nucleic acid strand.
- D) The ability to transport cargo chromosomes and membrane-limited vesicles.
- E) Net movement in a given direction or several directions.

28. Which of the following statement(s) is (are) true about the protein?

- A) Centrifugation separates proteins on the basis of their rates of sedimentation, which are influenced by their mass and shapes.
- B) The three-dimensional structures of proteins containing about as many as 200 amino acids can be studied with nuclear magnetic resonance spectroscopy.

- C) Electrophoresis separates molecules on the basis of their charge : shape ratio.  
D) Gel filtration chromatography resolves proteins by mass and charge.  
E) Liquid chromatography resolves proteins by charge or binding affinity.
29. Which of the following statement(s) is (are) true about protein biosynthesis?  
A) Translation initiation usually occurs at the first AUG.  
B) During chain elongation each incoming aminoacyl-tRNA moves through two ribosomal sites  
C) Polysomes and rapid ribosome recycling increase the efficiency of translation.  
D) Hydrolysis of the bound ATP is accompanied by cleavage of peptide chain from tRNA in the P site and release of the tRNAs and the two ribosomal subunits.  
E) Of the two methionine tRNAs found in all cells, only one functions in initiation of translation.
30. Which of the following statement(s) is (are) true?  
A) Host-cell ribosomes, tRNAs, and translation factors are used in the synthesis of all viral proteins in infected cells.  
B) Lytic infection occurs when the viral genome is integrated into the host-cell DNA and generally does not lead to cell death.  
C) Tumor viruses may have an RNA or a DNA genome.  
D) Release of enveloped viruses occurs by budding through the host-cell Golgi membrane.  
E) Most RNA viruses encode enzymes that can transcribe the DNA into viral mRNA.
31. Which of the following statement(s) is (are) true about membrane?  
A) The total surface area of internal membranes far exceeds that of the plasma membrane.  
B) Lipid rafts are microdomains containing phosphatidylcholine.  
C) Biomembranes make themselves selectively permeable to water-soluble.  
D) Biomembranes make themselves selectively permeable to ions.  
E) Most lipids and many proteins are laterally mobile in biomembranes.
32. Which of the following statement(s) is (are) true about membrane?  
A) All transmembrane proteins and glycolipids are asymmetrically oriented in the bilayer.  
B) Short-chain lipids attached to certain amino acids anchor some proteins to one or the other membrane leaflet.  
C) Lipid-binding motifs in peripheral proteins interact with the non-polar head group of membrane phospholipids.  
D) Some peripheral proteins associate with the membrane by interactions with integral proteins.  
E) Interactions with the cytoskeleton impede the mobility of integral membrane proteins.
33. Which of the following statement(s) is (are) true?  
A) DNA editing changes the proteins encoded by mRNA.  
B) Splicing consists of two transphosphorylation reactions.  
C) Many of the steps in the splicing process require GTP hydrolysis.  
D) Some RNA can undergo self-splicing in the absence of protein.  
E) Small nuclear RNAs in spliceosomes are regulators of splicing reactions.
34. Which of the following statement(s) is (are) true?  
A) Organells and macromolecules can be separated by low-speed centrifugation.  
B) Much of what we know about the molecular biology of the cell has been discovered by studying in cell systems.  
C) Confocal scanning provide sharp images of two-dimensional objects.  
D) Fluorescence microscopy can localize specific molecules in fixed and live cells.  
E) Fluorescence microscopy can quantify specific molecules in fixed and live cells.

35. Which of the following statement(s) is (are) true?
- A) Single-stranded DNA absorbs light less effectively than does double-helical DNA.
  - B) The absorbance of a DNA solution at a wavelength of 260 nm increases when the double helix is melted into single strands.
  - C) The double helix can be reversibly melted.
  - D) RNA and DNA differ in the sugar component and two of the bases.
  - E) Stem-loop structures may be formed from single-stranded DNA and RNA molecules.
36. Which of the following statement(s) is (are) true?
- A) All cellular RNA is synthesized by RNA polymerases.
  - B) Transcription begins near promoter sites and ends at UGA sites.
  - C) Most eukaryotic genes are mosaics of introns and exons.
  - D) Exons must encode protein domains.
  - E) DNA is replicated by RNA polymerases that take instruction from templates.
37. Which of the following statement(s) is (are) true?
- A) Selected DNA or RNA sequences can be greatly amplified by the polymerase chain reaction.
  - B) The eukaryotic DNA is wrapped around nuclear RNA, transcriptional factors, and histones.
  - C) The control of gene expression requires chromatin remodeling and DNA modification.
  - D) Genomic DNA can be expressed in different host cells.
  - E) Gene expression analysis using microarrays can determine initial tumor genes.
38. Which of the following statement(s) is (are) true?
- A) In general, splice sites are not tissue specific.
  - B) In general, the spliceosome for splicing is generic.
  - C) Nucleotide sequences signal when splicing occurs.
  - D) snRNAs are required for forming a spliceosome.
  - E) The spliceosome uses ATP hydrolysis to produce complex series of DNA-RNA rearrangements.
39. Which of the following statement(s) is (are) true?
- A) N-linked glycoproteins acquire their initial sugars from Dolichol donors in the Golgi.
  - B) Glucose residues are added and trimmed to aid in protein folding.
  - C) Oligosaccharide can be determined.
  - D) Influenza virus binds to sialic acid residues.
  - E) Lectins are general carbohydrate-binding proteins.
40. Reverse transcriptase has ribonuclease activity as well as polymerase activity. What is the role of its ribonuclease activity? (5 points)
41. Why is RNA synthesis not as carefully monitored for errors as is DNA synthesis? (5 points)
42. How do prokaryotes and eukaryotes differ in the timing of DNA synthesis before cell division (5 points)
43. What is one possible reason why nonstandard base pairing (wobble) is allowed during protein synthesis (5 points)
44. If proteins are suspended in buffers containing mercaptoethanol, disulfide bonds are broken. Would this be detectable by sedimentation? Explain (5 points)