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**Part I: single-choice question (60%)**

1. Which of the following is a negatively charged amino acid?
  - a. alanine
  - b. aspartate
  - c. glutamine
  - d. histidine
  - e. none of the above
2. Which of the following is defined as the tertiary structure of a protein?
  - a. the primary amino acid sequence
  - b. structural domains such as a DNA binding domain
  - c. folded structures such as an  $\alpha$  helix
  - d. structural features such as a turn
3. Which of the following is not part of a zinc-finger motif?
  - a. zinc ion
  - b. proline residue
  - c. cysteine residue
  - d. histidine residue
4. All the following statements about molecular chaperones are true except
  - a. They play a role in the proper folding of proteins.
  - b. They are located in every cellular compartment.
  - c. They are found only in mammals.
  - d. They bind a wide range of proteins.
5. Which of the following plays a role in the degradation of proteins?
  - a. chaperonin
  - b. ubiquitin
  - c. proteasome
  - d. b and c
  - e. all of the above
6. Which of the following is a mechanism for regulating protein activity?

(背面仍有題目,請繼續作答)

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- a. proteolytic processing  
b. phosphorylation/dephosphorylation  
c. ligand binding  
d. b and c  
e. all of the above
7. Kinases, which are responsible for the activation or inactivation of a number of proteins, serve to add phosphate groups onto
- a. tryptophan residues.  
b. serine residues.  
c. cysteine residues.  
d. a and c.  
e. none of the above
8. Which of the following methods can separate proteins based on their mass?
- a. centrifugation  
b. ion exchange chromatography  
c. SDS polyacrylamide gel electrophoresis  
d. a and c  
e. all of the above
9. The ability of DNA to denature is important for which process?
- a. DNA synthesis  
b. nucleic acid hybridization experiments  
c. RNA synthesis  
d. all of the above
10. Which of the following are removed from mRNAs during processing?
- a. exons  
b. noncoding sequences  
c. RNA cap structure  
d. poly(A) tail
11. Which of the following is a protein that is involved in translation?
- a. topoisomerase

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- b. ribosomal RNA
- c. RNA polymerase
- d. aminoacyl-tRNA synthetase

12. An enzyme that breaks DNA, dispels the tension, and reseals the strand ahead of a DNA replication growing fork is called a(n)

- a. topoisomerase.
- b. DNA polymerase.
- c. phosphodiesterase.
- d. aminoacyl-tRNA synthetase.

13. The polymerase chain reaction (PCR) technique can be used for

- a. direct isolation of a specific segment of genomic DNA.
- b. preparation of probes.
- c. synthesis of RNA from genomic DNA.
- d. a and b
- e. all of the above

14. A mutation that changes the recognition sequence for the restriction enzyme *EcoRI* from GAATTC to GATTTC is an example of a

- a. restriction fragment length polymorphism (RFLP).
- b. single nucleotide polymorphism (SNP).
- c. simple sequence repeat (SSR).
- d. a and b
- e. all of the above

15. What method can be used to functionally inactivate a gene without altering its sequence?

- a. gene knockout
- b. RNA interference
- c. dominant negative mutation
- d. b and c
- e. all of the above

16. In RNA interference studies, the double-stranded RNA

- a. disrupts the target DNA sequence.

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- b. results in the destruction of the target mRNA.
- c. destroys the target protein.
- d. all of the above

17. Open reading frame (ORF) analysis is not effective in identifying genes in higher eukaryotes because of the presence of

- a. promoters.
- b. enhancers.
- c. introns.
- d. repetitious DNA.

18. DNA that is transcriptionally active

- a. is more susceptible to DNase I digestion.
- b. is tightly packed into a solenoid arrangement.
- c. contains unacetylated histones.
- d. is more condensed than nontranscribed DNA.

19. All of the following statements about the essential carboxy terminal domain (CTD) of RNA polymerase are true except

- a. The CTD is present in RNA polymerase I, II, and III.
- b. The CTD can become phosphorylated.
- c. The CTD is critical for viability.
- d. The CTD of mammals contains more than 50 repeats of a heptapeptide.

20. The TATA box

- a. serves as a promoter sequence for genes transcribed by RNA polymerase III.
- b. is located approximately 100 base pairs upstream of the start site for mRNAs.
- c. is present in all eukaryotic genes.
- d. acts to position RNA polymerase II for transcription initiation.

21. Which of the following is not a structural motif found in a DNA-binding domain?

- a. homeodomain
- b. zinc-finger
- c. helix-loop-helix
- d. random-coil acidic domain

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22. All the following statements about heterochromatin are true except

- a. Heterochromatin stains more darkly with DNA dyes than does euchromatin.
- b. Heterochromatin contains more highly condensed DNA than does euchromatin.
- c. Heterochromatin is associated with inactive genes.
- d. Heterochromatin is more susceptible to DNaseI than is euchromatin.

23. Lipid soluble hormones activate transcription by

- a. binding to specific cell-surface receptors.
- b. phosphorylating a protein kinase.
- c. binding to a nuclear receptor.
- d. inhibiting a histone deacetylase.

24. Indicate the order in which the following steps occur in the production of a mature mRNA.

- a. initiation of transcription, splicing, addition of 5' cap, addition of poly(A) tail, transport to cytoplasm
- b. initiation of transcription, addition of 5' cap, splicing, addition of poly(A) tail, transport to cytoplasm
- c. initiation of transcription, addition of poly(A) tail, addition of 5' cap, splicing, transport to cytoplasm
- d. initiation of transcription, addition of 5' cap, addition of poly(A) tail, splicing, transport to cytoplasm

25. microRNAs play a key role in which of the following?

- a. translational repression
- b. viral RNA degradation
- c. RNA interference
- d. all of the above

26. Cholesterol mixes with phospholipids in a biomembrane because cholesterol molecules are

- a. amphipathic.
- b. steroid derivatives.
- c. entirely hydrophobic.
- d. phospholipid derivatives.

27. The discovery of green fluorescent protein (GFP) has greatly facilitated living cell experiments because

- a. GFP is green.
- b. GFP requires a jellyfish-specific cofactor.
- c. GFP sequences may be readily fused to those of other proteins.

(背面仍有題目,請繼續作答)

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d. wild-type GFP folding is adapted to normal seawater temperatures, 15–25°C.

28. Which of the following is not a common intracellular second messenger

- a. inositol 1,4,5-trisphosphate (IP<sub>3</sub>)
- b. 1,2 diacylglycerol (DAG)
- c. adenosine triphosphate (ATP)
- d. 3'-5' cyclic guanine monophosphate (cGMP)

29. Which of the following is a protein kinase?

- a. EGF receptor
- b. erythropoietin receptor
- c. STAT5
- d. a and b
- e. all of the above

30. The plasma membrane of eukaryotic cells is supported by

- a. actin filaments.
- b. microtubules.
- c. lamins.
- d. intermediate filaments.

31. Lamellipodia are located

- a. at a moving cell's trailing edge
- b. at a moving cell's leading edge
- c. around the entire periphery of a non motile cell
- d. throughout the cytosol of a moving cell

32. Which of the following occurs during anaphase A?

- a. The spindle elongates.
- b. Kinetochores remain attached to shortening kinetochore microtubules.
- c. Chromosomes move to the spindle equator.
- d. The spindle poles move closer together.

33. During which stage of the cell cycle is the chromosome content of a mammalian liver cell 1n?

- a. G<sub>1</sub>

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- b. S
- c. G<sub>2</sub>
- d. M
- e. none of the above

34. Which of the following are pro-apoptotic proteins?

- a. Bad
- b. Bax
- c. Bcl-2
- d. a and b
- e. a and c

35. In human embryos, the gene for insulin-like growth factor 2 is active on the copy of chromosome 11 that came from the father but inactive on the chromosome that came from the mother. This is an example of

- a. induction.
- b. imprinting.
- c. differentiation.
- d. dosage compensation.

36. Which of the following is characteristic of malignant tumors?

- a. localized to tissue of origin
- b. metastatic
- c. well differentiated
- d. b and c
- e. all of the above

37. Which of the following promotes angiogenesis?

- a. EGF
- b. PDGF
- c. TGF $\beta$
- d. VEGF
- e. all of the above

38. Telomerase

- a. induces apoptosis.

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- b. contains reverse transcriptase.
- c. is inactivated by Bcl-2.
- d. is active in all normal adult cells.
- e. all of the above

39. Hereditary cancers typically possess loss-of-heterozygosity in

- a. proto-oncogenes.
- b. tumor-suppressor genes.
- c. both a and b
- d. neither a nor b

40. Patients with an X-linked inherited disease called Hyper IgM (XHIGM) syndrome have a deficiency CD40 ligand, a protein found on the surface of T lymphocytes. Patients with XHIGM are unable to make the class switch between IgM and either IgA or IgG. From this information you could conclude that

- a. B-cell production of IgM does not depend on the CD40 ligand.
- b. the class switch between IgM and either IgA or IgG requires T cells.
- c. the switch between membrane-bounded IgM and secreted IgM requires T cells.
- d. Both a and b are correct.
- e. Both b and c are correct.
- f. all of the above

**Part II: short-answer question**

1. Describe how modification of histone tails can control chromatin condensation. (5%)
2. Describe how the electrophoretic mobility shift assay (EMSA), DNA affinity precipitation assay (DAPA), chromatin immunoprecipitation (ChIP) assay and DNase I footprinting techniques are used to identify DNA-protein interactions. (10%)
3. What stimulus is required for quiescent cells to reenter the cell cycle? What events occur after stimulation? (10%)
4. Explain the activation of apoptosis pathways. (10%)
5. Please define the following terms: (5%)
  - (a) genetic and epigenetic
  - (b) heterozygous and homozygous
  - (c) heterochromatin and euchromatin
  - (d) benign and malignant
  - (e) knockdown and knockout