

1. Describe the functions of the following proteins: (10%)
  - (a) V-type ATPase
  - (b) translocon
  - (c) NSF (N-ethylmaleimide-sensitive factor)
  - (d) caspases
  - (e) cyclin-dependent kinases
2. The following key proteins are involved in the transport of glucose from the lumen of the intestine to the blood:  $\text{Na}^+\text{K}^+$ -ATPase, SGLT1  $\text{Na}^+$ /glucose symporter, and GLUT5 uniporter. Describe how these key proteins work together to accomplish the above-mentioned glucose transport. (5%)
3. Biosynthesis of the vesicular stomatitis virus (VSV) membrane glycoprotein, G protein, in cultured mammalian cells has facilitated our understanding of protein trafficking. Design experiments to verify that newly synthesized VSV G proteins are transported from ER to Golgi to the plasma membrane. (5%)
4. Nitroglycerin is a drug widely used to relieve angina pectoris (心絞痛) associated with reduced blood flow in the heart. The drug sildenafil (Viagra) is used to treat impotence by stimulating erection of the penis. Both drugs regulate the levels of second messengers in order to relax smooth muscle. What are the involved second messengers? Describe the signaling pathway regulated by both drugs. (5%)
5. Please discuss the functions of chaperones, ubiquitin and proteasome (6%)
6. Show a few examples of biological membrane fusion (4%).
7. Describe how eukaryotic cell mitochondria is involved in apoptosis; one type of programmed cell death. (10%)
8. Describe how cells use microtubules to transport molecules to various cellular localizations. (5%).
9. Please explain following terms (12 %)
  - a. Zinc finger
  - b. Reporter gene
  - c. Electrophoretic mobility shift assay (EMSA)
  - d. Northern blotting

- e. Mediator
  - f. Polymerase chain reaction
10. In eukaryotes, the most gene promoters are restricted by nucleosomes. How do the genes remove these potential structure barriers for initiation of transcription? (6 %)
11. (a) A protein contains 300 amino acids. Is it translated by a mature mRNA containing 900 bases? Explain your answer. (3 %)
- (b) We want to clone a promoter for study of gene regulation. Can we clone it from a cDNA library? Explain your answer. (4 %)
12. Describe (a) two functions of DNA supercoiling, (3 %) (b) the structural features of a replication origin. (2 %)
13. (a) List three proteins or enzymes, other than DNA polymerase III, that are found at the replication fork in *E. coli*; describe each of their functions. (6 %)
- (b) Prolonged exposure to ultraviolet light can induce SOS response in *E. coli* as the normal DNA repair mechanisms are not up to the task of repairing the damage. Describe briefly the process of SOS response. (4 %)
14. Briefly describe the role of the following components involved in protein synthesis. (10 %)
- (a) 16S RNA
  - (b) Elongation factor G (EF-G)
  - (c) Nonsense suppressor tRNA
  - (d) Signal (leader) peptide
  - (e)  $N^{10}$ -formyltetrahydrofolate