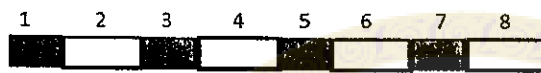


1. Taxol, a natural compound isolated from the Pacific yew tree, is known to stabilize microtubules. Please explain why this drug can be used in the treatment of many solid tumor cancers. (5%)

2. The open reading frame of *Multispin* gene is showed in the figure below. Please specify the transmembrane, intracellular and extracellular domain (a), and potential glycosylation and phosphorylation sites in which segment (b). (10%)



■ Hydrophobic segment

□ Hydrophilic segment

3. What is the difference between simple and facilitated diffusion? (5%)

4. How do the rough endoplasmic reticulum and the Golgi apparatus act in the production and secretion of proteins? (5%)

5. Somatic cells can be reprogrammed into pluripotent stem cells (iPSCs). List the master Yamanaka's factors for iPSCs. (4%)

6. Describe five different characteristics of autophagy. (10%)

7. Aneuploidy, an aberrant number of chromosomes, is mainly defective in spindle assembly and position checkpoints. Please indicate the mechanism underlying spindle assembly checkpoint. (6%)

8. Post-translational modifications (PTM) of histones are important biological processes in cellular responses. Please list five different types of histone PTMs. (5%)

9. Both eukaryotic mRNA and micro RNA (miRNA) are transcribed by RNA polymerase II (Pol II) (10%)

(a) What are the functions of mRNA and miRNA?

(b) Please describe the processing of mRNA and miRNA.

(c) Please describe the feature of the largest subunit of Pol II and its roles in transcription.

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10. Most eukaryotic promoters are positively regulated by activator proteins (9%)

- (a) Why are regulated by activators, not by repressors?
- (b) How do activators activate transcription generally?

11. Please select the required materials for PCR cloning from the following: genomic DNA, RNA, reverse transcriptase, RNA polymerase, Thermostable DNA polymerase, a pair of primers from sequences of mRNA coding region, a pair of primers from sequences of gene upstream, a pair of primers from complete mRNA, Deoxynucleoside triphosphates (dNTPs), Nucleoside triphosphates (NTPs) (6%).

- (a) A gene cloning for protein expression
- (b) A gene promoter for reporter analysis

12. At a specific area of a chromosome, the sequence of nucleotides below is present where the chain opens to form a replication fork:

3'- CCTAGGCTTGCAATCC-5'

An RNA primer is formed starting at the underlined T (T) of the template. What is the primer sequence (write it in the 5' to 3' direction)? (3%)

13. Describe the role of enzymes necessary for repairing a thymine dimer found on chromosomes by nucleotide excision repair. (6%)

14. (a) In *E. coli*, there is a mutation in a gene called *dnaB* that alters the helicase that normally acts at the origin. What would you expect as a result of this mutation? (2%)

(b) What is the function of topoisomerase during DNA replication? (2%)

(c) A biochemist isolates and purifies various molecules needed for DNA replication. When he adds some DNA, replication occurs, but each DNA molecule consists of a normal strand paired with numerous segments of DNA a few hundred nucleotides long. What has he probably left out of the mixture? (2%)

15. Describe the role of stop codons in the termination of protein synthesis. (5%)

16. What ensures fidelity in protein synthesis? (3%) How does this compare with the fidelity of replication? (2%)

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