

- I. Multiple choice. 30% (0.5% penalty for incorrect answers)
- All of the following molecules are carbohydrates **except**
A. lactose. B. cellulose. C. hemoglobin. D. glycogen. E. starch.
 - Which of the following is **not** a part of the endomembrane system?
A. mitochondria.
B. Golgi apparatus.
C. rough endoplasmic reticulum.
D. lysosomes.
E. smooth endoplasmic reticulum.
 - All of the structures listed below are associated with movement in cells or by cells **except**
A. cilia. B. dynein. C. myosin. D. peroxisomes. E. flagella.
 - Plants that fix CO₂ into organic acids at night when the stoma are open and carry out the Calvin cycle during the day when the stoma are closed are called
A. C₃ plant. B. C₄ plant. C. CAM plants. D. A and B. E. A, B, and C.
 - Receptor down-regulation occurs on the membrane of the cell,
A. when receptors are occupied by ligands for prolonged periods of time.
B. the cell become desensitized.
C. when the receptor regulated to respond to the cell that initiates changes in cell function.
D. when the affinity of the receptor is increased.
E. when the receptors are invaginated.
 - Cell signals in the induction of apoptosis in the infected cell by the killer lymphocytes include
A. the binding of the lymphocyte Ras ligand protein to the Ras receptors on the surface of the infected cell.
B. Ras receptor aggregation resulting in the adaptor proteins to the cluster.
C. assembling of the procaspases at the site of receptor clustering.
D. caspases activation.
E. swelling and rupture of the infected cells.
 - Regarding the coated vesicles found within eukaryotic cells, which is (are) correct?
A. clathrin coated vesicles are involved in the selected transport of protein from TGN to endosome.
B. clathrin coated coated vesicles are involved in the selected transport of material from the ER to the Golgi.
C. COP I-coated vesicles facilitate bidirectional transport of protein between the ER and Golgi complex.

(背面仍有題目,請繼續作答)

- D. COPII-coated vesicle are involved in the endocytosis of receptor ligand complexes from the plasma membrane.
- E. COP II -coated vesicles facilitate bidirectional transport of protein between cisternae of the Golgi complex.
8. Inhibitory neurotransmitters cause the opening of _____ channels and make it more difficult to stimulate the action potential.
- A. Na^+ B. K^+ C. Cl^- D. Ca^{++} E. Mg^{++}
9. In a chromosome, which of the following is true?
- A. RNAs of different genes can be transcribed off either DNA strand, always 5' 3'.
- B. RNAs of different genes can be transcribed off either DNA strand, always 3' 5'.
- C. The RNAs of all genes are synthesized 5' 3' off the same DNA strand.
- D. The RNAs of all genes are synthesized 3' 5' off the same DNA strand.
- E. Different genes can be transcribed off either strand, some in the 5' 3' direction and some in the 3' 5' direction.
10. Which of the following acts before the others?
- A. tRNA alignment with mRNA
- B. Aminoacyl-tRNA synthetase
- C. RNA polymerase
- D. Amino acid chain elongation
- E. Ribosome movement to the next codon
11. In eukaryotes, the enzyme that primarily transcribes the nucleolar organizer is
- A. RNA polymerase I
- B. RNA polymerase II
- C. RNA polymerase III
- D. primase
- E. reverse transcriptase
12. DNA methylation may be a significant mode of genetic regulation in eukaryotes. Methylation refers to
- A. altering RNA polymerase activity by methylation.
- B. changes in DNA-DNA hydrogen binding.
- C. altering translational activity especially of highly methylated tRNAs.
- D. alteration of DNA polymerase activity by addition of methyl groups to glycine residues.
- E. addition of methyl groups to the cytosine of CG doublets.
13. Which of the following statements are true about genome size?
- A. DNA content of the haploid genome is related to the morphological

complexity eukaryotes.

- B. The minimal genome size found in each phylum increases from prokaryotes to mammals.
- C. Nonrepetitive DNA complexity can estimate the genome size.
- D. Repetitive DNA complexity can estimate the genome size.
- E. The larger the genome, the more genes it encodes.
14. Which of the following statements are false about a T_m value?
- A. When denature nonrepetitive DNA, the duplex molecules melt sharply.
- B. When denature repetitive DNA, the duplex molecules melt sharply.
- C. When denature nonrepetitive DNA, the lower the T_m value.
- D. When denature repetitive DNA, the lower the T_m value.
- E. Addition of formamide or urea that form hydrogen bonds with pyrimidine and purine will increase T_m value.
15. The unit of DNA in which an individual act of replication occurs is called the _____.
- A. replisome
- B. chromosome
- C. genome
- D. replicon
- E. transposon

II. Assay questions. 70%

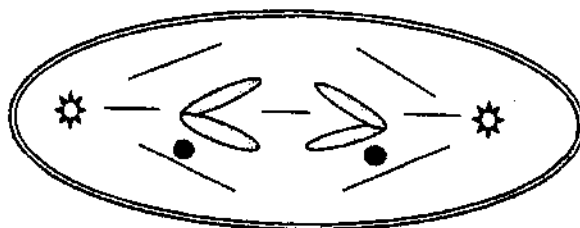
1. You have cloned a cDNA of unknown function. How could you experimentally determine the subcellular localization of the protein it encodes? (6%)
2. *RecA* mutants of *E. coli* are sensitive to UV irradiation in addition to being recombination-deficient. Why? (6%)
3. According to the following points, compare the use of sodium ions and calcium ions as intracellular signals. (10%)
- (a) what happens when sodium ions rush into a cell? What happens when the cytosolic calcium concentration rises? What is the difference?
- (b) Why would it be better to use calcium ions as a second messenger rather than sodium ions, if the ion must bind to a protein as part of a signal transduction pathway?
4. Vinblastin is a drug that interferes with the assembly of microtubule. It is widely used for chemotherapy in treating cancer patients. Suggest a hypothesis to explain

how vinblastin slows tumor growth. (3%)

5. The hyaluronic acid (HA) and proteoglycan combine into molecular superstructures (HA-GAG). What are the functions of the known largest biological molecule HA-GAG in the extracellular matrix? (3%)
6. MPF includes both CDK2 (CDC2) and cyclins. The activities of MPF fluctuate through cell cycle. Please explain how and why MPF fluctuates. (3%)
7. There are various forms of DNA conformation, i.e., A, B, and Z-forms. Please distinguish among these 3 forms of DNA. (3%)
8. Sketch a replication fork of bacterial DNA in which one strand is being replicated discontinuously and the other is being replicated continuously. List at least six different enzyme activities associated with the replication process, identify the function of each, and indicate on your sketch where each would be located on the replication fork. In addition, identify the following features on your sketch: DNA template, RNA primer, Okazaki fragments, and single-strand binding protein. (4%)
9. (a) What is meant by the term *pseudogene*? Give an example. (3%)
(b) Present a general definition for a multigene family. (3%)
10. Knowing that the base sequence of any given messenger RNA is responsible for precisely ordering the amino acids in a respective protein, present two mechanisms by which intrinsic properties of mRNA may regulate the "net output" of a given gene. (4%)
11. Assume that you are examining a cell under a microscope and you observe the following as the total chromosomal constituents of a nucleus. You know that $2n=2$ in this organism, that all chromosomes are metacentric, and that each G1 cell nucleus contains 8 picograms of DNA. (4%)

(a) Select the correct stage for this cell:

- A. anaphase of mitosis,
- B. anaphase of meiosis I,
- C. anaphase of meiosis II,



D. telophase of mitosis.

(c) How many picograms of chromosomal DNA would you expect in the cell shown above?

12. Illustrate the fluid mosaic model of membrane structure and explain the importance of membrane fluidity. (9%)
13. Why are the membrane carrier proteins facilitating passive transport also called a kind of enzymes? What is the possible mechanism for their activity? (9%)