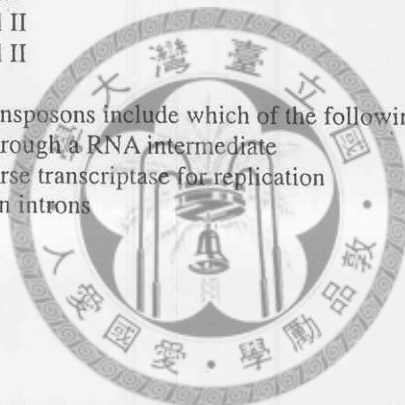


Part I

Questions 1-6: select one best answer (2 points/question)

1. A DNA fragment that comes from the promoter region of a light-inducible gene is spliced to the 5' end of the promoter of another plant gene. The artificially constructed hybrid gene exhibits light inducibility. When a fragment from the original light-inducible promoter is "flipped-over" in its new place, this artificially constructed hybrid gene is also light inducible. The above fragment contains
 - A) A repressor element
 - B) A TATA box
 - C) A CCAAT box
 - D) An enhancer
 - E) A GAGA box
2. Which of the following is the correct order of binding of general transcription factors to initiate transcription at RNA polymerase II controlled promoters
 - A) TFIID, TFIIB, pol II, TFIIF
 - B) Pol II, TFIID, TFIIB, TFIIF
 - C) TFIIB, pol II, TFIIF, TFIID
 - D) TFIID, TFIIF, TFIIB, pol II
 - E) TFIIB, TFIID, TFIIF, pol II
3. True statements about retrotransposons include which of the following
 - I. They replicate through a RNA intermediate
 - II. They utilize reverse transcriptase for replication
 - III. They may contain introns
 - A) I only
 - B) III only
 - C) I and III only
 - D) II and III only
 - E) I, II and III
4. When bacteriophage lambda infects a sensitive bacterium, one of the first mRNA species synthesized is very short, beginning at a site P_L and extending just through an adjacent gene N . After the appearance of the N protein, mRNA becomes much longer, still beginning at P_L but extending far beyond gene N . The gene N encodes
 - A) a protein that stabilizes the longer message
 - B) a new sigma factor acting on a promoter beyond gene N
 - C) an antiterminator acting just beyond gene N
 - D) an antirepressor that removes a protein repressor bound at N
 - E) an activator for a promoter beyond gene N
5. Which of the following is the most sensible order of techniques for mapping a chromosome and then locating a disease gene
 - A) contig alignment, restriction mapping, RFLP linkage analysis, chromosomal walking
 - B) chromosomal walking, contig alignment, restriction mapping, RFLP linkage analysis
 - C) restriction mapping, chromosomal walking, contig alignment, RFLP linkage analysis
 - D) chromosomal walking, restriction mapping, RFLP linkage analysis, contig alignment
 - E) restriction mapping, contig alignment, RFLP linkage analysis, chromosomal walking
6. In *E. coli*, the role of DnaB in DNA replication is to
 - A) bind single stranded DNA to prevent reannealing of the duplex
 - B) unwind the DNA duplex
 - C) ligate adjacent Okazaki fragments
 - D) correct errors introduced by DNA polymerase
 - E) remove positive supercoils that form at the growing fork.



7. In an in vitro protein synthesizing system derived from *E. coli*, the addition of ANY mRNA from the protozoan, *Tetrahymena thermophila* to the *E. coli* translational apparatus (consisting of ribosomes, tRNA and so forth) does not stimulate protein synthesis. Instead, short fragments of polypeptide chains are seen. Addition of a particular tRNA from *Tetrahymena* to the system stimulates the synthesis of proteins of normal length. Interpret these results (5 points)
8. After completing a partial DNase digestion of HeLa cell chromatin, you isolate the DNA, separate it by electrophoresis in an agarose gel, and then stain the gel with ethidium bromide. What pattern of DNA fragments would you expect on the gel? What gel pattern would you expect after a more extensive digest? (8 points)

Part II

Please choose the most appropriate terms/phrases/statements that complete or answer the questions 9-24. Attention: More than one of the choices provided may be correct in some cases. (3 points for each question)

9. Which of the following statement(s) is (are) true about the DNA?
 - A) Two polynucleotide chains running in opposite directions coil around a common axis to form a left-handed double helix.
 - B) Purine bases are on the inside of the helix.
 - C) Pyrimidine bases are on the outside of the helix.
 - D) Phosphate units are on the inside.
 - E) Deoxyribose units are on the outside.
10. Which of the following statement(s) is (are) true about the DNA?
 - A) Adenine is paired with thymine through three hydrogen bonds.
 - B) Guanine is paired with cytosine through two hydrogen bonds.
 - C) A-DNA is a double helix with different characteristics from those of the more common B-DNA.
 - D) The B helix is wider and shorter than A helix.
 - E) Many of the structural differences between B-DNA and A-DNA arise from different puckerings of their ribose units.
11. Which of the following statement(s) is (are) true about the DNA?
 - A) Double-helical nucleic acid molecules contain three grooves.
 - B) These grooves arise because the glycosidic bonds of a base pair are diametrically opposite each other.
 - C) The grooves are lined by potential hydrogen-bond donors and acceptors.
 - D) Z-DNA is a left-handed double helix.
 - E) Under physiological conditions most DNA is in the A form.
12. Which of the following statement(s) is (are) true about the DNA polymerases?
 - A) Two bound metal ions (typically, Cu^{2+}) participate in the DNA polymerase reaction.
 - B) One metal ion binds both the dNTP and the 5'-hydroxyl group of the primer.
 - C) the other ion interacts only with the 3'-hydroxyl group.
 - D) The two metal ions together help stabilize the negative charge that accumulates on the pentacoordinate transition state.
 - E) DNA polymerases are remarkably different in overall shape and they differ substantially in detail.
13. Which of the following statement(s) is (are) true?
 - A) The separation of DNA strands requires specific helicases and GTP hydrolysis.
 - B) Helicases constitute a large and diverse class of enzymes.
 - C) Some of helicases move in a 5' to 3' direction.
 - D) Some of helicases unwind RNA rather than DNA.
 - E) Some of helicases participate in processes such as mRNA editing.

14. Which of the following statement(s) is (are) true?
- A) Type I topoisomerases relax supercoiled DNA structures.
 - B) Type II topoisomerases relax supercoiled DNA structures.
 - C) Supercoiling of DNA is catalyzed by type I topoisomerases.
 - D) Supercoiled DNA structures is catalyzed by type III topoisomerases.
 - E) DNA gyrase is a type of bacterial type II topoisomerases.
15. Which of the following statement(s) is (are) true?
- A) Transcription is catalyzed by RNA polymerase I and II, but not III.
 - B) Transcription is initiated at enhancer sites on the DNA template.
 - C) Sigma subunits of RNA polymerase recognize enhancer sites.
 - D) Sigma subunits of RNA polymerase acts catalytically.
 - E) RNA polymerase must unwind the template double helix for transcription to take place.
16. Which of the following statement(s) is (are) true?
- A) Mitochondria DNA are single-stranded and linear.
 - B) Mitochondria DNA do not contain introns.
 - C) Each mitochondria contains its own splicing factors.
 - D) The codon usage for mitochondria genes is different from chromosomal genes.
 - E) Most of the proteins exist in mitochondria are synthesized in mitochondria.
17. Which of the following statement(s) is (are) true?
- A) RNA editing changes the proteins encoded by mRNA.
 - B) Splicing consists of three transesterification reactions.
 - C) Some RNA can undergo self-splicing in the absence of protein.
 - D) Small nuclear RNAs in spliceosomes are products of splicing reactions.
 - E) Many of the steps in the splicing process require ATP hydrolysis.
18. Which of the following statement(s) is (are) true?
- A) Organells and macromolecules can be separated by ultracentrifugation.
 - B) The molecular details of complex cellular processed can be deciphered in cell-free systems
 - C) Much of what we know about the molecular biology of the cell has been discovered by studying cell-free systems.
 - D) The density-gradient centrifugation in sucrose can separate nucleic acids.
 - E) The density-gradient centrifugation in sucrose can be used to purified virus.
19. Which of the following statement(s) is (are) true?
- A) Mobile genetic elements can move by either trans-positional or conservative mechanisms.
 - B) Trans-positional site-specific recombination can insert mobile genetic elements into any DNA sequence
 - C) Trans-position also has a key role in the life cycle of many viurues.
 - D) In the course of replicative transposition, the DNA sequence of the transposon is copied by RNA polymerases.
 - E) Retrovial-like retrotransposons resemble retrovirus and with a protein coat.
20. Which of the following statement(s) is (are) true?
- A) An operon consists of regulatory elements and protein-encoding genes.
 - B) The lac operator has an asymmetric base sequence.
 - C) The lac repressor protein in the presence of lactose binds to the operator.
 - D) The lac repressor protein in the presence of lactose blocks transcription.
 - E) Ligand binding can induce structural changes in regulatory proteins.

21. Which of the following statement(s) is (are) true?
- A) The nucleosomes are complexes of DNA, RNA, and histones.
 - B) The eukaryotic DNA is wrapped around histones.
 - C) The control of gene expression requires chromatin remodeling.
 - D) Transcriptional activation is mediated by protein-protein interactions.
 - E) Transcriptional repression is mediated by protein-protein interactions.
22. Which of the following statement(s) is (are) true?
- A) In general, splice sites are tissue specific.
 - B) In general, the spliceosome for splicing is generic.
 - C) Nucleotide sequences signal where splicing occurs.
 - D) Hundreds of snRNAs are required for forming a spliceosome.
 - E) The spliceosome uses ATP hydrolysis to produce complex series of RNA-RNA rearrangements.
23. Which of the following statement(s) is (are) true?
- A) Meiotic recombination is initiated by double-strand DNA breaks.
 - B) Telomerase replicates the middle and ends of chromosomes.
 - C) Telomerase recognizes the tip of a C-rich strand of an existing telomere DNA repeat sequence.
 - D) Telomerase recognizes an existing telomere DNA repeat sequence and elongates it in the 3' to 5' direction.
 - E) Telomere length is regulated by cells and organisms.
24. Which of the following statement(s) is (are) true?
- A) The ability of a molecule to pass through a gel depends on both the size and the shape of a molecule.
 - B) The nicked circle has a higher mobility than a linear molecule (the same size of molecules).
 - C) A supercoil has higher mobility than a nicked circle (the same size of molecules).
 - D) In general, the mobility of the same size of molecules: supercoil > nicked circle > linear form.
 - E) If a single twist is introduced into a covalent circle, the mobility of the DNA decreases.
25. Why would replication come to a halt in the absence of topoisomerase II? (5 points)
26. The sequence of part of an mRNA is 5'-AUGAACCAGGC-3'. What is the sequence of the DNA coding strand? Of the DNA template strand? (5 points)
27. Would you expect the reaction between specific antibody and a protein antigen (assayed in any way) to depend on whether the protein is native or denatured? Explain (5 points)
28. In two-dimensional chromatography and electrophoresis, does it matter which is done first? Explain (3 points)
29. Will two molecules having the same molecular weight and charge have the same mobility? Explain (3 points)
30. Please briefly describe what "rapid amplification of cDNA ends (RASE)" can contribute in research. Explain its experimental procedure. (6 points)