

答卷注意事項：

I-II 兩大題*請在試卷【答案卷】內作答；

III-IV 兩大題*請在【電腦卡】內，以 2B 鉛筆作答。

I. Please answer the following questions briefly (3 簡答題，共有 13 分)

(1). Choose (A) or (B)，二選一作答 4%

(A) Describe and give the results of an experiment that shows the sequence (UACUAAC) within a yeast intron is required for splicing

(B) Describe and show the results of an experiment that demonstrates that the sequence (UACUAAC) within a yeast intron dictates [主導] splicing to an AG downstream.

(2). Describe and show the results of an experiment that indicates poly(A) is at the 3' end of mRNAs. (hint: RNase A cuts after the pyrimidine nucleotide C and U; RNase T1 cuts after G nucleotide; Base hydrolysis) 4%

(3). γ -Interferon (IFN γ) is a cytokine released by antigen-stimulated T-helper lymphocytes. When IFN γ binds to a specific receptor that is present on cell surface, it induces expression of a number of genes, producing an antiviral state. What is the model of IFN γ -mediated gene activation? 5%

II. Please fill-in the blanks (6 填充題，共有 12 分)

(1). Moderately repeated DNA includes the tandemly repeated genes encoding _____ (give the name of one gene).

(2). _____ are the short stretches of 1000-2000 bases produced during discontinuous replication.

(3). In the absence of hormone, glucocorticoid receptor is bound in a complex with _____.

(4). Assembly of the initiation complex on tRNA genes begins by binding of a _____ to the promoter.

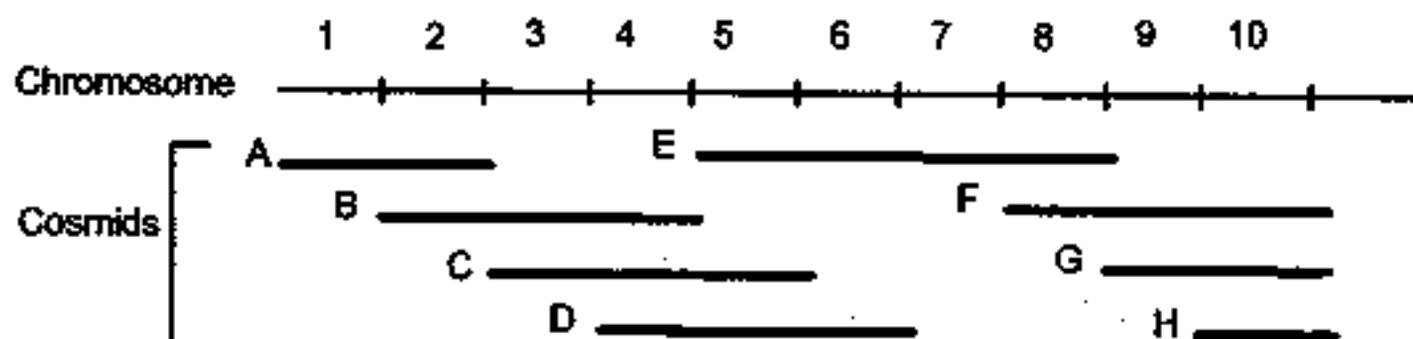
(5). A cloned fragment of DNA was sequenced by using the dideoxy chain termination method. A part of the autoradiogram of the sequencing gel is represented here.

ddA ddG ddC ddT



Deduce the nucleotide sequence of the DNA nucleotide chain synthesized from the primer. Label the 5' and 3' ends (_____).

- (6) A cotig for one region of human chromosome 2 (divided into 10 subregions) is as follows, where A through H are cosmids:



A cloned gene pBR322-x hybridized to cosmids C, D, and E. What is the approximate location of this gene x on the chromosome? Your answer is ().

以下 III-IV 兩大題中 標記之各題號 (1-30)
為作答於電腦卡上之題號

III. Select the best answer that fits the statement (16 單選題 每題 2.5 分,共有 40 分)

- Which of the following features would you NOT expect to find in heterogeneous nuclear RNA (hnRNA)?
 - intron
 - exon
 - poly adenylation at 3'-end
 - 5'-"cap" structure
 - none
- Which of the following is NOT part of RNA processing in eukaryotes?
 - splicing of exon
 - addition of a poly A tail
 - addition of a 5' cap
 - reverse transcription
 - intron removal
- A messenger RNA is 336 nucleotides long, including the initiator and stop codons. The number of amino acids in the protein translated from this mRNA is:
 - 111
 - 168
 - 336
 - 672
 - 112

4. Which of the following is the normal cause of chain termination in protein synthesis?
- A. the tRNA corresponding to a chain-termination triplet cannot bind an amino acid.
 - B. mRNA synthesis stops at a chain termination triplet.
 - C. No normal tRNA molecule has an anticodon complementary to any of the chain-termination triplet
 - D. The stop codons cannot be recognized by suppressor tRNAs.
 - E. No molecule is necessary to cause the termination.
5. Which of the following is NOT a feature of eukaryotic gene expression?
- A. mRNA is often extensively modified before translation
 - B. many genes are interrupted by non-coding DNA sequences
 - C. RNA synthesis and protein synthesis are coupled as in prokaryotes
 - D. polycistronic mRNAs are very rare
 - E. multiple copies of nuclear genes, and pseudo genes can occur
6. Which of the following is NOT involved in regulation of eukaryotic gene activity?
- A. active genes in euchromatin, and inactive genes in heterochromatin
 - B. amplification of some genes such as rRNA genes
 - C. regulation of mRNA stability
 - D. spliceosomes that stimulate synthesis of intron-containing hnRNAs
 - E. enhancers that can stimulate specific promoters
7. Which of the following is NOT part of the lac operon of E. coli?
- A. gene for RNA polymerase
 - B. genes for the repressor, a regulatory protein
 - C. genes for inducible enzymes of lactose metabolism
 - D. a promoter, the RNA polymerase binding site
 - E. the operator, the repressor binding site
8. Which statement is correct ?
- A. The modular structure of eukaryotic transcription factors contains RNA-binding domain and transcription termination domain.
 - B. A multiprotein complex that includes poly(A) polymerase carries the cleavage and polyadenylation factor of a pre-mRNA.
 - C. Nucleosome structure contains 4 pairs of Histones (H1, H2A, H2B and H3).
 - D. The large subunit in RNA polymerase II of eukaryotes has an essential amino terminal domain.

Questions 9~12 第 9-12 題內容

There are two methods to prepare a ^{32}P -labeled probe for Southern hybridization. A template, labeled and unlabeled precursors are needed for both methods. The enzymes used in the two reactions, however, are different. The DNase I and DNA polymerase I are used in the nick-translation reaction. A mixture of hexamer primers and Klenow (the large) fragment of DNA polymerase I are used in the random-primed multilabeling reaction. Answer the following questions.

9. Which precursors should be added to the reaction solution to prepare probes with uniformly labeled backbone phosphorus atoms with ^{32}P ?
 - A. α - ^{32}P -ATP
 - B. β - ^{32}P -ATP
 - C. α - ^{32}P -dATP
 - D. β - ^{32}P -dATP
 - E. γ - ^{32}P -dATP
10. Why DNase I is needed for the nick-translation reaction?
 - A. because DNase I can protect DNA from degradation
 - B. because DNase I can create single-stranded nick on DNA
 - C. because DNase I can create double-stranded break on DNA
 - D. because DNase I can synthesize single-stranded DNA
 - E. because DNase I can translate DNA
11. Why DNA polymerase I, in stead of Klenow fragment, is used for the nick-translation reaction?
 - A. because the DNA polymerase I possesses the DNA polymerization activity
 - B. because the DNA polymerase I can synthesize DNA without the need of primer
 - C. because the DNA polymerase I possesses 5' to 3' exonuclease activity
 - D. because the DNA polymerase I possesses 3' to 5' exonuclease activity
 - E. all of above
12. Why the Klenow fragment, in stead of DNA polymerase I, is used for the random-primed reaction?
 - A. because the Klenow fragment possesses the DNA polymerization activity
 - B. because the klenow fragment needs primer for DNA synthesis
 - C. because the Klenow fragment lacks 5' to 3' exonuclease activity
 - D. because the Klenow fragment lacks 3' to 5' exonuclease activity
 - E. all of above
13. In prokaryotes, translation is stopped when
 - A. the ρ protein reaches the ribosome
 - B. a stop codon pairs with a stop tRNA
 - C. termination or release factors recognize a stop codon
 - D. fMet binds to the AUG codon
 - E. the sigma protein reaches the stop codon.

14. Which of the following enzymatic activities is involved in the replicating the ends of eucaryotic chromosomes.
- A. DNA-dependent DNA polymerase
 - B. RNA-dependent RNA polymerase
 - C. RNA-dependent DNA polymerase
 - D. DNA-dependent RNA polymerase I
 - E. DNA-dependent RNA polymerase III
15. What would be the effect of deleting the gene for cAMP binding protein?
- A. glucose could not be metabolized.
 - B. The genes of the lac operon could not be turned on.
 - C. The genes of the lac operon would always be turned on.
 - D. cAMP could not be made.
 - E. There is no effect on the lac operon transcription.
16. Which of the following statements is correct.
- A. Attenuation control is widely used to decrease the translation of enzymes involved in the amino acid synthesis.
 - B. Attenuation control is widely used to decrease the translation of enzymes involved in the utilization of lactose.
 - C. Attenuation control involves ribosome pausing at specific site.
 - D. Attenuation control is one of the mechanisms controlling the eucaryotic gene expression.
 - E. Attenuation control requires the binding of a transcriptional factor to a specific site.

IV. Multiple-choice: each question has two true statements. Two right answers for your scores. (14 複選題，每題選 兩個正確答案 才計分，共有 35 分)

17. Transcription

- A. The bacterial genes encoding ribosomal RNA, tRNA and mRNA are transcribed by different RNA polymerases.
- B. Most DNA-binding proteins bind to the major groove of the double helix.
- C. The complex of DNA and protein in chromosomes is called chromatin.
- D. RNA polymerase stops transcribing at regions of DNA that are wrapped in nucleosomes.

18. Transcription

- A. Clones isolated from cDNA libraries contain promoter sequences
- B. To make a cDNA library, both a DNA polymerase and a reverse transcriptase must be used.
- C. Histone acetylation occurs in both the cytoplasm and nucleus.
- D. Acetylation of core histones allows the histones to bind strongly to DNA and stabilizing the nucleosomes.

19. Post-transcriptional events

- A. Group I introns can be removed *in vitro* with no help from protein.
- B. In yeast, the branch-point consensus sequence of introns is almost invariant: UACUAAC.
- C. Base pairing between U1 snRNA and the 3' splice site of an mRNA precursor is necessary for splicing.
- D. The first two bases of the intron are almost always AG and the last two are almost always GU.

20. Translation

- A. The amount of a protein present in the cell at a steady state depends on its rate of synthesis, its catalytic activity, and its rate of degradation.
- B. Ribosomes are cytoplasmic organelles that are encapsulated by a single membrane.
- C. Ribosomes subunits exchange partners after each round of translation.
- D. GTP hydrolysis is required for translation initiation.

21. Energy generation

- A. Ubiquinone and cytochrome C are both diffusible electron carriers.
- B. Both chlorophyll and heme contain an extensive system of double bonds that allows them to absorb visible light.
- C. The role of chlorophyll in photosynthesis is equivalent to that of heme in mitochondrial electron transport.
- D. All the electron-transfer reactions involve metal ions.

22. Development control

- A. The phenotypes of $\alpha 2$ or $a 1$ mutants are defective in mating.
- B. The phenotypes of $\alpha 2$ or $a 1$ mutants are defective in the mating-type switch.
- C. The Bicoid protein gradient extends more anteriorly as compared to the *bicoid* RNA gradient.
- D. The Bicoid protein gradient extends more posteriorly as compared to the *bicoid* RNA gradient.

23. Eukaryotic cell cycle

- A. The nuclear envelope of budding yeast never breaks down during mitosis.
- B. Mitosis-promoting factor deactivation generally precedes spindle assembly.
- C. Activation of mitosis-promoting factor requires phosphorylation and dephosphorylation at a tyrosine residue of Cdc13.
- D. Activated mitosis-promoting factor can activate more mitosis-promoting factor.

24. Eukaryotic cell cycle

- A. In the absence of microtubule-depolymerizing drugs, the *bub* mutants behave as normal cells.
- B. In the presence of microtubule-depolymerizing drugs, the *bub* mutants exhibit a prolonged mitosis.
- C. The anaphase-promoting complex can transfer ubiquitin to anaphase inhibitor and cyclin B.
- D. The anaphase-promoting complex is activated when the activity of mitosis-promoting factor is high and deactivated before entering the next G1 phase.

25. Eukaryotic cell cycle

- A. The S-phase Cdk complex can activate DNA synthesis of the G1 but not the G2 nucleus.
- B. Dephosphorylation of Sic1, an S-phase inhibitor, results in activation of S-phase Cdk complex.
- C. The Cdc7/Dbf4 kinase is required to initiate DNA replication and can prevent assembly of new pre-replication complexes.
- D. The function of cohesin complex is inactivated onset of anaphase.

26. Dynamic polymers

- A. Both microtubules and intermediate filaments are involved in cell motility and cell shape.
- B. The GTP bound to α -tubulin is able to hydrolyzed and exchanged with free nucleotide.
- C. Kinesin can mediate transport cargo by itself, while dynein requires a large complex of microtubule-binding proteins.
- D. Formation of a bipolar spindle occurs prior to M phase and the separation of spindle poles occurs during anaphase B.

27. Signaling

- A. SH3 domains bind to phosphotyrosine residues, while PH domains bind to proline-rich sequences.
- B. For both Gs and Ras proteins, the Gs and Ras-GDP complex represents the inactive form.
- C. Myristylation at N-terminal is required for Ras protein to anchor the cell membrane.
- D. 14-3-3 associated with inactive Raf in the cytosol.

28. Signaling

- A. Prostaglandins are lipophilic hormones that bind to cell-surface receptors.
- B. Serotonin binds to ion-channel receptors.
- C. The binding of ligands to cell-surface receptors leads to a short-lived increase or decrease in the concentration of intracellular second messengers.
- D. Adaptor proteins are essential for signaling in the G protein-coupled receptor pathway.

29. Cancer

- A. Deletions of Ras gene are frequently observed in human tumors.
- B. Mutations at C-terminal of c-Src may result in constitutively activation of this oncogene due to loss of the negative regulatory tyrosine residue.
- C. The lipid phosphatase activity of PTEN is critical for its tumor suppressor function.
- D. Myc forms dimer with Mad to activate transcription through to E-box.

30. Cancer

- A. The tumor suppressor RB directly represses transcription of genes that encode proteins for DNA synthesis.
- B. TGF β signaling promotes cell proliferation and development of malignancy.
- C. p53 can trigger apoptosis through direct signaling and transcriptional activation.
- D. Myc can enhance proliferation as well as trigger apoptosis.