

題號： 478

國立臺灣大學 107 學年度碩士班招生考試試題

科目： 細胞與分子生物學

題號： 478

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單選題 共 40 題 (A) (B) (C) (D) (E) 5 選 1 答錯不倒扣 第 1 至 20 題 每題 2 分; 第 21 至 40 題 每題 3 分

1. Indicate the order in which the following steps occur in the production of a mature mRNA.
 1. initiation of transcription
 2. splicing
 3. addition of 5' cap
 4. addition of poly(A) tail
 5. transport to cytoplasm

A. 1, 2, 3, 4, 5
B. 1, 3, 4, 2, 5
C. 1, 3, 4, 5, 2
D. 1, 3, 4, 2, 5
E. 1, 3, 2, 4, 5
2. Which one of the following statements about mRNA stability is true?
 - A. Degradation always proceeds in the 5' to 3' direction.
 - B. 5' poly(A) tail protects RNA from degradation.
 - C. Secondary structure in mRNA (hairpins, for example) slows the rate of degradation.
 - D. In general, bacterial mRNAs have longer half-lives than do eukaryotic mRNAs.
 - E. Rates of mRNA degradation are always at least 10-fold slower than rates of mRNA synthesis.
3. Phospholipids with short or unsaturated fatty acyl chains can:
 - A. decrease membrane fluidity.
 - B. increase membrane fluidity.
 - C. cause biomembranes to become thicker.
 - D. allow hydrophilic molecules to flip in the lipid bilayer.
 - E. allow hydrophilic molecules to diffuse across the lipid bilayer.
4. Select the correct statement listed below.
 1. The nuclear pore complex allows for passive diffusion of smaller molecules.
 2. The nuclear pore complex allows for import of proteins.
 3. The nuclear pore complex allows for active transport of very large molecules.

A. Only 3 is correct.
B. 1, 2 are correct.
C. 1, 3 are correct.
D. 2, 3 are correct.
E. All of the above are correct.
5. Glycosylphosphatidylinositol modification serves to target proteins to:
 - A. RER.
 - B. Golgi.
 - C. Plasma membrane.
 - D. Nucleus.
 - E. Lysosome

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6. Glycosylation, a post-translational modification to proteins, occurs in the:

- A. RER.
- B. Golgi.
- C. Proteasome.
- D. Endosome.
- E. Mitochondria.

7. Which one is NOT found in mitotic spindles?

- A. α -tubulin
- B. β -tubulin
- C. γ -tubulin
- D. Microtubule associated proteins
- E. Motor proteins

8. Which of the following is not a common intracellular second messenger?

- A. inositol 1,4,5-trisphosphate (IP₃)
- B. 1,2 diacylglycerol (DAG)
- C. adenosine triphosphate (ATP)
- D. 3'-5' cyclic guanine monophosphate (cGMP)
- E. All above are common intracellular second messenger.

9. Which one is the marker of autophagy?

- A. Caspase 3
- B. Cytochrome C
- C. LC-II
- D. Puma
- E. RIPK3

10. Which one is a major regulator in M phase?

- A. CDK1-cyclin B
- B. CDK2-cyclin A
- C. CDK2-cyclin E
- D. CDK4-cyclin D
- E. CDK6-cyclin D

11. Which one contains BH4 domain to inhibit apoptosis?

- A. Bak
- B. Bax
- C. Bcl-2
- D. Bid
- E. Bim

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12. Which one is NOT the biomarker of apoptosis?
- A. Cleaved PARP1
 - B. Phosphatidylserine
 - C. Nuclear DNA fragmentation
 - D. TUNEL staining
 - E. Caspase 8
13. During an action potential, which happens first?
- A. opening of voltage-gated Na⁺ channels
 - B. opening of voltage-gated Ca⁺ channels
 - C. closing of voltage-gated Na⁺ channels
 - D. opening of voltage-gated K⁺ channels
 - E. closing of voltage gated K⁺ channels
14. Which statement listed below regarding stem cells is correct?
- 1. Stem cells can perform asymmetric cell division.
 - 2. Stem cells can be found in both mouse embryonic and adult tissues.
 - 3. Totipotent stem cells can form all the cell types in a body, plus the extraembryonic or placental cells.
 - 4. Pluripotent stem cells can differentiate into endoderm, mesoderm or ectoderm cells.
- A. 1 and 2 are correct.
 - B. 1 and 3 are correct.
 - C. 1, 2, and 3 are correct.
 - D. 1, 2 and 4 are correct.
 - E. All of the above are correct.
15. The best primers for the PCR reaction have the following feature:
- A. They have a high G-C content.
 - B. They have a high A-T content.
 - C. They should be palindromic.
 - D. The AT/GC ratio does not matter.
 - E. They should anneal rapidly, before the larger DNA strands reanneal.
16. Which one is not required for RNA quantification by using PCR?
- A. Specific primers
 - B. Deoxynucleotides
 - C. Taq DNA polymerase
 - D. Genomic DNA
 - E. Complementary DNA
17. Which technique is not used to demonstrate DNA-protein interaction?
- A. DNase I footprinting
 - B. Electrophoretic mobility shift assay
 - C. Chromatin immunoprecipitation
 - D. Southwestern blotting assay
 - E. Fingerprinting

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18. Which statement listed below regarding a proteome or a transcriptome is correct?
1. A proteome is a collection of all the proteins produced in a given cell or tissue.
 2. A proteome is an improperly digested protein responsible for certain diseases such as "mad cow" disease.
 3. A transcriptome will reflect the protein expression levels for all expressed genes.
 4. A transcriptome is a collection of all the genes being transcribed in a given cell or tissue at a given time.
 5. A transcriptome is the mRNA transcribed to produce a fusion protein.
- A. 1 and 4 are correct.
B. 2, 3 and 5 are correct.
C. 1, 4 and 5 are correct.
D. 1, 3 and 4 are correct.
E. All of above are correct.
19. Which of the following statements about regulation of the lac operon is true?
- A. In the presence of lactose, the lac repressor, lacI, halts production of the enzymes encoded by the lac operon.
 - B. The gene product of lacZ is β -galactosidase which cleaves lactose into glucose and galactose.
 - C. Glucose in the growth medium does not affect the inducibility by lactose.
 - D. Glucose in the growth medium increases the inducibility by lactose.
 - E. Its expression is regulated mainly at the level of translation.
20. Monozygous twins share a common genotype. According to previous report, gene expression microarray analysis showed the differential transcription profiles between twin pairs. What is not different in twin pairs?
- A. 5-methylcytosine DNA
 - B. Histone acetylation
 - C. Histone methylation
 - D. DNA sequences
 - E. Fingerprint
21. Which statement is incorrect about translation regulation in eukaryotic mRNAs?
- A. Translational regulation may play an important role in regulating very long eukaryotic genes.
 - B. Translational initiation factor eIF2 can be phosphorylated to activate translation.
 - C. Some proteins bind directly to 3'UTR of mRNA and act as translational repressors.
 - D. Proteins 4E-BPs are inactivated by phosphorylation.
 - E. micro-RNAs are able to inhibit translation.
22. There is a protein containing 456 amino acids and encoded by a gene with ten exons. Which statement you can obtain from the statement above?
- A. The exon 10 contains 3'UTR of its mRNA.
 - B. The translation initiation site is located in exon 1.
 - C. The length of ten exons is 1368 nucleotides.
 - D. The length of ten exons is 1371 nucleotides.
 - E. The length of introns is shorter than exons.

23. Which one is incorrect about transcription factors?
- A. Leucine zipper is a dimer formation domain.
 - B. They can bind to specific DNA elements.
 - C. They always locate in nuclei.
 - D. The gene expression is often regulated by transcription activators more than repressors in eukaryotes.
 - E. They may interact with the Mediator complex.
24. Which one is NOT a component of pre-replication complex?
- A. MCM
 - B. ORC
 - C. RPA
 - D. GINS
 - E. Cdc45
25. Which core histone does NOT have a variant?
- A. H2A
 - B. H2B
 - C. H3
 - D. H4
 - E. H1
26. Which of the following classes of noncoding RNAs is directly involved in RNA interference?
- 1. siRNA
 - 2. snoRNA
 - 3. piRNA
 - 4. miRNA
 - 5. hnRNA
- A. 1, 3, 4, 5 are involved.
 - B. 1, 2, 3, 4 are involved.
 - C. 1, 4, 5 are involved.
 - D. 1, 3, 4 are involved.
 - E. All of the above are involved.
27. Which of the following general statement about a G protein-coupled receptor is true?
- 1. It contains twelve transmembrane domains.
 - 2. It is organized with the N-terminus on the cytoplasmic face of the membrane.
 - 3. It is organized with the C-terminus on the cytoplasmic face of the membrane.
 - 4. It is found only in eukaryotes
- A. Only 3 is correct
 - B. 2, 4 are correct.
 - C. 3, 4 are correct.
 - D. 1, 2 are correct..
 - E. 1, 3, 4 are correct.

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28. Which one of the following statements about mitochondrial DNA is incorrect?
- A. Products of mitochondrial genes are not exported to cytosol
 - B. All the mitochondria of a developing embryo are derived from the mother's egg
 - C. Mitochondrial genetic codes differ from the standard nuclear code
 - D. Mitochondria contain one non-histone mitochondria DNA molecule
 - E. Mutations in mitochondrial DNA would cause genetic diseases.
29. Which E3 ligase is involved in sister chromatid segregation during mitosis?
- A. APC/C
 - B. RNF8
 - C. RNF168
 - D. BRCA1
 - E. Cul3-KLHL20
30. Which one is NOT the difference between microtubules and microfilaments?
- A. Microfilament is made of G-actin.
 - B. Microtubule is made of α/β tubulin
 - C. Dynein is a motor protein in microfilaments.
 - D. Microtubules have branching.
 - E. Microtubules need GTP but microfilaments need ATP for their formation.
31. The functional activity of proteins can be modulated by protein modification. Which description is not true?
- A. Mass spectrometry is a tool to identify protein modification.
 - B. Protein phosphorylation occurs at the residues of Ser, Thr, and Tyr.
 - C. Protein methylation occurs at the residues of Leu and Arg.
 - D. Histone acetylation results in gene activation.
 - E. Histone methylation would activate or repress gene expression.
32. Binding of hormone to a receptor tyrosine kinase causes all of the following except:
- A. dimerization of the receptor.
 - B. autophosphorylation of the receptor.
 - C. activation of Ras through an interaction with GRB2 and Sos.
 - D. hydrolysis of GTP bound to Ras.
 - E. All of the above are incorrect.
33. Predict the consequences of a temperature sensitive mutation in which the phosphorylation of the b-catenin protein is blocked. Above the permissive temperature,
- A. b-catenin levels will increase and b-catenin will be constitutively active.
 - B. b-catenin levels will increase and b-catenin will be inactive.
 - C. b-catenin levels will decrease and cells will be inactive.
 - D. b-catenin will remain decrease and cells will be more sensitive to Wnt signaling
 - E. b-catenin will remain constant but cells will be unresponsive to Wnt signaling.

34. Fully differentiated mouse fibroblasts can be reprogrammed or induced to form pluripotent stem cells when transfected with retroviral vectors expressing:

1. KLF4.
2. c-MYC.
3. SOX2.
4. Ngn1
5. Oct4

- A. 1, 2, 3, 5
- B. 1, 2, 3, 4
- C. 1, 2, 4, 5
- D. 1, 3, 4, 5
- E. 2, 3, 4, 5

35. Which one is NOT the marker of Epithelial-mesenchymal transition?

- A. N-cadherin
- B. E-cadherin
- C. vitronectin
- D. integrin
- E. Zeb1

36. Which statement listed below concerning general molecular biology techniques is correct?

1. Run-on transcription determines the translational rate.
2. Primer extension determines the start of transcription.
3. Southern blot determines if a probe is complementary to a DNA target.
4. Northern blot determines the size and abundance of a RNA.
5. Gel mobility shift assay determines whether a protein binds DNA.

- A. 1, 2, 3, 4 are correct.
- B. 1, 3, 4, 5 are correct.
- C. 2, 3, 4, 5 are correct.
- D. 1, 3, 4, 5 are correct.
- E. All of above are correct.

37. What method can be used to functionally inactivate a gene without altering its sequence?

1. gene knockout
2. RNA interference
3. dominant negative mutation
4. CRISPR/Cas9 system

- A. 1 and 2 are correct.
- B. 2 and 3 are correct.
- C. 2 and 4 are correct.
- D. 1, 2 and 4 are correct.
- E. All of above are correct.

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38. Next generation sequencing is much more efficient than the Sanger method because:
1. It uses an RNA template instead of DNA.
 2. It uses gel electrophoresis to resolve end-labeled strands of DNA.
 3. It uses PCR amplification.
- A. 1 is correct
B. 2 is correct
C. 3 is correct
D. 1 and 3 are correct
E. All of above are correct
39. Compare the advantages and limitations of microarrays and Northern blots for analyzing gene expression. Which statement listed below is correct?
1. Microarrays allow a more global analysis of gene expression by analyzing thousands of genes simultaneously.
 2. Microarrays data analysis can reveal groups of known and unknown genes that are regulated in a coordinated fashion.
 3. Northern blots allow the analysis of only a few genes at a time.
 4. Northern blot can reveal the presence of multiple mRNAs from one gene locus that may be differentially expressed. The presence of multiple mRNAs could be missed by microarray analysis.
- A. 1, 2, 3 are correct.
B. 1, 3, 4 are correct.
C. 2, 3, 4 are correct.
D. 1, 2, 4 are correct.
E. All of above are correct.
40. Which of the following best describes the function of reverse transcriptase?
- A. It's involved in viral attachment to a host cell.
 - B. It uses an RNA template to make a double-stranded DNA.
 - C. It uses DNA to synthesize an RNA in the 3' to 5' direction.
 - D. It joins the gene segments that code for antibodies.
 - E. Its reaction products can be inserted directly into plasmid.

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