

國立臺灣大學 113 學年度碩士班招生考試試題

題號：371

科目：細胞與分子生物學

題號： 371

國立臺灣大學 113 學年度碩士班招生考試試題

科目： 細胞與分子生物學

節次： 7

題號：371

共 8 頁之第 1 頁

請用 2B 鉛筆作答於答案卡，並先詳閱答案卡上之「畫記說明」。

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. RNA is involved in many cellular processes. Which method is not used for RNA detection?
 - A. Real-time PCR
 - B. Fluorescence in situ hybridization
 - C. Northern blotting
 - D. Footprinting
 - E. cDNA microarray

2. Which is incorrect about eukaryotic mRNA?
 - A. Transcribed by RNA polymerase II
 - B. Contain 5' cap and 3' poly(A) tail
 - C. Contain 5'UTR to regulate translation efficiency
 - D. Contain 3'UTR to be targeted by microRNAs
 - E. Cannot be modified

3. Which is incorrect about genomic imprinting?
 - A. Imprinting genes show mono-allelic, parent-specific gene expression.
 - B. All imprinting genes encode proteins.
 - C. It is epigenetically regulated in imprinting control regions (ICR).
 - D. ICR is under DNA methylation in the C5 position of a cytosine residue, forming 5-methylcytosine (5 mC).
 - E. Prader-Willi syndrome is a known imprinting disorder.

4. Which part of the ribosome is responsible for decoding?
 - A. LSU
 - B. SSU
 - C. mRNA
 - D. tRNA
 - E. siRNA

5. The initiation phase of the translation involves binding which component to mRNA?
 - A. LSU
 - B. SSU
 - C. lncRNA
 - D. mitochondria
 - E. RNase A

見背面

6. Which organelle is responsible for protein degradation?
- A. Mitochondria
 - B. Ribosome
 - C. Lysosome
 - D. Centriole
 - E. Endoplasmic reticulum
7. Na^+ , K^+ , Ca^{2+} , and Cl^- permeation through their respective ion channels represents an example of
- A. Passive transport
 - B. Primary active transport
 - C. Secondary active transport
 - D. A and C only
 - E. A, B, and C
8. Which of the following can be used as a temperature-sensitive mutant to study the endomembrane system?
- A. Adenovirus
 - B. Vesicular Stomatitis Virus
 - C. Human Immunodeficiency Virus
 - D. Tobacco Mosaic Virus
 - E. Retrovirus
9. The signal sequence that determines whether a protein will be synthesized on a free ribosome or ribosome attached to endoplasmic reticulum is located at _____
- A. hydrophobic tail
 - B. hydrophilic tail
 - C. COOH-terminus
 - D. NH₂-terminus
 - E. transmembrane region
10. Which of the following is not a common intracellular second messenger?
- A. adenosine triphosphate (ATP)
 - B. 1,2 diacylglycerol (DAG)
 - C. inositol 1,4,5-trisphosphate (IP₃)
 - D. 3'-5' cyclic guanine monophosphate (cGMP)
 - E. Ca^{2+}
11. Which source of stem cells has the greatest potential for producing different kinds of new stem cells?
- A. Umbilical cord
 - B. Bone marrow
 - C. Inner cell mass of blastocysts
 - D. Fetuses
 - E. Ectoderm

12. Which one is a major regulator in G1 phase?
- A. CDK1-cyclin B
 - B. CDK2-cyclin A
 - C. CDK2-cyclin E
 - D. CDK4/6-cyclin D
 - E. CDK7-cyclin E
13. Which cell is responsible for innate immune response?
- A. T cell
 - B. B cell
 - C. NK cell
 - D. Platelet
 - E. Neutrophil
14. Which enzyme is responsible for excising damaged or incorrect nucleotides during base excision repair?
- A. DNA ligase
 - B. DNA polymerase
 - C. DNA helicase
 - D. DNA glycosylase
 - E. DNA topoisomerase
15. Necrosis is often associated with:
- A. Cellular shrinkage
 - B. Inflammatory response
 - C. Energy-dependent process
 - D. Controlled and programmed events
 - E. Preservation of cell structure
16. What are the advantages of monoclonal antibodies over antisera?
- A. They can be produced with higher purity.
 - B. They have a more uniform specificity.
 - C. They can be produced in higher quantities.
 - D. They can be made against molecules that constitute only a minor component of a complex mixture.
 - E. All of the above.
17. The AgeI restriction enzyme recognizes the sequence ACCGGT and cuts each strand between the first (A) and the second (C) nucleotide. This can be represented as A|CCGGT, with the vertical bar indicating the cleavage position. If a DNA fragment is cut with AgeI at both ends, cutting a plasmid with which of the following enzymes would then allow insertion of the fragment into the plasmid by simple ligation of sticky ends?
- A. MroI, with the recognition sequence T|CCGGA
 - B. AatI, with the recognition sequence AGG|CCT
 - C. BstZI, with the recognition sequence C|GGCCG
 - D. FseI, with the recognition sequence GGCCGG|CC
 - E. None of the above

見背面

18. In Sanger sequencing, does each labeled DNA molecule have a fluorescently labeled dideoxynucleotide at its 5' end or its 3' end? Do the labeled nucleotides lack the 2' or 3' hydroxyl group?
- A. 3' end; 2' hydroxyl group only
 - B. 3' end; 3' hydroxyl group only
 - C. 5' end; 2' hydroxyl group only
 - D. 5' end; 3' hydroxyl group only
 - E. 3' end; both hydroxyl groups
19. The DNA-binding proteins that recognize and accurately initiate transcription at specific eukaryotic promoter sequences are called:
- A. enhancers
 - B. transcription factors
 - C. response elements
 - D. chromatin-remodeling complexes
 - E. All are true
20. Functional DNA is not found in:
- A. bacterial nucleoids
 - B. chloroplasts
 - C. lysosomes
 - D. mitochondria
 - E. nuclei
21. The cell metabolism is tightly connected to the regulation of gene expression. The lac operon (lactose operon) in *Escherichia coli* is an example. Which statement below regarding the lac operon is correct?
- A. There are lacZ, lacY and lacA genes in lac operon and they are transcribed independently.
 - B. RNA polymerase binds to operator in the absence of lactose.
 - C. The operon is controlled by negative and positive transcription factors.
 - D. In the presence of lactose, the lac repressor encoded by the lacI gene is not expressed for operon activation.
 - E. In the presence of high concentration glucose, the catabolite activator protein (CAP) is activated to increase LacZ expression.
22. The 2019 Nobel Prize in Physiology or Medicine was awarded to three scientists for discovering hypoxia-inducible factor (HIF), a key transcription factor that regulates gene expression in response to decreases in cellular oxygenation. Under the hypoxia condition, HIF1 α -HIF1 β heterodimer bonds to target genes' HRE (hypoxia-response element), leading to gene (). Under the high oxygen condition, HIF1 α is hydroxylated in two () residues and recruits E3 () ligase for protein degradation. What are the three blanks?
- A. Activation, proline, ubiquitin.
 - B. Inhibition, proline, ubiquitin.
 - C. Activation, histidine, ubiquitin.
 - D. Inhibition, histidine, SUMO.
 - E. Activation, proline, SUMO.

23. Translation defines the cellular proteome; which statement is correct?

- A. Translational control has nothing to do with mRNAs.
- B. The Ccr4-Not complex affects mRNA translatability.
- C. The elongation of translation is a uniform process.
- D. Ribosome pausing increases translation efficiency.
- E. The regulation of translation is independent of cell status and environment.

24. Consider the canonical nuclear localization sequence (cNLS) mediated protein transport mechanism; which statement is correct?

- A. The cargo-carrier import complex is assembled in the nucleus.
- B. The cargo protein utilizes its cNLS direct contact with the importin β .
- C. The RanGDP protein is more concentrated within the cytoplasm than the nucleus in preparation for cargo protein transport.
- D. The RanGDP protein is essential to export the importin from the nucleus.
- E. The cargo protein translocation is through the nuclear pore complex in the endoplasmic reticulum.

25. Vesicular transport describes vesicles bud off from one compartment and fuse with another. Most transport vesicles form from specialized, coated regions of membranes. They therefore bud off as coated vesicles. Which statement(s) is correct regarding coated vesicles?

- (1) Clathrin-coated vesicles mediate transport originating from the Golgi apparatus, endosome, and the plasma membrane..
- (2) COPI-coated vesicles contribute to the ER-to-Golgi transport, comprising large protein subcomplexes that are made of seven different protein subunits.
- (3) The retromer complex has been shown to mediate retrieval of various transmembrane receptors, such as the cation-independent mannose 6-phosphate receptor.

- A. (3) only
- B. (1) and (2)
- C. (2) and (3)
- D. (1) and (3)
- E. All of above are correct.

26. Which of the following statement(s) is correct regarding to protein endocytosis or exocytosis?

- (1) Clathrin-mediated endocytosis involves cargo recognition and coat assembly, followed by membrane invagination, and finally pinching off to deform membranes.
- (2) Proteins being internalized move to the lysosome and recycling endosome for protein degradation and reuse, respectively.
- (3) Neurotransmitters are typically released from synaptic vesicles into the synaptic cleft via exocytosis, which is the fusion of vesicles with the plasma membrane.

- A. (1) and (2)
- B. (2) and (3)
- C. (1) and (3)
- D. (3) only
- E. All of above are correct.

見背面

27. Which of the following statements regarding stem cells (SCs) is correct?

- (1) A stem cell can divide to one copy of itself and to one differentiated cell.
- (2) The pluripotent SCs showed higher differentiation potency than the totipotent and multipotent SCs.
- (3) Stem cells could be used to test new drug.

A. (1) B. (2) C. (3) D. (1) and (3) E. (2) and (3)

28. Which of the following statement regarding neurotransmitter is correct?

- (1) A neurotransmitter can be re-uptaken back to the presynaptic neuron.
- (2) Gamma aminobutyric acid (GABA) is the principal inhibitory neurotransmitter in the brain.
- (3) The role of a neurotransmitter agonist is to mimic or enhance the effects of specific neurotransmitters.

A. (1) and (2)
B. (1) and (3)
C. (2) and (3)
D. all of the above
E. none of the above

29. Which of the following statement about membrane potential and action potential propagation is NOT correct?

- A. The resting membrane potential of animal neurons depend largely on non-gated K^+ channels.
- B. The resting potential of a typical neuron is -30 mV.
- C. During an action potential, opening of voltage-gated Na^+ channels happens first
- D. Repolarization during the refractory period is largely due to opening of voltage-gated K^+ channels.
- E. All above are incorrect.

30. Which strategy is the current immune checkpoint blockade for cancer immunotherapy?

- A. Anti-CTLA4 antibody
- B. CAR-T therapy
- C. Cancer vaccine
- D. Bi-specific antibody
- E. Antibody-dependent cytotoxicity

31. Re-replication during S phase results in DNA damage and genomic instability. Which one does NOT prevent the origin re-replication during DNA replication?

- A. ORC, CDC6, CDT1, and MCM are the origin licensing factors.
- B. Geminin directly binds to CDT1 to inhibit its licensing activity.
- C. Dephosphorylation of pre-RC complex, MCM, ORC1, CDC6, and CDT1, represses reactivation of origins.
- D. Cullin-based E3 ligases mediate the degradation of ORC1 and CDT1.
- E. APC/C targets the degradation of CDC6 and CDT1

32. Which one is responsible for DNA damage checkpoint?
- A. APC/C E3 complex B. Cul3-KLHL20 E3 ligase C. Motor proteins
D. ATM kinase E. ATR kinase
33. Which repair mechanism is primarily responsible for fixing thymine dimers caused by UV radiation?
- A. Base excision repair
B. Mismatch repair
C. Nucleotide excision repair
D. Homologous recombination
E. Non-homologous end joining
34. Which organelle plays a central role in initiating the intrinsic pathway of apoptosis?
- A. Mitochondria
B. Endoplasmic reticulum
C. Golgi apparatus
D. Lysosomes
E. Peroxisomes
35. To study the function of the essential cyclin genes in yeast, researchers constructed a shuttle vector in which a copy of the cyclin gene was ligated to the GAL1 promoter. The vector was then introduced into haploid yeast cells in which all copies of the cyclin genes had been disrupted. Following introduction of the vector, you would expect that
- A. the yeast cells would grow on both glucose and galactose media.
B. the yeast cells would grow on glucose but not galactose medium.
C. the yeast cells would grow on galactose but not glucose medium.
D. on transfer to either glucose or galactose medium, the vector-carrying cells would eventually stop growing because of insufficient cyclin expression.
E. none of the above
36. In intestinal epithelial cells, the different plasma membrane domains are separated from each other by special barriers. Which of the following statements is false?
- (1) These barriers are set up by nanoscale lipid raft domains.
(2) Proteins normally cannot pass through these barriers, whereas any membrane lipid can do so freely.
(3) The asymmetric distribution of membrane proteins resulting from these barriers is functionally important.
(4) These barriers are a result of proteins of the apical surface forming a large aggregate that excludes proteins of the other domains.
- A. (1), (2) and (3)
B. (2), (3) and (4)
C. (1) and (4)
D. (1), (2) and (4)
E. All of the above

37. Which of the following lipids do you expect to be a canonical scramblase substrate in the plasma membrane?
- A. Galactocerebroside
 - B. Phosphatidylethanolamine
 - C. Glycosylphosphatidylinositol
 - D. Cholesterol
 - E. Ganglioside GM1
38. "Housekeeping genes" in bacteria are commonly expressed constitutively, but not all of these genes are expressed at the same level (the same number of molecules per cell). The primary mechanism responsible for variations in the level of constitutive enzymes from different genes is that:
- A. all constitutive enzymes are synthesized at the same rate, but are not degraded equally.
 - B. their promoters have different affinities for RNA polymerase holoenzyme.
 - C. some constitutively expressed genes are more inducible than others.
 - D. some constitutively expressed genes are more repressible than others.
 - E. the same number of mRNA copies are made from each gene but are translated at different rates.
39. The tryptophan operon of *E. coli* is repressed by tryptophan added to the growth medium. The tryptophan repressor probably:
- A. binds to RNA polymerase when tryptophan is present.
 - B. binds to the *trp* operator in the absence of tryptophan.
 - C. binds to the *trp* operator in the presence of tryptophan.
 - D. is a DNA sequence.
 - E. is an attenuator.
40. All are characteristics of transposons except:
- A. segments of DNA moved non-enzymatically in the genome.
 - B. unstable location within genome.
 - C. range in size from hundreds of bps to 8 kbp.
 - D. the smallest transposons are called insertion sequences.
 - E. a major force in evolution.