

題號： 352

國立臺灣大學 114 學年度碩士班招生考試試題

科目： 細胞與分子生物學

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※ 注意：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. Which of the following best describes the process of endocytosis?
 - A. The movement of large particles from inside the cell to the extracellular space.
 - B. The formation of a vesicle by the Golgi to transport proteins.
 - C. The uptake of extracellular material into the cell via vesicles.
 - D. The fusion of vesicles with lysosomes to degrade waste.
 - E. The release of neurotransmitters from synaptic vesicles.
2. Which of the following is the key function of the *trans*-Golgi network (TGN)?
 - A. Protein synthesis
 - B. Protein folding
 - C. Sorting and sending proteins to their final destinations (e.g., lysosomes, plasma membrane)
 - D. Degradation of misfolded proteins
 - E. Detoxification of cellular waste
3. Which enzyme is responsible for sealing the nick in the sugar-phosphate backbone after a damaged nucleotide is removed and replaced?
 - A. DNA helicase
 - B. DNA polymerase
 - C. DNA topoisomerase
 - D. DNA primase
 - E. DNA ligase
4. Which family of proteins is central to the regulation of apoptosis by controlling mitochondrial membrane permeability?
 - A. Cyclins
 - B. Bcl-2 family
 - C. Histones
 - D. Topoisomerases
 - E. cAMP
5. CRISPR-Cas9 is commonly used for genome editing. The "Cas9" portion of the system is:
 - A. A reverse transcriptase enzyme
 - B. An RNA-guided exonuclease
 - C. An RNA-guided endonuclease
 - D. A RNA helicase
 - E. An DNA-guided endonuclease

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6. Which one is required for the progression of G1 to S phase?

- A. Phosphorylated p53
- B. Unphosphorylated p53
- C. Unphosphorylated Rb
- D. Hypophosphorylated Rb
- E. Hyperphosphorylated Rb

7. Which one is the driving force to M phase?

- A. Cdk1-cyclin B
- B. Cdk2-cyclin B
- C. Cdk4-cyclin A
- D. Cdk4-cyclin B
- E. Cdk6-cyclin A

8. Which one is often used in flow cytometry to detect DNA synthesis?

- A. BrdU
- B. Insulin
- C. Hydroxyurea
- D. Nocodazole
- E. DideoxyNTP

9. The human genome project shows about 20,000 human protein-coding genes. However, the total expressed proteins are more than 20,000. What mechanism can one gene express more than one protein?

- A. Alternative splicing
- B. Alternative promoter
- C. Alternative poly(A) signal.
- D. Alternative translation initiation site
- E. All mechanisms are involved.

10. In 1970, David Baltimore discovered reverse transcriptase (RT), which could flow information from RNA to DNA. Which statement is incorrect?

- A. Telomerase is one kind of RT.
- B. RT is found in retrovirus.
- C. RT needs a primer and template.
- D. RT synthesizes DNA from 3' to 5'.
- E. The RT-qPCR is a method for RNA level determination.

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11. All are true for translation in eukaryotic cells **except**:

- A. transcription and translation are spatially separated.
- B. mRNAs are monocistronic.
- C. transcription occurs in the nucleus.
- D. primary transcripts undergo processing to mature mRNAs.
- E. All are true.

12. Mitochondrial and chloroplastic ribosomes resemble _____ ribosomes.

- A. prokaryotic
- B. lower eukaryotic
- C. higher eukaryotic
- D. no other
- E. None are true.

13. Forensic uses of DNA to identify victims or criminals exploit the following trait in DNA:

- A. Footprinting.
- B. DNA with proteins bound moves slower in gel electrophoresis.
- C. Site directed mutations.
- D. Differences in sizes of DNA fragments (RFLPs).
- E. None of the above.

14. Which of the following is normally found in a eukaryotic membrane?

- (1) Octylglucoside
- (2) Cholesterol
- (3) Sphingomyelin
- (4) Ganglioside G_{M1}
- (5) Phosphatidylinositol

- A. (1), (2), and (5)
- B. (1), (2), (3), and (5)
- C. (2), (3), (4), and (5)
- D. (2), (3), and (5)
- E. All of the above

15. Why do cells not have membrane transport proteins for O_2 ?

- A. Because oxygen can dissolve in the lipid bilayer and diffuse in and out rapidly without the need for a transporter.
- B. Because oxygen can dissolve in water and leak in via water channels.
- C. Because they need to keep the oxygen concentration low inside the reducing environment of the cell.
- D. Because oxygen transport across a membrane is energetically unfavorable.
- E. Because oxygen is transported in and out of the cell in special oxygen-carrying proteins such as hemoglobin.

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16. Which of the following is required for the transport of proteins into the nucleus?

- A. Signal peptidase
- B. Nuclear localization signal
- C. Translocon complex
- D. Ubiquitin tag
- E. Endoplasmic reticulum targeting sequence

17. Which component is directly responsible for initiating translation in eukaryotic cells?

- A. mRNA cap-binding proteins
- B. Ribosomal small subunit (40S)
- C. tRNA
- D. Golgi apparatus
- E. RNA polymerase II

18. The lysosome is primarily responsible for degrading

- A. Misfolded proteins in the cytosol
- B. Proteins tagged with ubiquitin
- C. Extracellular material taken up by endocytosis
- D. Lipids synthesized in the endoplasmic reticulum
- E. Ribosomal subunits

19. Stem-cell populations are thought to exist in adult animals at which of the following organs?

- (1) skin
- (2) intestine
- (3) bone marrow

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

20. Which of the following statements regarding stem cells (SCs) is incorrect?

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

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

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21. Vesicular transport describes the budding and fusion behavior of vesicles. Which of the following statement(s) is **correct** regarding vesicular transport?

- (1) The vesicular transport process is ATP-dependent, as ATP is required for both the budding and fusion of vesicles.
- (2) COPI-coated vesicles are primarily involved in anterograde transport from the endoplasmic reticulum (ER) to the Golgi apparatus.
- (3) Dynamin is a GTPase that is responsible for the vesicle budding from the donor membrane during clathrin-mediated endocytosis.

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

22. Membrane transport describes different ways for molecules to across the cell membrane. Which of the following statements is **correct** regarding membrane transport?

- (1) In facilitated diffusion, molecules move across the membrane through a protein channel or carrier down their concentration gradient.
- (2) The presence of aquaporins in the cell membrane facilitates the active transport of water molecules into and out of the cell.
- (3) Secondary active transport does not directly utilize ATP but relies on the electrochemical gradient created by primary active transport.

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

23. Which of the following statement(s) is **correct** regarding ER-Golgi transport pathway?

- (1) The process of cisternal maturation suggests Golgi cisternae is used to replenish its resident enzymes without forming the vesicles.
- (2) The Rab GTPase proteins play a role in vesicular transport and in regulating the maturation of Golgi cisternae, coordinating their movement and fusion.
- (3) Signal sequence is responsible for targeting a protein to the ER membrane during translation.

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

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24. Which of the following statements about translesion DNA synthesis (TLS) is true?
- A. It uses conventional DNA polymerase δ to replicate across lesions.
 - B. It is a repair mechanism for DNA breaks.
 - C. It prevents replication collapse by allowing specialized polymerases to bypass lesions.
 - D. It occurs only in prokaryotes, not in eukaryotes.
 - E. It strictly follows base-pairing rules without introducing mutations.
25. Which chromatography method would best separate proteins based on their isoelectric points (pI)?
- A. Ion exchange chromatography
 - B. Gel filtration chromatography
 - C. Reverse-phase chromatography
 - D. Affinity chromatography
 - E. IMAC (Immobilized metal affinity chromatography)
26. To repair the insertion/deletion created by the Crispr/Cas9 editing mainly needs:
- A. Base excision repair
 - B. Nuclear excision repair
 - C. Mismatch repair
 - D. Homologous recombination
 - E. Non-homologous end-joining
27. Antibody-dependent cytotoxicity will evoke:
- A. cell proliferation
 - B. auto-immune response.
 - C. Epidermal-mesenchymal transition
 - D. apoptosis of cancer cells
 - E. activation of PI3K/Akt signaling
28. The molecular mechanism of the gene expression revealed the role of specific transcription factors, promoters, enhancers, and cofactors involved. Which experiment is incorrect?
- A. The transcription factor-binding sequences can be determined with chromatin-immunoprecipitation (IP) followed by DNA sequencing.
 - B. The promoter and enhancer were cloned from the cDNA library for the reporter assay.
 - C. The transcription factor was knocked down by siRNA for the loss-of-function analysis.
 - D. The transcription factor was overexpressed with a viral vector for the gain-of-function analysis.
 - E. The transcription factor-associated cofactors were identified by the IP-Mass Spectrometry (MS) analysis.

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29. Long noncoding RNAs (lncRNAs) are described as long transcripts more than 200 nucleotides, lacking protein-coding potential. LncRNAs participate in regulation of gene expression at multiple levels via interacting with DNA, RNA and proteins.

- A. LncRNAs are transcribed by RNA pol II but no intron, no cap and no poly(A) tail.
- B. LncRNAs have high expression levels.
- C. LncRNAs are more enriched in the cytoplasm.
- D. LncRNAs recruit PRC2 complex and lead to H3K27 methylation for gene inhibition.
- E. All are correct.

30. The 2024 Nobel Prize in Physiology or Medicine was awarded to Victor Ambros and Gary Ruvkun for discovering microRNA and its role in post-transcriptional gene regulation. Which statement is incorrect?

- A. Lin-4 was the first microRNA to be discovered by Victor Ambros's team.
- B. Victor Ambros's team found that lin-4 negatively regulates LIN-14 protein expression.
- C. Gary Ruvkun's team found the 5'UTR of lin-14 mRNA is required for lin-4 inhibition.
- D. In *C. elegans*, the microRNA lin-4 critically regulates developmental timing.
- E. Most microRNAs are conserved across species.

31. There is no codon for the amino acid hydroxyproline, but this amino acid is a prominent feature of collagen structure. Which of the following is a likely explanation?

- A. Hydroxyproline is substituted for proline after translation by a cut and patch mechanism.
- B. Proline is covalently modified to give hydroxyproline after translation.
- C. There is an alternative mechanism for synthesis of proteins that contain hydroxyproline.
- D. All of above are likely explanations.
- E. It is not possible to form a hypothesis from the information given.

32. One of the hopes for use of recent knowledge gained about non-coding RNAs lies with the possibilities for their use in medicine. Of the following scenarios for future research, which would you expect to gain most from RNAs?

- A. Exploring a way to turn on the expression of pseudogenes.
- B. Targeting siRNAs to disable the expression of an allele associated with autosomal recessive disease.
- C. Targeting siRNAs to disable the expression of an allele associated with autosomal dominant disease.
- D. Creating knock-out organisms that can be useful for pharmaceutical drug design.
- E. Looking for a way to prevent viral DNA from causing infection in humans.

33. Which of the following statement regarding bacterial artificial chromosomes (BACs) is correct?

- A. BACs are generally not stable.
- B. BACs are present in high copy numbers per cell.
- C. BACs are derived from the *E. coli* chromosome.
- D. BACs can maintain DNA sequences of hundreds of thousands of nucleotide pairs.
- E. All of the above.

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34. Which of the following descriptions regarding cDNA libraries is correct?

- (1) The production of cDNA requires use of reverse transcriptase.
- (2) cDNA contain intronic sequences.
- (3) cDNA libraries are enriched in protein-coding genes.
- (4) cDNA libraries are cell-type specific.

- A. (1) and (2)
- B. (1), (3), and (4)
- C. (1) only
- D. (2), (3), and (4)
- E. All of the descriptions are correct.

35. Which of the following descriptions regarding the electrical properties of cellular membranes is correct?

- A. If the membrane is impermeable to an ion, the membrane potential approaches the equilibrium potential for that ion.
- B. The resting potential in most animal cells is between 20 mV and 120 mV (positive inside).
- C. Setting up (or changing) the membrane potential requires changing the bulk concentrations of the ions on the two sides of the membrane.
- D. The resting potential decays immediately following the inhibition of the $\text{Na}^+\text{-K}^+$ pump by a drug.
- E. None of the above.

36. Which of the following accurately describes the role of Ran-GTP in the directionality of nuclear transport?

- A. Ran-GTP is hydrolyzed to Ran-GDP in the cytoplasm, releasing cargo from exportins.
- B. The Ran-GTP gradient, maintained by RanGEF in the nucleus and RanGAP in the cytoplasm, ensures unidirectional cargo transport.
- C. Ran-GTP directly phosphorylates nuclear transport receptors to facilitate cargo import and export.
- D. Ran-GTP binds importin in the cytoplasm to prevent premature cargo release.
- E. Ran-GTP hydrolysis occurs exclusively within the nuclear pore complex to control bidirectional movement.

37. Which of the following best explains how proteasomal and lysosomal degradation differ in substrate specificity and regulation?

- A. Both systems rely on molecular chaperones, but only lysosomes degrade non-protein cellular components such as lipids.
- B. Lysosomes selectively degrade misfolded proteins through autophagy, while proteasomes degrade native proteins marked for turnover.
- C. Proteasomes degrade extracellular and cytosolic proteins, while lysosomes are restricted to extracellular material.
- D. Proteasomal activity is regulated by lysosomal enzymes, ensuring coordinated protein turnover.
- E. Proteasomal degradation requires substrate ubiquitination and ATP hydrolysis, while lysosomal degradation is ubiquitin-independent and primarily pH-dependent.

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38. Control of gene expression by Ca^{2+} can occur through which of the following mechanism?

- (1) Changes in the transactivating properties of transcription factors following the activation of Ca^{2+} dependent kinases.
- (2) Changes in the transactivating properties of transcription factors following the activation of Ca^{2+} -dependent phosphatases.
- (3) Translocation of the C-terminal fragment of an L-type Ca^{2+} channel to the nucleus where it binds to a nuclear transcription factor.

- A. (1)
- B. (2)
- C. (3)
- D. All of above are correct
- E. None of above is correct

39. The term "synapse" has been used to describe the contact points between :

- (1) neuronal cells.
- (2) immune cells.
- (3) epithelial cells.

- A. (1)
- B. (2)
- C. (3)
- D. None of above
- E. All of the above

40. Which of the following statement about myelination is incorrect?

- A. Myelination is required in both the CNS (central nervous system) and PNS (peripheral nervous system).
- B. Myelination involves the ensheathment and insulation of axons by radial glial cell membranes.
- C. Myelinating Schwann cells extend their processes to wrap up axons at a 1:1 relationship.
- D. Myelinating Oligodendrocytes extend multiple processes that will contact and myelinate several axons.
- E. None of above is incorrect.

試題隨卷繳回