

注意：考試開始鈴響前，不得翻閱試題，
並不得書寫、畫記、作答。

國立清華大學 115 學年度碩士班考試入學試題

系所班組別：生命科學暨醫學院
丁組(醫學生物科技學程)

科目代碼：0705

考試科目：細胞生物學

—作答注意事項—

1. 請核對答案卷(卡)上之准考證號、科目名稱是否正確。
2. 考試開始後，請於作答前先翻閱整份試題，是否有污損或試題印刷不清，得舉手請監試人員處理，但不得要求解釋題意。
3. 考生限在答案卷上標記「由此開始作答」區內作答，且不可書寫姓名、准考證號或與作答無關之其他文字或符號。
4. 答案卷用盡不得要求加頁。
5. 答案卷可用任何書寫工具作答，惟為方便閱卷辨識，請儘量使用藍色或黑色書寫；答案卡限用 2B 鉛筆畫記；如畫記不清(含未依範例畫記)致光學閱讀機無法辨識答案者，其後果一律由考生自行負責。
6. 提早交卷者不可攜出試題，請將試題連同答案卷(卡)交予監考人員，攜出將以違規論處。當節考試結束後試題將置於講台，可自行取回，本試場不負保管責任。
7. 其他應考規則、違規處理及扣分方式，請自行詳閱准考證明上「國立清華大學試場規則及違規處理辦法」，無法因本試題封面作答注意事項中未列明而稱未知悉。

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考試科目（代碼）：細胞生物學(0405、0705)

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*請在【答案卡】作答

I. Multiple Choice - Select the Single Best Answer (50%)

1. What is the diameter of microtubules?
 - A) 15 nm
 - B) 20 nm
 - C) 25 nm
 - D) 30 nm
 - E) 35 nm
2. What is the smallest subunit of a microtubule?
 - A) tubulin
 - B) alpha-tubulin
 - C) beta-tubulin
 - D) alpha/beta-tubulin
 - E) protofilament
3. What is the angle of a branched actin filament powered by Arp2/3?
 - A) 45degrees
 - B) 70degrees
 - C) 90degrees
 - D) 100degrees
 - E) 120degrees
4. Which actin binding protein depolymerizes actin at the plus-end?
 - A) Gelsolin
 - B) Profilin
 - C) ADF/Cofilin
 - D) Myosin
 - E) Formin
5. Which actin binding protein makes the tightest bundles such as in microvilli?
 - A) Alpha-actinin
 - B) Fimbrin
 - C) Filamin
 - D) Spectrin
 - E) Formin

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*請在【答案卡】作答

6. What is the smallest subunit of a muscle?
 - A) Muscle fiber
 - B) Muscle fibril
 - C) Actin
 - D) Myosin
 - E) Sarcomere
7. Where do we find basal bodies?
 - A) Stress Fiber
 - B) Filopodia
 - C) Microvilli
 - D) Stereocilia
 - E) Primary cilia
8. Which process needs GTP?
 - A) Actin polymerization
 - B) Tubulin polymerization
 - C) Dynein movement
 - D) Kinesin movement
 - E) Myosin movement
9. Which drug stabilizes microtubules?
 - A) Colchicine
 - B) Nocodazole
 - C) Latrunculin
 - D) Taxol
 - E) Phalloidin
10. In which cell type can we find keratin?
 - A) Muscle cell
 - B) Fibroblasts
 - C) Hair cell
 - D) Neurons
 - E) Nuclear envelope

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共 7 頁，第 3 頁

*請在【答案卡】作答

11. Where do we find troponin?
 - A) In thin filaments
 - B) In thick filaments
 - C) In microvilli
 - D) Bound to tubulin
 - E) Bound to desmin
12. What is the function of the sarcoplasmic reticulum?
 - A) It's a neuromuscular junction
 - B) It is to channel the action potentials in muscles
 - C) It's the membrane of myofibrils
 - D) It is to store calcium
 - E) It is to store ATP
13. In smooth muscle cells what is needed to activate myosin?
 - A) Nerve impulse or hormone signal
 - B) Calcium
 - C) Calmodulin
 - D) MLCK
 - E) All of above
14. In cell-cell adhesion what do integrins bind?
 - A) Glycoproteins
 - B) P-Selectin
 - C) E-Cadherin
 - D) N-CAM
 - E) ICAM
15. What is a primary physiological role of aquaporins in plant cells?
 - A) They facilitate the transport of glucose across the cell membrane.
 - B) They transport ions to help establish and maintain electrochemical gradients.
 - C) They enable the rapid movement of water molecules across the membrane, essential for maintaining turgor pressure.
 - D) They are involved in the synthesis of ATP through proton gradients.
 - E) They facilitate the passive diffusion of amino acids necessary for protein synthesis in the cytoplasm.

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*請在【答案卡】作答

16. What antibodies are found in a person with blood type A?
- A) Anti-A antibodies
 - B) Anti-B antibodies
 - C) Anti-A and Anti-B antibodies
 - D) No antibodies
 - E) All of above
17. Which of the following would yield the most highly mobile phospholipid (listed as number of carbons and number of double bonds, respectively)?
- A) 24 carbons with one double bond
 - B) 15 carbons with two double bonds
 - C) 20 carbons with two double bonds
 - D) 16 carbons with no double bond
 - E) 20 carbons with one double bonds
18. What is the function of the cell surface's carbohydrate layer?
- A) Energy storage
 - B) DNA replication
 - C) Protein transport
 - D) Cell-cell recognition
 - E) Nutrient absorption
19. Which of the following cellular responses does NOT normally occur as part of the unfolded protein response (UPR)?
- A) Upregulation of ER chaperone proteins
 - B) Temporary inhibition of global protein synthesis
 - C) Expansion of the endoplasmic reticulum
 - D) Induction of apoptosis when ER stress is severe or prolonged
 - E) Increased transport of misfolded proteins to lysosomes
20. Which of the following molecules can diffuse rapidly across the lipid bilayer?
- A) Glucose
 - B) K^+
 - C) O_2
 - D) Amino acids
 - E) Na^+

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共 7 頁，第 5 頁

*請在【答案卡】作答

21. In a resting animal cell, what is the typical state of the K^+ leak channels?
 - A) Closed and unresponsive to external stimuli
 - B) Open, allowing K^+ to move down its concentration gradient
 - C) Active, transporting K^+ into the cell
 - D) Open, transporting K^+ against its concentration gradient
 - E) Inactivated, preventing K^+ movement
22. Where does glycosylation of proteins initially occur?
 - A) In the cytosol
 - B) In the Golgi apparatus
 - C) In the endoplasmic reticulum
 - D) In the plasma membrane
 - E) In the ribosomes
23. A drug that specifically inhibits voltage-gated calcium channels would most directly inhibit
 - A) depolarization of nerve cell membranes.
 - B) repolarization after depolarization of nerve cell membranes.
 - C) hyperpolarization of nerve cell membranes.
 - D) presynaptic neurotransmitter release.
 - E) postsynaptic receptor signal response.
24. What is the driving force for the secondary active transport mechanism?
 - A) Concentration gradients of ions like Na^+ or H^+
 - B) Hydrolysis of ATP
 - C) Light energy
 - D) Phosphorylation
 - E) Hydrolysis of glucose
25. Both excitatory and inhibitory neurons form junctions with muscles. By what mechanism do inhibitory neurotransmitters prevent the postsynaptic cell from firing an action potential?
 - A) By closing Na^+ channels
 - B) By preventing the secretion of excitatory neurotransmitters
 - C) By opening K^+ channels
 - D) By opening Cl^- channels
 - E) By blocking voltage-gated Ca^{2+} channels

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II. Short-Answer Questions (50%)

1. Explain the cellular mechanism by which botulinum toxin A (Botox) acts to cause muscle paralysis (5%).
2. Collagen secreted by fibroblasts in connective tissue is a critical component of the extracellular matrix and is derived from procollagen. Please answer the following questions (10%):
 - A) Identify one specific structural difference between collagen and procollagen.
 - B) Indicate the location where procollagen is converted into collagen.
 - C) Describe how this conversion occurs.
3. Insulin, which is secreted by pancreatic endocrine β -cells and plays a critical role in glucose metabolism, is derived from proinsulin. Please answer the following questions (10%):
 - A) Identify one specific structural difference between insulin and proinsulin.
 - B) Indicate the location where proinsulin is converted into insulin.
 - C) Describe how this conversion occurs.
4. A scientist has been studying the three most abundant proteins found in *Fungus amungus* plasma membranes. He calls them proteins A, B, and C. When he treats the membranes with a high-salt solution, he no longer detects protein B in the membrane, even though controls show that his detection procedure is working properly. The salt treatment has no effect on proteins A and C. (10 %)
 - A) Please briefly describe the three main classes of membrane proteins.
 - B) What should the scientist conclude about protein B? Explain your answer.
5. Transverse diffusion (flip-flop) is very infrequent in artificial bilayers, yet can be observed readily in biological membranes. What is the explanation for this phenomenon? (3 %)
6. *Pseudomonas* toxin will transfer from the Golgi apparatus to the endoplasmic reticulum in mammalian cells. The C-terminal 24 amino acids of the B subunit of *Pseudomonas* toxin are shown below: (6 %)

KEQAISALPD YASQPGKKPPR KDEL

 - A) From inspection of these sequences, what is the most likely targeting receptor responsible for the transfer of *Pseudomonas* toxin from the Golgi apparatus to the endoplasmic reticulum?

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- B) What coat protein complex is most likely required for this transfer? Explain your answer.
7. A mutation in a Gas protein was found to decrease its intrinsic GTPase activity (6 %).
- A) What is the downstream 2nd messenger of the Gas protein?
- B) How would this mutation affect the cellular concentration of this 2nd messenger? Explain your answer.