國立清華大學 106 學年度碩士班考試入學試題

系所班組別：生命科學院甲組、丁組

考試科目（代碼）：細胞生物學(0505、0805)

Part 1 單選題 (每題 5 分，共 20 分，答錯不倒扣。請在【答案卡】作答)

1. (5%) Which amino acid is phosphorylated in response to activation of cellular signaling?
   (A) Tyrosine
   (B) Serine
   (C) Threonine
   (D) All the above
   (E) None of the above

2. (5%) The longest neurite is defined as a(n):
   (A) Axon
   (B) Dendrite
   (C) Myelin
   (D) Oligodendrocyte
   (E) Glia

3. (5%) Which of the following is NOT a component of mammalian plasma membrane?
   (A) Cholesterol
   (B) Sphingomyelin
   (C) Laminin
   (D) Phosphatidylcholine
   (E) Phosphatidylserine

4. (5%) Which of the following is NOT involved in vesicular transport?
   (A) Rab
   (B) v-SNARE
   (C) p53
   (D) Synaptotagmin
   (E) Ca^{2+}

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Part 2 單選題 (每題 2 分，共 20 分，答錯倒扣 1 分。請在【答案卡】作答)

5. In which actin-based structure are all microfilaments *bundled* AND *uniformly* oriented?
   (A) Filopodia, (B) Flagella, (C) Lamellipodia, (D) Stress fibers,
   (E) Actin (cell) cortex

6. Which actin-binding protein facilitates (powers) the elongation (lengthening) of actin?
   (A) Gelsolin, (B) Filamin, (C) ADF/Cofilin, (D) Thymosin-beta 4, (E) Formin

7. How many doublet microtubules are found in the axoneme of the cilia?
   (A) 13, (B) 10, (C) 9, (D) 8, (E) None

8. Why does the endoplasmic reticulum (ER) break down when cells are treated with nocodazole (ND)?
   (A) ND depolymerizes actin filaments and the cell loses its mechanical stability damaging the ER
   (B) ND makes small holes into the plasma membrane leading to cell collapse damaging the ER
   (C) ND depolymerizes microtubules that organize and are closely associated with the ER
   (D) ND affects intermediate filaments which wrap around the nucleus and the closely associated ER
   (E) ND inhibits molecular motors which are important to organize the ER

9. During the cross-bride cycle what happens if ADP is released from myosin?
   (A) The power stroke occurs
   (B) Myosin head detached from actin
   (C) Myosin head binds more tightly to actin
   (D) Myosin enters high energy configuration
   (E) Myosin enters low energy configuration

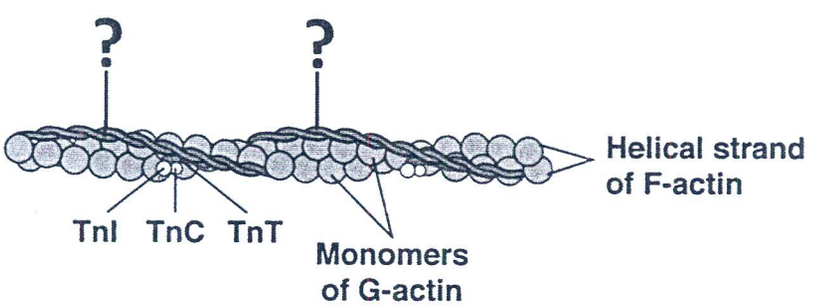
10. What type of structure is used in plant cells for intercellular communication?
(A) Adherens belt, (B) Gap junctions, (C) Desmosomes, (D)Plasmodesmata, (E) Tight junctions

11. Which antigens can be found on the membrane of erythrocytes in the blood of humans with blood type AB?
(A) A antigen, (B) B antigen, (C) AB antigen, (D) A antigen + B antigen, (E) O = no antigen

12. In microscopy how is "refraction" defined?
(A) It occurs when an obstacle is brought into a ray of light, and light changes its path pattern
(B) It is the bending of light that occurs at the interface of two media with different densities
(C) It is the reflection of light at very smooth surfaces
(D) It happens near pin holes in the focal planes of confocal microscopes
(E) It happens in TEM when light is scattered by electrons

13. What does "DIC microscopy" stands for?
(A) Differential interference contrast microcopy
(B) Digital interference contrast microscopy
(C) Dark field interchange contrast microscopy
(D) Deferrable interface cumulative microscopy
(E) Diminished intrinsic laser cumulative microscopy

14. What is the name of the (long, rope-like) protein that wraps around F-actin?



(A) Myosin, (B)Filamin, (C)Troponin, (D)Tropomodulin, (E)Tropomyosin

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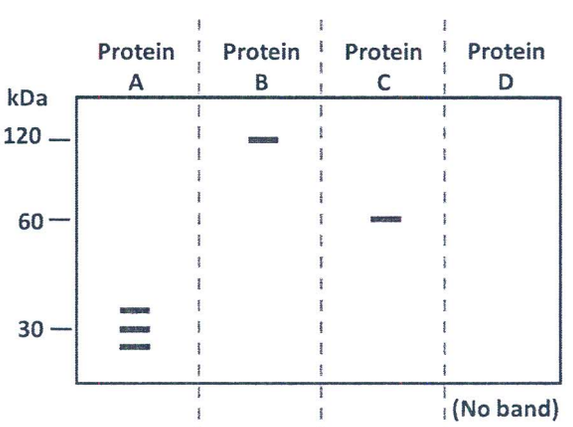
Part 3 問答題 (共 40 分)

1. What are the two models which depict the flow of lipids and proteins through the Golgi complex? Please provide brief descriptions for each model. Which model describes the retrograde flow of lipids and proteins through the Golgi complex? (8 %)

2. Trypsin is a hydrophilic protease and therefore **unable** to cross the plasma membrane and enter a cell. However, it is capable of digesting the hydrophilic portions of membrane proteins. As a result of these properties, researchers investigating membrane proteins have treated cells with trypsin first, then separated the proteins by SDS-PAGE to gain insight into the orientation of particular proteins within the membrane. After exposure of the cells to trypsin, membrane-associated proteins were isolated and subjected to SDS-PAGE. The SDS-PAGE result is shown in the figure below. Please draw **one** possible form of proteins A, B, C, and, D in the membrane with appropriate orientation and describe the type (class) of these proteins according to the experimental result. Please explain your reasoning. (Assume the proteins are single polypeptides with molecular mass of 120 kDa.) (12 %)



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3. Please describe (a) how receptor tyrosine kinase acts through Ras-dependent pathway to promote cell proliferation, and (b) how Transforming growth factor β receptor pathway inhibits cell division (8%).

4. Please explain how p53 and Rb function as tumor suppressor genes, respectively? (8%)

5. Please describe the current model for the signal mechanism of cotranslational import. (4%)

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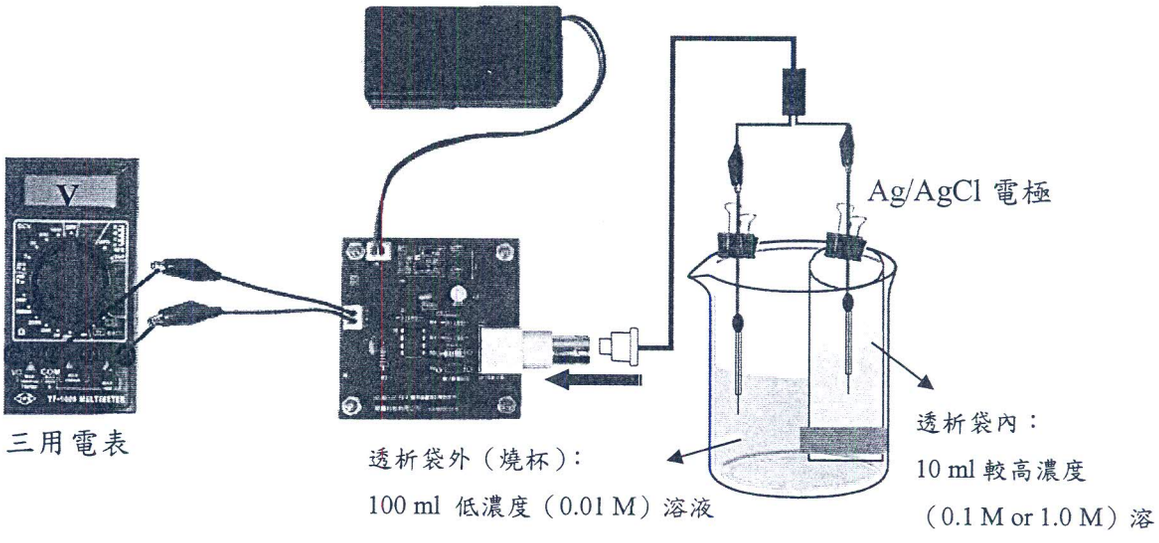
Part 4 實驗題 (共 20 分)



實驗裝置圖

以下為使用上圖所量測的實驗數據，透析袋內外溶液不同濃度的電壓差值

透析袋內外濃度/ 溶液	NaCl	KCl	HCl	NaOH
0.01 M 內/ 0.01 M 外	-3 mV	-6 mV	-2 mV	-3 mV
0.1 M 內/ 0.01 M 外	-52 mV	-57 mV	-60 mV	-1 mV
1 M 內/ 0.01 M 外	-97 mV	-99 mV	-115 mV	-2 mV

注意: 透析袋是透析蛋白質大分子用，不同離子進出完全無差別

請回答以下問題:

1. 請解釋為何(除 NaOH 外)透析袋內外溶液不同濃度有電壓差，且接近-60 mV? (4%)
2. 請解釋為何(除 NaOH 外)透析袋內外溶液濃度較低之組合卻又沒有電壓差? (4%)
3. 請解釋為何透析袋內外 NaOH 溶液三種不同濃度的組合都沒有電壓差? (4%)
4. 根據此實驗，到底證明或推翻“膜內外離子濃度差造成細胞膜電位”此一說法 (靜止細胞膜與透析袋特性相似，但透析袋較利於離子流動) (4%)
5. 請解釋到底細胞為何會有細胞靜止膜電位? (4%)