

國立中山大學生物科學系 100 學年上學期
博士班資格考試(筆試)

科目：微生物免疫學

※請自行就選擇題及問答題進行配分答題，兩部份總核計分數為 100 分。

選擇題（每題 4 分，每題選出一個最正確的選項）

※請在答案卷首頁勾選答題數，超過自選答題數，以答錯題扣分計。

1)Place the steps of the Gram stain in the correct order:

1-Alcohol-acetone; 2-Crystal violet; 3-Safranin; 4-Iodine.

A)2-1-4-3 B)1-3-2-4 C)1-2-3-4 D)2-4-1-3 E)4-3-2-1

2)Which microscope is used to observe a specimen that emits light when illuminated with an ultraviolet light?

A)Darkfield microscope B)Electron microscope C)Fluorescence microscope
D)Phase-contrast microscope E)Compound light microscope

3)Which of the following structures is **NOT** found in prokaryotic cells?

A)Cilium B)Flagellum C)Axial filament D)Pilus E)Peritrichous flagella

4)Which of the following is **NOT** a chemical component of a bacterial cell wall?

A)N-acetylmuramic acid B)Peptidoglycan C)Teichoic acids D)Peptide chains
E)Cellulose

5)What will happen if a bacterial cell is placed in distilled water with lysozyme?

A)No change will result; the solution is isotonic. B)The cell will plasmolyze.
C)Lysozyme will diffuse into the cell. D)Water will leave the cell.
E)The cell will undergo osmotic lysis.

6)Cyanobacteria are a type of

A)Photoautotroph. B) Chemoheterotroph. C)Chemoautotroph. D) Photoheterotroph.

7)Salts and sugars work to preserve foods by creating a

A)Hypotonic environment. B)Lower pH. C)Lower osmotic pressure.
D)Depletion of nutrients. E)Hypertonic environment.

8)The term facultative anaerobe refers to an organism that

A)Requires less oxygen than is present in air. B)Doesn't use oxygen but tolerates it.
C)Is killed by oxygen. D)Uses oxygen or grows without oxygen.
E)Prefers to grow without oxygen.

9)During which growth phase will gram-positive bacteria be most susceptible to penicillin?

A)Stationary phase B)Log phase C)Lag phase D)Death phase
E)The culture is equally susceptible during all phases.

- 10)The source of nutrients in nutrient agar is
A)Agar. B)Nutrient. C)Peptone and NaCl. D)Peptone and beef extract.
E)All of the above.
- 11)Which of the following is a limitation of the autoclave?
A)Can not be used with glassware B)Requires a long time to achieve sterilization
C)Can not kill endospores D)Cannot inactivate viruses
E)Can not be used with heat-labile materials
- 12)Which concentration of ethanol is the most effective bactericide?
A)50% B) 100% C) 40% D) 30% E) 70%
- 13)An enzyme produced in response to the presence of a substrate is called
A)A promoter. B)An operator. C)A repressible enzyme. D)A restriction enzyme.
E)An inducible enzyme.
- 14)The mechanism by which the presence of glucose inhibits the lactose operon is
A)Repression. B)Catabolite repression. C)Translation. D)DNA polymerase.
E)Induction.
- 15)Bacteria and archaea are similar in which of the following?
A)Plasma membrane ester linkage B)Methionine as the start signal for protein synthesis
C)Peptidoglycan cell walls D)Possessing prokaryotic cells E)Sensitivity to antibiotics
- 16)Rickettsias differ from chlamydias in that rickettsias
A)Are intracellular parasites. B)Lack cell walls. C)Require an arthropod for transmission.
D)Form elementary bodies. E)Are gram-negative.
- 17)You have isolated a bacterium that grows in a medium containing only inorganic nutrients. Ammonia is oxidized to nitrate ion. This bacterium is
A)Gram-negative. B)Using anaerobic respiration. C)A photoheterotroph.
D)A chemoautotroph. E)A photoautotroph
- 18)Actinomycetes differ from fungi in that actinomycetes
A)Require light. B)Are chemoheterotrophs. C)Cause disease. D)Are decomposers.
E)Lack a membrane-bounded nucleus.
- 19)The most common route of accidental AIDS transmission to health care workers is
A)Mouth to mouth. B)Environmental surface contact. C)Needlestick. D)Aerosol.
E)Fecal – oral.
- 20)A nosocomial infection is
A)Always present but is inapparent at the time of hospitalization.
B)Always caused by pathogenic bacteria.
C)Acquired during the course of hospitalization.
D)Always caused by medical personnel.
E)Only a result of surgery.
- 21)Which of the following is **NOT** a communicable diseases?
A)Tuberculosis B)Typhoid fever C)Tetanus D)AIDS E)Malaria

22)Endotoxins are

- A)Specific in their method of action. B)Excreted from the cell.
C)Part of the gram-negative cell wall. D)Associated with gram-positive bacteria.
E)A-B toxins.

23)Which of the following statements is true?

- A)Endospores are easily stained in a Gram stain.
B)A cell produces one endospore and keeps growing.
C)Endospores allow a cell to survive environmental changes.
D)A cell can produce many endospores.
E)Endospores are for reproduction.

24)Where are phospholipids most likely found in a prokaryotic cell?

- A)Ribosomes B)Flagella C)Plasma membrane D)Around organelles E)B and C

25)You are observing a cell through a microscope and note that it has no apparent nucleus. You conclude that it most likely

- A)Is part of a multicellular animal. B)Moves by pseudopods. C)Has a cellulose cell wall.
D)Has a peptidoglycan cell wall. E)Is a plant cell.

問答題（每題20分）※依答題卷上答題順序批改，超過選答之題數以零分計算。

1. Compare and contrast the molecular details of antigen presentation by class I and class II MHC molecules.
2. One of major characteristics of immune response is to recognize self and non-self. Describe how our immune system achieves this goal along the developmental path of immune cells.
3. Compare and contrast five types of hypersensitivity. What are the mediators of each type? Describe the detail pathogenic mechanism for each type of hypersensitivity.
4. An effective adaptive immune response requires the collaboration of B-, T- and antigen-presenting cells. The interplay between components of innate and adaptive immunity is critical for eliciting effective immune response against invading pathogens. Describe how these various elements are activated and how the relevant cell types interact to establish effective adaptive immune response?
5. Describe the structural basis for the antibody specificity. What is the molecular mechanism used to create this specificity during B-cell development.

國立中山大學生物科學系 100 學年上學期
博士班資格考試(筆試)

科目：生物化學(Biochemistry)

◎任選五題作答，每題 20 分。答題超過五題者，依考題題號順序批改五題計分。

1. Explain the following terms:
 - (1) Allosteric proteins
 - (2) Bacteriorhodopsin
 - (3) Chargaff's rules
 - (4) Exons
 - (5) Glycomics
2. Describe the general mechanism for signal transduction by using the effect of glucagon on glycogen metabolism in liver cells as the example.
3. Enzyme-catalyzed reactions can be described mathematically by the Michaelis-Menten equation. (1) Write out the equation and describe the proposed assumptions to derive the equation. (2) Discuss the meanings of the kinetic constants of the equation.
4. A metabolic pathway appears to be either catabolic or anabolic. However, the citric acid cycle is amphibolic (both catabolic and anabolic). (1) Describe the overall reaction in respect of the catabolic role of the citric acid cycle and (2) give four examples to illustrate the anabolic role of the citric acid cycle.
5. Describe the following terms:
 - (1) Ion-exchange chromatography
 - (2) Southern blotting
 - (3) PCR
 - (4) Coenzyme
 - (5) cDNA
6. Describe how ATP is synthesized in mitochondria.
7. If you obtain a cell extract, describe how you get it purified to gain a pure protein as you expected.
8. Describe how the enzyme activity is regulated within the cell.

◎**Choose 5 questions to answer (each question 20 points). If more than 5 questions are answered, only 5 questions in numerical order will be graded and counted in the total points.**

國立中山大學生物科學系 100 學年上學期
博士班資格考試(筆試)

科目：生態學

1. Based on biogeochemical cycle of an ecosystem, please explain the common components by drawing a figure. (10)
 2. Using population dynamics, what factors can influence population dynamic? (15)
 3. Please describe the mechanisms that plant adapts to environment in different ecosystems. (25)
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- (1) 請就湖泊與森林演替的觀點評論生態保育團體在河口栽植水筆仔或在淡水濕地為食蟲植物移除莎草科植物對那些棲地類型的生物群聚的影響。(25)
 - (2) 標識再捕法對生物族群量估計的限制性為何？有何實際有效的改進方法？(25)

國立中山大學生物科學系 100 學年上學期
博士班資格考試(筆試)

科目：演化生物學

1. For the genetic code, the information of genetic code are sharing for all of species in the world. Based in it, is the genetic code a homologous trait for the clade of mammals? Is the genetic code a synapomorphy for the clade of mammals? Explain. Generally, what kinds of homologies are not synapomorphies?(15)
 2. Gene duplication is an important mechanism to increase number of gene and force of evolution. In human hemoglobin, why are the globin genes thought to have arisen by gene duplication? What are different functions obtain after gene duplication?(20)
 3. Based on recent study, threatened species like *Amentotaxus formosana*, *Cycas taitungensis*, and *Keteleeria formosana* have lower heterozygosity and high inbreeding coefficient. Please explain what kinds of processes are caused lower heterozygosity and high inbreeding coefficient. What does this imply for the long-term future of these threatened taxa?(15)
- (1) 如何偵測新物種的生成由 allopatric, parapatric 或 sympatric speciation 所造就? (25)
- (2) 性擇與天擇的利益在什麼樣的場合可能會有衝突? 而這樣的衝突效應對新物種的生成有何影響? (25)

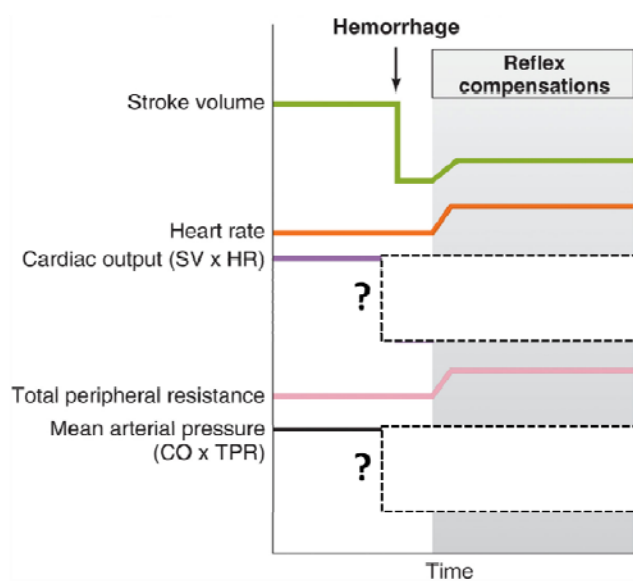
國立中山大學生物科學系 100 學年上學期
博士班資格考試(筆試)

科目：動物生理學

！！請自下列六個題目中任選四題作答，若答題超過四題者，以“最低分四題”計算成績；請於答案卷中註明題號。

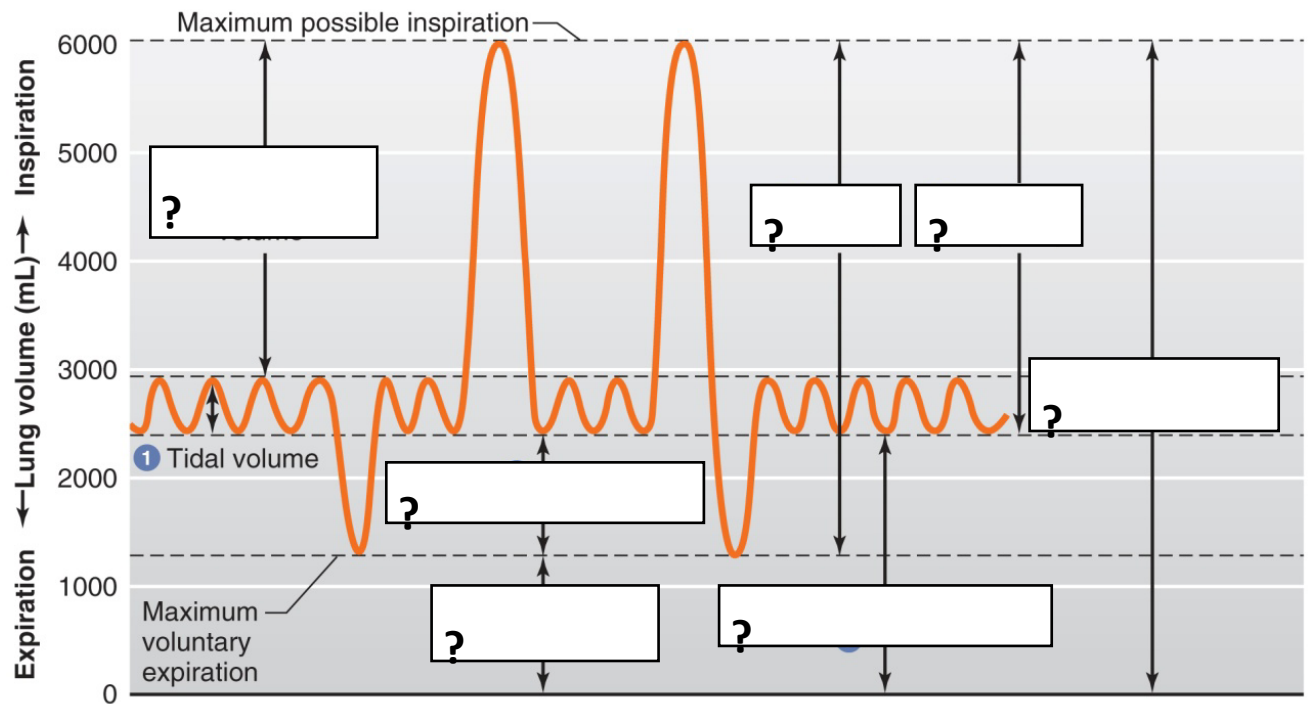
1. Cardiovascular Physiology (25 %)

The figure depicts time course of cardiovascular effects of hemorrhage. Please describe the mechanism underlying “reflex compensation” via the following concepts.



- Please draw the putative changes of cardiac output & mean arterial pressure curve following hemorrhage.(5 %)
- Following hemorrhage, which reflex pathway is evoked? Please include receptor, afferent, central integrated nucleus, efferent and effector involved in this pathway. (10 %)
- How does autonomic nervous system influence changes of heart rate and total peripheral resistance following hemorrhage? Please describe in detail. (10 %)

2. Respiratory Physiology (25 %)



- A. The figure demonstrates lung volumes and capacities recorded on a spirometer. Please fill the following terms in the figure. (10%)
- Inspiratory reserve volume
 - Expiratory reserve volume
 - Residual volume
 - Vital capacity
 - Inspiratory capacity
 - Functional residual capacity
 - Total lung capacity
- B. Please provide the definition of "tidal volume". (3%)
- C. When you inhale 5 % CO_2 , what will happen to the tidal volume ? (increase, decrease or no change). (2 %)
- D. Please explain the detail mechanism underlying changes of tidal volume following inhalation of 5 % CO_2 (10 %).

3. Gastrointestinal Physiology (25 %)

The primary functions of the gastrointestinal system are secretion, digestion, absorption and motility.

- A. Please list exocrine secretions from the stomach, pancreas, liver and small intestine, and briefly describes function of these gastrointestinal exocrine secretions. (10 %)
- B. After protein was digested into small peptide and amino acid in the small intestine, how does small intestine absorb these small peptides and amino acid ? Please describe the detail cellular/molecular mechanism. (10 %)
- C. Please compare the function of segmenting contraction and peristaltic activity of the small intestine. (5 %)

4. Compare the role and source of Ca^{2+} in smooth muscle, skeletal muscle and cardiac muscle contraction (25%).

5. Why is an excitatory synapse on the soma more effective in evoking action potentials in the postsynaptic neuron than an excitatory synapse on the tip of a dendrite (10%)? The nerve terminal of a neuron can be far away from soma, how neuron transmits its excitatory signal to nerve terminal (and hence elicit neurotransmitter release) without any decay (15%).

6. GABA (γ -aminobutyric acid) is a very important neurotransmitter in central nervous system. Name 3 examples of how chemical compounds achieve their therapeutic/pathological effects by modulating the function of GABA_A receptor (25%).

國立中山大學生物科學系 100 學年上學期
博士班資格考試(筆試)

科目：細胞分子生物學

◎任選五題作答，每題 20 分。答題超過五題者，依考題題號順序批改五題計分。

1. Although bacteria (*E. coli*) are ideal models for studying many conserved properties of cells, they can not be used for studying the aspects of cell structure and function that are unique to eukaryotes. Describe and explain which model organism (1) would provide the simplest system for studying eukaryotic DNA replication, (2) is most widely used for studying animal development and cell differentiation, and (3) would be best suited for studying a gene involved in mammalian embryonic development.
2. A variety of methods have been used to visualize cells and subcellular structures and to determine the intracellular localization of specific molecules. Describe the information provided by each method listed below. (1) Green fluorescent protein (GFP) labeling
 - (2) Western blotting
 - (3) Transmission electron microscopy
 - (4) Subcellular fractionation
 - (5) Confocal microscopy
3. The role of the endoplasmic reticulum in protein processing and sorting was first demonstrated by Palade and his coworkers in the 1960s. They studied the pathway taken by secreted proteins using pulse-chase labeling of proteins and autoradiography. Their experiments defined the secretory pathway taken by secreted proteins. Describe the pathway in detail.
4. The synthesis of a polypeptide is not equivalent to the production of a function protein. To be functioning, polypeptides must fold into specific three-dimensional structures. Recent studies have shown that the proper folding of proteins within cells is mediated by the activities of many proteins. Describe any three proteins that are involved in protein folding.
5. Gene expression requires the cooperation between two types of regulatory cis-acting and trans-acting factors. Define what they are and deduce the experiments that you will conduct to prove their existence.
6. Eukaryotic cell initiates DNA replication when entering S phase of cell cycle. Describe the molecular mechanism operated to initiate DNA replication. In your answer also address how cell ensures that the genome is copied only once in each cell cycle.
7. Describe how eukaryotic cell prevents the initiation of anaphase when there is improper assembly of the mitotic spindle.

8. Describe the method commonly used to label stem cell in adult tissues. Where is mammalian skin/hair stem-cell niche? What are the signals in maintaining the niche and controlling stem cell fate?

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