

國立中山大學 106 學年度碩士暨碩士專班招生考試試題

科目名稱：普通生物學【海資系碩士班甲組】

題號：452003

※本科目依簡章規定「不可以」使用計算機(問答申論題)

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問答題：(7 題，共 100 分)

- (1) 請繪圖說明真核細胞與原核細胞在構造上有何不同。(15分)
- (2) 酵素 (enzyme) 是什麼？功能為何？酵素活性如何被調控？可舉例說明。(15分)
- (3) 請簡單敘述孟德爾遺傳定律中的分離律 (law of segregation) 以及獨立分配律 (law of independent assortment)。(10分)
- (4) 利用 β -galactosidase 的活性進行藍白篩選是分子生物學上被廣泛使用的技術，請說明這項篩選方法的原理。(10分)
- (5) 請問真核細胞粒線體 (mitochondrion) 中的呼吸電子傳遞鏈 (respiratory electron transport chain)，有哪些細胞膜蛋白參與電子傳遞，請列舉兩個。如何製造出化學勢能 (proton gradient)，其生理意義為何？(20分)
- (6) 請繪圖說明真核細胞蛋白質合成 (transcription and translation) 過程。(20分)
- (7) 請解釋為何某些 tRNA 上的 anticodon 可與多個 mRNA codon 辨識？目的為何？(10分)

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單選擇(每題5分，答錯不倒扣)

1. ATP is a renewable resource that can be regenerated by the addition of a phosphate group to ADP. Which is **NOT CORRECT**?
 - (A) A working muscle cell recycles its entire pool of ATP once each minute. More than 10 million ATP molecules are consumed and regenerated per minute per cell.
 - (B) The free energy to phosphorylate ADP comes from exergonic (catabolic) reactions in the cell.
 - (C) Catabolic (exergonic) pathways, especially cellular respiration, provide the energy for the endergonic regeneration of ATP.
 - (D) Regeneration of ATP is an endergonic process, requiring an investment of energy: $\text{ADP} + \text{P}_i \rightarrow \text{ATP} + \text{H}_2\text{O}$ where $\Delta G = +7.3 \text{ kcal/mol}$, under standard conditions.
 - (E) Plants can use light energy to generate ATP via photosynthesis.

2. Catabolic metabolic pathways release energy stored in complex organic molecules.
 - (A) Fermentation, leads to the partial degradation of sugars with the use of partial oxygen. aerobic respiration, consumes oxygen as a reactant to complete the breakdown of a variety of organic molecules.
 - (B) Reactions that result in the transfer of one or more electrons (e^-) from one reactant to another are oxidation-reduction reactions, or redox reactions. Electron transfer from NADH to oxygen is an exergonic reaction with a free-energy change of -106 kcal/mol
 - (C) Catabolic pathways transfer the electrons stored in food molecules, releasing
 - (D) energy that is used to synthesize ATP. $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + \text{energy}$ (ATP + heat)
 - (E) The catabolism of glucose is exergonic, with $\Delta G = -686 \text{ kcal}$ per mole of glucose.
 - (F) Fructose generates more energy than glucose

3. An enzyme is a macromolecule that acts as a catalyst, a chemical agent that speeds up the rate of a reaction without being consumed by the reaction. Binding by inhibitors prevents enzymes from catalyzing reactions. Certain chemicals selectively inhibit the action of specific enzymes. Which is **NOT CORRECT**?

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- (A) Some reversible inhibitors resemble the substrate and compete for binding to the active site. Competitive inhibition can be overcome by increasing the concentration of the substrate.
- (B) If inhibitors attach to the enzyme by covalent bonds, inhibition may be irreversible. It is irreversible inhibition. If inhibitors bind by weak bonds, inhibition may be reversible.
- (C) Noncompetitive inhibitors that impede enzymatic reactions are also binding to the active site of the enzyme.
- (D) Many antibiotics are inhibitors of specific enzymes in bacteria. Penicillin blocks the active site of an enzyme that many bacteria use to make their cell walls.
- (E) Toxins and poisons are often irreversible enzyme inhibitors. For example, Sarin, the nerve gas that was released by terrorists in the Tokyo subway in 1995, binds covalently to the R group on the amino acid serine.
4. The mitotic phase alternates with interphase in the cell cycle. Which is **CORRECT**?
- (A) Chromosomes are duplicated during the G₁-S phase.
- (B) The mitotic (M) phase of the cell cycle, which includes mitosis and cytokinesis, alternates with the much shorter interphase. Interphase accounts for about 30% of the cell cycle.
- (C) A typical human cell might divide once every 12 hours. Of this time, the M phase would last less than an hour and the S phase might take 10–12 hours, or half the cycle.
- (D) Interphase has three subphases: the G₁ phase (“first gap”), the S phase (“synthesis”), and the G₂ phase (“second gap”). The daughter cells may then repeat the cycle. During all three subphases, a cell that will eventually divide grows by producing proteins and cytoplasmic organelles such as mitochondria and endoplasmic reticulum.
- (E) The rest of the time would be divided between the G₁ and G₂ phases. The G₂ phase varies most in length from cell to cell.
5. Cancer cells have escaped from cell cycle controls. Cancer cells divide excessively and invade other tissues because they are free of the body’s control mechanisms. Which is **NOT CORRECT**?

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- (A) Cancer cells do not stop dividing when growth factors are depleted. This is because a cancer cell manufactures its own growth factors, has an abnormality in the signaling pathway, or has an abnormal cell cycle control system.
- (B) Cells in culture that acquire the ability to divide indefinitely are said to have undergone transformation, the process that causes them to behave like cancer cells. Normally, the immune system recognizes and destroys transformed cells.
- (C) If and when cancer cells stop dividing, they do so at random points, not at the normal checkpoints in the cell cycle. HeLa cells from a tumor removed from a woman (Henrietta Lacks) in 1951 are still reproducing in culture.
- (D) Cancer cells are abnormal in many ways. For example, cancer cells may have an unusual number of chromosomes, their metabolism may be disabled, and they may cease to function in any constructive way. Cancer cells may secrete signal molecules that cause blood vessels to grow toward the tumor.
- (E) Cells that evade destruction proliferate to form a tumor, a mass of abnormal cells. If the abnormal cells remain at the originating site, the lump is called a benign tumor. Most benign tumors immediately cause serious problems and can be fully removed by surgery.
6. Cancer cells often lose their attachment to nearby cells, are carried by the blood and lymph system to other tissues, and start more tumors in an event called metastasis. Which description is **NOT CORRECT**?
- (A) Treatments for metastasizing cancers include high-energy radiation and chemotherapy with toxic drugs. These treatments target actively dividing cells.
- (B) Chemotherapeutic drugs interfere with specific steps in the cell cycle.
- (C) The side effects of chemotherapy are due to the drug's effects on normal cells.
- (D) Nausea results from chemotherapy's effects on intestinal cells, hair loss results from its effects on hair follicle cells, and susceptibility to infection results from its effects on immune system cells.
- (E) Taxol prevents microtubule depolymerization, preventing cells from proceeding past anaphase.
7. Which of the statement about digestion system in animals is **CORRECT**?
- (A) Secretin modulates digestion by triggering acid release in the stomach
- (B) The bile salts function in fat digestion by dispersing big droplets of fats to small droplets
- (C) Stomach acid activates pepsinogen into pepsin.

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- (D) A fatty acid absorbed into an intestinal cell becomes part of a chylomicron
- (E) Glucagon, the pancreatic hormone, functions to stimulate the liver to release glucose.
8. For the transport in the animal, which statement is **CORRECT**?
- (A) An adaptive advantage of having a three-chambered heart, as found in amphibians, over the two-chambered heart of fish is that fully oxygenated blood is kept completely separate from relatively deoxygenated blood in the heart.
- (B) Concurrent flow is not as efficient in exchange as countercurrent flow because the latter provides more diffusion at the end of capillary flow than midway through the capillary
- (C) The fluid that moves around in the circulatory system of a typical arthropod is the hemolymph.
- (D) Birds organisms breathe through tracheae
- (E) When a girl goes running, her face begins to flush mainly due to systolic pressure
9. About the animal excretory system, which statement is **NOT CORRECT**?
- (A) Animals that can produce exceptionally concentrated urine should be expected to have nephrons with longer descending limbs of the loops of Henle and ascending limbs of the loops of Henle.
- (B) The worms have flame bulbs that eliminate nitrogenous wastes.
- (C) Osmoregulation is the processes by which animals control solute concentrations and balance water gain and loss.
- (D) When urea and KCl become more abundant in the kidney medulla's interstitial fluid as one progresses deeper into the medulla, it promotes better retention of water
- (E) Marine bony fishes have more and larger nephrons than freshwater fishes, and their nephrons also lack a proximal tubule.
10. Which of the following statement is **CORRECT**?
- (A) An infant suckling on the breast of a woman who has recently given birth sends a nerve impulse to the pituitary gland. The pituitary gland then secretes oxytocin, which stimulates the mammary glands in the breasts to release milk. This is the case for negative feedback.
- (B) The formation of the fertilization membrane and the slow block to polyspermy are dependent on the departure of sodium ions from the egg.

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- (C) In humans, oogenesis is completed after ovulation, but before the sperm enters the oocyte.
- (D) Males produce estradiol in high levels.
- (E) Spermatogenesis and oogenesis differ in that oogenesis produces one egg and spermatogenesis produces four sperm.

11. Melatonin is

- (A) a methoxyindole
- (B) secreted by the pineal gland during the summer
- (C) autonomic nervous system during the winter
- (D) posterior pituitary gland during the day

12. The absorption of fats differs from that of carbohydrates in that _____.

- (A) fat absorption primarily occurs in the stomach, whereas carbohydrates are absorbed from the small intestine
- (B) carbohydrates need to be emulsified before they can be digested, whereas fats do not
- (C) fats, but not carbohydrates, are digested by bacteria before absorption
- (D) most absorbed fat first enters the lymphatic system, whereas carbohydrates directly enter the blood

13. In a well-fed human eating a Western diet, the richest source of stored chemical energy in the body is _____.

- (A) glucose in the blood
- (B) fat in adipose tissue
- (C) glucose in muscle cells
- (D) fat in muscle cells

14 Which of the following ions is most likely to cross the plasma membrane of a resting neuron?

- (A) Ca^{2+}
- (B) Na^+
- (C) Mg^{2+}
- (D) K^+

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15. Which statement about hyperpolarization of a neuron is true? When hyperpolarization occurs,
- (A) membrane potential is closer to E_{Na} than it is to E_K .
 - (B) Na^+ and/or Cl^- channels are open.
 - (C) membrane potential is more negative than during resting potential.
 - (D) if it occurs in a downstream neuron, EPSPs are more likely to be generated than are IPSPs.
 - (E) generation of action potentials is likely to occur
16. Which statement is **TRUE**?
- (A) Arousal and sleep are controlled by the part of the brain called the medulla oblongata
 - (B) Neurons are arranged according to the part of the body that receives the motor commands.
 - (C) In PET (positron-emission tomography) scanning of the brain, scientists and physicians inject radioactive glucose and detect activity in a specific brain region by changes in the local blood concentration.
 - (D) About the somatosensory and motor cortex, the cortical surface area devoted to each body part is proportional to the size of the part.
 - (E) The establishment of differences in cortical hemisphere function is called the “split-brain effect.”
17. The roles of glia in the vertebrate brain do **NOT** include:
- (A) Protecting the nervous system from invading microorganisms.
 - (B) Providing structural support for neurons.
 - (C) Receiving neurotransmitters.
 - (D) Modulating synaptic transmission.
 - (E) Generating neurons and additional glia.
18. Which is **CORRECT** for the relationship between photosynthesis and respiration in plants.
- (A) Plants respire only when they don't photosynthesize.
 - (B) Photosynthesis is the plant's form of cellular respiration.
 - (C) Respiration is not only needed for energy generation in the plants, but also provides compounds for the synthesis of other metabolites that is necessary for the plant life.

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- (D) Because photosynthesis supplements the plant the energy under light condition, the respiration will reduce when the plant is transferred from dark condition to light condition
- (E) Cellular respiration takes place only in plant roots, not throughout the plant.
19. Photosynthetic pigments in the thylakoid are light receptors. Which is **NOT CORRECT**?
- (A) Chlorophyll a, which participates directly in the light reactions and absorbs best in the red and violet-blue wavelengths and absorbs least in the green, participates directly in the light reactions, but accessory photosynthetic pigments absorb light and transfer energy to chlorophyll a.
- (B) An overall action spectrum for photosynthesis profiles the relative effectiveness of different wavelengths of radiation in driving the process. The action spectrum of photosynthesis was first demonstrated in 1883 in a clever experiment performed by Thomas Engelmann.
- (C) Accessory pigments include chlorophyll b, carotenoids, and anthocyanin.
- (D) Each light-harvesting complex consists of pigment molecules (which may include chlorophyll a, chlorophyll b, and carotenoids) bound to proteins, in which the light-harvesting complexes act as an antenna for the reaction-center complex.
- (E) The action spectrum of photosynthesis does not match exactly the absorption spectrum of any one photosynthetic pigment, including chlorophyll a.
20. The first product by the Calvin cycle is
- (A) Glucose
- (B) Sucrose
- (C) Glyceraldehyde-3-phosphate
- (D) Starch
- (E) Malic acid

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題號：

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- (1) 請繪圖說明原核細胞和真核細胞在蛋白質合成 (transcription and translation) 過程中有哪些不同。(20分)
- (2) 請繪圖說明在蛋白質純化過程中，親合性管柱層析法 (affinity chromatography)、離子交換樹脂 (ion exchange chromatography) 以及膠體過濾法 (gel filtration chromatography)，在功能上有何不同，目的為何？(25分)
- (3) 酵素動力論 (enzyme kinetics) 中，Michaelis-Menten curve 如何詮釋 K_m , V_{max} 以及基質濃度 $[S]$ ，請繪圖說明。並繪圖說明 Competitive Inhibition (競爭性抑制)，Noncompetitive Inhibition (非競爭性抑制) 以及 Uncompetitive Inhibition (反競爭性抑制) (20分)。
- (4) 請列舉胺基酸側鏈 (amino acid side chain) 帶有正電荷、負電荷及不帶電之胺基酸各兩個 (15分)。
- (5) 何謂蛋白質二級結構 (secondary structure)，請繪圖說明 (10分)。
- (6) 請解釋搖擺理論 (Wobble base pairing) (10分)

國立中山大學 106 學年度碩士暨碩士專班招生考試試題

科目名稱：科學英文【海資系碩士班乙組】

題號：452002

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PART I Essay questions (問答題 60%, 每題 10 分)

1. Differences in the sensitivity of marine species to ocean acidification will influence the structure of marine communities in the future. Reproduction is critical for individual and population success, yet is energetically expensive and could be adversely affected by rising CO₂ levels in the ocean. We investigated the effects of projected future CO₂ levels on reproductive output of two species of coral reef damselfish, *Amphiprion percula* and *Acanthochromis polyacanthus*. Adult breeding pairs were maintained at current-day control (446 μ atm), moderate (652 μ atm) or high CO₂ (912 μ atm) for a 9 month period that included the summer breeding season. The elevated CO₂ treatments were consistent with CO₂ levels projected by 2100 under moderate (RCP6) and high (RCP8) emission scenarios. Reproductive output increased in *A. percula*, with 45–75 % more egg clutches produced and a 47–56 % increase in the number of eggs per clutch in the two elevated CO₂ treatments. In contrast, reproductive output decreased at high CO₂ in *Ac. polyacanthus*, with approximately one-third as many clutches produced compared with controls. Egg survival was not affected by CO₂ for *A. percula*, but was greater in elevated CO₂ for *Ac. polyacanthus*. Hatching success was also greater for *Ac. polyacanthus* at elevated CO₂, but there was no effect of CO₂ treatments on offspring size. Despite the variation in reproductive output, body condition of adults did not differ between control and CO₂ treatments in either species. Our results demonstrate different effects of high CO₂ on fish reproduction, even among species within the same family. A greater understanding of the variation in effects of ocean acidification on reproductive performance is required to predict the consequences for future populations of marine organisms [Welch, M.J. & Munday, P.L. Coral Reefs (2016)].

Read the above article then answer the following two questions.

Question 1: What is “ocean acidification”? (以英文作答, 10 分)

Question 2: Please describe the significant findings of this study. (以英文作答, 10 分)

2. Trophic cascades occur when predators in a food web suppress the abundance or alter the behavior of their prey, thereby releasing the next lower trophic level from predation (or herbivory if the intermediate trophic level is a herbivore). For example, if the abundance of large piscivorous fish is increased in a lake, the abundance of their prey, smaller fish that eat zooplankton, should decrease. The resulting increase in zooplankton should, in turn, cause the biomass of its prey, phytoplankton, to decrease. (This article is excerpted from Wikipedia)

Read the above paragraph then answer the following two questions.

Question 1: What is “trophic cascade”? (以中文作答, 10 分)

Question 2: Please give an example of trophic cascade you can find in the marine ecosystem. (以中文作答, 10 分)

3. Read the description below and following two cases then determine which type of speciation they belong to.

In general, there are 4 types of speciation including

Allopatric speciation: a population splits into two geographically isolated populations (for example, by habitat fragmentation due to geographical change such as mountain formation). The isolated populations then undergo genotypic or phenotypic divergence as: (a) they become subjected to dissimilar selective pressures; (b) they independently undergo genetic drift; (c) different mutations arise in the two populations.

Peripatric speciation: In peripatric speciation, a subform of allopatric speciation, new species are formed in isolated, smaller peripheral populations that are prevented from exchanging genes with the main population. It is related to the concept of a founder effect, since small populations often undergo bottlenecks. Genetic drift is often proposed to play a significant role in peripatric speciation.

Parapatric speciation: In parapatric speciation, there is only partial separation of the zones of two diverging populations afforded by geography; individuals of each species may come in contact or cross

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habitats from time to time, but reduced fitness of the heterozygote leads to selection for behaviours or mechanisms that prevent their interbreeding. Parapatric speciation is modelled on continuous variation within a "single," connected habitat acting as a source of natural selection rather than the effects of isolation of habitats produced in peripatric and allopatric speciation.

Sympatric speciation: Sympatric speciation refers to the formation of two or more descendant species from a single ancestral species all occupying the same geographic location.

1. Africa's Lake Victoria is home to one of evolution's greatest experiments. In its waters, what began as a single lineage belonging to the cichlid family of fishes has since given rise to a dazzling array of forms. These cichlids represent a textbook example of what biologists term an adaptive radiation—the phenomenon whereby one lineage spawns numerous species that evolve specializations to an array of ecological roles. The more than 500 species that live there and only there today all evolved within the past 15,000 to 10,000 years. (Scientific American) (以中文作答, 10 分)
2. Darwin's finches (also known as the Galápagos finches) are a group of about fifteen species of passerine birds. They are often classified as the subfamily Geospizinae or tribe Geospizini. They belong to the tanager family and are not closely related to the true finches. The closest known relative of the Galápagos finches is *Tiaris obscura*. They were first collected by Charles Darwin on the Galápagos Islands during the second voyage of the Beagle. Apart from the Cocos finch, which is from Cocos Island, the others are found only on the Galápagos Islands. (Wikipedia) (以中文作答, 10 分)

PART II Translation (翻譯 40%)

For each of the following articles, please translate into Chinese 英翻中 (20%, 20 分)

In 2016, record oceans temperatures have led to record widespread coral bleaching on Australian coral reefs. This bleaching is part of the ongoing third global bleaching event, declared by the National Oceanic and Atmospheric Administration (NOAA) in 2015.

Between February and May, the Great Barrier Reef experienced record warm sea surface temperatures. Extensive field surveys and aerial surveys found bleaching was the most widespread and severe in the Far Northern management area, between Cape York and Port Douglas. Here, bleaching intensity was 'Severe' (more than 60% community bleaching). Bleaching intensity decreased along a southerly gradient. While most reefs exhibited some degree of bleaching, this bleaching varied in intensity (from less than 10% to over 90% community bleaching) and was patchy throughout most of the management area. (View the GBRMPA map for more information.)(Australian Institute of Marine Science)

For each of the following articles, please translate into English 中翻英(20%, 20 分)

大部分的深海珊瑚生長緩慢而且脆弱，容易被底拖漁具破壞。美國國家海洋大氣管理局（NOAA）不惜砸重金研究，經過三年的調查，定位珊瑚棲地，舉辦工作坊與漁民溝通，劃出禁止底拖的地區和界線。該保護區位於美國大西洋中部外海，面積超過 3 萬 8000 平方英里，約合 9 萬 8000 多平方公里，相當於 2.7 個台灣。（環境資訊中心）

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題號：452007

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1. 生物基因的表現需透過細胞內一連串分子層級的訊息傳遞而達成，請敘述 DNA、RNA 及蛋白質在其中所扮演的角色。(20%)
2. 請列舉一個存在於台灣地區的海洋生態系，並敘述其中生物與生物、生物與環境間的關係。(20%)
3. 達爾文在十八世紀所提出的諸多假說對演化學 (Evolution) 的發展有相當大的貢獻，請就過程及結果分別敘述何謂演化。(20%)
4. 近年來人類逐漸意識到原為生活方便所大量製造及使用的塑膠，會對海洋生物造成相當大的危害。請以生理學的角度，推測塑膠可能會如何影響海洋生物的生存？(20%)
5. 2016 年十月，在美國、紐西蘭及『南極海洋生物資源保育委員會(CCAMLR)』許多會員國的共同催生下，全球最大的海洋保護區即將設置在南極洲的羅斯海。請申述設置海洋保護區的意義及重要性。(20%)

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科目名稱：有機化學【海資系碩士班丙組】

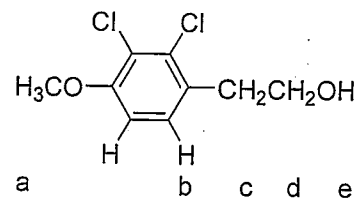
題號：452001

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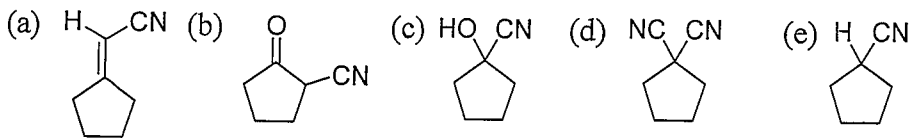
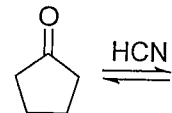
一、單選選擇題(45%, 3% for each)

1. Which of the protons indicated will be observed as a doublet in ^1H NMR spectrum of the molecule shown as right?

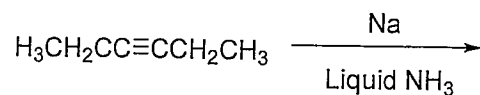


- (a) a (b) b (c) c (d) d (e) e

2. Which of the following substance is in equilibrium with cyclopentanone and HCN shown as right?

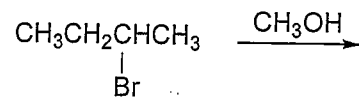


3. Which of the following is the major products of the reaction shown as right?



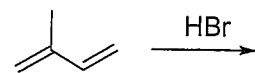
- (a) $\text{H}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CC}\equiv\text{CNa}$
 (b) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$
 (c)
 (d)
 (e)

4. The reaction of 2-bromobutane with methanol, as shown as right, yields which of the following as the major product?



- (a) (b) (c)
 (d) $\text{H}_3\text{CH}_2\text{CH}=\text{CH}_2$ (e) $\text{H}_3\text{CC}\equiv\text{CCH}_3$

5. Which of the following is a 1,4-addition product of the reaction shown right?



- (a) (b) (c) (d)
 (e)

6. How many bonds are there in acetylene, shown as right?



- (a) 1 (b) 2 (c) 3 (d) 4 (e) 5

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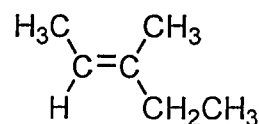
科目名稱：有機化學【海資系碩士班丙組】

題號：452001

※本科目依簡章規定「不可以」使用計算機(混合題)

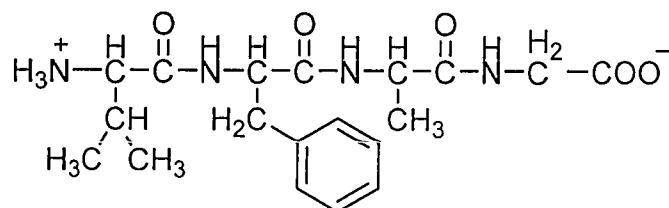
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7. What is the correct IUPAC name for compound shown right?



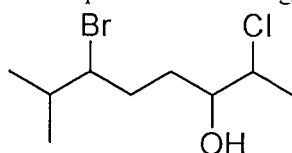
- (a) *trans*-3-methyl-3-pentene
 (b) *cis*-2-ethyl-2-butene
 (c) (*E*)-3-methyl-2-pentene
 (d) (*Z*)-3-methyl-2-pentene
 (e) (*Z*)-3-ethyl-2-butene

8. the total number of peptide bonds in the structure shown under is?



- (a) 1 (b) 2 (c) 3 (d) 4 (e) 5

9. How many stereoisomers possible for the compound shown right?

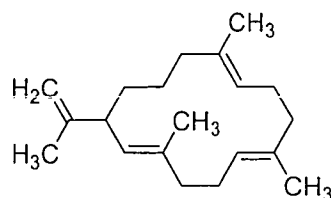


- (a) 3 (b) 4 (c) 6 (d) 8 (e) 10

10. Vitamin B12, an essential nutrient for humans, contains which of the following elements?

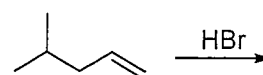
- (a) Cobalt
 (b) Chromium
 (c) Copper
 (d) Zinc
 (e) Iron

11. the species shown right is



- (a) a polyketide
 (b) a peptide
 (c) a diterpene
 (d) a disaccharide
 (e) an alkaloid

12. Which of the following is the major carbocation rearrangement product of the reaction shown right?



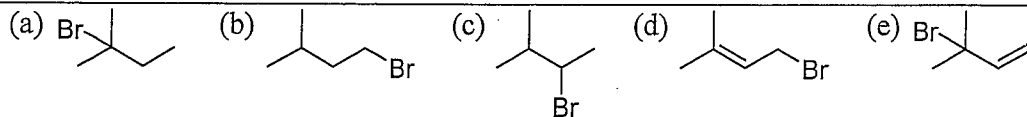
國立中山大學 106 學年度碩士暨碩士專班招生考試試題

科目名稱：有機化學【海資系碩士班丙組】

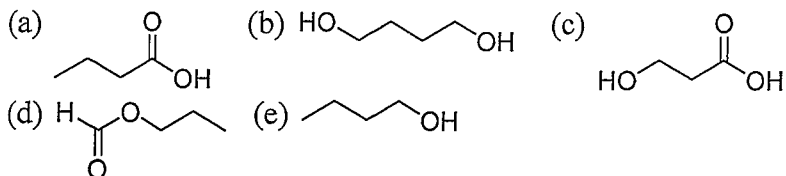
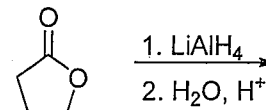
題號：452001

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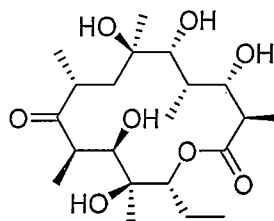


13. Which of the following is the major organic product of the reaction shown right?

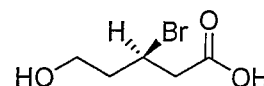


14. the species shown right is

- (a) an alkaloid
- (b) a peptide
- (c) a diterpene
- (d) a disaccharide
- (e) a polyketide



15. Oxidation of (*R*)-3-bromo-5-hydroxypentanoic acid, shown right, yields the corresponding 3-bromopentanedicarboxylic acid product that is



- (a) a mixture of two diastereomers in unequal amounts
- (b) a racemic mixture
- (c) a single pure enantiomer
- (d) a meso compound
- (e) an achiral compound

國立中山大學 106 學年度碩士暨碩士專班招生考試試題

科目名稱：有機化學【海資系碩士班丙組】

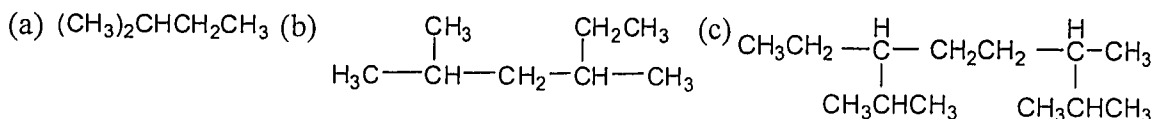
題號：452001

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二：問答題：(55%)

1. Provide IUPAC names for the following compounds. (9%, 3% for each)

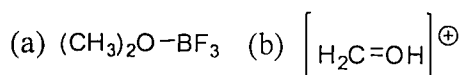


2. Provide a structure for each of the following compounds. (6%, 3% for each)

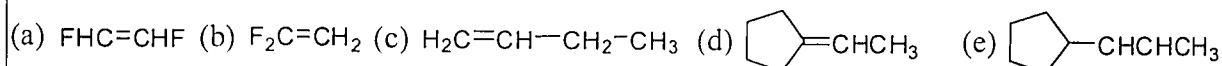
(a) 5-(1,2,2-trimethylpropyl)nonane

(b) 3,3-diethyl-4-(2,2-dimethylpropyl)octane

3. Draw Lewis structures for the following compounds and ions, showing appropriate formal charges. (6%, 3% for each)



4. Which of the following compounds show cis-trans isomerism? Draw the cis and trans isomers of those that do. (5%)



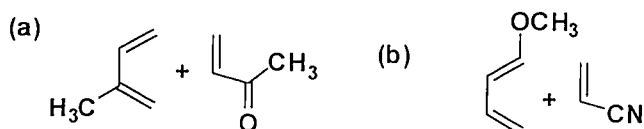
5. Explain the following terms (9%, 3% for each)

a. Geminal coupling

b. diamagnetic anisotropy

c. Claisen condensation

6. Predict the products of the following proposed Diels-Alder reactions and carefully explain the control of regioselectivity and stereoselectivity (10%, 5% for each)



7. **DETERMINE** and **EXPLAIN** the structure of the compound whose molecular formula is $\text{C}_6\text{H}_4\text{Cl}_2\text{O}$ for which the mass, IR, ^1H NMR, DQFCOSY and ^{13}C /DEPT NMR spectra are given. (10%)

國立中山大學 106 學年度碩士暨碩士專班招生考試試題

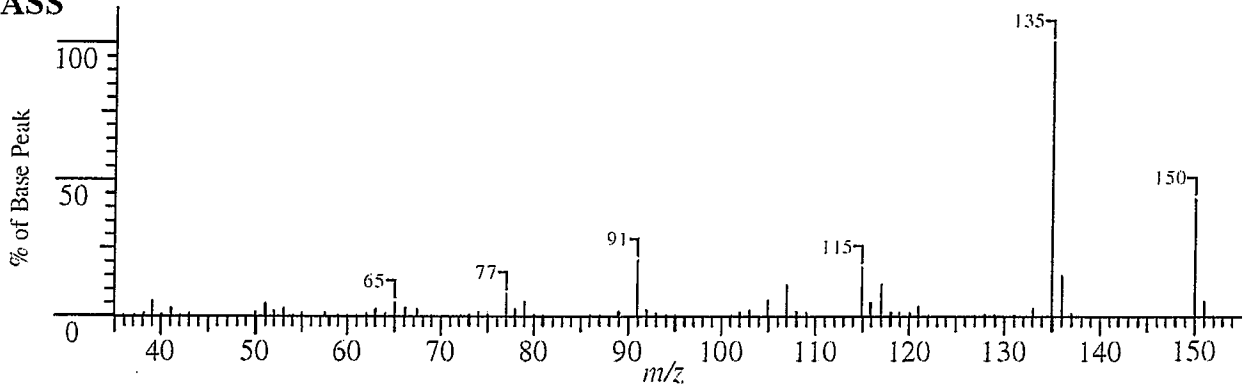
科目名稱：有機化學【海資系碩士班丙組】

題號：452001

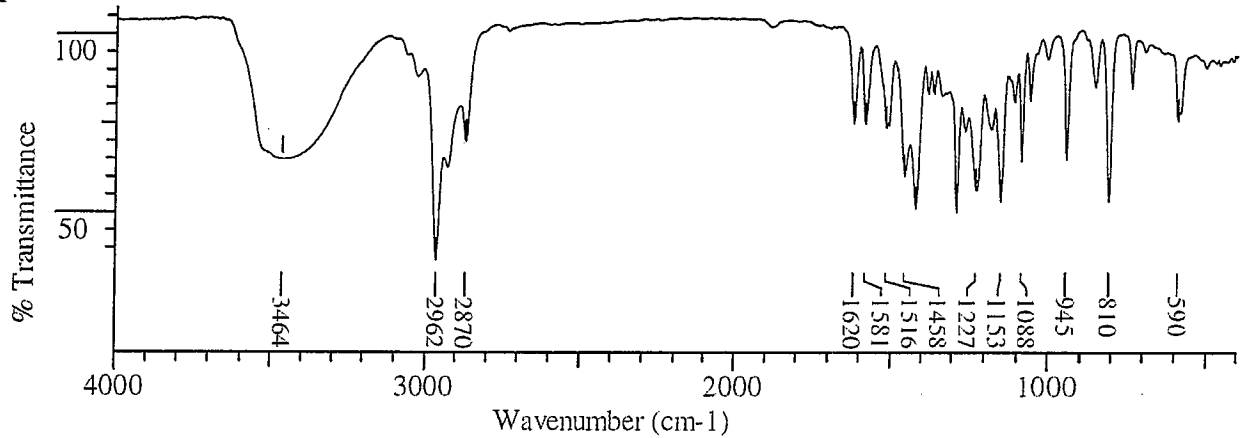
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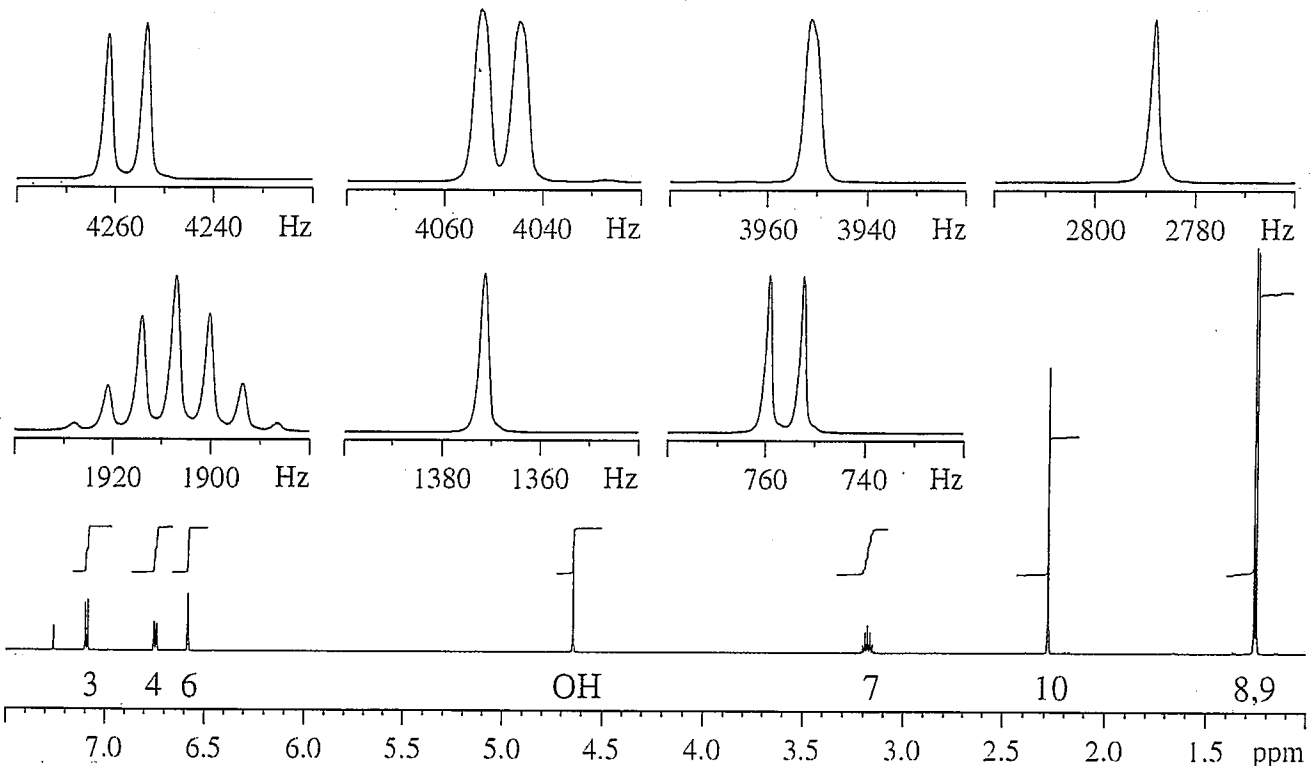
MASS



IR



¹H NMR 600 MHz



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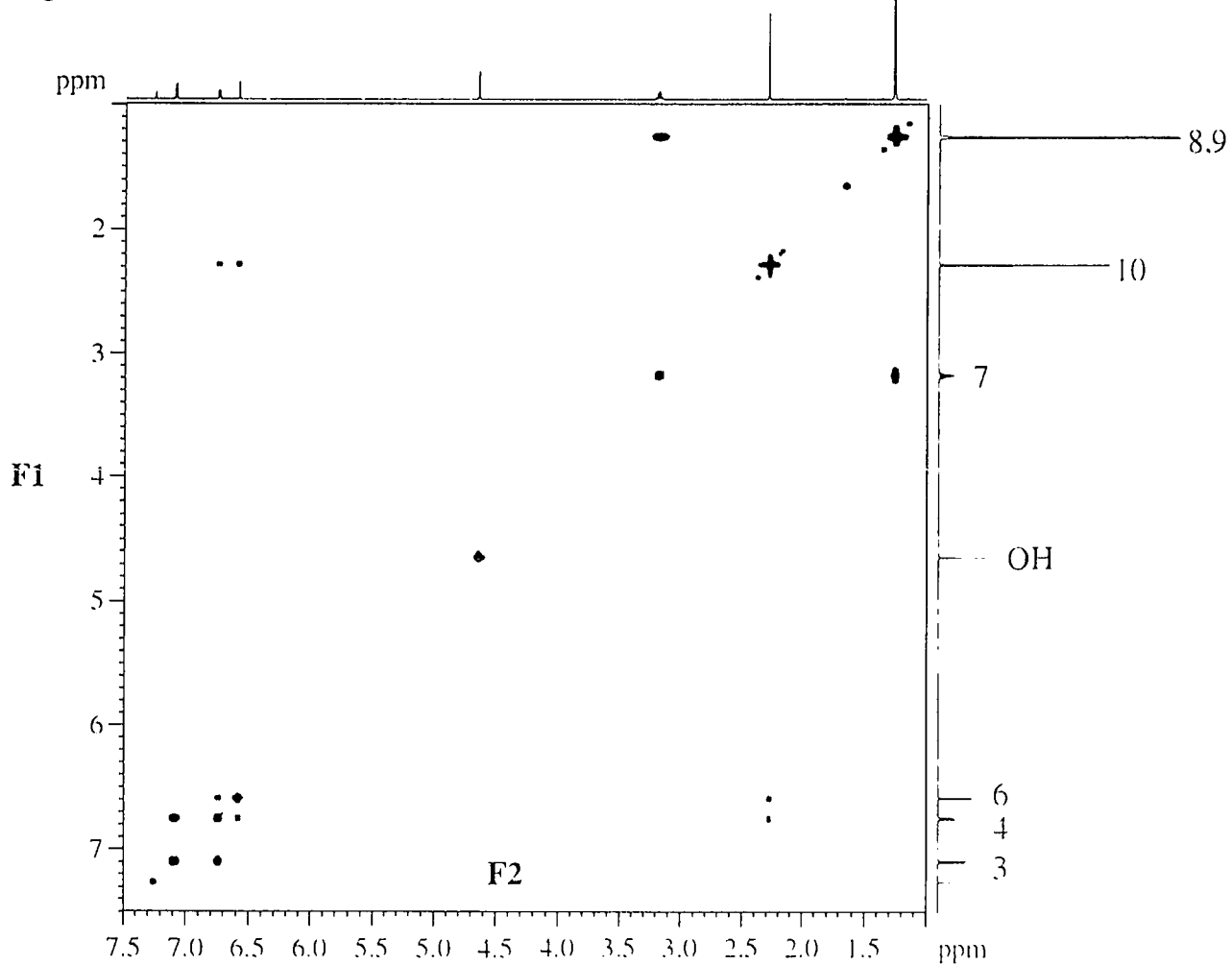
科目名稱：有機化學【海資系碩士班丙組】

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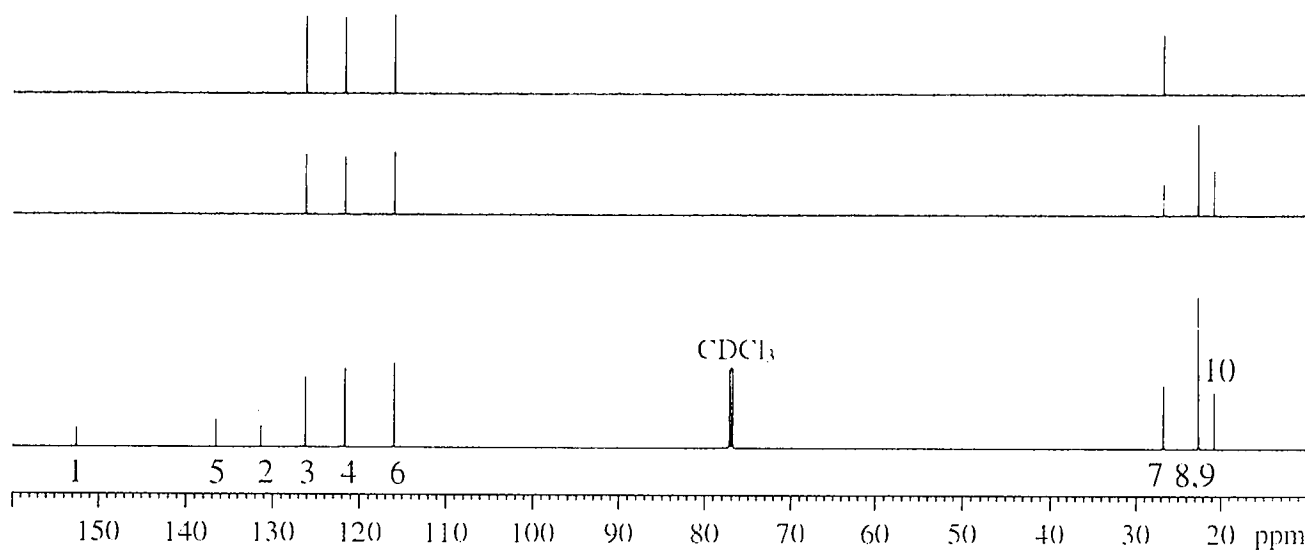
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DQFCOSY 600 MHz



¹³C/DEPT NMR 150.9 MHz



國立中山大學 106 學年度碩士暨碩士專班招生考試試題

科目名稱：分析化學【海資系碩士班丙組】

題號：452004

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請注意：(a)若涉及計算，請將演算過程列出，否則不予計分

(b)選擇題請畫答案卡，否則不予計分

(c)問答題請寫在本試卷，否則不予計分

一、Multiple choice(單選選擇題)

1. Which one is the right order of High-performance liquid chromatography ? (A) Column→Pump→Injector→Detector (B) Pump→Injector→Column→Detector (C) Injector→Pump→Column→Detector (D) Injector→Column→Pump→Detector. (4%)
2. Which one is not correlated with the column efficiency in liquid chromatography? (A) Effects of particle size of packing (B) Sample size (C) Extra-column band broadening (D) Temperature. (4%)
3. If we are going to set up the temperature for the quality analysis of Methyl tertiary butyl ether (MTBE) in a gasoline sample using GC. The boiling point of MTBE is 120°C. What is the appropriate temperature for the sample injector system? (A) 50°C (B) 100°C (C) 120°C (D) 170°C (4%)
4. Electronic transitions among certain of the energy levels can be brought about by the absorption of radiation. Which energy is required to induce the transition is large than the other transitions? (A) $\sigma \rightarrow \sigma^*$ (B) $n \rightarrow \sigma^*$ (C) $\sigma \rightarrow \pi^*$ (D) $\pi \rightarrow \pi$. (4%)
5. Please list the order of wavenumber in infrared spectra (from large to small) (A) C-C > C≡C > C=C (B) C≡C > C=C > C-C (C) C=C > C-C > C≡C (D) C≡C > C-C > C=C. (4%)
6. Which one is NOT the auxochrome? (A) -OH (B) -SH (C) C=C (D) -Cl. (4%)
7. Which molecule could absorb the longest wavelength of radiation energy among these four chemical molecules? (A) CH₃CH₂CH=CHCH₃ (B) CH₂=CHCH₂CH₂CH=CH₂ (C) CH₂=CHCH₂CH₂CH₂CH=CH₂ (D) CH₂=CH-CH=CHCH₂CH₃ (4%)
8. Instruments for measuring the absorption of ultraviolet, visible, and near-infrared radiation are made up of some components. Please set the right order of the instrument components. (A) Filter→Cell→Detector→Source (B) Cell→Filter→Detector→Source (C) Source→Cell→Detector→Filter (D) Source→Filter→Cell→Detector. (4%)
9. Which one is the material of the cells or cuvettes for the ultraviolet/visible molecular absorption spectrometry? (A) Ceramic Rod (B) KBr (C) Plastic Rod (D) Quartz. (4%)
10. This mirror-image relationship of the excitation and emission spectra is very useful in determining the (A) Electronegative (B) Molecular weight (C) Purity (D) Chemical structure of a fluorescent substance. (4%)
11. What is the Wrong description about exclusion chromatography? (A) It is a powerful technique that is particularly applicable to different molecular size species (B) From this equation, $V_r = V_m + K_d V_s$, values of K_d range from zero to ten to achieve the purpose of isolation (C) For molecules too large to enter the gel pores, $K_d = 0$ (D) V_s is the total of a column packed with a porous polymer. (4%)
12. Which one is the most common used of carrier gas in gas chromatography? (A) CO₂ (B) CH₄ (C) O₂ (D) N₂. (4%)
13. What kind of characteristic of silica gel to make it be the stationary phase in adsorption chromatography? (A) The enriched amino groups in the surface (B) The enriched hydroxyl group in the surface (C) The enriched negative charge in the surface (D) The enriched positive charge in the surface. (4%)
14. One of the wavelengths of fluorescence is right. (A) It is shorter than ultraviolet (B) It is longer than infrared (C) It is near infrared (D) It includes ultraviolet, visible, and near-infrared. (4%)
15. Which one is belong to strong cationic exchanger? (A) Polyamine (B) Quaternary amine (C) Carboxylic acid (D) Sulfonic acid. (4%)
16. Suggest a type of chromatographic method that would be suitable for separate two kinds of amino acid in the milk. (A) Paper chromatography (B) Gas chromatography (C) High-pressure liquid

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國立中山大學 106 學年度碩士暨碩士專班招生考試試題

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chromatography (D) (B) and (C). (4%)

17. The following description is wrong about gradient elution? (A) The components of the mobile phase is changed in the chromatographic process (B) The components of the mobile phase is not changed in the chromatographic process (C) It can be used in the isolation of multiple components (D) The time for isolating multiple components is less than isocratic elution. (4%)
18. The dispersion that takes place in open tubular column, results from the parabolic velocity profile that occurs under conditions of (A) Multiple flow (B) Single flow (C) Longitudinal flow (D) Newtonian flow. (4%)

二、Questions and problems

1. Substance A and B were found to have retention times of 16.40 and 17.63 min, respectively, on a 30.0 cm column. An unretained species passed through the column in 1.30 min. the peak widths (at base) for A and B were 1.11 and 1.21 min, respectively. Calculate (A) the column resolution; (B) the average number of the plates in the column; (C) the plate height; (D) the length of column required to achieve a resolution of 1.5. (20%)
2. A solution containing the complex formed between Bi(III) and thiourea has a molar absorptivity of $9.32 \times 10^3 \text{ L mol}^{-1} \text{ cm}^{-1}$ at 470 nm. (4%)
(A) What is the absorbance of a $3.79 \times 10^{-5} \text{ M}$ solution of the complex at 470 nm in a 1.00-cm cell?
3. In a normal-phase column, a solute was found to have a retention time of 29.1 min, while an unretained species required 1.05 min for elution when the mobile phase was 50% methanol and 50% water. Calculate the capacity factor k' . (4%)