

## 國立中山大學100學年度碩士班招生考試試題

科目：普通生物學【海資系碩士班甲組選考】

單選題(每題 2 分;共 50 分)

- (1) Water is able to form hydrogen bonds because \_\_\_\_\_.
- (A) oxygen has a valance of 2.
  - (B) the water molecule is shaped like a tetrahedron.
  - (C) the oxygen atom in a water molecule has a weak positive charge.
  - (D) each of the hydrogen atoms in a water molecule is weakly negative in charge.
  - (E) the bonds that hold together the atoms in a water molecule are polar covalent bonds.
- (2) Which of these functional groups does not contain oxygen ?
- (A) phosphate
  - (B) carboxyl
  - (C) hydroxyl
  - (D) sulfhydryl
  - (E) carbonyl
- (3) Large organic molecule are usually assembled by polymerization of a few kinds of simple subunits. Which of the following is an exception to this statement ?
- (A) RNA
  - (B) an enzyme
  - (C) cellulose
  - (D) DNA
  - (E) a steroid
- (4) Organelles other than the nucleus that contain DNA include \_\_\_\_\_.
- (A) ribosomes
  - (B) mitochondria
  - (C) chloroplasts
  - (D) B and C only
  - (E) A, B, and C
- (5) According to the fluid mosaic model of cell membranes, which of the following is a true statement about membrane phospholipids?
- (A) They occur in an uninterrupted bilayer, with membrane proteins restricted to the surface of the membrane.
  - (B) They have hydrophilic tails in the interior of the membrane.
  - (C) They are free to depart from the membrane and dissolve in the surrounding solution.
  - (D) They frequently flip-flop from one side of the membrane to the other.
  - (E) They can move laterally along the plane of the membrane.
- (6) Glucose diffuses slowly through artificial phospholipid bilayers. The cells lining the small intestine, however, rapidly move large quantities of glucose from the glucose-rich food into their glucose-poor cytoplasm. Using this information, which transport mechanism is most probably functioning the intestinal cells ?
- (A) exocytosis
  - (B) phagocytosis

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- (C) simple diffusion  
(D) facilitated diffusion  
(E) active transport pumps
- (7) Where is the electron transport chain found in plant cells ?  
(A) cytoplasm  
(B) thylakoid membranes of chloroplasts  
(C) stroma of chloroplasts  
(D) matrix of mitochondria  
(E) inner membrane of mitochondria
- (8) Which of the following is not considered a second messenger ?  
(A) GTP  
(B) calcium ions  
(C) cAMP  
(D) inositol trisphosphate (IP<sub>3</sub>)  
(E) diacylglycerol (DAG)
- (9) From the perspective of the cell receiving the message, the three stages of cell signaling are \_\_\_\_\_.  
(A) signal reception, signal transduction, and cellular response.  
(B) signal reception, cellular response, and cell division.  
(C) signal reception, nucleus disintegration, and new cell generation.  
(D) the paracrine, local, and synaptic stages.  
(E) the alpha, beta, and gamma stages.
- (10) What is the name for the special region on a duplicated chromosome that holds the sister chromatids together ?  
(A) centromere  
(B) centrosome  
(C) kinetochore  
(D) microtubule organizer region  
(E) desmosome
- (11) What kind of chemical bond is found between paired bases of the DNA double helix ?  
(A) covalent  
(B) ionic  
(C) phosphate  
(D) sulfhydryl  
(E) hydrogen
- (12) The archenteron develops into \_\_\_\_\_.  
(A) the endoderm  
(B) the blastocoel  
(C) the lumen of the digestive tract  
(D) the mesoderm  
(E) the placenta
- (13) Without the formulation of an ectoderm, vertebrates would not form \_\_\_\_\_.

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- (A) a heart
  - (B) kidneys
  - (C) a liver
  - (D) a pancreas
  - (E) a nervous system
- (14) Which of the following is a characteristic of the early stages of local inflammation ?
- (A) arteriole constriction
  - (B) antibody-and complement- mediated lysis of microbes
  - (C) fever
  - (D) release of histamine
  - (E) attack by cytotoxic T cells
- (15) The movement of substances from the blood into the proximal tubule is known as \_\_\_\_\_.
- (A) dialysis
  - (B) reabsorption
  - (C) filtration
  - (D) secretion
  - (E) none of these
- (16) The hybridoma technique is used for \_\_\_\_\_.
- (A) creating new varieties of a species
  - (B) over-expression of proteins
  - (C) making monoclonal antibodies
  - (D) increasing disease resistance
  - (E) all of the above
- (17) The net energy yield of glycolysis is \_\_\_\_\_ ATP.
- (A) 1
  - (B) 2
  - (C) 5
  - (D) 10
  - (E) 36
- (18) The shortest period of the cell cycle is the \_\_\_\_\_ phase.
- (A) G1
  - (B) G2
  - (C) M
  - (D) S
  - (E) inter-
- (19) Sponges are classified as \_\_\_\_\_.
- (A) Echinodermata
  - (B) Chordate
  - (C) Mollusca
  - (D) Porifera
  - (E) Cnidaria
- (20) What limits the resolving power of a light microscope ?

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- (A) the type of heavy metal or dye that is used to stain the specimen.  
(B) the ratio of an object's image to its real size.  
(C) the shortest wavelength of light used to illuminate the specimen.  
(D) the type of lens used to magnify the object under study.  
(E) the type of lens that focuses a beam of electrons through the specimen.
- (21) Where does glycolysis take place ?  
(A) mitochondrial inner membrane  
(B) cytosol  
(C) mitochondrial outer membrane  
(D) mitochondrial matrix  
(E) mitochondrial intermembrane space
- (22) DNA microarrays have made a huge impact on genomic studies because they \_\_\_\_\_. Please describe the difference between open circulatory system and closed circulatory systems.  
(A) can be used to eliminate the function of any gene in the genome  
(B) can be used to introduce entire genomes into bacterial cells  
(C) allow the expression of many or even all of the genes in the genome to be compared at once.  
(D) allow physical maps of the genome to be assembled in a very short time  
(E) dramatically enhance the efficiency of restriction enzymes
- (23) From the perspective of the cell receiving the message, the three stages of cell signaling are \_\_\_\_\_.  
(A) signal reception, nucleus disintegration, and new cell generation  
(B) signal reception, signal transduction, and cellular response  
(C) signal reception, cellular response, and cell division  
(D) the paracrine, local, and synaptic stages  
(E) the alpha, beta, and gamma stages
- (24) RNA polymerase moves along the template strand DNA in the \_\_\_\_\_ direction, and nucleotides to the \_\_\_\_\_ end of the growing transcript.  
(A) 5'→3'; 3'  
(B) 3'→5'; 3'  
(C) 3'→5'; 5'  
(D) 5'→3'; 5'  
(E) Randomly
- (25) Which of the following are transcribed from DNA ?  
(A) protein  
(B) exons  
(C) rRNA  
(D) introns  
(E) B and C

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簡答題(每題 10 分;共 20 分)

1. Please describe the body's defense (including of nonspecific defense and specific defense mechanisms)
2. Please describe the difference between gram-positive and gram negative bacteria. How to distinguish the two types of bacteria ?

解釋名詞 (每題 3 分;共 30 分)

1. depolarization
2. electrochemical gradient
3. excitatory postsynaptic potential
4. date maps
5. euryhaline animal
6. tandemly repetitive DNA
7. mutagens
8. spliceosome
9. DNA lagging strand
10. bacteriophage

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科目：分子生物學【海資系碩士班甲組選考】

- (1) What is the replication process of prokaryote. (20%)
- (2) What is splicing procedure of eukaryotic mRNA, including the components and mechanism that are involved in? (20%)
- (3) Design a protocol to clone a gene of virus. Describe the conditions and criteria for the design. (10%)
- (4) Describe a protocol to isolate a plasmid of 6000 base pairs. (10%)
- (5) Draw the tRNA and describe its components. (10%)
- (6) What is the meaning of following terminology: (30%; 3% each)
  - (a) TATA box
  - (b) Pribnow box
  - (c) Southern blotting
  - (d) Stem-loop
  - (e) Transcription factor
  - (f) Shine-Dalgarno sequence
  - (g) Cistronic
  - (h) Super coil
  - (i) Electrophoresis
  - (j) Alpha helix

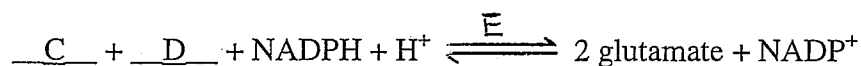
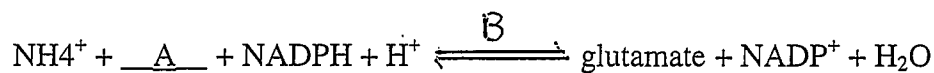
- 一、人體如何適應低溫。(30分)
- 二、詳述下視丘(hypothalamus)如何控制生殖。(30分)
- 三、詳述控制人體飲食行為(feeding behavior)的生理機制。(30分)
- 四、繪圖說明具髓鞘神經細胞(myelinated neuron)與不具髓鞘的神經細胞(un-myelinated neuron)。(10分)

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Ten (10) points for each question.

1. Please compare the DNA helix and  $\alpha$  helix.
2. Please draw the general formula of  $\alpha$ -amino acids and the peptide bond of a dipeptide.
3. What is the "chemiosmotic hypothesis" and how energy is generated?
4. Please draw the tricarboxylic acid (TCA) or Krebs' cycle with key intermediates and mark the steps where high energy compounds are synthesized.
5. Please write the Michaelis-Menten Equation and explain the meaning and unit of each symbol.
6. Please explain the competitive, noncompetitive and uncompetitive inhibitors of an enzyme.
7. Under anaerobic conditions, the yeast can only make 2 ATP's from a molecule of glucose. Please explain why and how the yeast does biochemically to correct the situation of lacking  $\text{NAD}^+$  ?
8. What are the primary, secondary, tertiary, and quaternary structures of proteins?
9. Please explain the overall regulation of tryptophan synthesis at the DNA and enzyme levels.
10. The following 2 equations are related to ammonium metabolism. Please identify A, B(enzyme), C, D, and E(enzyme).





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科目：生態學【海資系碩士班乙組】

## 一. 選擇題 (20%) (單選, 10題, 每題2分)

- ( ) 1. 在海洋中具有固氮作用的是 A)鞭毛藻 B)矽藻 C)綠藻 D)褐藻 E)藍綠藻
- ( ) 2. 哪一種溫室氣體所造成的溫室效應最大且在大氣的停留期也最長? A) 二氧化碳 B)氟氯碳化物 C)氧化亞氮 D)六氟化硫 E)甲烷
- ( ) 3. 國內現已設立了幾個國家公園? A) 9個 B) 8個 C) 7個 D) 6個 E) 5個
- ( ) 4. 地球海洋與大氣形成的時期大約在 A) 1~14億年前 B) 6~20億年前 C) 16~30億年前 D) 30~44億年前 E) 40~54億年前
- ( ) 5. 地球大氣層所產生的溫室效應可使地表氣溫上升約 A)6°C B)18°C C)24°C D)33°C E)46°C
- ( ) 6. 所謂「酸雨」是指酸鹼值小於 A)3.0 B)4.0 C)5.0 D)6.0 E)7.0 之雨水
- ( ) 7. 依照植物對水之喜好度來區分的話, 小麥及玉米是屬於 A)中生植物 B)水生植物 C)沼生植物 D)濕生植物 E)旱生植物
- ( ) 8. 臺北關渡紅樹林的種類是 A)海茄苳 B)五梨朥 C)欖李 D)紅茄苳 E)水筆仔
- ( ) 9. 所謂是 $Q_{10}$ 定律(Vant Hoff's law)是指在適溫範圍內每增加10°C, 生物生理代謝速率會增加 A) 1~2倍 B) 2~3倍 C) 3~4倍 D) 4~5倍 E) 5~6倍
- ( ) 10. 能量在不同營養階層之生態轉換效率一般是介於 A)1~10% B)10~20% C) 20~30% D)30~40% E)40~50% 之間

## 二. 解釋名詞(30%)(每題5分)

- |                            |                          |
|----------------------------|--------------------------|
| 1. Biological accumulation | 2. Compensation depth    |
| 3. Climax                  | 4. Zooplankton           |
| 5. Omnivore                | 6. Homoiothermic species |

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## 三. 問答題 (50%，共五題)

1. 生物演化過程(The process of evolution)是經由哪些基本的機制?(10分)
2. 請敘述一般河川上游 (Headwaters)、中游 (Midsection)、及下游 (Lower reaches) 各流域之營養型態(Trophic types)、相對生物多樣性 (Relative biodiversity)、平均有機顆粒大小 (Relative particle size)、及生產量/呼吸量比值 (Production/Respiration Ratio) 之變化趨向為何? (12分)
3. 光週期對動物的影響有哪些? 請舉出四點並舉例說明。(8分)
4. 海洋所發現的動物門(Phylum)比淡水及陸地還多，但目前世界上所知的動物種類(Species)中卻有80%不屬於海洋，請解釋可能的原因為何?(10分)
5. 下表為物種間之各種交互關係，請自製下表並以+ (得利)；-(受害)，0 (無影響) 填入空格中 (10分)。請在答卷上作答，下表為參考樣品。

Type of interaction	Species 1	Species 2
1. Competition		
2. Amensalism		
3. Protocooperation		
4. Commensalism		
5. Parasitism		

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## 科目：生物統計學【海資系碩士班乙組】

共五題，每題 20 分。答題時，每題都必須寫下題號與詳細步驟。  
請依題號順序作答，不會作答題目請寫下題號並留空白。

1. 1998 年的夏天，麥奎爾和索沙激烈角逐美國職棒單季全壘打紀錄，成為大眾焦點。以下是麥奎爾從 1987 年(它的職棒生涯第一年)到 1999 年之間的全壘打數：

1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
49	32	33	39	22	42	9	9	39	52	58	70	65

- (a) 繪出全壘打數的莖葉圖。(5 分)
- (b) 求全壘打數的中位數和第一、三四分位數。(5 分)
- (c) 求全壘打數的平均數和標準差。(5 分)
- (d) 求全壘打數的最大值和最小值。(5 分)
2. 解釋名詞
- (a) 95% 信賴區間 (5 分)
- (b)  $P$ -值 ( $P$ -value) (5 分)
- (c) 檢定力 (power) (5 分)
- (d) 型 I 和型 II 誤差 (5 分)
3. 假設某之免付費電話，在一天當中開放使用的 12 小時當中打進來的電話數  $X$ ，是參數  $\mu = 900$  的卜瓦松隨機變數。試用常態分配求  $P(850 \leq X \leq 950)$  的近似值。(20 分)
4. 某次有關速限提升到 110 公里的問卷調查中， $A$  城鎮 500 人中有 385 人贊成，而  $B$  城鎮 400 人中有 267 人贊成。
- (a) 請問在顯著水準在 5% 下，此兩個城鎮對於提升速限議題是否有顯著差異？及  $P$  值為何？(10 分)
- (b) 試問兩城鎮支持率差異 95% 的信賴區間。(10 分)
5. 在 20 次研究化學蒸餾過程中製造純氧純度時，發現純氧純度  $y$  (單位：%) 和碳氫化合物濃度  $x$  (單位：%) 線性關係的統計值如下： $\bar{x} = 1.1960$ ,  $\bar{y} = 92.1605$ ,  $\sum_{i=1}^n (x_i - \bar{x})^2 = 0.68088$ ,  $\sum_{i=1}^n (y_i - \bar{y})(x_i - \bar{x}) = 10.17744$ ,  $se(\hat{\beta}_1) = 1.31645$ ,  $\hat{\sigma}^2 = 1.18$ 。
- (a) 求迴歸直線方程式  $\hat{y} = \hat{\beta}_0 + \hat{\beta}_1 x$ 。(5 分)
- (b) 求碳氫化合物濃度為 1% 時，純氧純度的預測值。(5 分)
- (c) 已知  $t_{0.005, 18} = 2.88$ ，統計檢定  $\alpha = 0.01$ ,  $H_0: \beta_1 = 0$ ,  $H_1: \beta_1 \neq 0$ 。(5 分)
- (d) 已知  $t_{0.025, 18} = 2.101$ ，求碳氫化合物濃度為 1% 時，純氧純度平均的 95% 信賴區間。(5 分)

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Table 2: 標準常態累積分佈函數： $\Phi(x) = \int_{-\infty}^x \frac{1}{\sqrt{2\pi}} e^{-t^2/2} dt$ 

$\Phi(x)$	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998

~全卷完~

## 國立中山大學100學年度碩士班招生考試試題

科目：普通物理學【海資系碩士班丙組選考】

一. 單選題，共二十題，每題三分

1. A force acting on an object moving along the  $x$  axis is given by

$$F_x = (14x - 3.0x^2) \text{ N}$$

where  $x$  is in m. How much work is done by this force as the object moves from  $x = -1$  m to  $x = +2$  m?

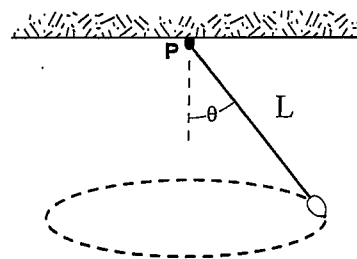
(A) +12 J (B) +28 J (C) +40 J (D) +42 J (E) -28 J

2. A solid wheel with mass  $M$ , radius  $R$ , and rotational inertia  $\frac{1}{2}MR^2$ , rolls without sliding on a horizontal surface. A horizontal force  $F$  is applied to the axle and the center of mass has an acceleration  $a$ . The magnitudes of the applied force  $F$  and the frictional force  $f$  of the surface, respectively, are:

- (A)  $F = Ma$ ,  $f = 0$  (B)  $F = Ma$ ,  $f = Ma/2$   
 (C)  $F = 2Ma$ ,  $f = Ma$  (D)  $F = 2Ma$ ,  $f = Ma/2$   
 (E)  $F = 3Ma/2$ ,  $f = Ma/2$

3. A hanged ball moves in a horizontal circle, as shown in the figure below. The length of the string is  $L$ , and the gravitational acceleration is  $g$ . What is the period of this circular motion?

- (A)  $2\pi\sqrt{\frac{L\cos\theta}{g}}$  (B)  $\sqrt{\frac{L\cos\theta}{g}}$  (C)  $\frac{1}{2\pi}\sqrt{\frac{L\cos\theta}{g}}$   
 (D)  $2\pi\sqrt{\frac{L}{g}}\cos\theta$  (E)  $\frac{1}{2\pi}\sqrt{\frac{L}{g}}\cos\theta$



4. A simple pendulum is suspended from the ceiling of an elevator. The elevator is accelerating upwards with acceleration  $a$ . The period of this pendulum, in terms of its length  $L$ ,  $g$ , and  $a$  is:

- (A)  $2\pi\sqrt{L/g}$  (B)  $2\pi\sqrt{L/(g+a)}$  (C)  $2\pi\sqrt{L/(g-a)}$  (D)  $2\pi\sqrt{L/a}$  (E)  
 $(1/2\pi)\sqrt{g/L}$

5. A spherical shell has inner radius  $R_1$ , outer radius  $R_2$ , and mass  $M$ , distributed uniformly throughout the shell. The magnitude of the gravitational force exerted on the shell by a point particle of mass  $m$  located a distance  $d$  from the center, outside the inner radius and inside the outer radius, is:

- (A) 0 (B)  $GMm/d^2$  (C)  $GMm/(R_2^3 - R_1^3)$   
 (D)  $GMm(d^3 - R_1^3)/d^2(R_2^3 - R_1^3)$  (E)  $GMm/(d^3 - R_1^3)$

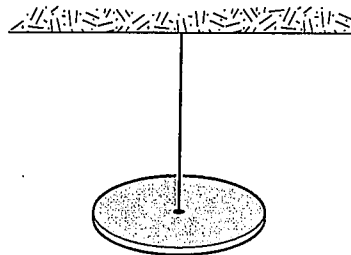
## 國立中山大學100學年度碩士班招生考試試題

科目：普通物理學【海資系碩士班丙組選考】

6. A satellite of mass  $m$  circles a planet of mass  $M$  and radius  $R$  in an orbit at a height  $2R$  above the surface of the planet. What minimum energy is required to change the orbit to one for which the height of the satellite is  $3R$  above the surface of the planet?

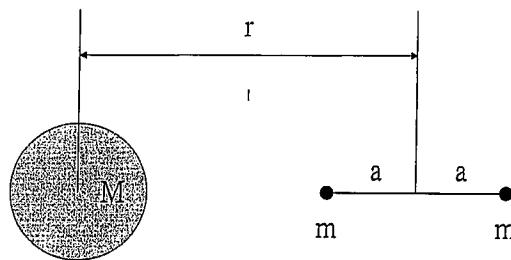
(A)  $\frac{GmM}{24R}$  (B)  $\frac{GmM}{15R}$  (C)  $\frac{GmM}{12R}$  (D)  $\frac{2GmM}{21R}$  (E)  $\frac{3GmM}{5R}$

7. A torsional pendulum consists of a solid disk (mass = 2.0 kg, radius = 1.0 m) suspended by a wire attached to a rigid support. The body oscillates about the support wire. If the torsion constant is 16 N · m. What is the angular frequency (in rad/s)?



(A) 2 (B) 4 (C) 6 (D) 8 (E) 7

8. A dumbbell has a massless rod and a rod length of  $2a$ . It is placed next to a solid sphere. If  $r \gg a$ , what is the force difference (the tidal force) between the two particles?



(A)  $\frac{4GMa}{5r^3}$  (B)  $\frac{4GMa}{r^3}$  (C)  $\frac{GMa}{r^3}$  (D)  $\frac{GMm}{r^2}$  (E)  $\frac{4GMm}{r^3}$

9. The temperature of  $n$  moles of an ideal monatomic gas is increased by  $T$  at constant pressure. The energy  $Q$  absorbed as heat, change  $E_{\text{int}}$  in internal energy, and work  $W$  done by the environment are given by:

(A)  $Q = (5/2)nRT$ ,  $E_{\text{int}} = 0$ ,  $W = -nRT$   
 (B)  $Q = (3/2)nRT$ ,  $E_{\text{int}} = (5/2)nRT$ ,  $W = -(3/2)nRT$   
 (C)  $Q = (5/2)nRT$ ,  $E_{\text{int}} = (5/2)nRT$ ,  $W = 0$   
 (D)  $Q = (3/2)nRT$ ,  $E_{\text{int}} = 0$ ,  $W = -nRT$   
 (E)  $Q = (5/2)nRT$ ,  $E_{\text{int}} = (3/2)nRT$ ,  $W = -nRT$

10. An ideal gas is allowed to expand adiabatically. Assume the process is reversible. The change in entropy is:

(A) 0 (B)  $nR \ln(V_2/V_1)$  (C)  $nR \ln(T_2/T_1)$  (D)  $kn \ln(V_2/V_1)$  (E)  $kn \ln(T_2/T_1)$ .

## 國立中山大學100學年度碩士班招生考試試題

科目：普通物理學【海資系碩士班丙組選考】

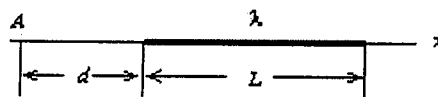
11. Positive charge  $Q$  is placed on a conducting spherical shell with inner radius  $R_1$  and outer radius  $R_2$ . A point charge  $q$  is placed at the center of the cavity. The magnitude of the electric field at a point outside the shell, a distance  $r$  from the center, is:

(A)  $Q/4\pi\epsilon_0 R_1^2$  (B)  $Q/4\pi\epsilon_0 (R_1^2 - r^2)$  (C)  $q/4\pi\epsilon_0 r^2$   
 (D)  $(q+Q)/4\pi\epsilon_0 r^2$  (E)  $(q+Q)/4\pi\epsilon_0 (R_1^2 - r^2)$

12. A wire of uniform charge density  $\lambda$  and length  $L$  lies along the  $x$  axis as shown in Figure.

What is the electric potential at point  $A$ ? [ $k=1/(4\pi\epsilon)$ ]

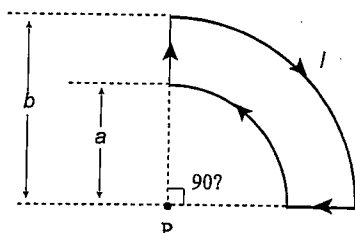
(A)  $k\lambda\ln[1+d/L]$  (B)  $k\lambda\ln[1+L/d]$  (C)  $k\lambda L/d$   
 (D)  $k\lambda d/L$  (E)  $k\lambda d/(L+d)$ .



13. The semicircular wire of radius  $R$  connects two straight wire segments. If a current  $I$  follows along the wire, the magnetic field at the center of the semicircular wire due to the current in the semicircular wire is

(A)  $\mu_0 I/(2R)$  (B)  $\mu_0 I/(4R)$  (C)  $\mu_0 I/(8R)$  (D)  $\mu_0 I/(2\pi R)$

14. If  $a = 1.0$  cm,  $b = 3.0$  cm, and  $I = 30$  A, what is the magnitude of the magnetic field at point  $P$ ?



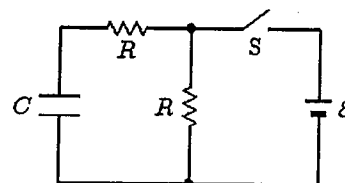
(A) 0.62 mT (B) 0.59 mT (C) 0.35 mT (D) 0.31 mT (E) 0.10 mT

15. Two conducting spheres have radii  $R_1$  and  $R_2$ , with  $R_1$  greater than  $R_2$ . If they are far apart the capacitance is proportional to:

(A)  $R_1 R_2 / (R_1 - R_2)$  (B)  $R_1^2 - R_2^2$  (C)  $(R_1 - R_2) / R_1 R_2$   
 (D)  $R_1^2 + R_2^2$  (E) none of these.

16. In the circuit shown, both resistors have the same value  $R$ . Suppose switch  $S$  is initially closed. When it is then opened, the circuit has a time constant  $\tau_a$ . Conversely, suppose  $S$  is initially open. When it is then closed, the circuit has a time constant  $\tau_b$ . The ratio  $\tau_a/\tau_b$  is:

(A) 1 (B) 2 (C) 0.5 (D) 0.667 (E) 1.5



17. If an electron travels with speed  $v$  around a circle of radius  $r$ , then the magnitude of the orbital magnetic dipole moment is:

(A)  $evr/2$  (B)  $ev/r$  (C)  $ev/2\pi r$  (D)  $2\pi er/v$  (E)  $2\pi ev/r$ .

## 國立中山大學100學年度碩士班招生考試試題

科目：普通物理學【海資系碩士班丙組選考】

18. An inductance  $L$ , resistance  $R$ , and ideal battery of emf  $\varepsilon$  are wired in series. A switch in the circuit is closed at time 0, at which time the current is zero. At any later time  $t$ , the emf of the inductor is given by:

- (A)  $\varepsilon(1 - e^{-Lt/R})$  (B)  $\varepsilon e^{-Lt/R}$  (C)  $\varepsilon(1 + e^{-Rt/L})$  (D)  $\varepsilon e^{-Rt/L}$  (E)  $\varepsilon(1 - e^{-Rt/L})$

19. Faraday's law states that an induced emf is proportional to:

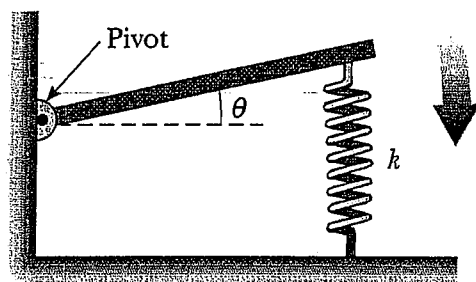
- (A) the rate of change of the magnetic field.  
 (B) the rate of change of the electric field.  
 (C) the rate of change of the magnetic flux.  
 (D) the rate of change of the electric flux.  
 (E) zero.

20. A  $2\text{-}\mu\text{F}$  capacitor in series with a  $2\text{-k}$  resistor is connected to a  $60\text{-Hz}$  ac source. Calculate the impedance of the circuit.

- (A) 1500 ohms (B) 1800 ohms (C) 2100 ohms (D) 2400 ohms (E) 8600 ohms

二. 計算題，每題二十分

1. A horizontal plank of mass  $m$  and length  $L$  is pivoted at one end. The plank's other end is supported by a spring of force constant  $k$ . The moment of inertia of the plank about the pivot is  $\frac{1}{3}mL^2$ . The plank is displaced by a small angle  $\theta$  from its horizontal equilibrium position and released. (a) Find the angular frequency when it moves with simple harmonic motion. (10%)  
 (b) Evaluate the frequency if the mass is  $5.00\text{ kg}$  and the spring has a force constant of  $100\text{ N/m}$ . (10%)



2. A capacitor consists of two long concentric metal cylinders of length  $L$  with the line charge density  $\lambda$ . The inner and outer cylinders have radii  $a$  and  $b$ , respectively.

- (a) Find the capacitance of this cylindrical capacitor. (10%)  
 (b) Find the energy stored in this cylindrical capacitor. (10%)



## 國立中山大學100學年度碩士班招生考試試題

## 科目：普通地質學【海資系碩士班丙組選考】

## 一、解釋名詞（15%，每小題3分）

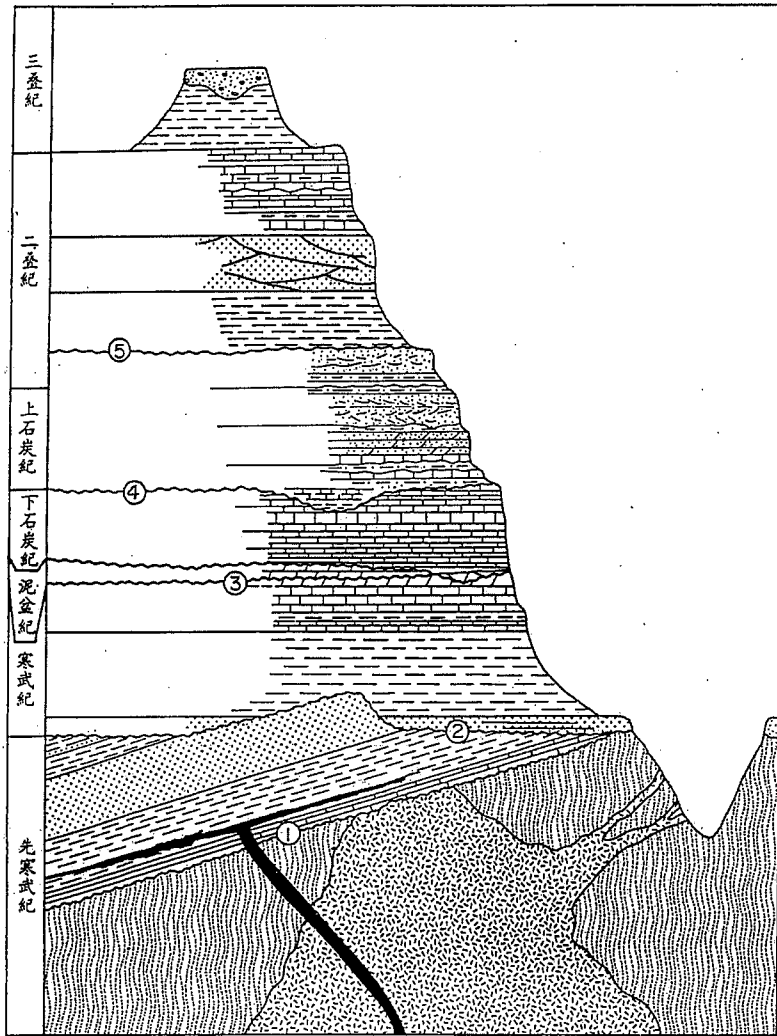
- |                |                                  |
|----------------|----------------------------------|
| 1、Benioff zone | 4、plutonic rock                  |
| 2、conglomerate | 5、slaty cleavage (slaty texture) |
| 3、placer       |                                  |

## 二、問答題（85%，第1小題5分，第2~9題每小題10分）

- 1、海洋地殼由上到下可以分為哪五個岩層單位？（5%）
- 2、(a) (5%)何謂河流台地(stream terrace, 或稱階地)? (b) (5%)其如何形成？
- 3、請說明台灣以及鄰近地區之板塊地體構造特徵，例如有哪些板塊？有哪些類型之板塊界線？有哪些地質作用或現象是和板塊運動相關的？（請繪圖補助說明）（10%）
- 4、台灣的西部麓山地質區、中央山脈西翼地質區和中央山脈東翼地質區在岩石的類型和特性上有什麼差異？（10%）
- 5、風化作用是地表非常重要的地質作用，請說明(a) (6%)風化作用的兩種主要型式，並進一步說明其各有哪些次分類的風化作用類型；(b) (4%)風化作用的重要性在哪裡？
- 6、請以一個玄武岩質的原始岩漿為例，(a) (6%)說明什麼是包溫氏反應系列(Bowen's reaction series)；(b) (4%)說明一個均質的原始岩漿如何形成不同種類的火成岩。
- 7、要判斷地層的上下層序可以利用哪些沈積構造或火山噴發之構造？寫出至少四種此等構造之名稱，並說明其構造特徵所指示之地層上下（新老）順序。（可繪圖補助說明）（10%）
- 8、石油和天然氣仍是目前人類倚賴最多的能源，請問油氣田的形成需要有哪些地質條件的配合？並說明之。（10%）
- 9、下圖（見第2頁）是美國科羅拉多河大峽谷（Grand Canyon）的地層剖面，圖中標示①~⑤代表的是地層的界面構造，請問(a) (2%)這五個界面構造統稱為什麼？(b) (4%)這種構造代表什麼地質意義？(c) (4%)這五個界面是否又可以細分成不同之構造類型？請分別寫出①~⑤之構造類型。

國立中山大學100學年度碩士班招生考試試題

科目：普通地質學【海資系碩士班丙組選考】



問答第 9 題附圖

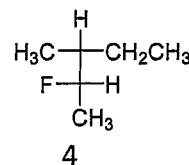
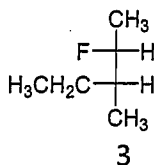
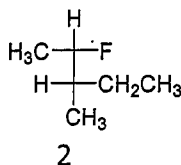
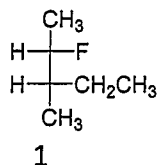
## 國立中山大學100學年度碩士班招生考試試題

科目：微積分【海資系碩士班丙組選考】

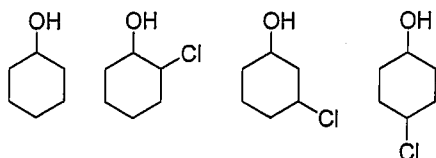
請詳細回答下列問題。

1. (a) Find an equation of the line tangent to the graph of  $f(x) = 2x^2 - 2x + 4$  at the point  $(0, 4)$ . [10%]  
(b) Find the relative extreme values of  $f(x) = \frac{x^2+1}{x}$ . [10%]
2. (a) Evaluate  $\int_0^1 (3x+2)^9 dx$ . [10%]  
(b) Evaluate the integral  $\int \frac{1}{e^x+e^{-x}} dx$ . [10%]
3. (a) Evaluate the integral  $\int \frac{2x^2}{x^2-1} dx$ . [10%]  
(b) Evaluate the integral  $\int_0^\infty t^2 e^{-st} dt$  for  $s > 0$ . [10%]
4. (a) Let  $f(x, y) = e^{x^2y} + x \ln y$ . Find all first-order and second-order partial derivatives. [10%]  
(b) Find all critical points for  $f(x, y) = x^2 - y^2 + 2x + 6y + 2$  and determine whether each corresponds to a relative maximum, a relative minimum, or a saddle point. [10%]
5. (a) Let  $R = \{(x, y) | 0 \leq x \leq 2, 1 \leq y \leq 3\}$ . Evaluate the double integral  $\iint_R (x + x^2y) dA$ . [10%]  
(b) Let  $R = \{(x, y) | 0 \leq x \leq 2, x^2 + y^2 \leq 4\}$ . Evaluate the double integral  $\iint_R xy dA$ . [10%]

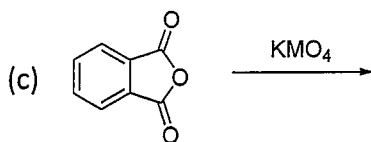
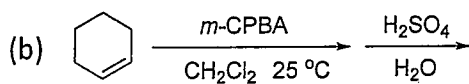
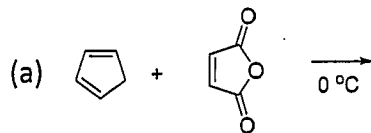
- Draw the structure of the following compounds. (10%)
  - 7-hydroxy-7-methyl-4-octen-2-one
  - Bicycle [4.1.0] heptane
  - N*-methylacetamide
  - 2-acetyloxybenzoic acid
  - (*E*)-3-methyl-2-hexenoic acid
- Explain the following terms. (15%)
  - Wittig reaction
  - Aldol condensation
  - McLafferty rearrangement
  - Baeyer-Villiger oxidation
  - Geminal coupling
- What are the stereochemical relations (identical, enantiomers, diastereomers) of the following four molecules? Assign absolute configuration at each stereocenter and draw the most stable conformation in Newman projection. (10%)



- Rank the following alcohols in order of increasing acidity. (5%)



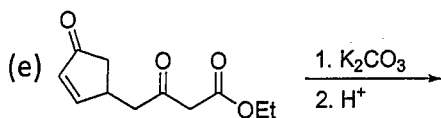
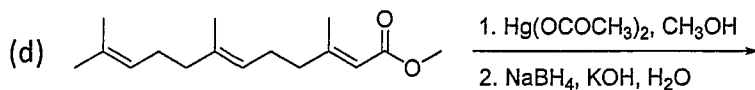
- Predict the main product in each of the following reaction. Be sure to show stereochemistry where it is known. (10%)



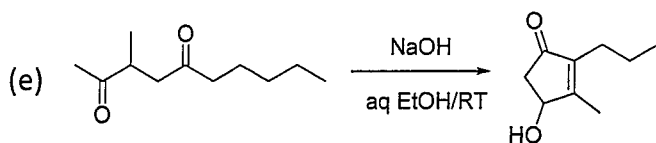
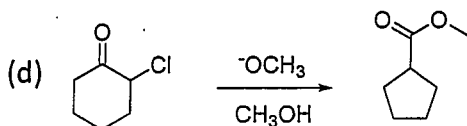
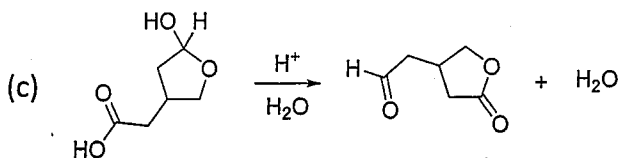
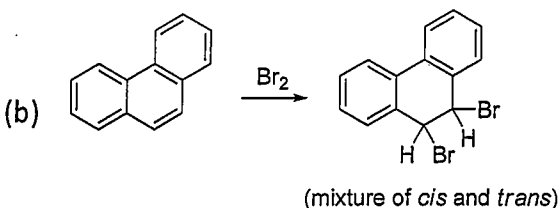
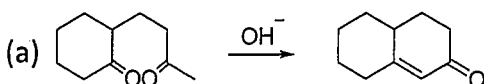
## 國立中山大學100學年度碩士班招生考試試題

科目：有機化學【海資系碩士班丁組】

2



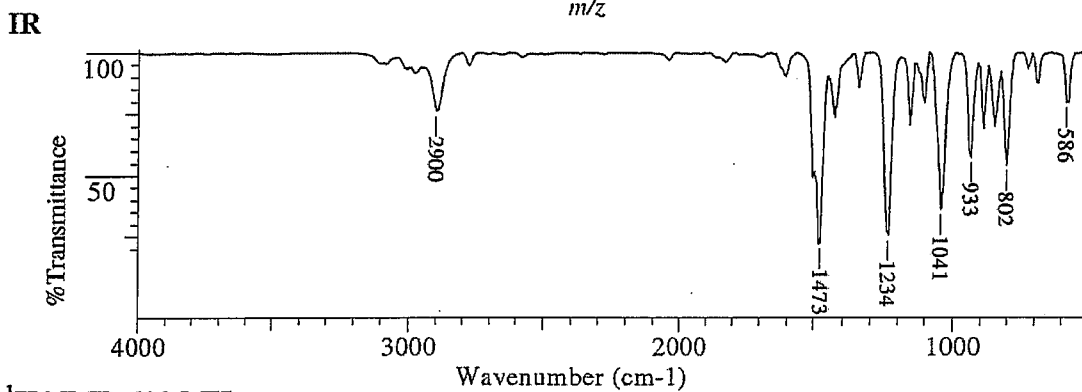
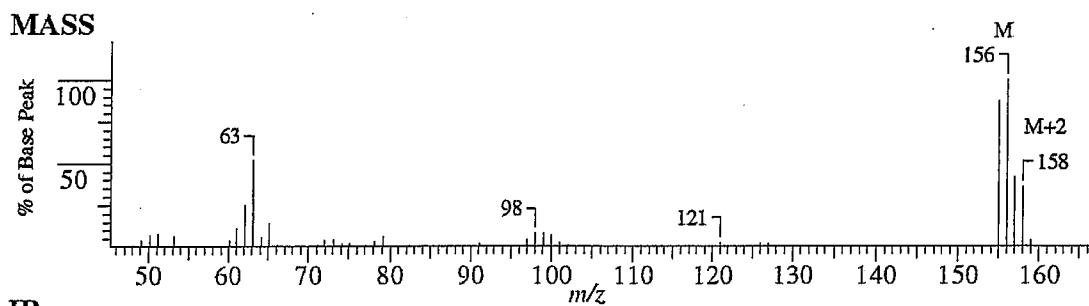
6. Propose a mechanism for each reaction: (20%)



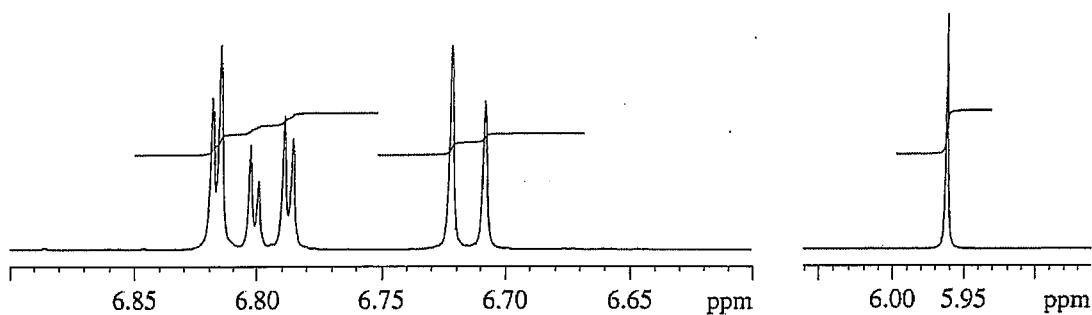
7. Draw all the isomers of triphenylcyclopropane. Indicate which are enantiomers. State the appearance of the upfield proton of the NMR spectrum of each (mark protons Ha, Hb, Hc then state eg. one singlet, two singlets,....., one doublet,... one triplet, double doublets) (10%)

8. From each group of three molecules, pick the one whose structure is most consistent with the proton-decoupled  $^{13}\text{C}$ -NMR data. Explain your choices (8%)
- (a)  $\text{CH}_3(\text{CH}_2)_4\text{CH}_3$ ,  $(\text{CH}_3)_3\text{CCH}_2\text{CH}_3$ ,  $(\text{CH}_3)_2\text{CHCH}(\text{CH}_3)_2$ ;  $\delta = 19.5$  and  $33.9$
- (b) 1-Chlorobutane, 1-chloropentane, 3-chloropentane;  $\delta = 13.2, 20.0, 34.6,$  and  $44.6$
- (c)  $\text{ClCH}_2\text{CHClCH}_2\text{Cl}$ ,  $\text{CH}_3\text{CCl}_2\text{CH}_2\text{Cl}$ ,  $\text{CH}_2=\text{CHCH}_2\text{Cl}$ ;  $\delta = 45.1, 118.3,$  and  $133.8$
- (d) Cyclopentanone, cycloheptanone, cyclononanone;  $\delta = 24.0, 30.0, 43.5,$  and  $214.9$

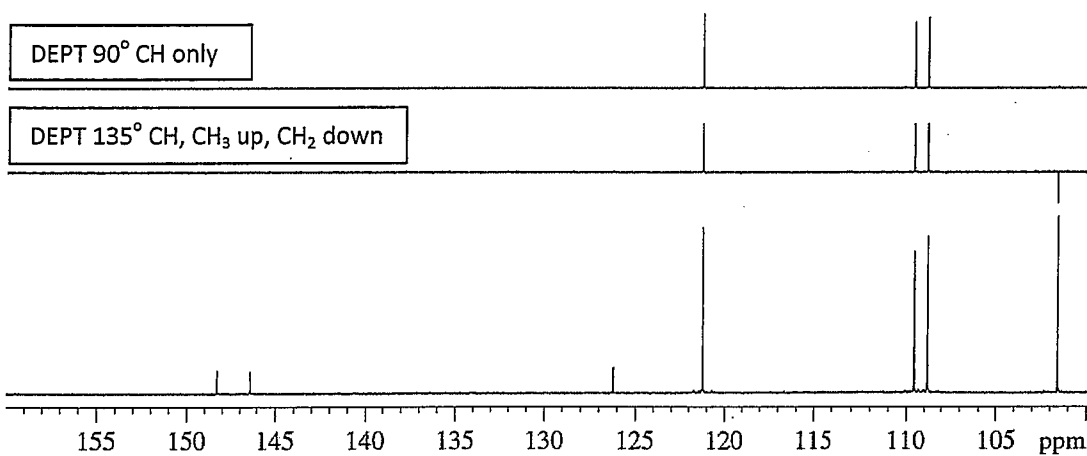
9. Determine the structure which is consistent with the following spectra. (12%)



$^1\text{H}$  NMR 600 MHz



$^{13}\text{C}/\text{DEPT}$  NMR 150.9 MHz

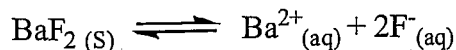


## 國立中山大學100學年度碩士班招生考試試題

## 科目：分析化學【海資系碩士班丁組】

請注意：考題中若涉及計算，請將演算過程列出，否則不予計分。

(10%) 1.

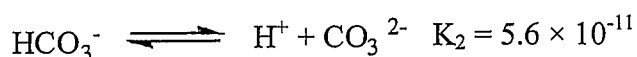
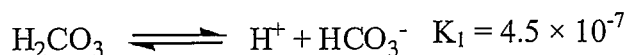


The value of the solubility product,  $K_{\text{sp}}$ , for the reaction above is  $4.0 \times 10^{-6}$  at  $25^{\circ}\text{C}$ .

(a) Write the  $K_{\text{sp}}$  expression for  $\text{BaF}_2$ .

(b) What is the concentration of  $\text{F}^{-}$  ions in a saturated solution of  $\text{BaF}_2$  at  $25^{\circ}\text{C}$ ?

(10%) 2.



The acid dissociation constants for the reactions above are given at  $25^{\circ}\text{C}$ .

(a) What is the pH of a 0.050 M solution of  $\text{H}_2\text{CO}_3$  at  $25^{\circ}\text{C}$ ?

(b) What is the concentration of  $\text{CO}_3^{2-}$  ions in the solution in (a)?

(10%) 3. Which is more accurate, a transfer pipet or measuring pipet? Explain your answer.

(10%) 4. Calculate the ionic strength of (a) 0.008 M KOH (b) 0.0002 M  $\text{La}(\text{IO}_3)_3$  (assuming complete dissociation at this low concentration).

(10%) 5. Sketch the general appearance of the curve for the titration of a weak diprotic acid with NaOH. Explain in words what chemistry governs the pH in each distinct region of the curve.

(10%) 6. What is the difference between  $E$  and  $E^{\circ}$  for a redox reaction? Which one runs down to 0 when the complete cell comes to equilibrium?

(10%) 7. What is a Clark (oxygen) electrode and how does it work?

(10%) 8. What is the difference between a single-beam and double-beam spectrophotometer? What are the advantages of the double-beam instrument?

(5%) 9. Why is high pressure needed in HPLC?

(15%) 10. To which kinds of analytes do the following gas chromatography detectors respond?

(a) thermal conductivity

(b) flame ionization

(c) electron capture