1. What are the categories of animal tissue? What are the functions of these tissues? How are the structure of these tissues suited for these functions? 20%

2. What four factors influence the structure of a community and how? 10%

3. How would you define the trophic structure of an ecosystem? What are the five trophic levels possible in an ecosystem? What criteria can be used to distinguish among these five trophic levels? 10%

4. How are RNA viruses classified? What type of virus is HIV? 10%

5. 詳述細胞的大小如何決定? 25%

6. 詳述細胞間如何傳遞訊息? 25%
1. 詳述人體血壓的調控機制？（30分）
2. 細胞的膜電位（resting membrane potential）如何產生？（20分）
3. 何謂生理節律（biological rhythm）？（10分）詳述其控制機制（20分）
4. 何謂 neurotransmitter？（10分）何謂 neuromodulator？（10分）
1. (5%) What are the differences between terms of motif and domain in protein structures?

2. (20%) Please draw the structure of glucose and fructose, and use the concepts of structure to explain their biochemical properties.

3. (10%) Please list the environmental factors that change the enzyme activities, and explain your reasons on each listed.

4. (20%) Write the sequence of the mRNA molecule synthesized from a DNA template strand having the sequence 5'-ATCGTACGGTTA.

5. (10%) A transfer RNA with a UGU anticodon is enzymatically charged with a $^{14}$C-cysteine. The cysteine unit is then chemically modified to aniline, using Raney nickel which removes the sulfur atom of cysteine. The altered aminoacyl-tRNA is added to a protein-synthesizing system containing normal components except for this tRNA. The mRNA added to this mixture contains the following sequence:

\[ 5'\text{-UUUUGCCAUGUUUGGCU} \]

6. (35%) Please translate the following message into Chinese. What is the best title for this message?

The absence of galactose-1-phosphate uridyl transferase causes galactosemia, a severe disease that is inherited as an autosomal recessive trait. The metabolism of galactose in persons who have this disease is blocked at galactose 1-phosphate. Afflicted infants fail to thrive. Vomiting or diarrhea occurs when milk is consumed, and enlargement of the liver and jaundice are common. Furthermore, many galactosemics become mentally retarded. The blood galactose level is markedly elevated, and galactose is found in the urine. The absence of the transferase in red blood cells is a definitive diagnostic criterion.
國立中山大學九十四學年度碩士班招生考試試題

科目：生態學【海資系碩士班乙組】

一、解詮名詞(40%) (每題5分)

1. Ecology  2. Character displacement
3. Euphotic zone  4. Entropy
5. Vant Hoff's law  6. Red tide

二、問答題 (60%)

1. 請敘述台灣四周有哪些海域、海峽及海流？各水域特徵為何？有何季節變化？
   (15分)
2. 請問台灣現存的紅樹林有哪些種類（寫出其中三種即可）？它們分布的地區或範圍大概在哪裡？各有何重要生理生態特徵？紅樹林有何重要性？(15分)
3. 請列點說明影響生物群落構造（或消長）的因素有哪些？(10分)
4. 請繪圖並舉例說明族群生存曲線(Survivorship curves)型式有哪些？(10分)
5. 要建立一個好的生態模式必須具備哪些要件？(10分)
(20%) 1. 培養兩週所養的某種魚，其繁殖後平均重量為380克，今年由族群中選機
取49隻魚，經以新飼料，所得試之體重資料為：n=49， 1=390克，S=35克
請測試新飼料所養之魚平均重量是否大於380克？(α=0.01)

注：
\[ S = \sqrt{\frac{\sum (Y_i - \bar{Y})^2}{n-1}} \]

(15%) 2. 家庭廢水的排放會影響水體中，動物賴以生存之溶解氧量，生態學家每個星期在
河口同一位置採樣，持續2個月，共獲9個樣品，請利用以下電氣印出之基本
資料（Sample Statistics），來估計水體中平均溶解的95%可信界限
（Confidence interval）。

Sample Statistics
Sample size = 9
\[ \bar{Y} = 4.95 \text{ ppm} \quad S^2 = 0.2025 \text{ ppm}^2 \quad S = 0.450 \text{ ppm} \]

(25%) 3. 高雄附近海域有兩條海洋排污管，其中兩條（分別在左營、大林蒲）是工業
廢水，而另一條（中洲）是漁業家庭廢水，如果你（或）想知道這兩條排污管對魚
類飼養是否有影響，請設計一個單因子變異數分析（One-way Analysis of
Variance）實驗，並詳述採樣項目、採樣方法、及數據分析之統計方法（15%）；
並以你的實驗設計配合完成下列變異方差分析表中，A-E之空格，其中自由度（df）
請按設計內容於C-E格寫出阿拉伯數目（10%）

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td>C</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td>D</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>E</td>
</tr>
</tbody>
</table>

(20%) 4. 為配製某種染料，需使用塩酸，以下數據為6批（batch）塩酸，每批做5個
測定，所得數值（克）：

<table>
<thead>
<tr>
<th>batch</th>
<th>Sample mean</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>505</td>
</tr>
<tr>
<td>2</td>
<td>528</td>
</tr>
<tr>
<td>3</td>
<td>564</td>
</tr>
<tr>
<td>4</td>
<td>498</td>
</tr>
<tr>
<td>5</td>
<td>600</td>
</tr>
<tr>
<td>6</td>
<td>470</td>
</tr>
</tbody>
</table>

數據分析如下表，請完成其中F-L之空格（14%），並下結論(α=0.05)（6%）。

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
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</thead>
<tbody>
<tr>
<td>Between batches</td>
<td>F</td>
<td>G</td>
<td>J</td>
<td>L</td>
</tr>
<tr>
<td>Within batches</td>
<td>58824</td>
<td>H</td>
<td>K</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
(20%) 5. 由以下表格，(1) 請寫出所獲得的訊息。(10%) 
(2) 若繼續分析，可進行哪些分析？並請說明為何要進行這些分析。(10%) 

Linear regression equations depicting the relationships in the spring (Cruises 606 and 638) in the South China Sea of the euphotic-layer averaged primary production (IPP/Deu, g C m⁻² d⁻¹) and nitrate-based new production (INP/Deu, g C m⁻² d⁻¹) with 3 independent variables including the surface chlorophyll a concentration (Chl, mg m⁻³), surface water temperature (Temp, °C) and nitracline depth (Nitracline, m), which are mutually covaried, n=11

<table>
<thead>
<tr>
<th>Production</th>
<th>Linear regression equation</th>
<th>R²</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPP/Deu</td>
<td>0.00035+0.024 Chl</td>
<td>0.70</td>
<td>**</td>
</tr>
<tr>
<td></td>
<td>0.051-0.002 Temp</td>
<td>0.49</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>0.011-0.000158 Nitracline</td>
<td>0.53</td>
<td>*</td>
</tr>
<tr>
<td>INP/Deu</td>
<td>-0.00033+0.008 Chl</td>
<td>0.84</td>
<td>**</td>
</tr>
<tr>
<td></td>
<td>0.015-0.001 Temp</td>
<td>0.45</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>0.003-0.000050 Nitracline</td>
<td>0.51</td>
<td>*</td>
</tr>
</tbody>
</table>

*p < 0.05; **p < 0.01
### Percentage Points of the F Distribution

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<th>df1</th>
<th>df2</th>
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<th>a = .025</th>
<th>a = .01</th>
<th>a = .005</th>
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<td>19</td>
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<td>6.62</td>
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<td>5.40</td>
</tr>
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<td>240</td>
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<td>8.41</td>
<td>6.50</td>
<td>6.15</td>
<td>5.25</td>
</tr>
</tbody>
</table>


### From "Table of Percentage Points of the t-Distribution." Computed by Maxine Merrington, Biometrika, Vol. 32 (1941), p. 300. Reproduced by permission of the Biometrika Trustees.
(1) (10%) Find the first three nonzero terms of the Taylor series expanded about \( x = 0 \) for \( f(x) = x^2e^{-x^2} \).

(2) (15%) Evaluate \( \int \frac{1}{4x^2 + 4x + 3} \, dx \).

(3) (15%) Find all relative extreme values of \( f(x) = x + \frac{1}{x} \).

(4) (15%) Find the limit \( \lim_{x \to \infty} (1 + \frac{1}{x})^x \).

(5) (15%) Determine whether the improper integral \( \int_0^\infty \frac{1}{e^x + e^{-x}} \, dx \) exist and, if so, find the value.

(6) (15%) Find all relative extreme values of \( f(x, y) = 4x - 2y - x^2 - 2y^2 + 2xy - 10 \).

(7) (15%) Evaluate the double integral
\[
\int \int_R xy \, dA
\]
where \( R = \{(x, y) | x^2 + y^2 \leq 4, y \geq 0\} \).
1. Two blocks are connected by a string and pulley as shown in the right. Assuming that the string and pulley are massless, what is the magnitude of the acceleration of each block? (10%)

2. An automobile moves on a level horizontal road in a circle of radius 30 m. The coefficient of friction between tires and road is 0.50. What is the maximum speed this car can round this curve? (10%)

3. A 0.50-kg block attached to an ideal spring with a spring constant of 80 N/m oscillates on a horizontal frictionless surface. When the spring is 4.0 cm shorter than its equilibrium length, the speed of the block is 0.50 m/s. What is the greatest speed of the block? (10%)

4. A playground merry-go-round (讓轉木馬) has a radius of 3.0 m and a rotational inertia of 600 kg m². It is initially spinning at 0.80 rad/s when a 20-kg child crawls from the center to the rim. When the child reaches the rim, find the angular velocity of the merry-go-round. (10%)

5. A 5.0 m weightless strut, hinged to a wall, is used to support an 800-N block as shown in the right. What is the tension in the horizontal rope? (10%)

6. A wave is described by \( y(x,t) = 0.1 \sin(3x + 10t) \), where \( x \) is in meters, \( y \) is in centimeters and \( t \) is in seconds. Find out the wavelength and frequency. (10%)

7. Each of the four capacitors shown is 500 \( \mu \)F. The voltmeter reads 1000V. What is the magnitude of the charge, in Coulombs, on each capacitor plate? (10%)

8. In an RC series circuit, \( \text{emf } \mathcal{E} = 12.0 \text{ V}, R = 1.4 \text{ M\Omega}, \) and \( C = 1.80 \mu \text{F} \).
   (a) Calculate the time constant. (b) Find the maximum charge that will appear on the capacitor during charging. (10%)

9. What is the entropy change for 3.2 mol of an ideal monatomic gas undergoing a reversible increase in temperature from 380 K to 425 K at constant volume? (10%)

10. A plumber has constructed the pipe system shown in the right, where the radii of the pipe sections are given in terms of \( R_0 = 2.0 \text{ cm} \). The pipe sections have vertical standpipes, which are tubes that are too tall for water to be pushed out of them by the pressure in the pipe system. The tubes are open at the top to an air pressure of 1.0 atm. If the water extends up into the standpipe for section \( D \) by 0.50 m, and the volume flow rate through the pipe sections is \( 2.0 \times 10^{-3} \text{ m}^3/\text{s} \), then how high does the water extend up into the standpipe for section \( B \)? (10%)
一、解释名词（每小题2.5分，共20分）

1. ionic bonding
2. pillow basalt
3. pyroclastic flow
4. spheroidal weathering
5. transform fault
6. unconformity
7. metasomatism
8. ophiolite

二、问答题（每小题10分，共80分）

1. 矿床（mineral deposit）从成因上分可以区分为那几类类型？并说明其成因机制或过程。

2. 试分别叙述火山及寒武岩层中火山岩浆活动对地壳地球构造环境。

3. 岩浆的黏滞性（viscosity）取决于哪些因素？和火山活动有何关系？

4. 试叙述在中洋脊（mid-ocean ridge）扩张中心（spreading center）处所发生的各种地质作用，并讨论这些作用对海水中所含元素的影响以及其和深海沉积间的关系。

5. 岩风化成何种物质？试以简单之矿物反应式讨论之。这些腐朽的石点所产的产物有无经济用途？

6. (a) 变质作用可以分为那些类型？各有其特征，请举例说明。
   (b) 台湾的中央山脉变质岩区域属于哪一类变质作用类型？
   (c) 台湾的台中石铜矿区属于哪一类变质作用类型？

7. 变质岩中重要的一个特征是具有片理（foliation）。试说明变质岩的片理是如何形成的。

8. 常见的变质岩有石英、方解石、钙质长石、钙质长石、钾质长石、辉石、橄榄石、角闪石、钠长石、以及硅土矿等，如果这些矿物暴露于地表，你认为它们之中哪些是容易遭受风化，哪些比较抗风化？请依先后顺序，分析其原因。
問答題（每題 10 分，共 100 分）

1. (a) 磷物的定義是甚麼？(b) 為什麼同一種磷物（例如石英）的所有樣品都具有相似的物理性質？

2. 研究磷物學有什麼重要性？

3. 何謂點群（point group）？何謂空間群（space group）？兩者的基本不同點在那裡？

4. 何謂 octahedral site（or octahedral vacancy）與 tetrahedral site？試以白雲母為例說明之，
白雲母化學式為 KAl₂(Si₂AlO₆)(OH)₂。

5. 試繪圖說明氯化銅（CuCl）結構和氯化銦（CsCl）結構，並說明其布拉維晶格型式。

6. 我們在日常生活中用到非常多的金屬資源，例如銅、鋁、和銅等。請問銅、鋁、和銅主要分別來自什麼磷物。這些磷物資源產出於什麼樣的地質條件或環境。試說明之。

7. 有一種磷物（olivine）礦石，經由化學分析知其化學成份為 SiO₂ = 41.07 %, TiO₂ = 0.05%,
Al₂O₃ = 0.56 %, Fe₂O₃ = 0.65 %, FeO = 3.78 %, MnO = 0.23 %, MgO = 54.06 %（重量百分比）。
試計算此磷物之化學式（需写出計算過程，原子量 O = 16.0, Si = 28.1, Ti = 47.9,
Al = 27.0, Fe = 55.8, Mn = 54.9, Mg = 24.3）。

8. 一個磷物可以有一個 2-軸對稱軸（2-fold axis of symmetry），也可以有好幾個 2-軸對稱軸，
但是没有一個磷物會剛好有兩個 2-軸對稱軸。為什麼磷物不會有兩個 2-軸對稱軸？一個磷物最多可以有幾個 2-軸對稱軸？（可以利用簡繪之立方投影圖繪圖輔助說明）

9. 等軸晶系和正方晶系中各有哪幾種形式之布拉維晶格（Bravais lattices）？那一種布拉維晶格
是等軸晶系中有而正方晶系中沒有？為什麼？（請繪圖討論並說明其理由）

10. 何謂配位數（coordination number）？假設離子鍵磷物其化學式為 AX（A: 陰離子，X:
陽離子），當其 Rₐ/Rₓ（陽離子半徑比值）分別是落在 0.22–0.41，0.41–0.73，和 > 0.73
等範圍時，請討論其對應之配位數值，以及離子堆疊方式（即結晶構造，可用結晶構造實
例作說明）。
1. Write a structure for each of the following compounds. (2% each)
   
   a. (1R, 2R)-2-Bromocyclohexanol  
   b. m-Chloroperoxybenzoic acid  
   c. 4-Methoxypyridine  
   d. Indole-3-carboxylic acid  
   e. 3,5-Cyclohexadiene-1,2-dione  
   f. 2-(2-Propenyl)cyclohexanone  
   g. 5-Bromo-3-ethynylcycloheptanone  
   h. Ethyloxacyclopropane

2. Give the expected major product for each of the following reactions. (3% each)
   
   a. 
   \[ \text{MeLi} \]

   b. 
   \[ \text{H}_2\text{SO}_4, \Delta \rightarrow \text{H}_2\text{O} \]

   c. 
   \[ \text{CH}_3\text{COOH} \]

   d. 
   \[ \text{MCPBA} \]

   e. 
   \[ \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH} \]

   f. 
   \[ \text{SO}_3 \text{conc. H}_2\text{SO}_4 \]

   g. 
   \[ \text{NaBH}_4 \]

   h. 
   \[ \Delta \]
1. 

\[
\begin{align*}
\text{CH}_3\text{P(C}_6\text{H}_5\text{)_3Br}^- & \rightarrow 1. \text{n-BuLi} \\
& \rightarrow 2. \text{O} = \text{CO}_2\text{Et}
\end{align*}
\]

2. 

\[
\begin{align*}
\text{CH}_3\text{CH}_2\text{C≡N} & \rightarrow 1. \text{C}_6\text{H}_5\text{MgCl} \\
& \rightarrow 2. \text{H}^+
\end{align*}
\]

3. Give a detailed mechanism for each of the following reactions. (8% each)

a. 

\[
\text{HO} 
\]

b. 

\[
\text{O} = \text{CO}_2\text{H}
\]

c. 

\[
\begin{align*}
\text{CH}_3\text{CBr} & \rightarrow \text{KOH, H}_2\text{O} \\
& \rightarrow \text{H}_2\text{O}
\end{align*}
\]

d. 

\[
\begin{align*}
\text{CH}_3\text{O} & \rightarrow \text{CH}_3\text{O}\text{C}_6\text{H}_5\text{OOCCH}_3 \\
& \rightarrow 1. \text{NaC}_6\text{H}_5\text{OCH}_2\text{OH} \\
& \rightarrow 2. \text{H}^+, \text{H}_2\text{O}
\end{align*}
\]

4. Deduce the structure for each of the following compounds with the provided molecular formulas and NMR spectral data.

a. \( \text{C}_7\text{H}_5\text{BrO}_2 \) : \( \delta \) 1.3(t, 3H), 1.8(d, 3H), 4.3(quintet, 3H).
   The latter peaks arise from two nearly overlapped quartets. (7%)

b. \( \text{C}_6\text{H}_12\text{NO}_2 \) (an ester) : \( \delta \) 1.3(t, 3H), 2.4(s, 6H), 3.2(s, 2H), 4.2(q, 2H). (7%)

c. \( \text{C}_{15}\text{H}_{20}\text{O}_4 \) : \( \delta \) 0.8(t, 3H), 1.2(t, 6H), 2.3(q, 2H), 4.2(q, 4H), 7.3(s, 5H). (8%)
請注意：(a) 若涉及計算，請將演算過程列於，否則不予計分
(b) log2=0.30, log3=0.48

(15%) 1. Define the following terms:
   (a) weak acid
   (b) zwitterion
   (c) amphiprotic solute
   (d) precision
   (e) accuracy

(10%) 2. The solubility products for a series of iodides are
   TlI  $K_{sp}=6.5\times10^{-8}$
   AgI  $K_{sp}=8.3\times10^{-17}$
   PbI₂ $K_{sp}=6.4\times10^{-9}$
   BiI₃ $K_{sp}=8.1\times10^{-19}$
   List these four compounds in order of decreasing molar solubility in
   (a) 0.10M NaI solution.
   (b) a 0.010M solution of the solute cation.

(6%) 3. What will be the pH of a 1.00M CH₃COOH solution?
   (For CH₃COOH, pKₐ=5)

(10%) 4. Neglecting any effects cause by volume changes, would you expect the
   ionic strength to (1) increase (2) decrease, or (3) remain unchanged by
   addition of HCl solution to a dilute solution of
   (a) NaOH.
   (b) acetic acid.
   Explain your answer in detail.

(6%) 5. How many milliliters of 0.0500M EDTA are required to react with 50.0
   mL of 0.0100M Ca²⁺? With 50.0mL of 0.0100M Al³⁺?

(6%) 6. What causes a liquid junction potential? How does this potential limit
   the accuracy of potentiometric analyses?

(10%) 7. List the sources of error associated with pH measurement using glass
   electrode.
(6%) 8. Explain what concentration polarization is. How does it affect the magnitude of voltage available from a galvanic cell and the magnitude of voltage required for electrolysis?

(10%) 9. Distinguish between fluorescence and phosphorescence. Why is phosphorescence rarer than fluorescence?

(6%) 10. Which molecular process correspond to the energies of microwave, infrared, visible and ultraviolet photons?

(15%) 11. Describe the mechanism of interaction of the solute with the stationary phase for the following types of chromatography:
   (a) adsorption chromatography
   (b) partition chromatography
   (c) ion-exchange chromatography
   (d) size-exclusion chromatography
   (e) affinity chromatography