

問答題 (100 points)

1. Describe the current understanding of protein folding in cells in the following aspects: (20 points)
  - (1) The information needed to specify the native structure of a protein
  - (2) Pathway of folding
  - (3) Driving force for the folding
  - (4) Proteins assisting the folding (give three examples)
  - (5) Prediction of the folding of protein
2. Discuss how the metabolic processes within cells are regulated at the level of individual reactions. (15 points)
3. Using "normal concentration of blood glucose is maintained in humans" as the example to discuss how the metabolic activities of different tissues or organs are integrated and coordinated. (15 points)
4. Why was it advantageous for a cell to develop glycolysis? Why are the enzymes that catalyze the steps of glycolysis so similar in bacteria, in yeast and in humans? (10 points)
5. What are the fundamental types of biological macromolecules and the functions of each type of macromolecule in a cell? (10 points)
6. Give two specific examples to illustrate the application of enzyme competitive inhibition in medical therapy. (10 points)
7. What is the difference between  $\Delta G^{\circ}$  and  $\Delta G$ ? What is the significance of a  $\Delta G$  of a given reaction? (10 points)
8. Give the reason for the following facts or observations: (10 points)
  - (1) Triacylglycerols as stored fuels
  - (2) Glycerophospholipids are membrane lipids
  - (3) DNA stores genetic information
  - (4) Thymine (T) in DNA and uracil (U) in RNA
  - (5) DNA contains deoxyriboses

I. 選擇題：請自下列 1~7 題選擇題各選出一正確答案。每題 2 分。

- Which of the followings is not contributed to assembly of the pre-initiation complex of transcription in eukaryotes?  
(A) RNA polymerase II                      (B) Mediator complex                      (C) sigma factor  
(D) Chromatin remodeling complex      (E) Histone acetyltransferase
- Ultraviolet light causes DNA damage. The common lesion found is  
(A) Single strand breaks                  (B) pyrimidine dimers                  (C) transposition  
(D) purine dimers                          (E) base deletions
- Telomere and telomerase are important in chromosome integrity and genome stability. All of the following statements about telomere and telomerase are correct EXCEPT  
(A) Telomeric DNA shortens in each round during cell division.  
(B) Expression of telomerase gene is essential in replication of telomeric DNA.  
(C) Expression of telomerase gene and activation of telomerase are found in every cell of vertebrate organisms.  
(D) Telomeres contain multiple copies of a short DNA sequence.  
(E) Telomere can be extended and maintained by telomerase.
- The origin of multigene families is most likely processed by which of the following mechanism?  
(A) Convergent evolution of dissimilar genes      (B) Horizontal gene transfer  
(C) Viral infection      (D) Endosymbiosis      (E) Gene duplication
- “Leucine zipper” is important in cellular regulation of both prokaryotes and eukaryotes because  
(A) It is restricted to the extracellular domain of many membrane receptors  
(B) It is a feature of palindromic sequence of specific DNA  
(C) It is at the catalytic domain of many kinases  
(D) It is a structural motif in many DNA-binding proteins  
(E) It is structure with high redox potential
- All of the followings are required for RecA-dependent recombination between two DNA molecules EXCEPT  
(A) Mismatch repair      (B) Ligation                      (C) Strand migration  
(D) DNA synthesis      (E) Nuclease digestion
- All of the following statement about RNA editing are correct EXCEPT  
(A) RNA editing has been observed in tRNA, rRNA and mRNA of eukaryotes.  
(B) RNA editing includes nucleoside modifications such as C to U and A to I.  
(C) RNA editing in mRNAs alters amino acid sequence of the encoded protein.  
(D) RNA editing occurs only in the nucleus of eukaryotes.  
(E) RNA editing occurs in plant.

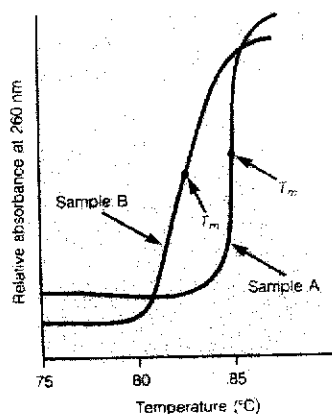
請自下列 8~14 題選擇題各選出一正確答案。每題 3 分。

8. Ribosomes are one of the indispensable components of a living cell. True statements about ribosomes include which of the following?
- I. mRNA binding at the initiation codon
  - II. aminoacylation of tRNA
  - III. peptide bond formation
  - IV. binding of protein factors during translation elongation
- (A) I, II, III (B) II, III, IV (C) I, II, IV (D) I, III, IV (E) I, II, III, IV
9. To loss gene function, which of the following is most likely to occur?
- (A) A point mutation from A to G in the promoter sequence
  - (B) A frameshift mutation in the coding sequence
  - (C) A point mutation in the 3' untranslated region
  - (D) A TAA codon change to a TGA codon in the coding sequence
  - (E) A missense mutation in the coding sequence
10. Which of the following deletion experiments will produce the same effect?
- I. Deletion of the *lac* operator
  - II. Deletion of the gene encoding CAP
  - III. Deletion of the gene encoding *lac* repressor
- (A) I, II (B) I, III (C) II, III (D) All of the above (E) None of the above
11. There are methods to switching off the expression of a specific mRNA without changing the gene encoding the protein or the gene's regulatory sequences. Which of the following can be designed and included in the experiment?
- I. A transcription inhibitor
  - II. Antisense RNA
  - III. siRNA
  - IV. A translation inhibitor
  - V. shRNA
- (A) I, IV (B) III (C) II, III (D) II, III, IV (E) II, III, V
12. A senior student was working on a PCR experiment. He got many bands of PCR products on the agarose gel when he used 55°C as annealing temperature. Followed the suggestion of his advisor, he changed the annealing temperature to 58°C and got one band with a supposed molecular weight. What is the reason of the results?
- (A) Some PCR products dissolved at higher temperature
  - (B) Higher temperature of annealing is more stringent condition
  - (C) Higher temperature of annealing is less stringent condition
  - (D) Higher temperature of annealing is advantageous to PCR enzyme
  - (E) Lower temperature of annealing is advantageous to PCR enzyme
13. Translation is a complex and accurate process. Which of the followings is the only one component decodes the genetic code?
- (A) Small ribosomal subunit
  - (B) Large ribosomal subunit
  - (C) Aminoacyl-tRNA synthetases
  - (D) Initiation factors
  - (E) Elongation factors

14. A student designs a mutation which would prevent the sigma factor from dissociation from E. coli RNA polymerase core enzyme. What would be the likely consequence of this experiment?
- (A) RNA synthesis would be faster                      (B) RNA synthesis would be slower  
(C) No RNA synthesis                                      (D) Mutant RNA molecules would be produced  
(E) The same as normal

## II. 問答題：

- A student has isolated a virus which infects orchid leaves. She treated the sample with phenol to remove viral proteins followed by applying the residual substance to scraped orchid leaves. Formation of lesions was observed. She hypothesized that the infectious substance is nucleic acid. How would be your suggestion of simple and highly sensitive method of determining whether the infectious nucleic acid is DNA or RNA? (5 分)
- Production of a mutant mRNA which was 700 nucleotides longer than that for normal protein was observed in a patient. This mutant mRNA contained a poly(A) tail that was located a few nucleotides after the only AAUAAA signal in the additional sequence. What would be the mutation mechanism which leads to the production of this mutant mRNA? (5 分)
- What processes enable the proteome more complex than the genome? (5 分)
- The 2006 Nobel prize in Physiology or Medicine was awarded to Craig Mello and Andrew Fire for their discovery of the gene-silencing technique called RNA interference.
  - Describe the mechanism of RNA interference. (5 分)
  - Define, compare and contrast two noncoding RNAs, microRNA (miRNA) and small interfering RNA (siRNA) involve in the process of RNA interference. Include in you answers their source and biological significances. (10 分)
- The figure below shows the melting curves for two DNA samples that were thermally denatured under the same conditions.



- Define  $T_m$  in the curve and describe its biological significance. (5 分)

- (b) What effect would be on the melting curve if a small amount of urea was added to the incubation mixture? (5 分)
- (c) Base on the information given in the above melting curves, draw and explain the **theoretical**  $C_{0t}$  curves (DNA renaturation curves) of sample A and B. [percent DNA renatured in Y axis and  $C_{0t}$  (concentration of DNA x time) in X axis] (5 分)
6. Define guide RNA. ((5 分) Name two examples of guide RNA, and describe their biological functions. (5 分)
7. Below is part of the RNA sequence of *E. Coli* X gene, the sequence underlined is its Shine-Dalgarno sequence.
- 5'-CUAGUAAAGGAGGUGCGAAUGCUAUGAAAGCAACUAAACUAGUACUUGG  
GGCGGUGAUUAACC-3'
- (a) Define and explain the function of the Shine-Dalgarno sequence? (4 分)
- (b) What is the name of its homologue in eukaryotes? (3 分)
- (c) Describe the effect on X gene product if a mutation deleted this Shine-Dalgarno sequence? (3 分)

1. Describe the processes of the photo-transduction of a retinal rod cell. (10%)
2. Voltage clamp and Patch clamp techniques have greatly improved our understanding of cell physiology. Please
  - a. describe major differences in using these techniques in physiology experiment.
  - b. describe differences in parameters that can be obtained from these experiments.
  - c. list one possible application of each technique on the investigation of physiology principles. (15%)
3. Explain how passively spread electric signals on cell membrane can affect the propagation of an action potential. (5%)
4. How sympathetic nerves and parasympathetic nerves are differed functionally and chemically. (10%)
5. How ADH ( antidiuretic hormone ) acts on epithelial tissue to regulate water and electrolyte balances in mammals. (10%)
6. How Juvenile hormone, a major insect developmental hormone, regulates metamorphosis in holometabolous insects ( insects with complete metamorphosis during development, such as a moth). (10%)
7. Discuss the role of calcium on cardiac muscle contraction. (10%)
8. Discuss factors determining net movement of fluids across capillary walls in edematous status. (10%)
9. Describe briefly all factors affecting the rate and depth of breathing. (10%)
10. Discuss the role of bile in digestive processes. (10%)

Answer the following questions:

1. Where are the CDR regions located on an antibody molecule and what are their functions? (10%)
2. Innate immunity collaborates with adaptive immunity to protect the host. Describe this collaboration, naming key points of interaction between the two systems. (20 %)
3. Draw and explain the structure and the reproductive cycle of HIV. Explain abnormal immune functions which lead to disease states. (30 %)
4. Describe the methods employed by malaria parasites in order to evade the host immune responses in human in detail. (20 %)
5. Describe the types and their applications of antibodies engineered by recombinant DNA. (10%)
6. Summarize the four major functions of the complement system. (10%)

★ 請務必依題號依序作答

1. Define and describe the following terms (5 points each)

- (1) Bioremediation
- (2) Selective medium
- (3) Prophage
- (4) Pandemic disease
- (5) Autotroph
- (6) Auxotroph
- (7) cDNA
- (8) Koch's postulates
- (9) Ames test
- (10) Nosocomial infections

2. How do you perform a Gram staining? Please list all procedures in detail. (20%)

3. Provide evidence to substantiate the hypothesis that eukaryotic cells evolved from prokaryotic cells. (20%)

4. Please name two bacterial genera that can produce endospore and briefly describe their oxygen demand. (10%)



**(I). Term explanation: 40%**

1. water potential
2. aquaporin
3. apoplast pathway
4. antenna complex
5. proton motive force
6. ATP synthase
7. plasmodesma
8. jasmonic acid
9. hypersensitive response
10. systemic acquired resistance

**(II). Questions: 60%**

1. Describe the Crassulacean acid metabolism (CAM).
2. Describe the pressure-flow model for phloem transport.
3. Describe how phytochrome effects on ion fluxes across membranes.
4. Describe the transduction cascade of blue light-stimulated stomatal opening.
5. Describe the chemiosmotic model of polar auxin transport.
6. Describe the composite model for the induction of  $\alpha$ -amylase synthesis in aleurone layers by GA.

一、解釋下列各應用於植物分類學上之名詞或術語(如有必要，可繪圖說明)(40%):

Phylogenetic classification

Characters

Type specimen

Angiosperms

Herbarium

Identification key

Phyllotaxy

Panicle inflorescence

Axile placentation

ii). Corolla

二、簡答下列各問題(60%):

1. 寫出植物體具有白色汁液的任意二種植物中名、其屬於科(Family)之中名及學名。

2. A 君發現了一新種植物，他必須依照國際命名法規規定的那種方法給與學名，才能得到國際認可。
3. 寫出近三十年來，分類學者常用於植物系統分類上的二種分析方法 (classification method)。
4. 被子植物中有一些科(Family)的學名字尾可不為 *aceae*，具有保留名，寫出任意五科的保留名及對應的學名(具字尾 *aceae*)。
5. 寫出到野外採集植物及當時壓製標本時，所需的五項物品和工具。
6. 植物分類學上，常需要與生物有關的各個學門提供證據。寫出植物形態學、植物解剖學、孢粉學，生態學、有機化學(或生物化學、或化學分類學)各個學門中提供的二項證據。
7. 廣義的豆科包括了那些狹義的科?寫出中名及學名。
8. 寫出分類學上主要的分類級(category)和種以下的任意二個分類級(中名及英名)。
9. 寫出許多學者認為早期原始植物，花的構造中任意二個特徵。
10. 如果有一屬植物只有 A、B 和 C 三種，且 A 分佈於巴西，B 分佈於非洲南端，C 分佈於澳洲西端。試推測此三種中那二種的親緣關係可能最近，那二種親緣關係可能最疏，並略解釋之。
11. 種子植物類的下一分類級有幾大類植物?主要的區分特徵為何?
12. 任意寫出三科(Family)的中名和學名，其中的一些或全部植物可發生卷鬚的構造。

1. The measures of variation usually employed are range, inter-quartile range, standard deviation, and coefficient of variation. What are the differences and advantages using each of these measures? (12%)

2. The data summarize blood groups and sex for a population.

Sex	Blood Type			
	A	B	AB	O
Male	540	620	420	550
Female	100	350	390	530

- Find the following probabilities:  $P(\text{not A})$ ,  $P(\text{A or O or male})$  and  $P(\text{A} \mid \text{male})$ . (9%)
- What is the odds ratio being blood type A over B comparing males with females? (4%)
- If two persons are randomly selected, what is the probability that they both are males? (4%)
- Test whether sex and blood type are independent. (12%)

3. The snout-vent length (mm) of five snakes were recorded as 290, 280, 300, 312, and 290.

- Find the sample mean and 99% confidence interval for the mean. (10%)
- Test whether the mean snout-vent length is greater than 300? (10%)

4. The body size and egg clutch size of five female beetles are shown below.

Body size (mm)	20.0	21.0	21.5	22.0	23.1
Egg clutch size	20	26	30	32	20

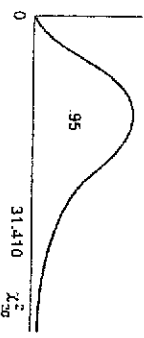
- Find out the regression coefficients to predict egg clutch size from body size. What do these coefficients mean? (13%)
- Test whether one can claim that the body size can significantly predict egg clutch size? (12%)

5. The 4 samples of biodiversity indices of five natural reserves were compared with the ANOVA table shown below.

Source of variation	Sum of squares	Degrees of freedom	Mean squares	F
Among reserves	320			
Within reserves				
Total	440			

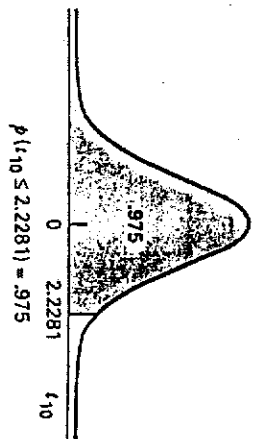
- Complete the ANOVA table. (9%)
- Are the indices different among the natural preserves? (5%)

TABLE F Percentiles of the Chi-Square Distribution



d.f.	$\chi^2_{.995}$	$\chi^2_{.99}$	$\chi^2_{.95}$	$\chi^2_{.90}$	$\chi^2_{.85}$	$\chi^2_{.80}$	$\chi^2_{.75}$	$\chi^2_{.70}$	$\chi^2_{.65}$	$\chi^2_{.60}$	$\chi^2_{.55}$	$\chi^2_{.50}$	$\chi^2_{.45}$	$\chi^2_{.40}$	$\chi^2_{.35}$	$\chi^2_{.30}$	$\chi^2_{.25}$	$\chi^2_{.20}$	$\chi^2_{.15}$	$\chi^2_{.10}$	$\chi^2_{.05}$	$\chi^2_{.025}$	$\chi^2_{.01}$	$\chi^2_{.005}$	
1	161	200	216	225	230	234	237	239	241	242	244	244	246	246	248	248	248	248	248	248	248	248	248	248	248
2	18.5	19.0	19.2	19.2	19.3	19.3	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4
3	10.1	9.55	9.28	9.12	9.01	8.94	8.85	8.85	8.81	8.79	8.74	8.74	8.70	8.66	8.66	8.66	8.66	8.66	8.66	8.66	8.66	8.66	8.66	8.66	8.66
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96	5.91	5.86	5.86	5.86	5.86	5.86	5.86	5.86	5.86	5.86	5.86	5.86	5.86	5.86	5.86
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74	4.68	4.62	4.62	4.62	4.62	4.62	4.62	4.62	4.62	4.62	4.62	4.62	4.62	4.62	4.62
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06	4.00	3.94	3.87	3.87	3.87	3.87	3.87	3.87	3.87	3.87	3.87	3.87	3.87	3.87	3.87
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64	3.57	3.51	3.44	3.44	3.44	3.44	3.44	3.44	3.44	3.44	3.44	3.44	3.44	3.44	3.44
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35	3.28	3.22	3.15	3.15	3.15	3.15	3.15	3.15	3.15	3.15	3.15	3.15	3.15	3.15	3.15
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14	3.07	3.01	2.94	2.94	2.94	2.94	2.94	2.94	2.94	2.94	2.94	2.94	2.94	2.94	2.94
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98	2.91	2.85	2.77	2.77	2.77	2.77	2.77	2.77	2.77	2.77	2.77	2.77	2.77	2.77	2.77
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90	2.85	2.79	2.72	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80	2.75	2.69	2.62	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71	2.67	2.60	2.53	2.46	2.46	2.46	2.46	2.46	2.46	2.46	2.46	2.46	2.46	2.46	2.46	2.46
14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65	2.60	2.53	2.46	2.39	2.39	2.39	2.39	2.39	2.39	2.39	2.39	2.39	2.39	2.39	2.39	2.39
15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54	2.48	2.40	2.33	2.33	2.33	2.33	2.33	2.33	2.33	2.33	2.33	2.33	2.33	2.33	2.33
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54	2.49	2.42	2.35	2.28	2.28	2.28	2.28	2.28	2.28	2.28	2.28	2.28	2.28	2.28	2.28	2.28
17	4.45	3.59	3.20	2.96	2.81	2.70	2.62	2.55	2.49	2.45	2.38	2.31	2.23	2.23	2.23	2.23	2.23	2.23	2.23	2.23	2.23	2.23	2.23	2.23	2.23
18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46	2.41	2.34	2.27	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19
19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42	2.37	2.30	2.23	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39	2.35	2.28	2.20	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12
21	4.32	3.47	3.07	2.84	2.68	2.57	2.57	2.49	2.42	2.37	2.30	2.23	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10
22	4.30	3.44	3.05	2.82	2.66	2.55	2.55	2.46	2.40	2.34	2.27	2.20	2.07	2.07	2.07	2.07	2.07	2.07	2.07	2.07	2.07	2.07	2.07	2.07	2.07
23	4.28	3.42	3.03	2.80	2.64	2.53	2.53	2.44	2.37	2.31	2.24	2.17	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04
24	4.26	3.40	3.01	2.78	2.62	2.51	2.51	2.42	2.35	2.29	2.22	2.15	2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.02
25	4.24	3.39	2.99	2.76	2.60	2.49	2.49	2.40	2.33	2.27	2.20	2.13	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00

Values of  $F_{\alpha, \nu_1, \nu_2}$



d.f.	$F_{.90}$	$F_{.95}$	$F_{.975}$	$F_{.99}$	$F_{.995}$
1	3.078	6.3138	12.706	31.821	63.657
2	1.886	2.9200	4.3027	6.965	9.9248
3	1.638	2.3534	3.1825	4.541	5.8409
4	1.533	2.1318	2.7764	3.747	4.6041
5	1.476	2.0150	2.5706	3.365	4.0321
6	1.440	1.9432	2.4469	3.143	3.7074
7	1.415	1.8946	2.3646	2.998	3.4995
8	1.397	1.8595	2.3060	2.896	3.3554
9	1.383	1.8331	2.2622	2.821	3.2498
10	1.372	1.8125	2.2281	2.764	3.1693
11	1.363	1.7959	2.2010	2.718	3.1058
12	1.356	1.7823	2.1788	2.681	3.0545
13	1.350	1.7709	2.1604	2.650	3.0123
14	1.345	1.7613	2.1448	2.624	2.9768
15	1.341	1.7530	2.1315	2.602	2.9467
16	1.337	1.7459	2.1199	2.583	2.9208
17	1.333	1.7396	2.1098	2.567	2.8982
18	1.330	1.7341	2.1009	2.552	2.8784
19	1.328	1.7291	2.0930	2.539	2.8609
20	1.325	1.7247	2.0860	2.528	2.8453

Degrees of freedom for denominator

1. What are common distinctive characteristics of Chordata, and Cephalochordata, and Vertebrata. Explain the differences among them. (18%)
2. Explain the following terms: systematics, taxon, phylogeny, cladistics, principle of priority, junior synonym. (18%)
3. Describe the following wing structures and give one bird species of each: Elliptical wing, high speed wings, high-aspect wings, and slotted high-lift wings. (16%)
4. Compare and differentiate the morphological characteristics, habitat and food of Insectivora, and Carnivora, and Rodentia. (18%)
5. Describe the following locomotion patterns of fish: anguilliform, carangiform, ostraciiform, and balistiform. What kinds of fishes are associated with each of the locomotion patterns? (16%)
6. Compare and differentiate the morphological characteristics of Viperidae and Elapidae. (14%)

**答題建議：**

- (1) 本卷題目僅有一題，請詳讀問題，注意對問題、策略、與結果在敘述上的流暢與邏輯性。
- (2) 若能引用或引述所讀過的文獻以佐證想法更佳(不需詳列文獻完整來源)。
- (3) 除文字敘述外，若能以簡單的圖表說明您的概念更佳。

**題目：**

請任選擇一種(或一群)昆蟲(不一定是台灣產)，請先介紹其分類地位、學名(從目至種級分類群)、分布、棲息環境、生物學特性、以及曾經有什麼樣類型的研究以此(類)昆蟲為研究材料。然後請依據這種(或這群)昆蟲的某些您有興趣的特性，以及打算測試的假說，進行實驗設計。實驗設計請敘述您的假說、可能的研究策略(包含如何飼養此種昆蟲)、可能需要的材料與方法以及預期結果與可能遭遇到的困難。

單選題，每題2分，共15題，共30分

1. What percentage of the DNA in the human genome codes for proteins or functional RNA approximately?  
(A) 85% (B) 48% (C) 30% (D) 12% (E) 2%
2. The most noticeable component of the DNA in eukaryotic genomes is  
(A) operons (B) tandemly repeating DNA (C) gene regulatory sequences  
(D) transposable elements and related sequences (E) *Alu* elements
3. What do pseudogenes and introns have in common?  
(A) they code for RNA end products, rather than proteins  
(B) they both contain uracil  
(C) they have multiple promoter sites  
(D) they both code for histones  
(E) they are not expressed, nor do they code for functional proteins
4. A eukaryotic gene typically has all of the following features EXCEPT  
(A) introns (B) a promoter (C) an operator (D) control elements (E) a terminator
5. Scientist often deduce the evolutionary relationship of the different members of a gene family by  
(A) comparing the sequences of the genes.  
(B) determining which of the genes are mutated in human diseases.  
(C) comparing the relative enzymatic activities of the proteins encoded by the genes.  
(D) overexpressing each of the genes in a cell and determining which has the most destructive effect.  
(E) examining the relative stability of the mRNAs produced from the genes.
6. The primary reason why certain trees tend to grow straight and tall with few lateral branches when compared with other trees is because:  
(A) of unknown reasons  
(B) Lateral buds are missing in many of these trees  
(C) Lateral bud development is dependent on temperature  
(D) Gibberellins affect the buds detrimentally  
(E) Auxins inhibit lateral bud development
7. Cytokinins are plant hormones that usually affect cell:  
(A) elongation (B) growth (C) division (D) wall expansion (E) turgor pressure
8. Gibberellins were discovered as a result of:  
(A) extractions of this hormone from plants  
(B) a fungal disease on rice  
(C) an application of the hormone accidentally  
(D) many years of experiments to isolate it from plants  
(E) discovery of its relationship to auxins
9. One of the important roles of ethylene in plant development is that it induces radial swelling in:  
(A) root and stem during seedling development (B) embryo expansion  
(C) seed germination (D) stem elongations (E) auxin production
10. The plant hormone that prevents seed germination even if conditions of temperature and moisture conditions are appropriate would be:  
(A) auxins (B) gibberellins (C) ethylene (D) abscisic acid (E) brassinosteroids
11. Which of the following statements is incorrect?  
(A) When signal molecules bind to receptor tyrosine kinases, the receptors phosphorylate themselves.  
(B) In response to some G-protein-mediated signals, a special type of lipid molecule associated with the plasma membrane is cleaved to form  $IP_3$  and calcium.  
(C) In most cases, signal molecules interact with the cell at the plasma membrane and never actually enter the cell.  
(D) Toxins such as those that cause botulism and cholera interfere with the ability of activated G proteins to hydrolyze GTP to GDP, resulting in adenylyl cyclase activity in the absence of an appropriate signal molecule.  
(E) Protein kinase A activation is one possible result of signal molecules binding to G-protein-linked receptors.
12. Inside an active mitochondrion, most electrons follow which pathway?  
(A) glycolysis  $\rightarrow$  NADH  $\rightarrow$  oxidative phosphorylation  $\rightarrow$  ATP  $\rightarrow$  oxygen  
(B) citric acid cycle  $\rightarrow$  FADH<sub>2</sub>  $\rightarrow$  electron transport chain  $\rightarrow$  ATP  
(C) electron transport chain  $\rightarrow$  citric acid cycle  $\rightarrow$  ATP  $\rightarrow$  oxygen  
(D) pyruvate  $\rightarrow$  citric acid cycle  $\rightarrow$  ATP  $\rightarrow$  NADH  $\rightarrow$  oxygen  
(E) citric acid cycle  $\rightarrow$  NADH  $\rightarrow$  electron transport chain  $\rightarrow$  oxygen
13. The presence of cholesterol in the plasma membranes of some animals  
(A) enables the membrane to stay fluid more easily when cell temperature drops.  
(B) enables the animal to remove hydrogen atoms from saturated phospholipids.  
(C) enables the animal to add hydrogen atoms to unsaturated phospholipids.  
(D) makes the membrane less flexible, allowing it to sustain greater pressure from within the cell.  
(E) makes the animal more susceptible to circulatory disorders.
14. Three-chambered hearts generally consist of which of the following numbers of atria and ventricles?  
(A) no atria; three ventricles  
(B) one atrium; one ventricle  
(C) two atria; one ventricle  
(D) three atria; no ventricles  
(E) one atrium; two ventricles
15. Which of the following statements about the adrenal gland is correct?



- (A) at all times, the adrenal gland monitors calcium levels in the blood and regulates calcium by secreting the two antagonistic hormones, epinephrine and norepinephrine.
- (B) during stress, TSH stimulates the adrenal cortex and medulla to secrete acetylcholine.
- (C) during stress, the alpha cells of islets secrete insulin and simultaneously the beta cells of the islets secrete glucagon.
- (D) during stress, ACTH stimulates the adrenal cortex, and neurons to the sympathetic nervous system stimulate the adrenal medulla.
- (E) at all times, the anterior portion secretes ACTH while the posterior portion secretes oxytocin.

單選題，每題2.5分，共28題，共70分

**16. The prebiotic soup was**

- (A) the assemblage of unicellular prokaryotes and eukaryotes that existed in the oceans of primitive Earth
- (B) the accumulation of organic molecules in the oceans of primitive Earth
- (C) the mixture of organic molecules that was found in the cytoplasm of the earliest cells on Earth
- (D) a pool of nucleic acids that contained the genetic information for the earliest organisms
- (E) none of the above

**17. Lamarck's vision of evolution differed from Darwin's in that Lamarck believed**

- (A) living things evolved in an upward direction
- (B) behavioral changes modified heritable traits
- (C) genetic differences among individuals in the population allowed for evolution
- (D) a and b only
- (E) none of the above

**18. Two or more homologous genes found within a particular species are called**

- (A) homozygous (B) orthologs (C) paralog (D) heterologs (E) duplicates

**19. The Hardy-Weinberg equation characterized the genotype frequencies and allele frequencies**

- (A) of a population that is experiencing selection for mating success
- (B) of a population that is extremely small
- (C) of a population that is very large and not evolving
- (D) of a community of species that is not evolving
- (E) of a community of species that is experiencing selection

**20. Which of the following does not alter allele frequencies?**

- (A) selection (B) immigration (C) mutation (D) inbreeding (E) emigration

**21. The neutral theory of evolution differs primarily from Darwinian evolution in that**

- (A) neutral theory states natural selection does not exist
- (B) neutral theory states that most of the genetic variation in a population is due to neutral mutations, which do not alter phenotypes
- (C) neutral variation alters survival and reproductive success
- (D) neutral mutations are not affected by population size
- (E) both b and c

**22. The biological species concept classifies a species based on**

- (A) morphological characteristics
- (B) reproductive isolation
- (C) the niche the organism occupies in the environment
- (D) genetic relationships between an organism and its ancestor
- (E) both a and b

**23. Founder events may lead to rapid speciation because of**

- (A) differences in natural selection on the new population versus the original population
- (B) genetic difference due to genetic drift
- (C) enhances gene flow between the new population and the original population
- (D) all of the above
- (E) a and b only

**24. The concept of punctuated equilibrium suggests that**

- (A) the rate of evolution is constant, with short time periods of no evolutionary change
- (B) evolution occurs gradually over time
- (C) small genetic changes accumulate over time to allow for phenotypic change and speciation
- (D) long periods of little evolutionary change are interrupted by short periods of major evolutionary change
- (E) both b and c

**25. A group composed of all species derived from a common ancestor is referred to as**

- (A) a phylum (B) a clade (C) a phenogram (D) an outgroup (E) a taxon

**26. The bacterial phylum that produces oxygen gas as the result of photosynthesis is**

- (A) the proteobacteria (B) the cyanobacteria (C) the Gram-positive bacteria
- (D) all of the above (E) none of the above

**27. Which group of organisms listed is most closely related to the kingdom Fungi?**

- (A) the animal kingdom
- (B) the green algae
- (C) the land plant
- (D) the bacteria
- (E) the archaea

**28. An important feature of land plants that originated during the diversification of charophycean algae is**

- (A) the sporophyte  
 (B) spores, which are dispersed in air and coated with sporopollenin  
 (C) tracheids  
 (D) plasmodesmata  
 (E) fruits
29. Which part of flower receives pollens from the wind or a pollinating animal?  
 (A) perianth (B) stigma (C) filament (D) peduncle (E) ovary
30. *Homo sepiens* are believed to have evolved most recently from  
 (A) *Homo erectus*  
 (B) *Homo neanderthaliensis*  
 (C) *Homo habilis*  
 (D) *Homo ergaster*  
 (E) *Australopithecus africanus*
31. The number of individuals that contribute genes to future populations is called  
 (A) the effective population size  
 (B) the adult population size  
 (C) the breeding coefficient  
 (D) the gene pool  
 (E) the female population size
32. The amount of energy that is fixed during photosynthesis is  
 (A) net primary production  
 (B) biomagnification  
 (C) trophic-level transfer efficiency  
 (D) gross primary production  
 (E) production efficiency
33. Eutrophication is  
 (A) caused by an overabundance of nitrogen, which leads to an increase in bacteria populations  
 (B) caused by an overabundance of nutrients, which leads to an increase in algal populations  
 (C) the normal breakdown of algal plants following a pollution event  
 (D) normally seen in dry, hot regions of the world  
 (E) none of the above
34. The Shannon diversity index is a measure of  
 (A) the number of different species in a community  
 (B) the abundance of a species in a community  
 (C) the types of species found in a typical climate  
 (D) the number of different species and their relative abundance in a community  
 (E) the distribution of members of a species in a community
35. A species interaction in which one species benefits but the other species is unharmed is called  
 (A) mutualism (B) amensalism (C) parasitism (D) commensalism (E) mimicry
36. The number of organisms in a given unit area is termed population  
 (A) dispersion (B) dispersal (C) density (D) ecology (E) growth
37. A life table usually contains information about  
 (A) the number of surviving individuals of a particular age class  
 (B) fertility for specific age classes  
 (C) dispersal patterns of a population  
 (D) all of the above  
 (E) a and b only
38. When each female in the population mates with several males, but each male mates with only one female, the mating system is referred to as  
 (A) polygamy (B) polyandry (C) polygyny (D) monogamy (E) harem mating
39. Which is the most important contribution to human-caused global warming?  
 (A) carbon dioxide (B) nitrous oxide (C) sulfur dioxide (D) methane (E) chlorofluorocarbons
40. Advantages of internal fertilization over external fertilization include  
 (A) ensuring that male gametes come into close proximity to female gametes  
 (B) protection of gametes from predation or other harmful  
 (C) decreased likelihood of desiccation of gametes  
 (D) all of the above  
 (E) a and b only
41. Where would you find female gametophytes in a flowering plant?  
 (A) in the anthers of a flower  
 (B) at the stigma of a pistil  
 (C) in the style  
 (D) within ovules in a flower's ovary  
 (E) none of the above
42. The presence of a bony skeleton, an operculum, and a swim bladder are all defining characteristics of  
 (A) Myxini (B) lampreys (C) Chondrichthyes (D) bony fishes (E) amphibians
43. The concept that the preferred evolutionary hypothesis is the one that is the simplest is  
 (A) phenetics (B) cladistics (C) the principle of parsimony (D) maximum likelihood (E) both b and d

# 國立中山大學 97 學年度碩士班招生考試試題

科目：生態學【生科系碩士班丙組選考】

共 / 頁 第 / 頁

1. What adaptations enable land PLANTS OR ANIMALS to live in an arid environment? (15 pts)
2. What can we learn from studies regarding population distribution and abundance of a species? What is the application toward conservation? (20 pts)
3. Contrast and discuss plants adapted to low-nutrient and high-nutrient environments. (15 pts)
4. What is the competitive exclusion principle? How does the principle relate to character displacement and niche specialization? (15 pts)
5. What is the model of island biogeography, and how do its related experiments tell us about species richness? (15 pts)
6. What is the intermediate disturbance hypothesis, and how does it relate to community diversity? (10 pts)
7. Name the terrestrial biomes you would expect to find when going from Chaiyi coast area to the mountaintop of Yushan, and briefly describe each of their characteristic features. (10 pts)