

國立中山大學 107 學年度碩士暨碩士專班招生考試試題

科目名稱：生態學【生科系碩士班甲組】

題號：421002

※本科目依簡章規定「不可以」使用計算機(混合題)

共 2 頁第 1 頁

一、選擇題(單選，共 30 分，每題 3 分)

1. Vegetation patterns affect the reflectance of solar radiation, known as its
A. albedo. B. evapotranspiration.
C. Hadley index. D. lapse rate.
E. Milankovitch index.
2. Which of the following types of change occurs over generations rather than within a lifetime?
A. Acclimatization B. Transpiration
C. Adaptation D. Equilibration
E. Pubescence
3. If a population of monkeyflowers has 500 members with 135 of genotype DD, 280 of genotype Dd, and 85 of genotype dd, what is the frequency of the D allele?
A. 0.135 B. 0.275 C. 0.415 D. 0.5 E. 0.55
4. Which of the following is not an abiotic feature of the environment?
A. The salinity of the soil
B. The density of earthworms present in the soil
C. The amount of sunlight the soil receives
D. The moisture content of the soil
E. The air temperature
5. The addition of excess nutrients into aquatic systems often disrupts the ecosystem. This phenomenon is known as
A. environmental stochasticity. B. Allele effects.
C. dampened oscillations. D. eutrophication.
E. resource dysgenesis.
6. Which of the following would most likely present a barrier to a population's experiencing the benefits of the rescue effect?
A. Inbreeding B. Delayed density dependence
C. Deterministic stochasticity D. Genetic drift
E. Isolation by distance
7. Many species of butterflies that are noxious to predators also have bright red coloration. This feature, which functions as a signal to potential predators that eating them will be unpleasant or harmful, is an example of _____ coloration.
A. exploitative B. cryptic
C. apomictic D. aposematic
E. induced
8. An organism that lives in or on another organism is called a(n)
A. parasite. B. parasitoid.
C. symbiont. D. endoparasite.
E. plasmodium.
9. Some plants have _____ that protect against specific parasites, much like the memory cells of the vertebrate immune system.
A. lignins B. resistance genes
C. scolexes D. merozoites
E. immunity genes

背面有題

試題隨卷繳回

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共 2 頁第 2 頁

10. Assume that lions running on grass neither benefit nor are harmed by this interaction, but their activity helps the grass grow. This is an example of a
- A. commensalism.
 - B. endosymbiosis.
 - C. mutualism.
 - D. symbiosis.
 - E. ammensalism.

二、問答題(共 70 分)

1. Defining a community by using biological or physical guidelines (15 points).
2. Describe the mechanisms of succession? (20 points).
3. Defining the alpha, beta, and gamma diversity (15 points).
4. Distribution and abundance of species in communities is dependent on: (20 points)

國立中山大學 107 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【生科系碩士班甲組】

題號：421004

※本科目依簡章規定「不可以」使用計算機(問答申論題)

共 1 頁第 1 頁

問答題

1. 請敘述全球暖化對於物種演化的影響。如可能，請盡量使用已知的例子來說明。(20 分)
2. 請敘述如何對特定的一個分類群取樣 DNA 並據此建構其組成份子之親緣關係(phylogeny)的步驟。(20 分)
3. 物種間的生殖隔離，可能由不同的生物因子所造成。請敘述前合子屏障(prezygotic barriers)及後合子屏障(postzygotic barriers)的各種不同因子。(20 分)
4. 過去地球有過 5 次大滅絕(mass extinction)，下次的大滅絕可能因為那些因素加快其步驟?大滅絕對於後續的生物多樣性的發展影響為何?又大滅絕存活的生物類群，一般具有那些共同的特徵?(20 分)
5. 請列出你所知道的物種概念(species concept)。以三種為限，討論這些概念的優缺點。(20 分)

國立中山大學 107 學年度碩士暨碩士專班招生考試試題

科目名稱：生物化學【生科系碩士班乙組】

題號：421001

※本科目依簡章規定「不可以」使用計算機(混合題)

共 6 頁第 1 頁

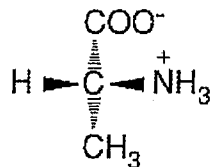
(一) 單選題 (60分，每題3分，共20題)：

1. 5-Phosphoribosyl-a-pyrophosphate (PRPP) is a synthetic precursor for all of the following *except*:
 A) AMP B) histidine C) UMP D) tryptophan E) arginine

2. If the binding of a small molecule to an enzyme "induces" a change in conformation that makes the enzyme site complimentary in structure to the geometric and electronic properties of the small molecule, then _____.
 A) the interaction is an example of an induced fit.
 B) the interaction will result in inhibition.
 C) the enzyme will be inactivated.
 D) the enzyme is subject to allosteric regulation.
 E) None of the above.

3. From the following, choose the best description of the figure:

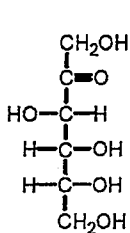
- A) L-Alanine
- B) D-Alanine
- C) L-Serine
- D) D-Serine
- E) D,L-Serine



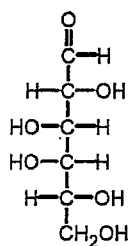
4. Which of the following is not an intermediate in the citric acid cycle?

- A) Acetyl-CoA
- B) Oxaloacetate
- C) Succinate
- D) Isocitrate
- E) Malate

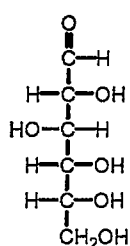
5. In the following figure, which two molecules are epimers?



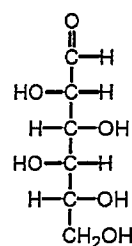
Molecule 1



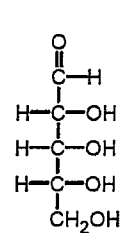
Molecule 2



Molecule 3



Molecule 4



Molecule 5

- A) Molecules 1 and 5
- B) Molecules 2 and 3
- C) Molecules 3 and 4
- D) Molecules 2 and 4
- E) Molecules 1 and 3

6. Coconut oil contains only a very small amount of unsaturated fatty acids. How can it still have a low melting point?

- A) It contains a lot of long-chain fatty acids.
- B) It contains mostly short-chain fatty acids.
- C) It has only a few hydrogen bonds per fatty acid chain.
- D) a) and c) are true.
- E) b) and c) are true.

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共 6 頁第 2 頁

7. Human alcohol dehydrogenase is capable of oxidizing several substrates; the kinetic parameters for these substrates are given in the table below. Which is the most preferred substrate according to these values? Assume a constant enzyme amount of 1 mg when these experimental values were obtained.

Answer Choice	Substrate	K _m (μM)	V _{max} (μmol min ⁻¹)
A)	Hexanol	12	27
B)	Butanol	15	28
C)	Ethylene Glycerol	39	15
D)	Methonal	16	10
E)	Propanol	32	29

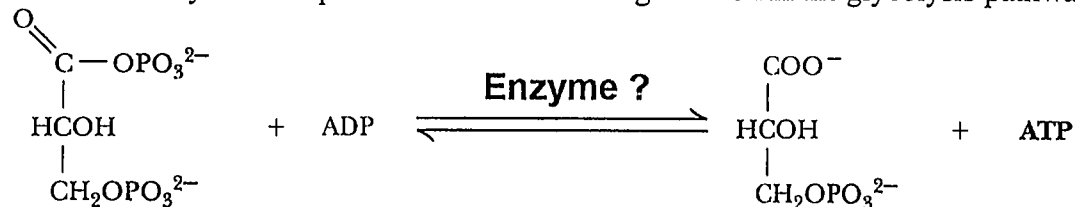
8. The use of NADPH as a source of reducing power for biosynthesis is favored by the fact that the cytosolic NADP⁺/NADPH ratio is:

- A) Much higher than in the mitochondrion.
- B) Very high, leading to nearly irreversible pathways.
- C) Approximately 1.0, allowing easy reversibility of pathways.
- D) Very low, allowing plentiful availability of reductant.
- E) This ratio cannot be calculated because it is an irrational number.

9. Proteins are effective buffers over a wide range of pHs because they usually contain:

- A) a large number of amino acids .
- B) amino acid residues with different pK_a values.
- C) amino-terminal and carboxyl-terminal residues that can donate or accept protons.
- D) peptide bonds that readily ionize, consuming H⁺ and OH⁻ ions.
- E) a large number of hydrogen bonds in α-helices.

10. Which enzyme is responsible for the following reaction in the glycolysis pathway?



- (A) triose phosphate isomerase
- (B) glyceraldehyde 3-phosphate dehydrogenase
- (C) pyruvate kinase
- (D) phosphoglycerate kinase
- (E) glucose 6-phosphate isomerase

11. Excesses of ketone bodies (acetoacetate and β-hydroxybutyrate) are found in the blood of a patient who lacks insulin because:

- A) Ketone bodies are converted into glucose to cause hyperglycemia.
- B) Ketone bodies serve as a substitute for urea in stressful conditions.
- C) Lack of insulin means that glucose can't enter fat cells.
- D) Insulin stimulates glycogen breakdown.
- E) The kidney can't excrete ketone bodies in the absence of insulin.

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共 6 頁第 3 頁

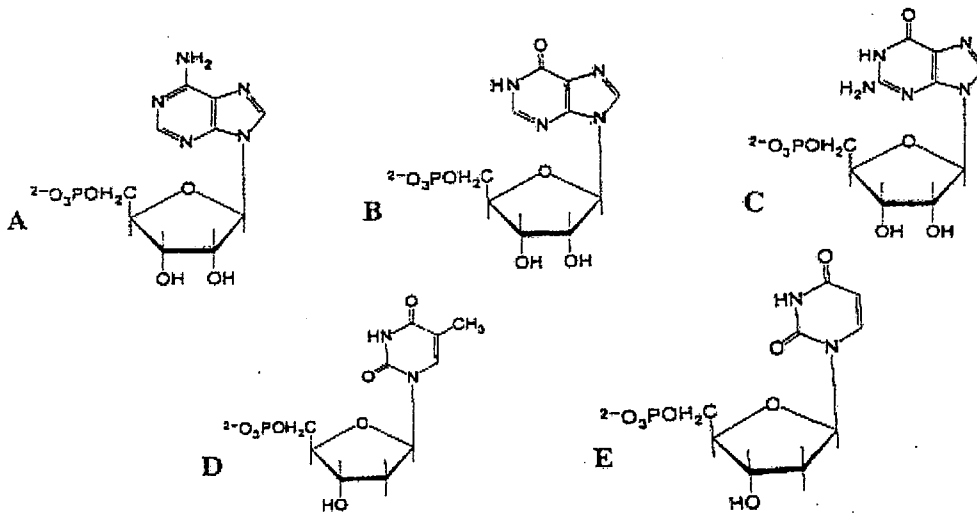
12. Photoheterotrophs require:

- A) organic carbon sources and oxidation-reduction reactions.
- B) carbon dioxide and light
- C) carbon dioxide and inorganic compounds.
- D) organic carbon sources and light.
- E) carbon dioxide and oxidation-reduction reaction.

13. Which of the following reactions is catalyzed by the enzyme HGPRT (hypoxanthine-guanine phosphoribosyl transferase) in the pathway to salvage purine bases? [PRPP = 5-phosphoribosyl-1-pyrophosphate] [THF = tetrahydrofolate]

- A) PRPP + hypoxanthine \rightarrow IMP + PPi
- B) glutamine + bicarbonate \rightarrow glutamate + carbamoyl phosphate
- C) glutamine + PRPP \rightarrow glutamate + 5-phosphoribosyl 1-amine
- D) dUMP + N⁵, N¹⁰-methylene THF \rightarrow dTMP + dihydrofolate
- E) CDP + NADPH \rightarrow dCDP + NADP⁺

14. A nucleotide that is the direct substrate of thymidylate synthase. Please choose the best answer from the structures below:



- A) compound A B) compound B C) compound C D) compound D E) compound E

15. Which of the following statements is **false** in reference to the mammalian synthesis of urea?

- A) Krebs was a major contributor to the elucidation of the pathway involved.
- B) The amino acid arginine is the immediate precursor to urea.
- C) The process of urea production is an energy-yielding series of reactions.
- D) The precursor to one of the nitrogen of urea is aspartate.
- E) The carbon atom of urea is derived from mitochondrial HCO₃⁻

16. In mammals, each of the following occurs during the citric acid cycle **except**:

- A) formation of α -ketoglutarate.
- B) generation of NADH and FADH₂.
- C) metabolism of acetyl-CoA to carbon dioxide and water.
- D) net synthesis of oxaloacetate from acetyl-CoA.
- E) oxidation of acetyl-CoA.

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共 6 頁第 4 頁

17. What is the correct order of function of the following enzymes of β oxidation?

1. β -Hydroxyacyl-CoA dehydrogenase
 2. Thiolase
 3. Enoyl-CoA hydratase
 4. Acyl-CoA dehydrogenase
- A) 1, 2, 3, 4
B) 1, 4, 3, 2
C) 3, 1, 2, 4
D) 4, 2, 3, 1
E) 4, 3, 1, 2

18. Which of the following statements about the ratio “moles of ATP synthesized per half mole of oxygen consumed” for oxidative phosphorylation in mitochondria, is **false**?

- A) Uncoupling protein in brown fat can increase the value of the ratio.
B) Experimental measurements have often found ratios of between 2 and 3 when NADH is the electron donor.
C) This ratio is sometimes called the P/O
D) Uncertainty in the value of this ratio in living cells is one reason that ATP yield from complete oxidation of glucose is not known precisely.
E) The value of the ratio can be non-integral.

19. The term “nitrogen fixation” refers to:

- A) Rapid breathing during exercise.
B) The urea cycle.
C) Incorporation of nitrogen from the atmosphere into ammonia.
D) Delayed oxidation of the lactate produced during strenuous exercise.
E) Ribonucleotide reductase.

20. The de novo biosynthesis of purines derives two of the four carbons in the base ring structure from:

- A) N¹⁰-formyl-H₄ folate
B) Aspartic acid
C) Glutamine
D) Threonine
E) Carbamoyl phosphate

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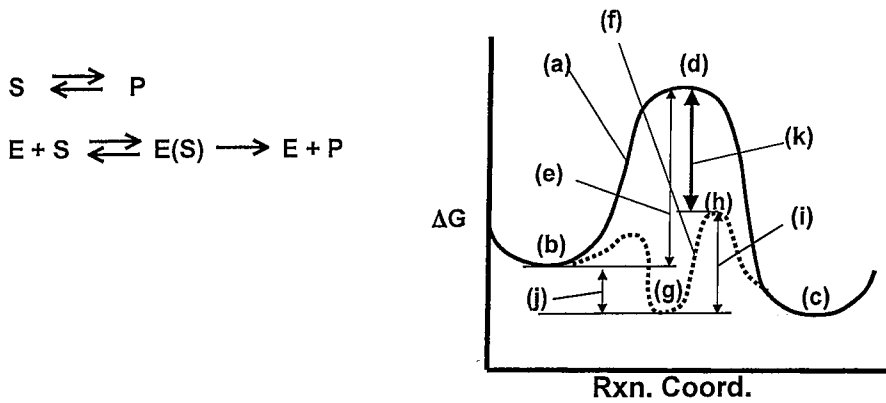
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共 6 頁第 5 頁

(二) 簡答與填充題: (40分, 共5大題)

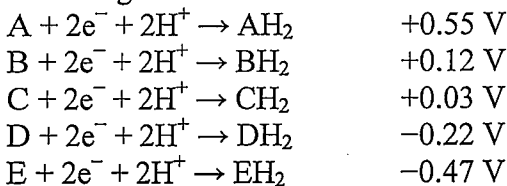
I. The free energy-reaction coordinate diagram shown below compares the following non-enzymatic reaction with the corresponding enzymatic reaction: (每小題1分, 共10分)



Identify elements (a)-(k) of the free energy diagram from the list given below:

- _____ (1) Energy well for the E(S) complex.
- _____ (2) Ground state energy well for reactants.
- _____ (3) Activation energy for the rate-limiting step of the enzyme-catalyzed reaction.
- _____ (4) Activation energy for the non-enzymatic reaction.
- _____ (5) Energy surface of lowest energy for the non-enzymatic reaction.
- _____ (6) Energy surface of the lowest energy pathway for the enzyme-catalyzed reaction.
- _____ (7) Transition state for the rate-limiting step of the enzyme-catalyzed reaction.
- _____ (8) Ground state energy well for products.
- _____ (9) Free energy change for the conversion of reactants to products.
- _____ (10) Transition state for the non-enzymatic reaction.

II. An unusual bacterium that has been shown to have a five-component electron transfer chain. The following reactions show the E_o' values for these five components:



The order of electron flow in this bacterium is : (please put in A, B, C, D, E) (每格 1 分, 共 5 分)

_____ → _____ → _____ → _____ → _____

III. Please briefly describe the terms:

- (a) Cori cycle (5 分)
- (b) Futile cycle (5 分)

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共 6 頁第 6 頁

IV. A peptide has the sequence Val-Cys-Thr-Ala-Lys-Asp-Pro-Gln-Ser-Tyr-Arg-Gly-His-Glu. and answer the following questions.

pK_R of amino acids: Asp (3.6); Arg (12.5); His (6.0); Glu (4.2); Lys (10.6); Tyr (10.1); Cys (8.2), α -COOH pK_a (3.8); α -NH₃⁺ pK_a (8.5).

(1) What is the net charge of the molecule at pH 3? _____ (1 分)

(2) Estimate the pI for this peptide. _____ (1 分)

(3) Please answer with the correct amino acid to the following questions (每格 1 分，共 3 分)

(a) What amino acid has an amide group? _____

(b) What amino acid absorbs UV light the most? _____

(c) What amino acid has a sulfhydryl side chain? _____

V. (1) Please explain what's the electron transfer chain (ETC). (5 分)

(2) Please draw a simple diagram of ETC including the major players and their functions. (5 分)

國立中山大學 107 學年度碩士暨碩士專班招生考試試題

科目名稱：分子生物學【生科系碩士班乙組】

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共 3 頁第 1 頁

問答申論題 (100%)

1. 請敘述細胞 DNA 複製時，所出現的 okazaki fragment 的原因? (10%)

2. 請描述細胞週期各時期及調控蛋白。(10%)

3. 請畫出細胞代謝中，Tricarboxylic acid (TCA) cycle。(10%)

背面有題

試題隨卷繳回

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共 3 頁 第 2 頁

4.請描述真核細胞和原核細胞的差別。(10%)

5.人類乳突病毒 (Human Papillomavirus, HPV) 16、18型如何造成子宮頸癌。(10%)

6.說明何謂The Meselson-Weigle 實驗?(10%)

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共 3 頁第 3 頁

7. 丹麥科學家革蘭發明Gram stain區分微生物種類，請敘述Gram stain之步驟及其原理。(10%)

8. 為何人類O型血，在緊急時可以輸血給其他不同血型的人？(10%)

9. 說明製作induced pluripotent stem cell (iPS) 的方法？(10%)

10. 說明Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR)/CRISPR-Associated Protein 9 (Cas9)的原理和應用。(10%)