

問答題：

1. Please explain how the photon energy can be absorbed and converted into chemical energy during light reaction of photosynthesis. (8 points)
2. In plant, the water potential determines the water flow direction of guard cells and affects the stomatal closure. Plant growth regulator, abscisic acid (ABA), plays a key role that affects the water potential of guard cells and stomatal closure. Please explain how ABA affects the water potential of guard cells and stomatal closure under drought stress. (7 points)
3. (10 points)
 - (a) Please explain photoperiod, long-day plant, short day plant and day-neutral plant.
 - (b) The continuous long night generally is important and affects floral transition of long-day plant and short-day plant. In continuous long night, a flash of white light, red light, or far-red light may cause significant and different influence on floral transition of long-day and short-day plants. Please predict the effects (promotion or inhibition) of the flash of white, red, or far-red light on floral transition of long-day plant and short-day plant, respectively.
4. Compare and contrast the characteristics of gene expression in prokaryotic and eukaryotic cells in term of the factors (cis or trans) involved, location and regulatory mechanism. (15 points)
5. Bicycle riding has become a very popular activity in recent years. Being a person jumping on the band wagon, you also take on the bicycle riding activity. In one hot and sunny summer morning you joined your group of friends for a bicycle ride. While waiting for the group member to arrive, someone challenged you for a 500-meter dashing strip race on the bicycle. After several rounds of strip racing, you finally took off on the long ride with your group of fair-weather friends.
 - (A) When you did the strip racing, a certain group of skeletal muscle fibers with specific metabolic and contraction characteristics were called up for this activity. What kind of metabolic and contraction features do they have? What about those muscle fibers that are less involved in the dashing race? What kind of metabolic and contraction features do they have? (8 points)

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- (B) After riding with your group for 90 minutes under the hot sun, you became very sweaty and thirsty. The group leader decided to take a break in front of a 7-Eleven. You went in the store and bought a liter-size beer to drink. One of the group members, a physician in sports medicine, strongly suggested that you do not drink that beer. Based on your knowledge in physiology, please explain his concern in details. (8 points)
- (C) Feeling arrogant and invincible, thinking that bad things will never happen to you, you ignored the physician's suggestion and finished that liter-size beer. Your group started riding again soon after. Thirty minutes later, you got the muscle cramp in both of your legs, then you blacked out, falling off your bike, and urinated yourself copiously. Luckily you did not hit your head on the way down. Please explain why you blacked out. Please give an explanation for your muscle cramp, and your copious urination. Were they related to your black out? If yes, why? If not, why not? (9 points)

解釋名詞

1. 此部份每小題 3 分共計 15 分
 - (a) Endosymbiosis
 - (b) Cambrian explosion
 - (c) Biological species concept (BSC)
 - (d) Mutualism
 - (e) Global warming
2. 此部份每小題 2 分共計 10 分
 - (f) microRNA
 - (g) totipotent stem cell
 - (h) Proteomics
 - (i) genomic imprinting
 - (j) telomerase

繪圖題：

1. 請繪圖比較無體腔、假體腔與真體腔動物的差異 (10 分)

Useful information:Gas constant, $R = 0.08206 \text{ L} \cdot \text{atm/K} \cdot \text{mol} = 8.3145 \text{ J/K} \cdot \text{mol}$ Atomic weight: $\text{H} = 1$; $\text{C} = 12$ $\text{Log } 2 = 0.301$; $\text{log } 3 = 0.477$; $\ln a = 2.303 \text{ log } a$; $e = 2.718$

一、單選題 (20 題；每題 2.5 分；共 50 分；答錯不倒扣分)

- The chemical formula of perchloric acid, chloric acid, chlorous acid, hypochlorous acid, and hydrochloric acid is
 - HClO , HClO_3 , HClO_2 , HClO_4 , and HCl , respectively.
 - HClO_4 , HCl , HClO_2 , HClO , and HClO_3 respectively.
 - HClO_3 , HClO_4 , HClO_2 , HClO , and HCl , respectively.
 - HClO_4 , HClO_3 , HClO_2 , HClO , and HCl , respectively.
 - HClO_4 , HClO_3 , HClO , HClO_2 , and HCl , respectively.
- What is the best answer to report for $(543 \times 0.0015) + 33.177$?
 - 33.985
 - 33.98
 - 33.9845
 - 34
 - 34.0
- A compound contains 77.4% C, 7.6% H, and 15.0% N; its molar mass is 93 g/mol. What is the molecular formula of the compound?
 - $\text{C}_5\text{H}_5\text{N}$
 - $\text{C}_6\text{H}_7\text{N}$
 - $\text{C}_4\text{H}_3\text{N}_3$
 - $\text{C}_5\text{H}_5\text{N}_2$
 - none of these
- The root mean square velocity of helium gas at 25°C is:
 - $1.36 \times 10^3 \text{ m/s}$
 - $1.35 \times 10^{-1} \text{ m/s}$
 - $3.95 \times 10^{-1} \text{ m/s}$
 - $3.92 \times 10^{-2} \text{ m/s}$
 - none of these
- Methane is a gaseous fuel with the enthalpy of combustion of -891 kJ/mol . How many grams of methane must be burned to raise 1.00 L water by 20.0°C if the process is 70.0% efficient? The specific heat capacity of water is $4.18 \text{ J}^\circ\text{C} \cdot \text{g}$. Assume the density of water is 1.00 g/cm^3 .
 - 3.00 g
 - 5.10 g
 - 1.05 g
 - 2.14 g
 - 1.50 g

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6. Which of the following atoms has the largest ionization energy?
- (A) O
 - (B) Li
 - (C) F
 - (D) B
 - (E) Ne
7. The formal charge for the central atom of PO_4^{3-} is:
- (A) 0
 - (B) 1
 - (C) 3
 - (D) 5
 - (E) 7
8. What is the bond order of H_2^- ?
- (A) 0
 - (B) 0.5
 - (C) 1
 - (D) 1.5
 - (E) 2
9. If an atom is placed in an octahedral hole of closest packed spheres, the atom is surrounded by _____ spheres?
- (A) 2
 - (B) 3
 - (C) 4
 - (D) 6
 - (E) 8
10. For each of the following solutions, would you expect it to be relatively ideal (with respect to Raoult's Law)?
- (A) Hexane (C_6H_{14}) and chloroform (CHCl_3)
 - (B) Ethyl alcohol ($\text{C}_2\text{H}_5\text{OH}$) and water
 - (C) Hexane (C_6H_{14}) and octane (C_8H_{18})
 - (D) Toluene (C_7H_8) and tetrahydrofuran ($\text{C}_4\text{H}_8\text{O}$)
 - (E) Ethyl acetate ($\text{C}_4\text{H}_8\text{O}_2$) and propionic acid ($\text{C}_3\text{H}_6\text{O}_2$)
11. At a particular temperature, N_2O_5 decomposes according to a first-order rate law with a half-life of 3.0 s. If the initial concentration of N_2O_5 is 1.0×10^{16} molecules/ cm^3 , what will be the concentration in molecules/ cm^3 after 20.0 s?
- (A) 9.9×10^{13}
 - (B) 3.4×10^{18}
 - (C) 1.0×10^{16}
 - (D) 1.8×10^{14}
 - (E) 2.3×10^{-1}

12. At a certain temperature, $K = 4.0 \times 10^{-6}$ for the reaction: $\text{N}_2\text{O}_4(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g})$
If 2.0 mol N_2O_4 is initially placed in a 5.0 L vessel, the equilibrium pressure of NO_2 is
(A) 1.0×10^{-3}
(B) 2.0×10^{-3}
(C) 3.0×10^{-3}
(D) 1.5×10^{-2}
(E) none of these
13. The pH of 0.01 M H_2SO_4 aqueous solution is _____. (K_a for HSO_4^- is 1.2×10^{-2})
(A) 1.00
(B) 2.00
(C) 1.84
(D) 2.14
(E) 3.01
14. The pH for the equivalence point of a weak acid-strong base titration is _____.
(A) > 7
(B) < 7
(C) $= 7$
(D) ≤ 7
(E) none of these
15. Na_3PO_4 is added slowly to a solution that is 0.010 M in Ag^+ , Sr^{2+} , Ca^{2+} , Ba^{2+} and Pb^{2+} .
The K_{sp} values for the phosphate salts are 1.8×10^{-18} , 1×10^{-31} , 1.3×10^{-32} , 6×10^{-39} , and 1×10^{-54} , respectively. Which compound will precipitate first?
(A) Ag_3PO_4
(B) $\text{Sr}_3(\text{PO}_4)_2$
(C) $\text{Ca}_3(\text{PO}_4)_2$
(D) $\text{Ba}_3(\text{PO}_4)_2$
(E) $\text{Pb}_3(\text{PO}_4)_2$
16. Which of the following is true for endothermic processes?
(A) $\Delta S_{\text{surr}} < 0$
(B) $\Delta S_{\text{surr}} = -\Delta H/T$
(C) $\Delta S_{\text{surr}} = 0$
(D) $\Delta S_{\text{surr}} > 0$
(E) two of these
17. Which of the following is used to etch SiO_2 in the semiconductor industry?
(A) HF
(B) HCl
(C) HBr
(D) H_2SO_4
(E) HNO_3

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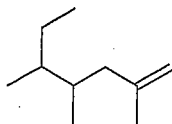
18. Which of the following is bidentate?

- (A) SCN^-
- (B) OH^-
- (C) EDTA
- (D) $\text{H}_2\text{NC}_2\text{H}_4\text{NH}_2$
- (E) H_2O

19. Crosslinked polymers cannot be dissolved in solvent because of its _____.

- (A) high molecular weight
- (B) network structure
- (C) high melting point
- (D) high lattice energy
- (E) none of these

20. The IUPAC of the following structure is _____.



- (A) 2-Ethyl-3,5-dimethylhex-5-ene
- (B) 3,4,6-Trimethylhept-6-ene
- (C) 2,3,5-Trimethylheptene
- (D) 2,4-dimethyl-5-ethylhexene
- (E) 5-Ethyl-2,4-dimethylhexene

二、簡答題 (5 大題; 每題 10 分; 共 50 分)

1. Write Lewis structures that obey the octet rule (duet rule for H) for NH_3 , O_2 , O_3 , HCN , and CO_2 . (10 分)

2. Draw molecular orbital energy-level diagrams to explain the bond strength of the following diatomic molecules. Would they be expected to weaken or strengthen as an electron is removed?

(A) B_2 (2 分); (B) H_2 (2 分); (C) He_2 (2 分); (D) OF (2 分); (E) F_2 (2 分)

3. A student needs to prepare a buffer solution using acetic acid, CH_3COOH , and sodium acetate, CH_3COONa . Calculate the ratio $\text{CH}_3\text{COONa}/\text{CH}_3\text{COOH}$ required to yield a pH of 5.0. (For acetic acid, $K_a = 1.8 \times 10^{-5}$) (10 分)

4. Calculate ΔG° for the weak acid, HF , at 25°C . ($K_a = 7.18 \times 10^{-4}$) (10 分%)

5. The line notation for a galvanic cell is



Calculate the cell potential. (10 分)

