

- I. 選擇題（共 84 分，每題 4 分，單選與多選混合，每題答案可能為一至多個，全部選項正確始得題分 4 分，答錯不倒扣）請於試卷內之「非選擇題作答區」標明題號依序作答。

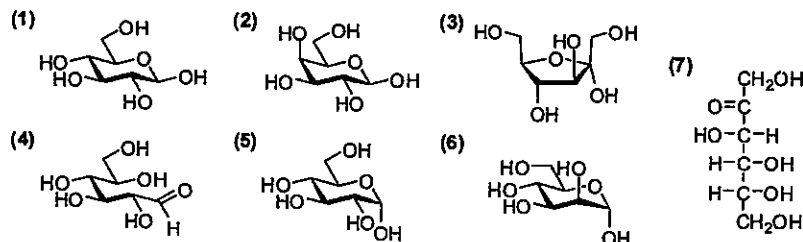
1. Which of the following statement(s) is or are *not* SI unit?

(A) Kilogram (B) Mole (C) Liter (D) Kelvin

2. Calculate the density of a material if 3.00×10^2 g occupies a volume of 4.63 cm^3 .

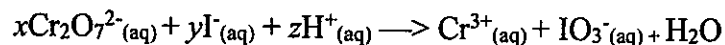
(A) 64.7 g/cm^3 (B) 64.8 g/cm^3 (C) 64.79 g/cm^3 (D) 64.80 g/cm^3

3. Seven different structures of carbohydrate $\text{C}_6\text{H}_{12}\text{O}_6$ are shown below. Which of the following statement(s) is or are correct?



- a. (1) and (2) are stereoisomers
 b. (5) and (6) are enantiomers
 c. (1) and (5) are diastereomers
 d. (3) and (7) are constitutional (structural) isomers
 e. (5) is the cyclic form of (7)
 f. In aqueous solution, (1) and (5) can be interchangeable through (4)

4. What is sum of x , y , and z in the following balanced reaction?



(A) 3 (B) 7 (C) 10 (D) 12

5. Which of the following statement about the name of HNO_2 , H_2SO_3 , and HClO_3 is correct?

- (A) HNO_2 : nitric acid, H_2SO_3 : sulfurous acid, HClO_3 : chlorous acid
 (B) HNO_2 : nitrous acid, H_2SO_3 : sulfurous acid, HClO_3 : chloric acid
 (C) HNO_2 : nitric acid, H_2SO_3 : sulfuric acid, HClO_3 : hypochlorous acid
 (D) HNO_2 : nitrous acid, H_2SO_3 : sulfuric acid, HClO_3 : chloric acid

6. Which of the following ion with a charge of 2?

(A) phosphate ion (B) chromate ion (C) sulfate ion (D) cyanide ion

7. Which of the following statement about orbital energy is correct?

- (A) In Na atom, the energy level: $2s < 2d$
 (B) In H atom, the energy level: $3s < 3d$

(C) In Mn atom, the energy level: $3d < 4s$

(D) In F atom, the energy level: $3s < 3d$

8. Which of the following molecule(s) is or are polar?

(A) CO_2 (B) SO_2 (C) BF_3 (D) BeCl_2

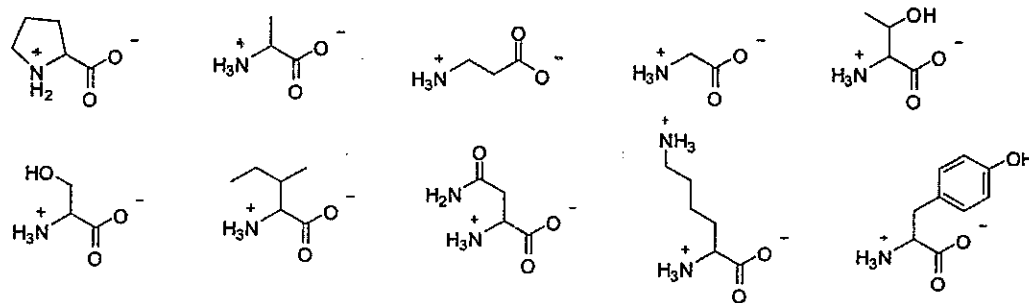
9. To consider about the periodic properties of the elements, which of the following statement(s) about radius is or are correct?

(A) $\text{Ne} > \text{Ar} > \text{Kr} > \text{Xe}$ (B) $\text{P} > \text{S} > \text{Cl} > \text{Ar}$ (C) $\text{Be} > \text{Mg} > \text{Ca} > \text{Sr}$ (D) $\text{Br} > \text{Se} > \text{As} > \text{Ge}$

10. Which of the following statement(s) about first ionization energy is or are *not* correct?

(A) $\text{N} > \text{C} > \text{B}$ (B) $\text{Si} > \text{Al} > \text{Mg}$ (C) $\text{Ne} > \text{F} > \text{O}$ (D) $\text{Cl} > \text{S} > \text{P}$

11. Amino acids are important biomolecules and/or building blocks for proteins. Ten of them are shown below. In these ten molecules, which of the following statement(s) is or are correct?



- There are six amino acids containing only one stereo carbon center
- There are two amino acids containing primary alcohol
- There is only one amino acid containing aromatic ring
- Eight amino acids are not "superimposable" on their mirror images (superimposable means "identical")
- All ten amino acids are commonly used in proteins

12. Which of the following biological process DOES NOT involve hydrogen bonding?

- (A) DNA base pairing (B) lipid bilayer formation (C) cellulose fiber formation (D) α -helix formation
(E) substrate binding in enzymes

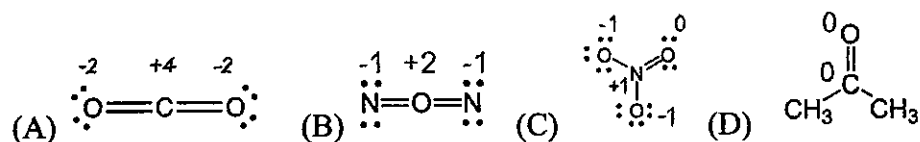
13. Which of the following statement(s) about covalent bonding is or are correct?

- (A) Electrons are shared between atoms of nonmetals to form stable compounds.
(B) The fact that the boiling point of HF is higher than that of HCl is due to the formation of covalent bonding
(C) Electrons are completely transferred from metal to nonmetal atom, and the resulting charged atoms are held together by electrostatic attractions.
(D) Molecules that have permanent dipoles are attracted to each other.

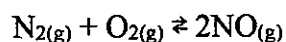
14. VSEPR theory is commonly employed to predict the shapes of molecules, which of the following prediction(s) in shape is or are correct?

- (A) N_2O : linear (B) SH_4 : seesaw (C) PCl_4^+ : tetrahedral (D) PF_3 : pyramidal

15. Which of following statement(s) about formal charge is or are correct?



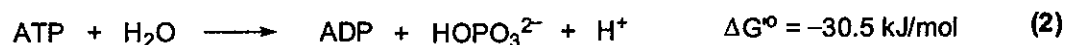
16. Consider the following equilibrium for which $\Delta H > 0$



Which of the following statement(s) is or are correct?

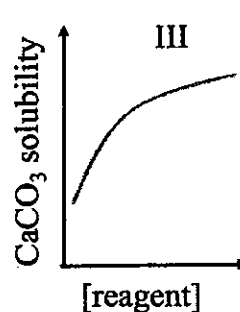
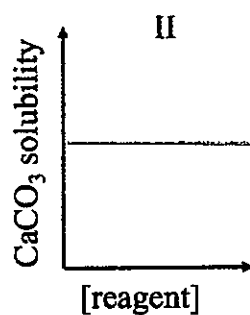
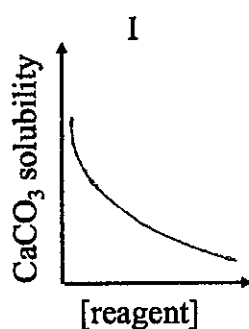
- (A) A catalyst is added to the mixture, the equilibrium shifts to the right
- (B) The reaction mixture is heated, the equilibrium shifts to the right
- (C) The volume of the reaction vessel is doubled, the equilibrium shifts to the left
- (D) $\text{O}_2(\text{g})$ is added to the system, the equilibrium shifts to the right

17. Glucose and ATP are both abundant in cells. Considering the following reactions, which of the following statement is correct?



- (A) Reaction (1) is a spontaneous process; therefore, it can produce free energy to power cellular functions
- (B) Reaction (2) is a spontaneous process; therefore, when ATP contacts with water, it hydrolyzes right away.
- (C) Reaction (3) is a spontaneous process; therefore, no enzyme is needed
- (D) Reaction (3) is a non-spontaneous process; therefore, enzyme is necessary to drive the reaction
- (E) Reaction (2) and (3) are pH-dependant, it can release more free energy in basic condition

18. The following graphs represent the behavior of CaCO_3 under different circumstances.

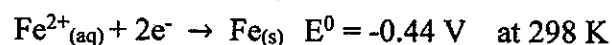
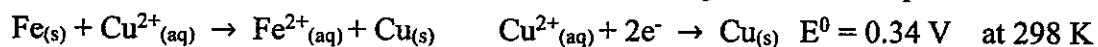


(a) Which graph represents what happens to the solubility of CaCO_3 as HNO_3 is added?

(b) Which graph represents what happens to the solubility of CaCO_3 as NaNO_3 is added?

(A) a: I, b: II (B) a: III, b: II (C) a: III, b: I (D) a: II, b: III

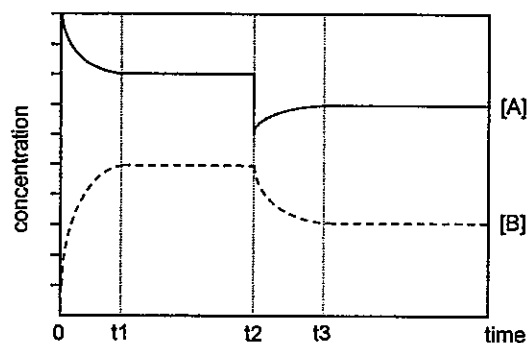
19. A voltaic cell is constructed that uses the following reaction and operates at 298 K:



What is the emf of this cell when $[\text{Cu}^{2+}] = 3.00 \text{ M}$ and $[\text{Fe}^{2+}] = 0.10 \text{ M}$?

(A) 0.80 V (B) 0.78 V (C) 0.76 V (D) 0.74 V

The compound **A** can react to form **B** in aqueous solution at 298K. Its reaction mechanism is not completely understood. However, scientists can observe a stable but short-lived intermediate **C** during the reaction. The time course was studied and shown below:



20. Which of the following statement(s) is or are correct?

- The reaction equation is $\text{A} \rightarrow 2\text{B}$
- The forward reaction rate, $\text{Rate}_f = k_f [\text{A}]$
- The conversion from **A** to **B** is an elementary reaction
- The reaction should be faster at 323K
- C** is the transition state of the reaction.

21. Which of the following statement(s) is or are correct?

- At time interval (0 to t_1), the forward reaction is faster than the backward one.
- At time interval (t_1 to t_2), the reaction is at equilibrium.
- At time point t_2 , the reactant was added into the reaction mixture.
- At time interval (t_2 to t_3), the reaction quotient (Q) is greater than the equilibrium constant (K).
- After time point t_3 , the reaction reaches equilibrium and stops.

II. 非選擇題(共 16 分)

1. Draw molecular orbital of the following diatomic molecules:

(A) B_2 (B) C_2 (C) N_2 (6 分)

2. Bond order of O_2^+ , O_2 , and O_2^- . (3 分)

3. Draw valid Lewis structures of following molecules:

(A) NO_3^- (B) ICl_4^- (4 分)

(C) NCS^- (three possible structures), which one is the dominant structure? (3 分)

試題隨卷繳回