一、 選擇題: (45 %; 每題 3 分)

1. Which is the correct formula for copper(I) sulfide?
   A) CuS ; B) Cu_2S; C) CuS_2 ; D) Cu_2S_2 ; E) none of these.

2. The mass percent of iron in an iron oxide is 77.7%. Find the empirical formula.
   A) Fe_3O_2; B) Fe_3O_4; C) Fe_2O_3; D) FeO; E) none of these. (Fe: 55.85 g/mol)

3. Which of the following is not an oxidation-reduction reaction?
   A) A precipitation reaction. ; B) A reaction in which a metal reacts with a nonmetal. C) A combustion reaction.; D) A metal reacting with an acid. E) All of the above are oxidation-reduction reactions.

4. Which statement about kinetic energy (K.E.) of an ideal gas is true?
   A) All objects moving with the same velocity have the same K.E. B) As the velocity of a body increases, its K.E. decreases. C) The K.E. of a body will double it its velocity doubles. D) The K.E. of a body is independent of its mass. E) none of these

5. Samples of the gases $H_2(g)$ and $SO_2(g)$ have equal masses and are at the same temperature and pressure. Calculate the ratio of the root mean square velocities V_{H2}/V_{SO2}: A) 1.0 ; B) 0.18; C) 32; D) 5.6; D) 180. (S: 32 g/mol)

6. If, at a given temperature, the equilibrium constant for the reaction
   $H_2(g) + Cl_2(g) \rightleftharpoons 2HCl(g)$ is K_p,
   then the equilibrium constant for the reaction
   $HCl(g) \rightleftharpoons 1/2\ H_2(g) + 1/2\ Cl_2(g)$ can be represented as:
   A)$1K_p^2$; B) K_p^2; C) $1/\sqrt{K_p}$; D) $\sqrt{K_p}$; E) none of these

7. For the reaction: $PCl_5(g) \longrightarrow PCl_3(g) + Cl_2(g)$; $\Delta H = -89$ kJ.
   Which of the following statements is true?
   A) Increasing the temperature of a system at equilibrium always increases the amount of product.; B) Increasing the temperature of a system at equilibrium always decreases the amount of product.; C) Increasing the temperature of a system at equilibrium changes the value of the equilibrium constant.; D) Changing the temperature of a system at equilibrium does not affect the equilibrium position.; E) none of the above.

8. If at 0 °C, the ion-product constant of water, K_w, is 1.2×10^{-15}. What is the pH of pure water at 0 °C ?
   A) 7.00; B) 6.88; C) 7.56; D) 7.46; E) none of these.

9. An indicator HIn has a $K_a = 1 \times 10^{-8}$. At pH = 6.0, what is the ratio HIn/In^-?
   A) 1/1; B) 100/1; C) 1/100; D) 1/1; E) none of these

10. Which of the following are state functions?
    A) work, heat; B) work, heat, enthalpy, energy; C) enthalpy, energy; D) work, heat, enthalpy; E) heat, enthalpy, energy

(背面仍有題目,請繼續作答)

11. An ideal gas expands isothermally and irreversibly work(w) is:
A) less than zero. B) equal to zero. C) greater than zero. D) More information is needed.

12. An ideal gas expands isothermally and irreversibly; ΔS_{surr} is:
A) less than zero. B) equal to zero. C) greater than zero. D) More information is needed.

13. Consider an electrochemical cell with a copper electrode immersed in 1.0 M Cu^{2+} and a silver electrode immersed in 1.0 M Ag^{+}.
$Cu^{2+} + 2e^{-} \longrightarrow Cu$; $E^{0} = 0.34$ V ; $Ag^{+} + e^{-} \longrightarrow Ag$; $E^{0} = 0.80$ V
Calculate E for this cell
A) 1.48 V; B) 1.26 V; C) 1.14 V; D) 0.46 V; E) none of these.

14. As above; If $[Cu^{2+}]_0$ is 0.0010 M and $[Ag^{+}]_0$ is 0.10 M, calculate E.
A) 0.40 V; B) 0.43 V; C) 0.49 V; D) 0.52 V; E) none of these

15. Calculate ΔE for a system that release 28 J of heat and while 63 J of work is done on it. A) 35 J; B) 91 J; C) –35 J; D) –91 J; E) none of the above.

二、 問答與計算題: (計算題需寫過程否則不予計分)

1. (a). Write down the Bragg equation. (3 %)
(b). Illustrate four intermolecular interactions. (4 %)

2. (a). Write down the Heisenberg uncertainty principle. (3 %)
(b). How many electrons in an atom have the quantum numbers $n = 3$, $l = 2$? (3 %)
(c). How many electrons can be contained in all of the orbitals with n = 4? (3%)

3. (a). Please draw the molecular orbital energy-level diagram for the B_2 molecule.
(b). Is the B_2 molecule antimagnetic or paramagnetic? (9 %)

4. (a). Derive the integrated rate law of the second-order reaction. (5 %)
(b). What is the Arrhenius equation? (3 %)
(c). For a first-order reaction with $t_{1/2}$ = 1.0 day, How long will it takes for the reactant concentration to decrease to 12.5 % of its initial value? (4 %)

5. A solution of 20.0 g of urea and 125 g of water at 25 °C has a vapor pressure of 22.67 torr. Vapor pressure of pure water = 23.76 torr. Calculate the molecular weight of urea. (6 %)

6. (a). What number of possible sequences exists for a polypeptide composed of 16 different amino acids? (3 %)
(b). Illustrate one example of the condensation polymers. (3 %)

7. Draw the crystal field diagram for $Co(CN)_6^{4-}$ complex ion, where CN^- is a strong field ligand. Is the $Co(CN)_6^{4-}$ complex ion paramagnetic or antimagnetic? (6 %)