

本試題是否可以使用計算機：可使用，不可使用（請命題老師勾選）

考試日期：0301，節次：2

一、選擇題：(45 %; 每題 3 分)

- Which is the correct formula for copper(I) sulfide?
A) CuS ; B) Cu₂S; C) CuS₂ ; D) Cu₂S₂ ; E) none of these.
- The mass percent of iron in an iron oxide is 77.7%. Find the empirical formula.
A) Fe₃O₂; B) Fe₃O₄; C) Fe₂O₃; D) FeO; E) none of these. (Fe: 55.85 g/mol)
- 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.
- 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 if its velocity doubles. D) The K.E. of a body is independent of its mass. E) none of these
- Samples of the gases H₂(g) and SO₂(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; E) 180. (S: 32 g/mol)
- If, at a given temperature, the equilibrium constant for the reaction

$$\text{H}_2(\text{g}) + \text{Cl}_2(\text{g}) \rightleftharpoons 2\text{HCl}(\text{g})$$
is K_p , then the equilibrium constant for the reaction

$$\text{HCl}(\text{g}) \rightleftharpoons \frac{1}{2} \text{H}_2(\text{g}) + \frac{1}{2} \text{Cl}_2(\text{g})$$
can be represented as:
A) $1/K_p^2$; B) K_p^2 ; C) $1/\sqrt{K_p}$; D) $\sqrt{K_p}$; E) none of these
- For the reaction: $\text{PCl}_5(\text{g}) \longrightarrow \text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g})$; $\Delta H = -89 \text{ kJ}$.
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.
- 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.
- 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
- 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)

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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^+ .
 $\text{Cu}^{2+} + 2e^- \longrightarrow \text{Cu}$; $E^\circ = 0.34 \text{ V}$; $\text{Ag}^+ + e^- \longrightarrow \text{Ag}$; $E^\circ = 0.80 \text{ V}$
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 $[\text{Cu}^{2+}]_0$ is 0.0010 M and $[\text{Ag}^+]_0$ 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)

- (a). Write down the Bragg equation. (3 %)
(b). Illustrate four intermolecular interactions. (4 %)
- (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 %)
- (a). Please draw the molecular orbital energy-level diagram for the B_2 molecule.
(b). Is the B_2 molecule antimagnetic or paramagnetic? (9 %)
- (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 %)
- 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 %)
- (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 %)
- Draw the crystal field diagram for $\text{Co}(\text{CN})_6^{4-}$ complex ion, where CN^- is a strong field ligand. Is the $\text{Co}(\text{CN})_6^{4-}$ complex ion paramagnetic or antimagnetic? (6 %)