

高雄醫學大學 114 學年度學生轉系考試【普通化學】試題

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- 一、「選擇題」請以答案卡劃卡作答，限用黑色2B軟心鉛筆劃記於答案卡上，劃線要粗黑、清晰，不可出格，答案卡不得折損，修正作答請以軟性橡皮擦擦拭乾淨，且不得使用修正液（帶）修正，未遵照正確作答方法而致無法判讀者，考生自行負責，不得提出異議。
- 二、考生應在答案卡上規定範圍內作答，且不得書寫任何與答案無關之文字、符號，違者該科不予計分。
- 三、答案卡每人各一張，不得要求增補；試題與答案卡必須繳回，不得攜出試場。

*可使用工程型計算機

Multiple Choice, choosing the one alternative that best completes the statement or answers the question (4 points each).

1. The density of osmium (the densest metal) is 22.57 g/cm^3 . If a 1.00-kg rectangular block of osmium has two dimensions of $4.00 \text{ cm} \times 4.0 \text{ cm}$, the third dimension of the block is _____ cm.
(A) 2 (B) 2.2 (C) 2.77 (D) 2.8 (E) 3
2. Which one of the following statements is **incorrect**?
(A) Lead(IV) carbonate has its formulas of $\text{Pb}(\text{CO}_3)_2$.
(B) The systematic name for NaH_2PO_4 is sodium dihydrogen phosphate.
(C) A possible name for CuBr_2 is cuprous bromide.
(D) The systematic name for AsF_5 is arsenic pentafluoride.
(E) The systematic name for TO_3^{2-} is tellurite.
3. Consider the reaction of 19.0 g of zinc with excess silver nitrate to produce silver metal and zinc nitrate. The reaction is stopped before all the zinc metal has reacted and 29.0 g of solid metal is present. The mass percentage of silver in the 29.0-g mixture is _____ %.
(A) 50.3 (B) 61.0 (C) 27.6 (D) 49.7 (E) 72.4
4. You are given an unknown gaseous binary compound, a compound consisting of two different elements. When 10.0 g of the compound is burned in excess oxygen, 16.3 g of water is produced. The compound has a density 1.38 times that of oxygen gas at the same conditions of temperature and pressure. The possible identity of the unknown compound is _____.
(A) C_3H_8 (B) BH_3 (C) HF (D) HCl (E) PH_3
5. Nitrogen content of organic compounds can be determined by the Dumas method. The compound in question is first reacted by passage over hot CuO(s) :
$$\text{Compound} \xrightarrow[\text{CuO(s)}]{\text{Hot}} \text{N}_2(\text{g}) + \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{g})$$

The product gas is then passed through a concentrated solution of KOH to remove the CO_2 and to leave the remaining gas containing N_2 saturated with water vapor. In a given experiment a 0.253-g sample of a compound produced 31.8 mL N_2 saturated with water vapor at 25°C and 726 torr. The vapor pressure of water at 25°C is 23.8 torr. The mass percent of nitrogen in the compound is thus _____.
(A) 13.3 (B) 0.9 (C) 81.4 (D) 75.1 (E) 46.5
6. A balloon filled with 39.1 moles of helium gas has a volume of 876 L at 0.0°C and 1.00 atm pressure. The temperature of the balloon is increased to 38.0°C as it expands to a volume of 998 L while the pressure remaining constant. The ΔE for the helium in the balloon after the expansion is _____ kJ. The molar heat capacity for helium gas is $20.8 \text{ J}^\circ\text{C} \cdot \text{mol}$.
(A) 18.5 (B) -43.2 (C) -18.5 (D) 30.9 (E) 43.2

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7. The maximum wavelength of light capable of removing an electron for a hydrogen atom from the energy state characterized by $n = 2$ is _____ nm.
(A) 4053 (B) 95.00 (C) 410.4 (D) 364.8 (E) 91.20
8. Which of the following statements is **true**?
(A) An orbital is the same as a Bohr orbit.
(B) The hydrogen atom doesn't have quantized energy levels.
(C) The 2s orbital in the hydrogen atom is larger than the 3s orbital also in the hydrogen atom.
(D) The Bohr model of the hydrogen atom has been found to be correct.
(E) The third energy level has three sublevels, the *s*, *p*, and *d* sublevels.
9. Which one of the following ions has a noble gas electron configuration?
(A) Ti^+ (B) Fe^{2+} (C) Co^{3+} (D) Sc^{3+} (E) Mn^{2+}
10. Which of the following statements is **true**?
(A) The ranking order of increasing electronegativity for the following element is $[\text{Ar}]4s^13d^5 < [\text{Ar}]4s^23d^{10}4p^3 < [\text{Ne}]3s^23p^3 < [\text{Ne}]3s^23p^5$.
(B) The order of decreasing size for the following ions is $\text{Ca}^{2+} > \text{K}^+ > \text{Cl}^-$.
(C) The compound AsF_3 exhibits resonance.
(D) SeCl_4 is a nonpolar compound with a tetrahedron structure.
(E) KrF_4 is a polar compound with a see-saw structure.
11. Which of the following statements is **true**?
(A) The order of decreasing bond length for the following ions is $\text{B}_2^- > \text{B}_2 > \text{B}_2^+$.
(B) XeCl_2 exhibits dsp^3 hybridization by the central atom, and is a linear and nonpolar molecule.
(C) One of the sulfur-oxygen bonds in SO_2 is longer than the other(s).
(D) SeO_2 exhibits sp^3 hybridization by the central atom.
(E) ICl_5 exhibits at least one bond angle that is approximately 120° .
12. A mineral called spinel contains 37.9% aluminum, 17.1% magnesium, and 45.0% oxygen, by mass, and has a density 3.57 g/mL. The edge of the cubic unit cell is measured to be 809 pm. The unit cell thus has _____ aluminum ions.
(A) 8 (B) 2 (C) 32 (D) 4 (E) 16
13. If the human eye has an osmotic pressure of 8.00 atm at 25°C , the concentration of solution particles in water will be _____ mmol/L in order to provide an isotonic eyedrop solution, a solution with equal osmotic pressure.
(A) 620 (B) 4,110 (C) 0.33 (D) 327 (E) 79
14. For the reaction $\text{SO}_2\text{Cl}_2(g) \rightarrow \text{SO}_2(g) + \text{Cl}_2(g)$, sulfuryl chloride undergoes first-order decomposition at 320°C with a half-life of 8.75 h. If the initial pressure of $\text{SO}_2\text{Cl}_2(g)$ is 791 torr and the decomposition occurs in a 1.25-L container, the molecules of $\text{SO}_2\text{Cl}_2(g)$ after 12.5 h of the reaction is _____.
(A) 1.6×10^{20} (B) 8.7×10^{20} (C) 1.57×10^{21} (D) 2.9×10^{21} (E) 5.99×10^{21}
15. A sample has 83.00% of the oxygen molecules dissociating to atomic oxygen at 5000 K and 1.000 atm. The pressure to give 95% dissociation of the molecules at the same temperature is _____ atm.
(A) 0.37 (B) 0.89 (C) 0.24 (D) 0.50 (E) 0.46

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16. The pH of a 1.0×10^{-7} -M solution of NaOH in water is _____.
 (A) 7.7 (B) 6.3 (C) 7.0 (D) 6.8 (E) 7.2
17. Please recognize one of the following groups that **correctly** places the species in order of increasing acid strength.
 (A) $\text{HIO}_3 < \text{HBrO}_3$
 (B) $\text{HONH}_3^+ < \text{NH}_4^+$
 (C) $\text{PH}_4^+ < \text{NH}_4^+$ (bond energies: N-H, 391 kJ/mol; P-H, 322 kJ/mol)
 (D) $\text{H}_3\text{PO}_4 < \text{H}_3\text{PO}_3$
 (E) $\text{F}_3\text{CCO}_2\text{H} < \text{F}_2\text{CHCO}_2\text{H} < \text{FCH}_2\text{CO}_2\text{H} < \text{CH}_3\text{CO}_2\text{H}$
18. Phosphate buffers are important in regulating the pH of intracellular fluids at pH between 7.1 and 7.2. What is the concentration ratio of H_2PO_4^- to HPO_4^{2-} in intracellular fluid at pH = 7.15? The stepwise dissociation constants of phosphoric acids are: $K_{a1}, 7.5 \times 10^{-3}$; $K_{a2}, 6.2 \times 10^{-8}$; $K_{a3}, 4.8 \times 10^{-13}$.
 (A) 2. (B) 3. (C) 0.25. (D) 0.5. (E) 1.
19. A solution saturated with a salt of the type M_3X_2 has an osmotic pressure of 2.64×10^{-2} atm at 25°C . Assuming ideal behavior of the salt, the K_{sp} value for the salt is _____.
 (A) 5.60×10^{-5} (B) 1.4×10^{-11} (C) 5.08×10^{-17}
 (D) 1.0×10^{-30} (E) 5.8×10^{-27}
20. For the equilibrium $\text{A(g)} + 2\text{B(g)} \rightleftharpoons \text{C(g)}$ the initial concentrations are $P_A = P_B = P_C = 0.100$ atm. Once equilibrium has been established, it is found that $P_C = 0.040$ atm. The ΔG° value for this reaction at 25°C is _____ kJ/mol.
 (A) 74.4 (B) 4.1 (C) -14 (D) -4.1 (E) -74.4
21. Which one of the following statements **correctly** describes the process when liquid water at 25°C is introduced into an evacuated and insulated vessel?
 (A) ΔH is negative. (B) ΔS is negative. (C) ΔT_{water} will be positive.
 (D) ΔS_{surr} is negative. (E) ΔS_{univ} is positive.
22. What mass of potassium metal is produced when molten KF is electrolyzed by current of 10.0 A for two hours?
 (A) 25 g (B) 16 g (C) 4.9 g (D) 29.2 g (E) 71 g
23. The following radioactive decay ${}^{68}_{31}\text{Ga} + {}^0_{-1}\text{e} \rightarrow {}^{68}_{30}\text{Zn}$ is a nuclear reaction of _____.
 (A) β particle production (B) γ ray production (C) positron production
 (D) electron capture (E) α particle production
24. Consider the following data: $\text{Co}^{3+} + \text{e}^- \rightarrow \text{Co}^{2+}$, $E^\circ = 1.82$ V; $\text{Co}^{2+} + 3\text{en} \rightarrow \text{Co(en)}_3^{2+}$, $K = 1.5 \times 10^{12}$; $\text{Co}^{3+} + 3\text{en} \rightarrow \text{Co(en)}_3^{3+}$, $K = 2.0 \times 10^{47}$ where en = ethylenediamine. The E° for the half reaction $\text{Co(en)}_3^{3+} + \text{e}^- \rightarrow \text{Co(en)}_3^{2+}$ is _____ V.
 (A) -0.26 (B) 0.66 (C) 2.71 (D) 1.56 (E) -0.97
25. When heat is added to proteins, the hydrogen bonding in the secondary structure is disrupted. Which of the followings gives the correct algebraic signs of ΔH and ΔS for the denaturation process?
 (A) $\Delta H = -$ and $\Delta S = -$ (B) $\Delta H = +$ and $\Delta S = +$ (C) $\Delta H = +$ and $\Delta S = -$
 (D) $\Delta H = -$ and $\Delta S = +$ (E) None of these