臺灣綜合大學系統 112 學年度學士班轉學生聯合招生考試試題

共同考科 類組代碼 普通化學A 科目名稱 E0017 科目碼 本科試題共計 3 頁 ※本項考試依簡章規定所有考科均「不可」使用計算機。

一、單選題 (80 %,每題 2.5 分,不到扣) 請於答案卡上作答,否則不予計分。

1. When 3.0 L of oxygen gas (O2) reacts with 1.5 L of nitrogen gas (N2), 3.0 L of gaseous product is formed. All volumes of gases are measured at the same temperature and pressure.

What is the formula of the product?

- (A) NO4 ; (B) NO2 ; (C) N2O3 ; (D) N2O ; (E) NO.
- 2. What is the correct formula for manganese (IV) oxide?
 - (A) MnO_4 ; (B) MnO_3 ; (C) Mg_2O_3 ; (D) MnO_2 ; (E) MgO.
- 3. The empirical formula of styrene is CH; its molar mass is 78.1. What is the molecular formula of styrene?
 - $(A) \; C_{6}H_{6} \; ; \\ (B) \; C_{8}H_{8} \; ; \\ (C) \; C_{10}H_{22} \; ; \\ (D) \; C_{12}H_{6} \; ; \\ (E) \; C_{14}H_{14}.$
- 4. When the equation NH₃ + O₂ \rightarrow NO + H₂O is balanced with the smallest set of integers, the sum of the coefficients is:
 - (A) 4; (B) 12; (C) 14; (D) 19; (E) 24.
- 5. In the following reaction, which species is the reducing agent?

$$3\text{Cu} + 6\text{H}^+ + 2\text{HNO}_3 \rightarrow 3\text{Cu}^{2+} + 2\text{NO} + 4\text{H}_2\text{O}$$

- (A) H^+ ; (B) N in NO; (C) Cu; (D) Cu^{2+} ; (E) N in HNO₃.
- 6. How much water must be added to 20.0 mL of a 9.60 M sulfuric acid solution to make a 0.480 M solution? (Assume volumes are additive.)
 - (A) 400 mL; (B) 200 mL; (C) 180 mL; (D) 380 mL; (E) none of these .
- 7. Consider three 1-L flasks at the same temperature and pressure. Flask A contains CO gas, flask B contains N2 gas, and flask C contains O2 gas. Which contains the lowest density?
 - (A) flask A; (B) flask B; (C) flask C; (\bar{D}) Two of the flasks contain gases at the same density.
 - (E) All are the same.
- 8. Calculate the following ratio of effusion rate at T_1 / Effusion rate at T_2 for a gas at Kelvin temperatures T_1 and T_2 where $T_2 = 2T_1$.
 - (A) 0.5; (B) 2.0; (C) 1.0; (D) $1/\sqrt{2}$; (E) $\sqrt{2}$
- 9. Calculate the temperature at which the average kinetic energy of O2 gas is twice that of He gas at 10.0°C.
 - (A) 293°C; (B) 20°C; (C) 2.5°C; (D) 40°C; (E) 859°C
- 10. The reduction potentials for Au^{3+} and Ni^{2+} are as follows: (Hint: 96500 x 1.73 = 167,000)

The reduction potentials for Au⁻ and Ai⁻ are as follows. (Thin: 30300 k 1.73 FeV, 600 y)
$$Au^{3+} + 3e^{-} \rightarrow Au \qquad E^{\circ} = +1.50 \text{ V} ; \quad Ni^{2+} + 2e^{-} \rightarrow Ni \qquad E^{\circ} = -0.23 \text{ V}$$
Calculate ΔG° (at 25°C) for the reaction: $2Au^{3+} + 3Ni \rightarrow 3Ni^{2+} + 2Au$

- (A) $-5.0 \times 10^2 \text{ kJ}$; (B) $5.0 \times 10^2 \text{ kJ}$; (C) -2140 kJ; (D) $1.0 \times 10^3 \text{ kJ}$; (E) $-1.0 \times 10^3 \text{ kJ}$.
- 11. To decrease the value of K for the following exothermic reaction, we should

$$2A(g) + B(g) = 2C(g)$$

- (A) decrease the temperature.; (B) increase the temperature.; (C) decrease the pressure.;
- (D) increase the C pressure.; (E) Two of these are necessary.
- 12. Calculate the pH of the $1.0 \times 10^{-12} M$ NaOH aqueous solutions at 25°C.
 - (A) $pH \approx 2.0$; (B) $pH \approx 12$; (C) $pH \approx 4.0$; (D) $pH \approx 6.0$; (E) $pH \approx 7.0$.
- 13. At 25°C, given that the K_a for HA is 3.5 x 10^{-8} , calculate the K value for the reaction of HA with OH⁻. (A) 3.5×10^6 ; (B) 3.5×10^{-8} ; (C) 3.5×10^{-22} ; (D) 2.9×10^{-7} ; (E) none of these
- 14. Which of the following species is present in the greatest concentration in a 0.100 M H₂SO₄ solution in H₂O?
 - (A) H₃O⁺; (B) HSO₄⁻; (C) H₂SO₄ ; (D) SO₄²⁻; (E) All species have the same concentration.

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科目名稱普通化學A類組代碼共同考科※本項考試依簡章規定所有考科均「不可」使用計算機。本科試題共計 3 頁

- 15. A 10-mL sample of tartaric acid ($K_{a1} = 1.5 \times 10^{-2}$, $K_{a2} = 2.0 \times 10^{-6}$) is titrated to a phenolphthalein(酚 歃) endpoint with 20. mL of 1.0 M NaOH. What is the molarity of the acid?
 - (A) 0.5; (B) 1.0; (C) 2.0; (D) 4.0; (E) impossible to determine.
- 16. How many different possible triethylbenzenes exist?
 - (A) 6; (B) 5; (C) 4; (D) 3; (E) 2.
- 17. When heat is added to proteins, the hydrogen bonding in the secondary structure breaks apart. What are the algebraic signs of ΔH and ΔS for the denaturation process?
 - (A) $\Delta H < 0$ and $\Delta S < 0$; (B) $\Delta H = 0$ and $\Delta S > 0$; (C) $\Delta H > 0$ and $\Delta S > 0$; (D) $\Delta H < 0$ and $\Delta S > 0$; (E) $\Delta H > 0$ and $\Delta S < 0$.
- 18. A solution containing 10. mmol of CO₃²⁻ and 5.0 mmol of HCO₃⁻ is titrated with 1.0 M HCl. What volume of HCl must be added to reach the first equivalence point?
 - (A) 5.0 mL; (B) 10.0 mL; (C) 15.0 mL; (D) 20.0 mL; (E) 25.0 mL.
- 19. A radioactive isotope of vanadium, $^{53}_{23}$ V, decays by producing β particles and gamma rays. The nuclide formed has the atomic number.
 - (A) 52; (B) 54; (C) 23; (D) 22; (E) 24.
- 20. The number of a certain radioactive nuclide present in a sample decays from 2.41 x 10² to 6.02 x 10¹ in 30 minutes. What is the half-life of this radioactive species?
 - (A) 2.0×10^1 minutes; (B) 2.4×10^2 minutes; (C) 1.5×10^1 minutes; (D) 6.0×10^2 minutes;
 - (E) 1.0×10^1 minutes.
- 21. Which of the following complexes shows geometric isomerism?
 - $(A) \ [\text{Co}(\text{H}_2\text{O})_5\text{Cl}] \text{SO}_4\ ; \\ (B) \ [\text{Co}(\text{H}_2\text{O})_6] \text{Cl}_3\ ; \\ (C) \ [\text{Co}(\text{H}_2\text{O})_5\text{Cl}] \text{Cl}_2\ ; \\ (D) \ K[\text{Co}(\text{H}_2\text{O})_2\text{Cl}_4]\ ; \\ (D) \ K[\text{Co}(\text{H}_2\text{O})$
 - (E) Na₃[CoCl₆].
- 22. How many unpaired electrons are there in the complex ion [Co(NO₃)₆]⁴⁻? For this ion, the nitrate ligands produce a very strong crystal field. (Co: [Ar]4s²3d⁷)
 - (A) 1; (B) 2; (C) 3; (D) 4; (E) 5.
- 23. What ions are very important for the proper functioning of biologic systems, such as nerves and muscles?
 - (A) alkali metal ions; (B) nitrogen ions; (C) oxygen ions; (D) sulfur ions;
 - (E) alkaline earth metal ions.
- 24. What is the expected osmotic pressure, in torr, of a 0.0100 M solution of NaCl in water at 25°C? (1.0 atm = 760 torr)
 - (A) 0.245 torr; (B) 0.495 torr; (C) 374 torr; (D) 187 torr; (E) 561 torr.
- 25. How many of the following molecules and ions contain double or triple bonds?

 N_2 ; H_2CO ; C_2H_4 ; C_2H_6 ; SCN

- (A) 1; (B) 2; (C) 3; (D) 4; (E) 5.
- 26. How many acceptable and equivalent resonance structures can be drawn for NO₃⁻?
 - $(A)\ 0\ ; (B)\ 1\ ; (C)\ 2\ ; (D)\ 3\ ; (E)\ 4.$
- 27. Which of the following molecules has a dipole moment?
 - (A) $SiCl_4$; (B) BCl_3 ; (C) PCl_3 ; (D) Cl_2 ; (E) none of these.
- 28. A certain substance, X, has a triple-point temperature of 20°C at a pressure of 2.0 atm. Which one of the following statements **cannot** possibly be true?
 - (A) X can exist as a liquid above 20°C.; (B) X can exist as a solid above 20°C. (C) Liquid X can exist as a stable phase at 25°C, 1 atm.; (D) Both liquid and solid X have the same vapor pressure at 20°C; (E) All of these statements could be true.
- 29. Calculate ΔE for a system that releases 32 J of heat while 56 J of work is done on it.
 - (A) 24 J; (B) 88 J; (C) -88 J; (D) -24 J; (E) 56 J.

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科目名稱	普通化學A	類組代碼	共同考科
		科目碼	E0017
※本項考試	依簡章規定所有考科均「不可」使用計算機。	本科試是	通共計 3 頁
 (A) E = C_p I 1. Specify the (A) sp³, sp², 2. Identify the 	the following statements is true for a monatomic ideal RT; (B) $C_p = 2.5 \text{ R}$; (C) $C_v = C_p + R$; (D) C_v is term hybridization of the nitrogen atom in each of the following NO ₃ ⁻ N ₂ NO ₂ ⁻ , sp ² ; (B) sp ² , sp, sp ² ; (C) sp ² , sp ² , sp ² (D) sp ² , sp, sp type of organic compound shown on right-hand side; (B) ketone; (C) ether; (D) aldehyde; (E) ester.	perature depende lowing, in order. p; (E) sp ² , sp, sp	p^3
二、非選擇是	題 (20% 計算與證明題需寫過程否則不予 請於答案卷上作答,否則不	·計分) 予計分。	
. (a) Justify: at (b) Justify: at	constant pressure, $\mathbf{q}_p = \Delta \mathbf{H}$. (3 %) to constant temperature and pressure, $\Delta \mathbf{G} = \mathbf{maximu}$	ım of W _{useful} (4 ^c	%)
. (a) Please der (b) Briefly de	rive the integrated rate law of the first-order reaction exercises how to get the activation energy of a chemic	on. (4 %) cal reaction. (3 %	%)
. Use the mole	cular orbital model to draw MO energy-level diag	rams for predict	ing the magnetis
	der of B ₂ molecule. (6 %)		
₹¢			