國立屏東大學 104 學年度學士班轉學考試

普通化學 試題

（應用化學系）

*注意事項：
（1）本試題共 5 頁。
（2）不必抄題，但請依序將題號標出，並寫在答案紙上，否則不予計分。

一、選擇題（每題 4 分，共 100 分）

1. Combining aqueous solutions of BaI_2 and Na_2SO_4 affords a precipitate of $BaSO_4$. Which ion(s) is/are spectator ions in the reaction?

   (A) Ba^{2+} only   (B) Na^+ only   (C) Ba^{2+} and SO_4^{2-}

   (D) Na^+ and I^- (E) SO_4^{2-} and I^-

2. The energy of a photon of light is _____ proportional to its frequency and _____ proportional to its wavelength.

   (A) directly, directly   (B) inversely, inversely   (C) inversely, directly
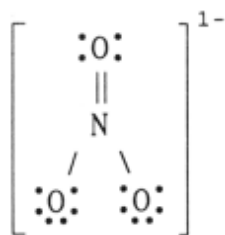
   (D) directly, inversely   (E) indirectly, not

3. Which of the following is an isoelectronic series?

   (A) $B^{5-}, Si^{4-}, As^{3-}, Te^{2-}$ (B) F^-, Cl^-, Br^-, I^- (C) S, Cl, Ar, K

   (D) $Si^{2-}, P^{2-}, S^{2-}, Cl^{2-}$ (E) O^{2-}, P^-, Ne, Na^+

4. The formal charge on nitrogen in NO_3^- is _____.

   (A) -1   (B) 0   (C) +1   (D) +2   (E) -2

5. The hybridization of the central atom in the XeF_4 molecule is _____.

   (A) sp   (B) sp^2 (C) sp^3 (D) sp^3d (E) sp^3d^2

6. A sample of a gas (1.50 mol) is contained in a 15.0 L cylinder.   The temperature is increased

   from 100 °C to 150 °C.   The ratio of final pressure to initial pressure $[\frac{P_2}{P_1}]$ is _____.

   (A) 1.50   (B) 0.667   (C) 0.882   (D) 1.13   (E) 1.00

7. Which one of the following substances will have hydrogen bonding as one of its intermolecular

   forces?

   (A)

   (B)

   (C)

   (D)

   (E)
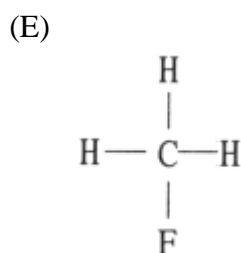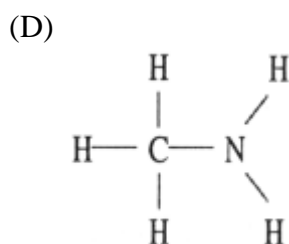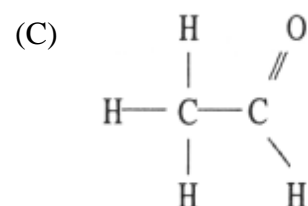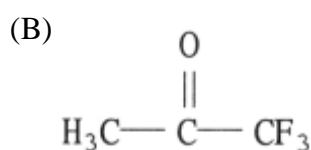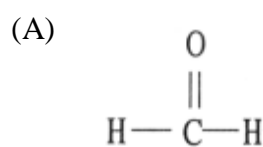
8. The phrase "like dissolves like" refers to the fact that _____.

   (A) gases can only dissolve other gases

   (B) polar solvents dissolve polar solutes and nonpolar solvents dissolve nonpolar solutes

   (C) solvents can only dissolve solutes of similar molar mass

   (D) condensed phases can only dissolve other condensed phases

   (E) polar solvents dissolve nonpolar solutes and vice versa

9. The relationship between the rate constants for the forward and reverse reactions and the

   equilibrium constant for the process is K_{eq} = _____.

   (A) $k_f k_r$ (B) $k_f - k_r$ (C) $k_f + k_r$ (D) k_f/k_r (E) k_r/k_f

10. Which one of the following pairs cannot be mixed together to form a buffer solution?

   (A) NH_3, NH_4Cl (B) $NaC_2H_3O_2$, HCl ($C_2H_3O_2$- = acetate)

   (C) RbOH, HBr   (D) KOH, HF   (E) H_3PO_4, KH_2PO_4

11. Which one of the following is always positive when a spontaneous process occurs?

(A) ΔS_{system} (B) $\Delta S_{surroundings}$ (C) $\Delta S_{universe}$ (D) $\Delta H_{universe}$

(E) $\Delta H_{surroundings}$

12. The half-reaction occurring at the anode in the balanced reaction shown below is _____.

$$3MnO_4^- (aq) + 24H^+ (aq) + 5Fe (s) \rightarrow 3Mn^{2+} (aq) + 5Fe^{3+} (aq) + 12H_2O (l)$$

(A) $MnO_4^- (aq) + 8H^+ (aq) + 5e^- \rightarrow Mn^{2+} (aq) + 4H_2O (l)$

(B) $2MnO_4^- (aq) + 12H^+ (aq) + 6e^- \rightarrow 2Mn^{2+} (aq) + 3H_2O (l)$

(C) $Fe (s) \rightarrow Fe^{3+} (aq) + 3e^-$

(D) $Fe (s) \rightarrow Fe^{2+} (aq) + 2e^-$

(E) $Fe^{2+} (aq) \rightarrow Fe^{3+} (aq) + e^-$

13. Atoms containing radioactive nuclei are called

(A) radionuclides.   (B) radioisotopes.   (C) nucleons.   (D) nuclides.

(E) radioisophores.

14. Which subatomic particle has the **smallest** mass?

(A) a proton   (B) a neutron   (C) an electron   (D) an alpha particle

15. HBr, HCl, $HClO_4$, KBr, and NaCl are all classified as

(A) acids.   (B) nonelectrolytes.   (C) strong electrolytes.   (D) weak electrolytes.

16. What is the ground-state electron configuration of Co?

(A) $[Ar]3d^9$ (B) $[Ar]4s^13d^8$ (C) $[Ar]4s^23d^7$ (D) $[Ar]4s^24p^64d^1$

17. Calculate the lattice energy for $MgCl_2(s)$ using a Born-Haber cycle and the following

information:

$MgCl_2(s) \rightarrow Mg^{2+}(g) + 2 Cl^-(g)$	?
$Mg(s) + Cl_2(g) \rightarrow MgCl_2(s)$	-641.6 kJ/mol
$Mg(s) \rightarrow Mg(g)$	+147.1 kJ/mol
$Mg(g) \rightarrow Mg^+(g) + e^-$	+737.8 kJ/mol
$Mg^+(g) \rightarrow Mg^{2+}(g) + e^-$	+1451.0 kJ/mol
$1/2 Cl_2(g) \rightarrow Cl(g)$	+121.7 kJ/mol
$Cl(g) + e^- \rightarrow Cl^-(g)$	-348.6 kJ/mol

(A) +641.6 kJ/mol   (B) +1240.5 kJ/mol   (C) +1882.1 kJ/mol   (D) +2523.7 kJ/mol

18. Which molecule contains the most polar bonds?

   (A) CF_4 (B) CO_2 (C) CN^- (D) CH_4

19. How many molecules of N_2 are in a 500.0 mL container at 780 mm Hg and 135°C ?

   (A) 8.76×10^{21} (B) 9.23×10^{21} (C) 2.65×10^{22} (D) 2.79×10^{22}

20. Arrange the following in order of increasing boiling point.

   CH3CH2OH   CH3CH2CH3   H3C-O-CH3   CH3CH2NH2
        I   II   III   IV

   (A) IV < III < II < I   (B) II < III < IV < I   (C) I < IV < III < II   (D) II < III < I < IV

21. Write the equilibrium equation for the **reverse** reaction:

   $2\ CH_4(g) + 3\ O_2(g) \;\rightarrow\; 2\ CO(g) + 4\ H_2O(g)$
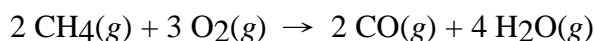
   (A) $K_p' = \dfrac{[P_{CH_4}]^2[P_{O_2}]^3}{[P_{CO}]^2[P_{H_2O}]^4}$ (B) $K_p' = \dfrac{[P_{CO}]^2[P_{H_2O}]^4}{[P_{CH_4}]^2[P_{O_2}]^3}$

   (C) $K_p' = \dfrac{2[P_{CO}]+4[P_{H_2O}]}{2[P_{CH_4}]+3[P_{O_2}]}$ (D) $K_p' = \dfrac{2[P_{CH_4}]+3[P_{O_2}]}{2[P_{CO}]+4[P_{H_2O}]}$

22. Which statement about buffers is true?

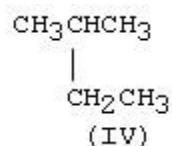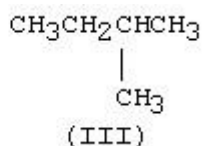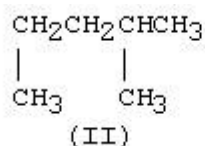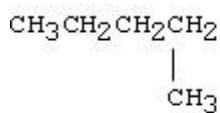   (A) Buffers have a pH = 7.

   (B) Buffers consist of a strong acid and its conjugate base.

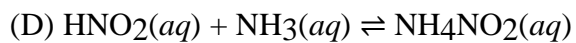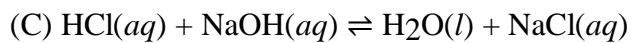   (C) A buffer does not change pH on addition of a strong acid or strong base.

   (D) Buffers resist change in pH upon addition of small amounts of strong acid or strong base.

23. Which is the condensed structure of a straight-chain hydrocarbon?

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CH3CH2CH2CH2     CH2CH2CHCH3     CH3CH2CHCH3     CH3CHCH3
        |          |    |              |              |
       CH3        CH3  CH3            CH3          CH2CH3
      (I)            (II)            (III)           (IV)
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   (A) I   (B) II   (C) III   (D) IV

24. Which of these neutralization reactions has a pH = 7 when equal molar amounts of acid and

base are mixed?

(A) $CH_3CO_2H(aq) + NaOH(aq) \rightleftharpoons H_2O(l) + NaCH_3CO_2(aq)$

(B) $HCl(aq) + C_5H_5N(aq) \rightleftharpoons C_5H_5NHCl(aq)$

(C) $HCl(aq) + NaOH(aq) \rightleftharpoons H_2O(l) + NaCl(aq)$

(D) $HNO_2(aq) + NH_3(aq) \rightleftharpoons NH_4NO_2(aq)$
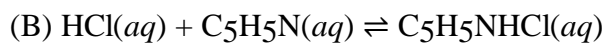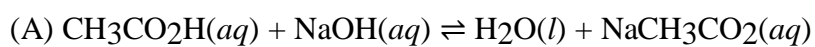
25. What is the reduction half-reaction for the following overall cell reaction?

$$Ni^{2+}(aq) + 2\ Ag(s) \rightarrow Ni(s) + 2\ Ag^+(aq)$$

(A) $Ag(s) + e^- \rightarrow Ag^+(aq)$

(B) $Ag^+(aq) + e^- \rightarrow Ag(s)$

(C) $Ni^{2+}(aq) + 2\ e^- \rightarrow Ni(s)$

(D) $Ni^{2+}(aq) + e^- \rightarrow Ni(s)$