國立屏東大學105學年度研究所碩士班入學考試

化學 試題

（應用化學系碩士班）

※請注意：1.本試題共六頁。

2.答案題號須標示清楚，並寫在答案卷上，否則不予計分。

一、選擇題（每題3分，共75分）

1. The atomic number indicates _____.

(A) the number of neutrons in a nucleus

(B) the total number of neutrons and protons in a nucleus

(C) the number of protons or electrons in a neutral atom

(D) the number of atoms in 1 g of an element

(E) the number of different isotopes of an element

2. When the following equation is balanced, the coefficient of H_2O is _____.

$$Ca\,(s) + H_2O\,(l) \rightarrow Ca(OH)_2\,(aq) + H_2\,(g)$$

(A) 1

(B) 2

(C) 3

(D) 5

(E) 4

3. The balanced net ionic equation for precipitation of $CaCO_3$ when aqueous solutions of $Na_2\,CO_3$ and $CaCl_2$ are mixed is _____.

(A) $2Na^+(aq) + CO_3^{2-}(aq) \rightarrow Na_2\,CO_3\,(aq)$

(B) $2\,Na^+(aq) + 2Cl^-(aq) \rightarrow 2NaCl\,(aq)$

(C) $Na^+(aq) + Cl^-(aq) \rightarrow NaCl\,(aq)$

(D) $Ca^{2+}(aq) + CO_3^{2-}(aq) \rightarrow CaCO_3(s)$

(E) $Na_2CO_3(aq) + CaCl_2\,(aq) \rightarrow 2NaCl\,(aq) + CaCO_3(s)$

4. What is the frequency of light (s^{-1}) that has a wavelength of $1.23\times10^{-6}\,cm$?

(A) 3.69

(B) 2.44×10^{16}

(C) 4.10×10^{-17}

(D) 9.62×10^{12}

(E) 1.04×10^{-13}

5. Oxides of the active metals combine with water to form _____.

(A) metal hydroxides

(B) metal hydrides

(C) hydrogen gas

(D) oxygen gas

(E) water and a salt

6. There are _____ unpaired electrons in the Lewis symbol for an oxygen atom.

(A) 0

(B) 1

(C) 2

(D) 4

(E) 3

7. According to VSEPR theory, if there are five electron domains in the valence shell of an atom, they will be arranged in a(n) _____ geometry.

(A) octahedral

(B) linear

(C) tetrahedral

(D) trigonal planar

(E) trigonal bipyramidal

8. When NaCl dissolves in water, aqueous Na^+ and Cl^- ions result. The force of attraction that exists between Na^+ and H_2O is called a(n) _____ interaction.

(A) dipole-dipole

(B) ion-ion

(C) hydrogen bonding

(D) ion-dipole

(E) London dispersion force

9. 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

10. If the rate law for the reaction

$$2A + 3B \rightarrow \text{products}$$

is first order in A and second order in B, then the rate law is rate = _____.

(A) $k[A][B]$

(B) $k[A]^2[B]^3$

(C) $k[A][B]^2$

(D) $k[A]^2[B]$

(E) $k[A]^2[B]^2$

11. The conjugate acid of HSO_4^- is _____.

(A) SO_4^{2-}

(B) H_2SO_4

(C) HSO_4^+

(D) H^+

(E) HSO_3^+

12. A solution containing which one of the following pairs of substances will be a buffer solution?

(A) NaI, HI

(B) KBr, HBr

(C) RbCl, HCl

(D) CsF, HF

(E) none of the above

13.CFC stands for _____.

(A) chlorinated freon compound

(B) chlorofluorocarbon

(C) carbonated fluorine compound

(D) caustic fluorine carbohydrate

(E) carbofluoro compound

14. Which one of the following is not one of the postulates of Dalton's atomic theory?

(A) Atoms are composed of protons, neutrons, and electrons.

(B) All atoms of a given element are identical; the atoms of different elements are different and have different properties.

(C) Atoms of an element are not changed into different types of atoms by chemical reactions: atoms are neither created nor destroyed in chemical reactions.

(D) Compounds are formed when atoms of more than one element combine; a given compound always has the same relative number and kind of atoms.

(E) Each element is composed of extremely small particles called atoms.

15. The balanced reaction between aqueous potassium hydroxide and aqueous acetic acid is _____.

(A) $KOH\ (aq) + HC_2H_3O_2\ (aq) \rightarrow OH^-\ (l) + HC_2H_3O_2^+\ (aq) + K\ (s)$

(B) $KOH\ (aq) + HC_2H_3O_2\ (aq) \rightarrow H_2O\ (l) + KC_2H_3O_2\ (aq)$

(C) $KOH\ (aq) + HC_2H_3O_2\ (aq) \rightarrow H_2C_2H_3O_3\ (aq) + K\ (s)$

(D) $KOH\ (aq) + HC_2H_3O_2\ (aq) \rightarrow KC_2H_3O_3\ (aq) + H_2\ (g)$

(E) $KOH\ (aq) + HC_2H_3O_2\ (aq) \rightarrow H_2KC_2H_3O\ (aq) + O_2\ (g)$

16. Which one of the quantum numbers does not result from the solution of the Schroedinger equation?

(A) principal

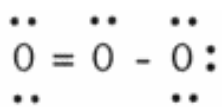
(B) azimuthal

(C) magnetic

(D) spin

(E) angular momentum

17. In the resonance form of ozone shown below, the formal charge on the central oxygen atom is _____.



(A) 0

(B) +1

(C) -1

(D) +2

(E) -2

18. "Isothermal" means _____.

(A) at constant pressure

(B) at constant temperature

(C) at variable temperature and pressure conditions

(D) at ideal temperature and pressure conditions

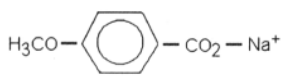
(E) that $\Delta H_{rxn} = 0$

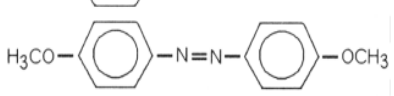
19. Which of the following is most likely to exhibit liquid-crystalline behavior?

(A) $CH_3CH_2\text{-}C(CH_3)_2\text{-}CH_2CH_3$

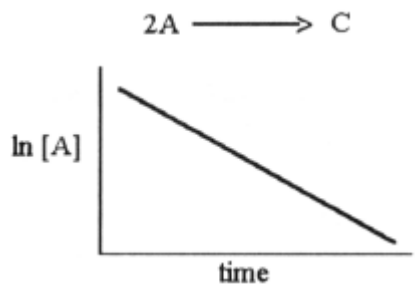
(B) $CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_3$

(C) $CH_3CH_2CH_2CH_2CH_2\text{-}Na^+$

(D) 

(E) 

20. The graph shown below depicts the relationship between concentration and time for the following chemical reaction.



The slope of this line is equal to _____.

(A) k

(B) -1/k

(C) $\ln[A]_o$

(D) -k

(E) 1/k

21. Nitric acid is a strong acid. This means that _____.

(A) aqueous solutions of HNO_3 contain equal concentrations of H^+ (aq) and OH^- (aq)

(B) HNO_3 does not dissociate at all when it is dissolved in water

(C) HNO_3 dissociates completely to H^+ (aq) and NO_3^- (aq) when it dissolves in water

(D) HNO_3 produces a gaseous product when it is neutralized

(E) HNO_3 cannot be neutralized by a weak base

22. Carbon dioxide contributes to atmospheric warming by _____.

(A) absorbing incoming radiation from the sun and converting it to heat

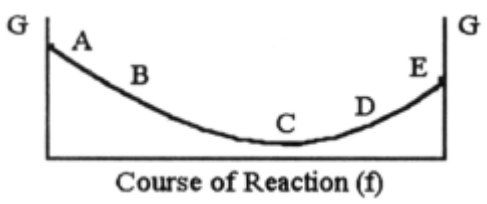
(B) absorbing radiation emitted from the surface of the earth preventing its loss to space

(C) undergoing exothermic reactions extensively in the atmosphere

(D) increasing the index of refraction of the atmosphere so that infrared radiation from the sun is refracted to the surface of the earth where it is converted to heat

(E) reducing the concentration of CO in the atmosphere.

23. The equilibrium position corresponds to which letter on the graph of G vs. f (course of reaction) below?



(A) A

(B) B

(C) C

(D) D

(E) E

24. The standard cell potential ($E°_{cell}$) for the reaction below is +0.63 V. The cell potential for this reaction is _____ V when $[Zn^{2+}] = 1.0$ M and $[Pb^{2+}] = 2.0 \times 10^{-4}$ M.

$$Pb^{2+}\ (aq) + Zn\ (s) \rightarrow Zn^{2+}\ (aq) + Pb\ (s)$$

(A) 0.52

(B) 0.85

(C) 0.41

(D) 0.74

(E) 0.63

25. Based on entropy considerations alone, which homogeneous aqueous equilibrium would be expected to lie to the right?

(A) $AgI_2^- + 2Br^- \Leftrightarrow AgBr_2^- + 2I^-$

(B) $Ni(H_2NC_2H_4NH_2)_3^{2+} + 6NH_3 \Leftrightarrow Ni(NH_3)_6^{2+} + 3H_2NC_2H_4NH_2$

(C) $CoCl_4^{2+} + 6H_2O \Leftrightarrow Co(H_2O)_6^{2+} + 4Cl^-$

(D) $Fe(NH_3)_6^{2+} + C_{20}H_{10}N_4^{2-} \Leftrightarrow Fe(NH_3)_2(C_{20}H_{10}N_4) + 4NH_3$

(E) $Cu(NH_3)_4^{2+} + 6H_2O \Leftrightarrow Cu(H_2O)_6^{2+} + 4NH_3$

二、問答題（共 25 分）

1. 試討論 NH_3, $MeNH_2$, Me_2NH, Me_3N 於水溶液中的鹼性大小順序。（5 分）

2. 當分析樣品中可能存在基質效應時，標準添加方法（Standard-Addition Methods）非常適合應用於複雜的樣品分析工作。舉例說明標準添加方法的操作流程。（5 分）

3. 舉例說明加成聚合物（Addition Polymer）與縮合聚合物（Condensation Polymer），其反應形式之差別。（10 分）

4. 何謂共沈澱？試舉例說明之。（5 分）