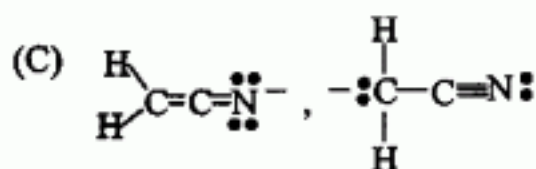
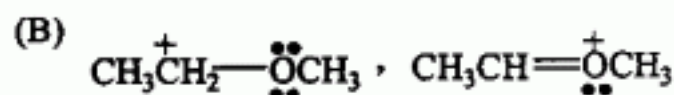
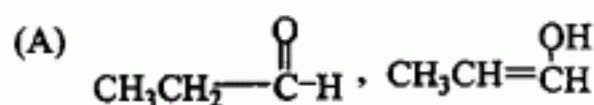


九十一學年度 化學 系(所) 化學、應用化學 組碩士班研究生招生考試
科目 綜合化學 科號 0601, 0701 共 6 頁第 1 頁 *請在試卷【答案卷】內作答

單選題，四選一

1. Which of the following choices represent(s) a pair of resonance structures?



(D) Both B and C

2. Which of the following is a bridged bicyclic alkane?

(A) cis-decalin (B) bicyclo[2.2.1]heptane (C) bicyclo[3.2.0]heptane

(D) bicyclo[4.2.0]heptane

3. A mixture of equal amounts of two enantiomers _____.

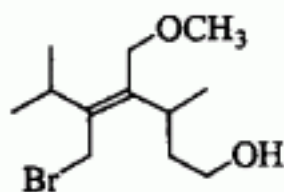
(A) is called a racemic mixture

(B) is optically inactive

(C) implies that the enantiomers are meso forms

(D) both A and B

4. Which of the following best describes the geometry about the carbon-carbon double bond in the alkene below?



(A) E (B) Z (C) neither E nor Z (D) cis

5. Addition of Br_2 to (Z)-3-hexene produces_____.

(A) a meso dibromide

(B) a mixture of enantiomeric dibromides which is optically active

(C) a mixture of enantiomeric dibromides which is optically inactive

(D) (Z)-3,4-dibromo-3-hexene

6. Which of the following alkyl halides would be suitable to use when forming a Grignard reagent?
(A) $\text{H}_2\text{NCH}_2\text{CH}_2\text{Br}$ (B) $(\text{CH}_3)_2\text{NCH}_2\text{CH}_2\text{Br}$ (C) $\text{CH}_3\text{COCH}_2\text{CH}_2\text{Br}$
(D) $\text{BrCH}_2\text{CH}_2\text{CH}_2\text{CN}$
7. 3-Methyl-1-butanol is classified as _____.
(A) a primary alcohol (B) a secondary alcohol (C) a tertiary alcohol
(D) none of the above
8. The Williamson ether synthesis proceeds via an _____ mechanism.
(A) $\text{S}_{\text{N}}1$ (B) $\text{S}_{\text{N}}2$ (C) $\text{E}1$ (D) $\text{E}2$
9. Which of the following undergoes solvolysis in methanol most rapidly?
(A) PhCH_2Br (B) Ph_3CBr (C) $\text{PhCH}_2\text{CH}_2\text{Br}$ (D) PhBr
10. What reagents can be used to convert 1-hexyne into 2-hexanone?
(A) 1. SiH_2BH ; 2. H_2O_2 , NaOH (B) Hg^{2+} , H_2SO_4 , H_2O
(C) 1. O_3 ; 2. $(\text{CH}_3)_2\text{S}$ (D) 1. CH_3MgBr ; 2. CO_2
11. Which of the species below is less basic than acetylide?
(A) CH_3Li (B) CH_3ONa (C) NaOH (D) both B and C
12. Which compound would be expected to show intense IR absorption at 1746 cm^{-1} ?
(A) $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$ (B) $\text{CH}_3\text{CO}_2\text{CH}_3$ (C) $\text{CH}_3\text{CH}_2\text{CCH}$ (D) $\text{CH}_3\text{CH}_2\text{SCH}_3$
13. Using a 60 MHz spectrometer, the protons in dichloromethane appear at 5.30 ppm. When the same sample is placed in a 600 MHz instrument, where does the signal appear?
(A) 8.33 (B) 3.18 (C) 5.30 (D) 0.53
14. The median for the set of data (19.4, 19.5, 19.6, 19.8, 20.1, 20.3) is
(A) 19.6 (B) 19.7 (C) 19.8 (D) 19.9
15. The spread for the set of data (19.4, 19.5, 19.6, 19.8, 20.1, 20.3) is
(A) 6 (B) 0.9 (C) 19.8 (D) 20.3
16. Which of the following techniques is not generally used to get a larger particle size of a precipitate when the gravimetric method of analysis was applied.
(A) slow addition of the precipitating agent
(B) reprecipitation (C) digestion (D) precipitation from homogeneous solution
17. The contraction of a solution prepared by dissolving 1 mg of solute in 1 L of water is
(A) 1 parts per thousand (B) 1 parts per million (C) 1 parts per billion
(D) 1 parts per trillion
18. K_{sp} of $\text{Ba}(\text{IO}_3)_2$ is 1.6×10^{-9} ; calculate the solubility of $\text{Ba}(\text{IO}_3)_2$ (mol/L) in a solution prepared by mixing 200 mL of 0.010 M $\text{Ba}(\text{NO}_3)_2$ with 100 mL of 0.10 M NaIO_3 .
(A) 3.2×10^{-6} (B) 4.0×10^{-6} (C) 5.4×10^{-6} (D) 6.2×10^{-6}

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19. What is the ionic strength of a solution that is 0.2 M in NaCl and 0.1 M in Na_2SO_4
(A) 0.2 (B) 0.3 (C) 0.4 (D) 0.5
20. Which of the following statements about activity coefficients is not true?
(A) The activity coefficient is always equal to or less than unity.
(B) The activity coefficient of an uncharged molecule is approximately unity, regardless of ionic strength
(C) At a given ionic strength, the variations of the activity coefficient of ions of the same charge can be correlated with the effective diameter of the hydrated ions.
(D) The activity coefficient of a given ion describes its effective behavior in all equilibria in which it participates.
21. What is the $[\text{H}_3\text{O}^+]$ of a solution that is 0.2 M in NH_3 and 0.3 M in NH_4Cl . Assuming the acid dissociation constant for NH_4^+ is 6×10^{-10} .
(A) 9×10^{-10} (B) 4×10^{-10} (C) 2×10^{-10} (D) 1×10^{-10}
22. Which of the following variables that influence the behavior of acid-base indicator most significantly?
(A) temperature (B) pressure (C) ionic strength (D) presence of organic solvent
23. Which of the following methods is not used for precipitation titration?
(A) The Mohr method (B) The Fajans method (C) The Volhard method
(D) The Zeeman method
24. Which of the following effects is not a sources for the line broadening of the atomic absorption line?
(A) the uncertainty effect (B) the Doppler effect
(C) the pressure effect (D) the temperature effect
25. The column efficiency of the chromatography can be expressed by the van Deemter equation:
 $H=A+B/u + Cu$, where u is the linear velocity of the mobile phase, and B is related to the phenomena of
(A) mass transfer for the stationary phase
(B) mass transfer for the mobile phase
(C) multiple flow paths (D) longitudinal diffusion
26. Which of the following detectors for gas chromatography is the most widely used
(A) flame ionization defector (B) thermal conductivity detector
(C) electron-capture detector (D) atomic emission detector
27. The redox potential of a molecule will not be affected by which of the following factors?
(A) the ratio of the oxidation and the reduction states (B) temperature
(C) pH (D) external pressure.
28. Which of the followings is a zero order reaction?
(A) Thermal isomerization of cis-stilbene to trans-stilbene
(B) enzyme oxidation of glucose to gluconic acid.

(C) decay of radioactivity of ^{60}Co

(D) decay of triplet excited C_{60} to ground state.

29. Hydrogen bonding between DNA strands occurs between pairs of nitrogen bases. Which of the following is a pair of nitrogen bases where hydrogen bonding in DNA is important?

(A) guanine-thymine

(B) cytosine-adenine

(C) adenine-thymine

(D) cytosine-thymine

(E) none of the above

30. Draw an energy level diagram for a nitrogen atom. How many unpaired electrons are present?

(A) 3

(B) 2

(C) 1

(D) 4

(E) none of the above

31. Under which condition is a reaction always in equilibrium?

(A) $\Delta H = 0$

(B) $\Delta S = 0$

(C) $\Delta H = <0$

(D) $\Delta H = >0$

(E) none of the above

32. Nowadays, nano materials are very important for developing nano electronics. What is the size of nano materials?

(A) $1 \sim 100 \times 10^{-15} \text{ m}$

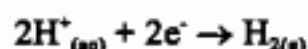
(B) $1 \sim 100 \times 10^{-12} \text{ m}$

(c) $1 \sim 100 \times 10^{-9} \text{ m}$

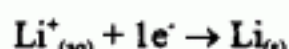
(D) $1 \sim 100 \times 10^{-3} \text{ m}$

(E) none of the above

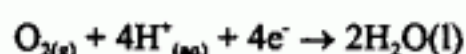
33. Consider the following half-reactions and voltages.



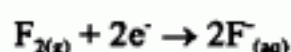
$$E^\circ = 0.0 \text{ V}$$



$$E^\circ = -3.05 \text{ V}$$



$$E^\circ = 1.23 \text{ V}$$



$$E^\circ = 2.87 \text{ V}$$

What is the product produced at the cathode when a current is passed through an aqueous solution of LiF ?

(A) lithium

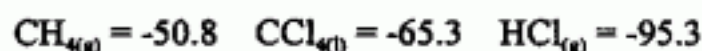
(B) fluorine

(C) hydrogen

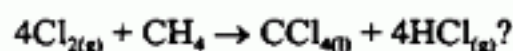
(D) oxygen

(E) none of the above

34. Given the following values of the ΔG_f in kJ mol^{-1} :



What is the value of ΔG_r for the reaction,



(A) 282 kJ mol^{-1}

(B) -282 kJ mol^{-1}

(C) -396 kJ mol^{-1}

(D) -425 kJ mol^{-1}

(E) none of the above

35. The K_a for hydrofluoric acid, HF , is 3.5×10^{-4} . What is the K_b for the fluoride ion, F^- ?

(A) 1.7×10^{-11}

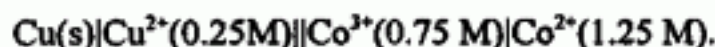
(B) 4.7×10^{-11}

(C) 3.5×10^{10}

(D) 3.5×10^{-10}

(E) none of the above

36. Consider the electrochemical cell,



If E° for the cell is 1.47 V, what is E (volts) for the cell?

- (A) 1.45 V (B) 1.57 V (C) 1.63 V (D) 1.31 V (E) none of the above

37. The mineral most important in the function of hemoglobin

- (A) Mg (B) Fe (C) Ca (D) Zn (E) none of the above

38. Which of the following equations is not correct?

- (A) $dG = VdP - SdT$ (B) $\varepsilon = \varepsilon^\circ - (nF/RT) \ln(Q)$ (C) $(\partial S/\partial P)_T = -(\partial V/\partial T)_P$

- (D) $dP/dT = \Delta H_m/T \Delta V_m$

39. Electrons have spins, α or β spin states. Transition of electron spin from α to β requires absorption of photon energy. The photon energy is in which range?

- (A) uv (B) visible (C) infra red (D) microwave (E) radio frequency.

40. Which one below has a partial B-X π bond (X = F, Me, Br, H)

- (A) BF_3 (B) BMe_3 (C) BBr_3 (D) BH_3

41. The magnetic moment of a metal ion is given by equation $u = g[S(S+1)+1/4L(L+1)]^{1/2}$ (unit = Bohr magneton, S = spin quantum number, L = orbital quantum number, $g = 2.0$). Please use this equation to calculate the magnetic moment (Bohr magneton) of Mn^{2+} ion (both orbital and spin terms should be taken into account).

- (A) 3.9 (B) 4.9 (C) 5.9 (D) 6.9

42. What is the magnetic moment (Bohr magneton) of $\text{V}(\text{H}_2\text{O})_6^{3+}$ if only spin quantum number is considered.

- (A) 1.73 (B) 2.43 (C) 2.83 (D) 3.87

43. What is the metal M if the complex $(\eta^5\text{-C}_5\text{H}_5)\text{M}(\text{CO})\text{PPh}_3\text{Cl}$ meets 18-electron rule

- (A) $\text{M} = \text{V}$ (B) Cr (C) Fe (D) Co

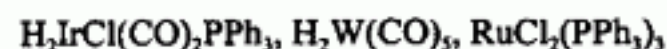
44. Which species has the largest bond order in gas phase

- (A) B_2 (B) C_2^+ (C) C_2 (D) C_2^-

45. Which complex has the largest $\nu(\text{CO})$ vibration frequency

- (A) $\text{Mn}(\text{CO})_5(\text{PPh}_3)^+$ (B) $\text{Mn}(\text{CO})_6^+$ (C) $\text{Cr}(\text{CO})_6$ (D) $\text{Cr}(\text{CO})_5(\text{PPh}_3)$

46. How many complexes below do not have 18-electron configuration $\text{RhCl}(\text{PPh}_3)_3$, $(\eta^5\text{-C}_5\text{H}_5)\text{Cr}(\text{CO})_3\text{Cl}$,



- (A) 1 (B) 2 (C) 3 (D) 4

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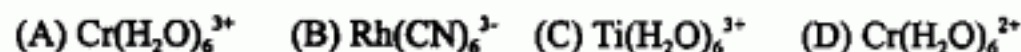
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47. For the following octahedral complexes, how many of them will not show Jahn-Teller distortions.

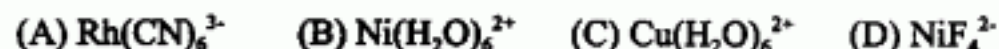


(A) 1 (B) 2 (C) 3 (D) 4

48. For the complexes below, which one will show the strongest Jahn-Teller distortion



49. In the absorption intensities of d-d transition bands, select the one which has the largest ϵ value.



50. Select the one which has the smallest ϵ value in d-d transition band

