

八十四學年度

化學研究

化學組

所 應用化學組碩士班研究生入學考試

科目

綜合化學

科號 0601
0701

共 11 頁第 1 頁 *請在試卷【答案卷】內作答

單選題，每題二分，不倒扣

1. Cathode-ray tubes experiments conducted by J. J. Thomson evidenced the presence of
(A) protons (B) electrons (C) X-ray (D) photons
2. Which of the following microscope allows scientists to observe single atom
(A) scanning electron (B) scanning tunneling
(C) scanning laser (D) scanning ion
3. Which halogen has a yellow color at room temperature
(A) F_2 (B) Cl_2 (C) Br_2 (D) I_2
4. Which of the following minerals is the most potential source for Cu metal?
(A) Cu_2S (B) $Cu_2(NO_3)(OH)_2$ (C) CuO (D) $Cu_3(CO_3)_2(OH)_2$
5. For Cr, which of the following oxidation numbers does not exist.
(A) 2 (B) 4 (C) 3 (D) 6
6. How many atoms of uranium, U, are present in 5 nanograms of uranium?
(A) 1.2×10^{23} (B) 3.0×10^{24} (C) 1.0×10^{12}
(D) 1.0×10^{13}
7. Which one of the following molecules has the bond with the greatest polarity
(A) IF (B) IBr (C) ICl (D) I_2

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8. In a cluster of 5×10^8 Al atoms, how many energy levels are there in the 3p conduction band?
(A) 1 (B) 3 (C) 5×10^8 (D) 15×10^8
9. When element Si is doped with B atoms, Si is changed into
(A) an ionic solid (B) a covalent solid
(C) n-type semiconductor (D) p-type semiconductor
10. Which one of the following ions would be useful in the removal of Fe^{3+} from water?
(A) OH^- (B) Cl^- (C) $[\text{SO}_4]^{2-}$ (D) $[\text{NO}_3]^-$
11. Which one of the following metal ions would be expected to undergo the most extensive degree of hydrolysis?
(A) Ca^{2+} (B) Cr^{2+} (C) Co^{2+} (D) V^{2+}
12. Zeeman background correction is generally used in which of the following instruments?
(A) IR (B) UV-VIS (C) GFAAS (D) MS
13. Which of the following is the strongest reducing agent?
(A) Zn (B) Fe (C) H_2 (D) Cu (E) Au.
14. Which of the following compounds present an explosion hazard?
(A) $\text{Mg}(\text{ClO}_4)_2$ (B) NaPF_6 (C) NH_4Cl (D) CsNO_3
(E) NH_4ClO_4 .

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15. Which compound is central symmetrical, i.e. possessing a center of inversion ?
(A) XeF_4 (B) SF_4 (C) PCl_5 (D) CF_4 .
16. Which of the following parameters are belongs to the triclinic crystal system.
(A) $a = b = c; \alpha = \beta = \gamma = 90^\circ$ (B) $a \neq b \neq c; \alpha = \beta = 90^\circ, \gamma \neq 90^\circ$
(C) $a \neq b \neq c; \alpha \neq \beta \neq \gamma \neq 90^\circ$ (D) $a = b \neq c; \alpha = \beta = 90^\circ, \gamma = 120^\circ$.
17. Which of the following complexes is called Vaska's complex.
(A) $\text{Na}_2\text{Fe}(\text{CO})_4$ (B) $\text{RhCl}(\text{PPh}_3)_3$ (C) $\text{IrCl}(\text{CO})(\text{PPh}_3)_2$
(D) $\text{cis-Pt}(\text{NH}_3)_2\text{Cl}_2$.
18. Which of the following synthetic, shape-selective zeolite has be used as catalyst in the conversion of methanol to gasoline?
(A) ZSM-5 (B) faujasite (C) molecular sieve (D) sodalite.
19. Which of the following statements about C_{60} molecule is incorrect.
(A) It contains 30 C-C double bonds (B) It contains 20 hexagonal rings
(C) It contains 12 pentagonal rings (D) 12 C-C double bonds are located at the 5,6-ring junctions.
20. Which of the following organometallic fragment would you expect to be isolobal with CH_3
(A) $\text{CpW}(\text{CO})_2$ (B) $\text{Fe}(\text{CO})_4$ (C) BH_4^- (D) $\text{Sn}(\text{CH}_3)_2$ (E) $\text{Re}(\text{CO})_5$.
21. Which of the following amines shows the highest affinity with Lewis acid BF_3 in gas phase.
(A) NMe_3 (B) NHMe_2 (C) PhNH_2 (D) NH_3 (E) NEt_3 .

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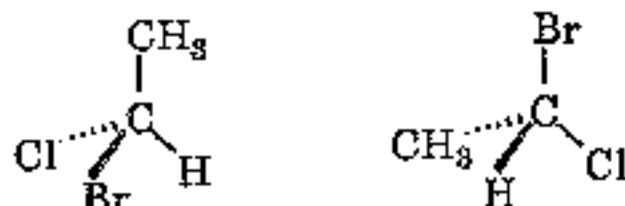
22. What is the correct way to name the hypothetical complex ion $[\text{Co}(\text{CN})_2(\text{NH}_2\text{CH}_2\text{CH}_2\text{NH}_2)_2]^+$
 (A) dicyanodi(ethylenediamine)cobalt(III)
 (B) dicyanobis(ethylenediamine)cobalt(III)
 (C) dicyanodi(dimethylamine)cobalt(1+)
 (D) bis(dimethylamine)dicyanocobalt(1+)
23. Which of the following compounds possesses the lowest molar extinction coefficient, ϵ , for the d-d transitions in their electronic absorption spectra
 (A) $\text{Mn}(\text{H}_2\text{O})_6^{2+}$ (B) $\text{Co}(\text{NH}_3)_6^{3+}$ (C) $\text{Cr}(\text{NH}_3)_6^{3+}$ (D) FeCl_4^{2+}
 (E) $\text{Ti}(\text{H}_2\text{O})_6^{2+}$
24. What is the symmetry representation of the 3p orbitals of the sulfur atom in SF_6 molecule.
 (A) A_{1u} (B) E_g (C) T_{2g} (D) T_{2u} (E) T_{1u}
25. Which of the Period 4 elements that forms neutral metal carbonyls with five carbonyl ligands.
 (A) silicon (B) germanium (C) nickel (D) iron
 (E) ruthenium.
26. Which of the following compounds has the largest dipole moment?
 (A) H_2O (B) NH_3 (C) CH_3COCH_3 (D) $\text{CH}_3\text{C}\equiv\text{N}$
27. The most stable conformation of cis-1,4-di-tert-butylcyclohexane is
 (A) chair (B) boat (C) half-chair
 (D) twist boat conformation

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28. The stereochemical relationship between the two isomers is

- (A) structural isomers (B) the same compound
(C) enantiomers (D) diastereomers



29. Which compound possesses the most acidic proton?

- (A) CH_3COCH_3 (B) $\text{CH}_3\text{COOCH}_3$ (C) $\text{CH}_3\text{COCH}_2\text{COCH}_3$
(D) $\text{CH}_2(\text{COOCH}_3)_2$

30. Which of the following compounds has the highest base strength?

- (A) CH_3NH_2 (B) CH_3CONH_2 (C) $(\text{CH}_3)_2\text{NH}$
(D) $(\text{CH}_3)_3\text{N}$

31. Which of the following cyclic polyenes would you expect to be the most stable aromatic compound?

- (A) [10]annulene (B) [12]annulene
(C) [14]annulene (D) [18]annulene

32. The two protons on the $-\text{CH}_2\text{Cl}$ group of 1,2-dichloropropane are

- (A) enantiotopic protons (B) diastereotopic protons
(C) geometric protons (D) none of the above

33. Peroxyacid epoxidation of an alkene is a kind of

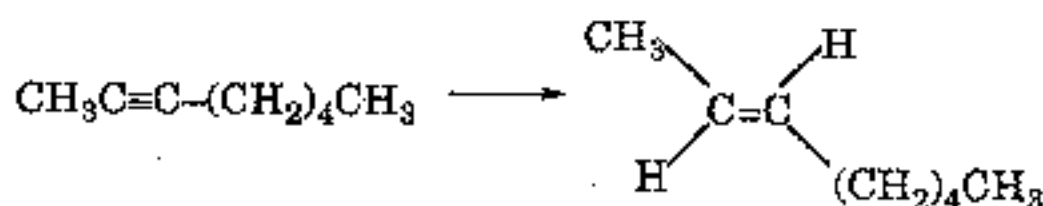
- (A) nucleophilic addition (B) free radical addition
(C) electrophilic addition (D) nucleophilic substitution

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34. Which of the following reducing agents is the most effective reagent for reduction of a carboxylic acid RCOOH to an alcohol RCH_2OH
 (A) NaBH_4 (B) LiAlH_4 (C) H_2, Pt (D) $\text{AlH}[\text{CH}_2\text{CH}(\text{CH}_3)_2]$
35. Which of the following oxidizing agents is the most effective for the oxidation of a primary alcohol(RCH_2OH) to an aldehyde(RCHO)
 (A) $\text{KMnO}_4, \text{H}_2\text{O}$ (B) PCC (pyridinium chlorochromate)
 (C) $\text{OsO}_4, \text{H}_2\text{O}_2$ (D) $\text{Na}_2\text{Cr}_2\text{O}_7, \text{H}_2\text{SO}_4, \text{H}_2\text{O}$
36. Select the best reaction condition for the following transformation



- (A) H_2, Pt (B) LiAlH_4 (C) NaBH_4 (D) Na/NH_3
37. Which is the most reactive reagent to form amides with amines
 (A) CH_3COOH (B) $(\text{CH}_3\text{CO})_2\text{O}$ (C) CH_3COCl
 (D) CH_3COOEt
38. For an electron described by the quantum numbers $n = 3$ and $l = 1$, for hydrogen atom which following statement is correct
 (A) the orbital is spherical
 (B) there are three orbitals of equal energy which the electron can occupy
 (C) the electron will be higher in energy than another electron in the same atom with quantum numbers $n = 3$ and $l = 2$
 (D) the electron resides in a d orbital in the first main energy level
 (E) the electron would have to reside in a forbidden orbital

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39. Which one of the following electron configurations is inconsistent with Hund's rule of maximum multiplicity?
- (A) $1s^2 2s^2 2p_x^1 2p_y^1 2p_z^1$ (B) $1s^2 2s^2 2p_x^2 2p_y^2 2p_z^2$
 (C) $1s^2 2s^2 2p_x^2 2p_y^1 2p_z^1$ (D) $1s^2 2s^2 2p_x^2 2p_y^2 2p_z^1$
 (E) $1s^2 2s^2 2p_x^2 2p_y^1 2p_z^0$
40. Which one of the following statements is correct?
- (A) the decay rate of a radioactive atom is a first order reaction
 (B) all of reaction rates will be increased as the temperature is increased
 (C) the rate constant will be increased when the concentrations of reactants are increased
 (D) all reaction rates will be increased as the concentrations of reactants are increased.
41. Which is the ground electronic state of O atom?
- (A) 3P (B) 1S (C) 3D (D) 3S (E) 1P
42. The number of molecules for 1 torr of gas in one liter container at room temperature is estimated to be close to
- (A) 10^{20} (B) 10^{19} (C) 10^{18} (D) 10^{17} (E) 10^{16}
43. Because of nuclear spin hydrogen molecules can be separated into para and ortho H_2 . What is the nature population ratio of para/ortho H_2 ?
- (A) 1:1 (B) 2:1 (C) 1:2 (D) 3:1 (E) 1:3

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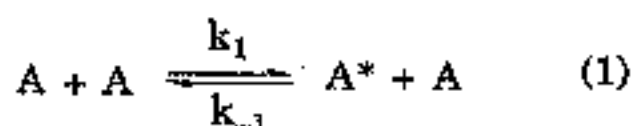
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44. Lindemann proposed that for a unimolecular reaction, $A \rightarrow$ products, the mechanism can be represented as follows:



where A and A^* are the normal and energized reactant, respectively. Assume that the steady-state approximation can be applied in this case.

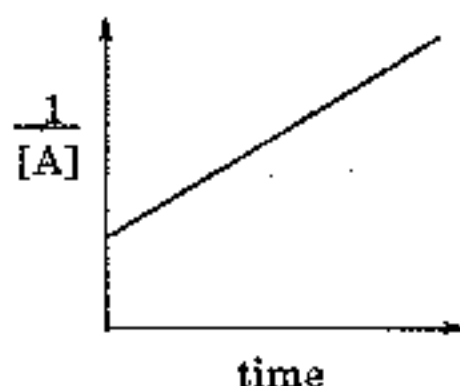
Which of the following choice is incorrect?

- (A) At high pressure limit the order of overall rate is first order.
 - (B) In the low pressure limit the order of overall rate is first order.
 - (C) In the low pressure limit the order of overall rate is a third order reaction.
 - (D) At high pressure limit, step (1) is the rate limiting step
45. Cyclohexane (boat form) belongs to the point group
(A) D_{2h} (B) C_{2v} (C) C_{2h} (D) C_2 (E) D_{6h}

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46. The linear plot of a reaction is

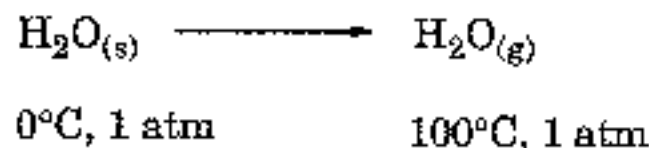


, where $[A]$ represents the concentration of reactant A.

What is the order of this reaction rate?

(A) 1 (B) 1.5 (C) 2 (D) 2.5 (E) 3

47. The entropy change of the following reaction for one mole of water is ΔS .



Assume that $\Delta H_{\text{fus}} = 1436 \text{ cal mol}^{-1}$ at 0°C , $\Delta H_{\text{vap}} = 9720 \text{ cal mol}^{-1}$ at 100°C , and the heat capacity of H_2O is $1 \text{ cal deg}^{-1}\text{g}^{-1}$. ΔS is

(A) 0 (B) 小於 $1000 \text{ cal deg}^{-1}$ (C) 大於 1000 小於 $1000 \text{ cal deg}^{-1}$
(D) 大於 $1000 \text{ cal deg}^{-1}$

48. The average speed of a hydrogen molecule at room temperature is approximately

(A) 10^3 m/sec (B) 10^4 m/sec (C) 10^5 m/sec
(D) 10^6 m/sec (E) 10^7 m/sec

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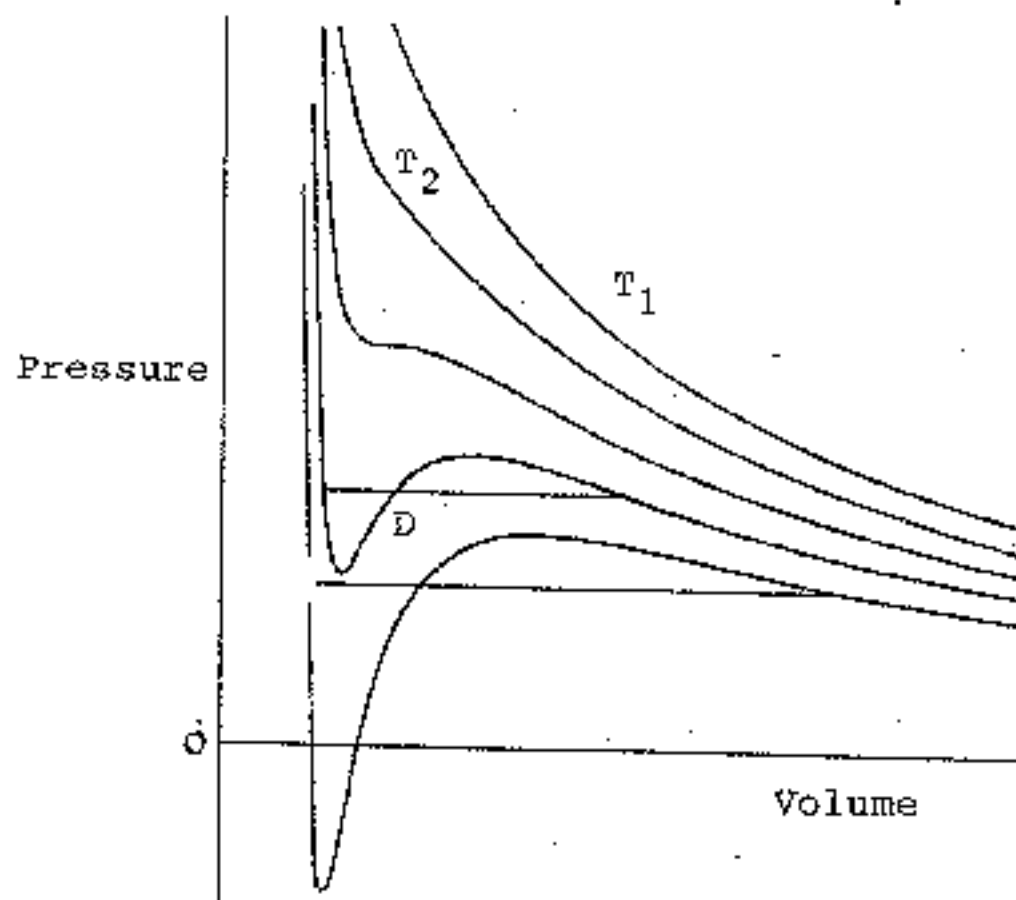
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49. The P-V diagram of isotherms for a van der Waals gas is shown in the figure.

The van der Waals equation is $(P + a/V^2)(V-b) = RT$. Statements derived for vdw gas are (i) temperature $T_1 > T_2$, (ii) critical volume is $3b$, (iii) a is the coefficient representing the attraction force between molecules, and (iv) D denotes the critical point.

The correct statements are

- (A) i, ii (B) i, iii (C) ii, iii (D) i, ii, iii (E) i, ii, iii, iv



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50. The curves a , b , e and f represent the four processes for a Carnot cycle.

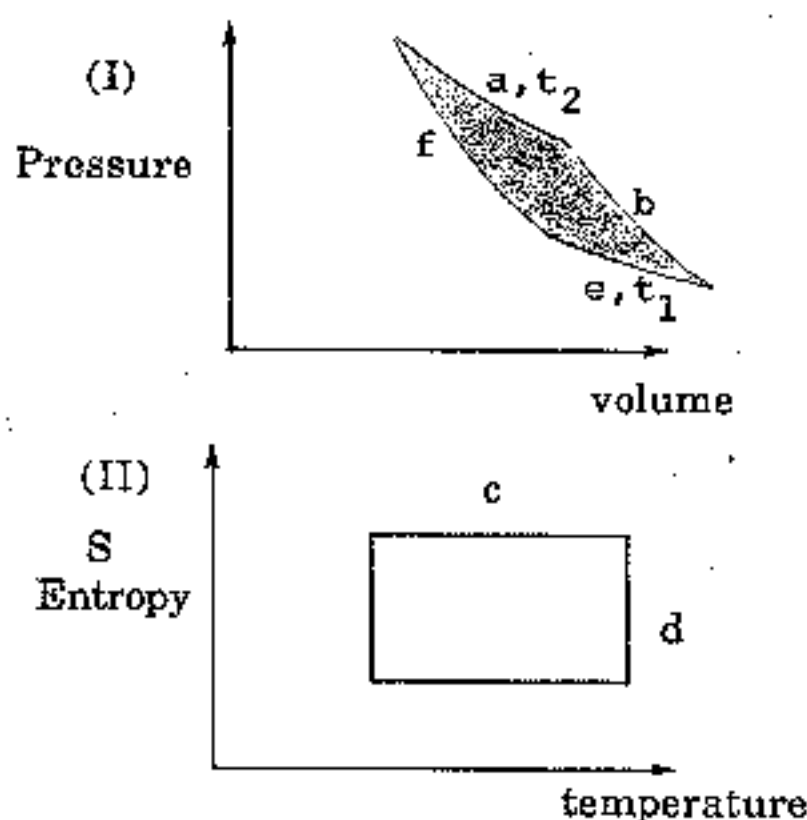


Figure II represents the Carnot cycle in a S - T diagram.

Curves a and e are isotherms for temperature t_2 and t_1 , respectively.

For curves a , b , c and d which curves represent an adiabatic process.

(A) a, b (B) a, c (C) b, c (D) b, d (E) c, d