

單選 50 題 (每題二分共 100 分) 答錯不倒扣

1. How many unpaired electrons are found in $\text{Mn}(\text{NH}_3)_4^{3+}$?

(A) 4 (B) 5 (C) 1 (D) 0 (E) 2

2. Which of the following is polar?

(A) PBr_3 (B) SiF_4 (C) SBr_6 (D) KrF_2 (E) BF_3

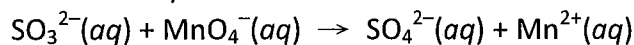
3. Which of the following bonds would be the most polar without being considered ionic?

(A) C-O (B) Mg-O (C) O-O (D) Si-O (E) N-O

4. In a 0.1 molar solution of NaCl in water, which of the following will be closest to 0.1?

(A) the molality of NaCl (B) the mass percent of NaCl (C) the mole fraction of NaCl (D) the mass fraction of NaCl (E) all of these are about 0.1.

5. How many electrons are transferred in the following reaction?



(A) 4 (B) 10 (C) 3 (D) 2 (E) 6

6. Ammonium metavanadate reacts with sulfur dioxide in acidic solution as follows (hydrogen ions and H_2O omitted): $x\text{VO}_3^{-} + y\text{SO}_2 \rightarrow x\text{VO}^{2+} + y\text{SO}_4^{2-}$

The ratio $x : y$ is

(A) 1 : 3 (B) 1 : 2 (C) 2 : 1 (D) 3 : 1 (E) 1 : 1

7. When the equation $\text{Cl}_2 \rightarrow \text{Cl}^{-} + \text{ClO}_3^{-}$ (basic solution) is balanced using the smallest whole-number coefficients, what is the coefficient of OH^{-} ?

(A) 1 (B) 2 (C) 3 (D) 4 (E) 6

8. Which of the following is(are) oxidation-reduction reactions?

I: $\text{PCl}_3 + \text{Cl}_2 \rightarrow \text{PCl}_5$; II: $\text{Cu} + 2\text{AgNO}_3 \rightarrow \text{Cu}(\text{NO}_3)_2 + 2\text{Ag}$; III: $\text{CO}_2 + 2\text{LiOH} \rightarrow \text{Li}_2\text{CO}_3 + \text{H}_2\text{O}$; IV: $\text{FeCl}_2 + 2\text{NaOH} \rightarrow \text{Fe}(\text{OH})_2 + 2\text{NaCl}$

(A) I, II, III, and IV (B) I and II only (C) I, II, and III only (D) IV only (E) III only

9. An aqueous solution of silver nitrate is added to an aqueous solution of potassium chromate, and this reaction produces a solid. What is the formula for the solid?

(A) AgCrO_4 (B) KNO_3 (C) AgK (D) K_2NO_3 (E) Ag_2CrO_4

10. Four identical 1.0-L flasks contain the gases He, Cl_2 , CH_4 , and NH_3 , each at 0°C and 1 atm pressure. Which gas has the highest density?

(A) NH_3 (B) CH_4 (C) Cl_2 (D) He (E) all the gases have the same density.

11. Consider the equation $2\text{X}(\text{g}) \rightleftharpoons 2\text{Y}(\text{g}) + \text{C}(\text{g})$. At a particular temperature, $K = 1.6 \times 10^4$.

Placing the equilibrium mixture in an ice bath (thus lowering the temperature) will

(A) have no effect (B) cause $[\text{X}]$ to increase (C) cause $[\text{Y}]$ to increase (D) cannot be determined (E) none of these

12. Calculate the percentage of pyridine ($\text{C}_5\text{H}_5\text{N}$) that forms pyridinium ion, $\text{C}_5\text{H}_5\text{NH}^+$, in a 0.10 M aqueous solution of pyridine ($K_b = 1.7 \times 10^{-9}$).

(A) 0.77% (B) 0.060% (C) 0.0060% (D) 1.6% (E) 0.013%

13. Identify the strongest base.

(A) CH_3OH (B) CH_3O^- (C) H_2O (D) NO_3^- (E) CN^-

14. The acids $\text{HC}_2\text{H}_3\text{O}_2$ and HF are both weak, but HF is a stronger acid than $\text{HC}_2\text{H}_3\text{O}_2$. HCl is a strong acid. Order the following according to base strength.

(A) $\text{Cl}^- > \text{F}^- > \text{C}_2\text{H}_3\text{O}_2^- > \text{H}_2\text{O}$ (B) $\text{C}_2\text{H}_3\text{O}_2^- > \text{F}^- > \text{H}_2\text{O} > \text{Cl}^-$ (C) $\text{C}_2\text{H}_3\text{O}_2^- > \text{F}^- > \text{Cl}^- > \text{H}_2\text{O}$ (D) $\text{F}^- > \text{C}_2\text{H}_3\text{O}_2^- > \text{H}_2\text{O} > \text{Cl}^-$ (E) none of these

15. A 0.210-g sample of an acid (molar mass = 192 g/mol) is titrated with 30.5 mL of 0.108 M NaOH to a phenolphthalein endpoint. The formula of the acid is

(A) H_3A (B) H_2A (C) H_4A (D) HA (E) not enough information given

16. Calculate the solubility of Ag_2SO_4 [$K_{\text{sp}} = 1.2 \times 10^{-5}$] in a 2.0 M AgNO_3 solution.

(A) 6.0×10^{-6} mol/L (B) 1.2×10^{-5} mol/L (C) 3.0×10^{-6} mol/L (D) 1.4×10^{-2} mol/L (E) none of these

17. Given the equation $\text{S}(s) + \text{O}_2(g) \rightarrow \text{SO}_2(g)$, $\Delta H = -296$ kJ, which of the following statements is(are) true?

I: The reaction is exothermic; II: When 0.500 mol of sulfur is reacted, 148 kJ of energy is released.

III: When 32.0 g of sulfur is burned, 2.96×10^5 J of energy is released.

(A) I and III are true (B) only II is true (C) all are true (D) I and II are true (E) none is true.

18. Given the following two reactions at 298 K and 1 atm, which of the statements is true?

(a) $\text{N}_2(g) + \text{O}_2(g) \rightarrow 2\text{NO}(g)$ ΔH_1

(b) $\text{NO}(g) + (1/2)\text{O}_2(g) \rightarrow \text{NO}_2(g)$ ΔH_2

(A) ΔH_f for $\text{NO}_2(g) = \Delta H_2 + (1/2)\Delta H_1$ (B) $\Delta H_1 = \Delta H_2$ (C) ΔH_f for $\text{NO}(g) = \Delta H_1$ (D) ΔH_f for $\text{NO}_2(g) = \Delta H_2$ (E) none of these

19. A 100-mL sample of water is placed in a coffee cup calorimeter. When 1.0 g of an ionic solid is added, the temperature decreases from 21.5°C to 20.8°C as the solid dissolves. Which of the following is true for the dissolving of the solid?

(A) $\Delta H < 0$ (B) $\Delta S_{\text{sys}} < 0$ (C) $\Delta S_{\text{univ}} > 0$ (D) $\Delta S_{\text{surr}} > 0$ (E) none of these

20. For a spontaneous endothermic process, which conditions must hold?

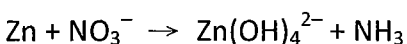
I: $w_{\text{max}} = \Delta G$; II: $\Delta S_{\text{surr}} > 0$; III: ΔS cannot be negative; IV ΔS is positive.

(A) all (B) none (C) I and III only (D) I, II, and IV only (E) III and IV only

21. At constant pressure, the reaction; $2\text{NO}_2(g) \rightarrow \text{N}_2\text{O}_4(g)$ is exothermic. The reaction (as written) is

(A) spontaneous at low temperatures but not at high temperatures (B) spontaneous at high temperatures but not at low temperatures (C) always spontaneous (D) never spontaneous (E) none of these

22. The reaction below occurs in basic solution. In the balanced equation, what is the sum of the coefficients?



(A) 27 (B) 19 (C) 23 (D) 12 (E) 15

23. How many unpaired electrons are there in an atom of sulfur in its ground state?

(A) 1 (B) 2 (C) 4 (D) 0 (E) 3

24. The valence electron configuration of an element is $ns^2(n-1)d^{10}np^2$. To which group does X belong?
(A) Group 3A (B) Group 4A (C) Group 6A (D) Group 5A (E) Group 7A
25. The _____ states that in a given atom no two electrons can have the same set of four quantum numbers (n, l, m_l, m_s).
(A) Pauli exclusion principle (B) Huygens-Fresnel principle (C) Cauchy's argument principle (D) Heisenberg uncertainty principle (E) Le Chatelier's principle
26. Of the following, which molecule has the smallest bond angle?
(A) CO_2 (B) H_2O (C) SCl_2 (D) SO_3 (E) NF_3
27. What type of structure does the XeOF_2 molecule have?
(A) trigonal planar (B) octahedral (C) pyramidal (D) T-shaped (E) tetrahedral
28. Which of the following statements is *false*?
(A) The carbon-carbon bond in C_2^{2-} is shorter than the one in CH_3CH_3 (B) the carbon-carbon bond in C_2^{2-} is stronger than the one in CH_3CH_3 (C) C_2 is diamagnetic (D) C_2 is paramagnetic (E) two of these statements are false.
29. Consider the molecular-orbital energy-level diagrams for O_2 and NO . Which of the following is true? I: Both molecules are paramagnetic; II: The bond strength of O_2 is greater than the bond strength of NO ; III: NO is an example of a homonuclear diatomic molecule; IV: The ionization energy of NO is smaller than the ionization energy of NO^+ .
(A) I and II only (B) I, II, and IV (C) I and IV (D) II and III (E) I only
30. How many of the following are paramagnetic?
 $\text{O}_2, \text{O}_2^-, \text{O}_2^{2-}, \text{B}_2, \text{C}_2, \text{N}_2, \text{F}_2, \text{CN}^-, \text{P}_2$
(A) 3 (B) 2 (C) 4 (D) 5 (E) 0
31. Doping Se with As would produce a(n) _____ semiconductor with _____ conductivity compared to pure Se.
(A) *n*-type, increased (B) *p*-type, increased (C) *n*-type, decreased (D) intrinsic, identical (E) *p*-type, decreased
32. Which of the following statements is *incorrect*?
(A) ionic solids have high melting points (B) the binding forces in a molecular solid include London dispersion forces (C) ionic solids are insulators (D) molecular solids have high melting points (E) all of these statements are correct.
33. A liquid placed in a closed container will evaporate until equilibrium is reached. At equilibrium, which of the following statements is *not* true?
(A) liquid molecules are still evaporating (B) the number of vapor molecules remains essentially constant (C) the partial pressure exerted by the vapor molecules is called the vapor pressure of the liquid (D) the boundary (meniscus) between the liquid and the vapor disappears (E) all of these statements are true.
34. How many different possible tetramethylbenzenes exist?
(A) 6 (B) 2 (C) 5 (D) 3 (E) 4

35. Oxidation of a primary alcohol results in a(n) _____, and oxidation of a secondary alcohol results in a(n) _____.
(A) ester, ether (B) ketone, aldehyde (C) amine, carboxylic acid (D) carboxylic acid, amine (E) aldehyde, ketone
36. Choose the correct molecular structure for IO_4^- .
(A) octahedral (B) tetrahedral (C) trigonal planar (D) trigonal bipyramidal (E) linear
37. What Group 6A elements are semiconductors?
(A) selenium and polonium (B) sulfur and tellurium (C) sulfur and selenium (D) selenium and tellurium (E) tellurium and polonium
38. Which is the most reactive form of phosphorus?
(A) white phosphorus (B) red phosphorus (C) black phosphorus (D) two of these forms of phosphorus are equally reactive (E) all of these forms of phosphorus are equally reactive
39. When a nonvolatile solute is added to a volatile solvent, the solution vapor pressure _____, the boiling point _____, the freezing point _____, and the osmotic pressure across a semipermeable membrane _____.
(A) decreases, decreases, increases, decreases (B) increases, decreases, increases, decreases (C) decreases, increases, decreases, increases (D) increases, increases, decreases, increases (E) decreases, increases, decreases, decreases
40. Which of the following statements is(are) true?
(A) the rate of dissolution of a solid in a liquid always increases with increasing temperature (B) the solubility of a solid in a liquid always increases with increasing temperature (C) according to Henry's law, the amount of gas dissolved in a solution is directly proportional to the pressure of the gas above the liquid (D) two of these statements are true (E) all of these statements are true.
41. Which statement regarding water is true?
(A) liquid water is less dense than solid water. (B) only covalent bonds are broken when ice melts (C) hydrogen bonds are stronger than covalent bonds (D) energy must be given off in order to break down the crystal lattice of ice to a liquid (E) all of these statements are false.
42. Which of the following is the smallest hole in a closest-packed lattice of spheres?
(A) trigonal (B) cubic (C) tetrahedral (D) octahedral (E) none of these
43. The unit cell in a certain lattice consists of a cube formed by an anion at each corner, an anion in the center, and a cation at the center of each face. The unit cell contains a net
(A) 2 anions and 3 cations (B) 2 anions and 2 cations (C) 5 anions and 3 cations (D) 3 anions and 4 cations (E) 5 anions and 6 cations.
44. How many of the following compounds exhibit geometric isomers?
I: $\text{Pd}(\text{NH}_3)_2\text{Br}_2$ (square planar); II: $[\text{Co}(\text{H}_2\text{O})_2]\text{Br}_3$; III: $[\text{Ni}(\text{H}_2\text{O})_4(\text{NO}_2)_2]$; IV: $\text{K}_2[\text{CoCl}_4]$
(A) 2 (B) 3 (C) 1 (D) 4 (E) 0
45. For which of the following metal ions would there be no distinction between low spin and high spin in octahedral complexes?
(A) Cr^{2+} (B) Mn^{2+} (C) Ni^{3+} (D) V^{2+} (E) Co^{3+}

46. Which of the following statements is true of the crystal field model?
(A) the electrons are assumed to be localized (B) the metal ion–ligand bonds are considered completely ionic (C) the ligands are treated as negative point charges (D) the interaction between metal ion and ligand is treated as a Lewis acid–base interaction (E) none of these statements is true
47. A d^6 ion (Fe^{2+}) is complexed with six strong-field ligands (for example, SCN^-). What is the number of unpaired electrons in this complex?
(A) 3 (B) 2 (C) 0 (D) 1 (E) 4
48. Which of the following statements are true about starch?
I: the monomers are fructose and glucose; II: the monomer is glucose; III: it is the main carbohydrate reservoir in plants; IV: It is the main carbohydrate reservoir in animals; V: It is an addition polymer; VI. It is a condensation polymer.
(A) II, III, VI (B) I, IV, V (C) I, III, IV, V (D) I, III, V (E) II, IV, VI
49. Which of the following pairs of substances could form an addition copolymer?
(A) $HOCH_2CH_2OH + HOOCH_2COOH$ (B) $HOOC(CH_2)_3COOH + HOCH_2CH_2CH_2NH_2$ (C) $HOOCCH_2CH_2COOH + HOCH_2OCH_2OH$ (D) $H_2C=CHCH=CH_2 + H_2C=CHCH_3$ (E) $H_2NCH_2COOH + H_2NCH_2CH_2COOH$
50. Which of the following statements is/are true of benzene?
I: Benzene belongs to a class of cyclic unsaturated hydrocarbons known as the aromatic hydrocarbons; II: Benzene undergoes substitution reaction in which hydrogen atoms are replaced by other atoms; III: sp^2 hybrid orbitals on each carbon of a benzene molecule are used to form the H-H and H-C σ bonds.
(A) III only (B) II only (C) I only (D) I and II (E) I and III