# 普通化學

選擇題，共40題，每題2.5分，共100分，答錯不倒扣。

1. Which of the following pairs of compounds can be used to illustrate the law of multiple proportions?
(a) $NH_4$ and $NH_4Cl$, (b) $ZnO_2$ and $ZnCl_2$, (c) $H_2O$ and HCl, (d)NO and $NO_2$, (e) $CH_4$ and $CO_2$.

2. A species with 12 protons and 10 electrons is
(a) $Ne^{2+}$, (b) $Ti^{2+}$, (c) $Mg^{2+}$, (d) Mg, (e) $Ne^{2-}$.

3. The correct name for LiCl is
(a) lithium monochloride, (b) lithium(I) chloride, (c) monolithium chloride, (d) lithium chloride,
(e) monolithium monochloride

4. Nitric acid contains what percent hydrogen by mass?
(a) 20.0, (b) 10.0, (c) 4.50, (d) 3.45, (e) 1.60%.

5. You take an aspirin tablet (a compound consisting solely of carbon, hydrogen, and oxygen) with a mass of 1.00 g, burn it in air, and collect 2.20 g of carbon dioxide and 0.400 g water. The molar mass of aspirin is between 170 and 190 g/mol. The molecular form of aspirin is
(a) $C_6H_8O_5$, (b) $C_9H_8O_4$, (c) $C_8H_{10}O_5$, (d) $C_{10}H_6O_4$, (e) none of these.

6. A solution contains the ions $Ag^+$, $Pb^{2+}$, and $Ni^{2+}$. Dilute solutions of NaCl, $Na_2SO_4$, and $Na_2S$ are available to separate the positive ions from each other. In order to effect separation, the solutions should be added in which order?
(a) $Na_2SO_4$, NaCl, $Na_2S$, (b) $Na_2SO_4$, $Na_2S$, NaCl, (c) $Na_2S$, NaCl, $Na_2SO_4$, (d) NaCl, $Na_2S$, $Na_2SO_4$
(e)NaCl, $Na_2SO_4$, $Na_2S$

7. Which of the following do you need to know to be able to calculate the molarity of a salt solution?

I. the mass of salt added
II. the molar mass of the salt
III. the volume of water added
IV. the total volume of the solution

(a) I, III, (b) I, II, III, (c) II, III, (d) I, II, IV, (e) You need all of the information.

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

I. $PCl_3 + Cl_2 \rightarrow PCl_5$
II. $Cu + 2AgNO_3 \rightarrow Cu(NO_3)_2 + 2Ag$
III. $CO_2 + 2LiOH \rightarrow Li_2CO_3 + H_2O$
IV. $FeCl_2 + 2NaOH \rightarrow Fe(OH)_2 + 2NaCl$

(a) III, (b) IV, (c) I and II, (d) I, II, and III, (e) I, II, III, and IV.

9-10. You have two samples of the same gas in the same size container, with the same pressure. The gas in the first container has a kelvin temperature four times that of the gas in the other container.

9. The ratio of the number of moles of gas in the first container compared to that in the second is
(a) 1 : 1, (b) 4 : 1, (c) 1 : 4, (d) 2 : 1, (e) 1 : 2.

10. The ratio of number of collisions with the wall in the first container compared to that in the second is

(a) 1 : 1, (b) 4 : 1, (c) 1 : 4, (d) 2 : 1, (e) 1 : 2.

11. A balloon has a volume of 1.20 liters at 24.0°C. The balloon is heated to 48.0°C. Calculate the new volume of the balloon.

(a) 1.20 L, (b) 1.30 L, (c) 1.70 L, (d) 2.10 L, (e) 2.40 L.

12. Calculate the density of nitrogen at STP.

(a) 0.312, (b) 0.625, (c) 0.800, (d) 1.25, (e) 1.60 g/L.

13. A 1.00-g sample of a gaseous compound of boron and hydrogen occupies 0.820 L at 1.00 atm and 3°C. What is the molecular formula for the compound?

(a) $BH_3$, (b) $B_2H_6$, (c) $B_4H_{10}$, (d) $B_3H_{12}$, (e) $B_5H_{14}$.

14-15. For the reaction given below, 2.00 moles of A and 3.00 moles of B are placed in a 6.00-L container.

$$A(g) + 2B(g) \rightleftharpoons C(g)$$

14. At equilibrium, the concentration of A is 0.300 mol/L. What is the concentration of B at equilibrium?

(a) 0.300, (b) 0.433, (c) 0.500, (d) 0.600 mol/L, (e) none of these.

15. At equilibrium, the concentration of A is 0.300 mol/L. What is the value of $K$?

(a) 0.146, (b) 0.253, (c) 0.300, (d) 0.589, (e) 1.043.

16. Calculate $K_p$ for $H_2O(g) + 1/2O_2(g) \rightleftharpoons H_2O_2(g)$ at 600 K, using the following data:

$H_2(g) + O_2(g) \rightleftharpoons H_2O_2(g)$ $K_p = 2.3 \times 10^6$ at 600 K

$2H_2(g) + O_2(g) \rightleftharpoons 2H_2O(g)$ $K_p = 1.8 \times 10^{37}$ at 600 K

(a) $4.4 \times 10^{43}$, (b) $9.8 \times 10^{24}$, (c) $1.2 \times 10^{-4}$, (d) $5.4 \times 10^{-13}$, (e) $2.6 \times 10^{-31}$.

17. A 5.95-g sample of an acid, $H_2X$, requires 45.0 mL of a 0.500 M NaOH solution for complete reaction (removing both protons). The molar mass of the acid is

(a) 132, (b) 178, (c) 264, (d) 529, (e) none of these.

18. Of energy, enthalpy, work, and heat, how many are non-state functions?

(a) 4, (b) 3, (c) 2, (d) 1, (e) 0.

19. Which of the following statements correctly describes the signs of $q$ and $w$ for the following exothermic process at $P = 1$ atm and $T = 370$ K?

$$H_2O(g) \rightarrow H_2O(l)$$

(a) $q$ and $w$ are negative. (b) $q$ is positive, $w$ is negative. (c) $q$ is negative, $w$ is positive. (d) $q$ and $w$ are both positive. (e) $q$ and $w$ are both zero.

20. Given the equation $S(s) + O_2(g) \rightarrow SO_2(g)$, $\Delta H = -296$ kJ, which of the following statement(s) is (are) true?

I. The reaction is exothermic.
II. When 0.500 mole sulfur is reacted, 148 kJ of energy is released.
III. When 32.0 g of sulfur are burned, $2.96 \times 10^5$ J of energy is released.
(a) All are true. (b) None is true. (c) I and II are true. (d) I and III are true. (e) Only II is true.

21. Consider the following processes:

$2A \rightarrow 1/2B + C$ $\quad \Delta H_1 = 5$ kJ/mol

$(3/2)B + 4C \rightarrow 2A + C + 3D$ $\quad \Delta H_2 = -15$ kJ/mol

$E + 4A \rightarrow C$ $\quad \Delta H_3 = 10$ kJ/mol

Calculate $\Delta H$ for: $C \rightarrow E + 3D$

(a) 0, (b) 10, (c) –10, (d) 20, (e) –20 kJ/mol.

22. For a particular chemical reaction

$\Delta H = 5.5$ kJ and $\Delta S = -25$ J/K

Under what temperature condition is the reaction spontaneous?

(a) When $T < -220$ K. (b) When $T < 220$ K. (c) The reaction is spontaneous at all temperatures.
(d) The reaction is not spontaneous at any temperature. (e) When $T > 220$ K.

23. For the reaction $A + B \rightarrow C + D$, $\Delta H^\circ = +40$ kJ and $\Delta S^\circ = +50$ J/K. Therefore, the reaction under standard conditions is

(a) spontaneous at temperatures less than 10 K.
(b) spontaneous at temperatures greater than 800 K.
(c) spontaneous only at temperatures between 10 K and 800 K.
(d) spontaneous at all temperatures.
(e) nonspontaneous at all temperatures.

24. Consider the freezing of liquid water at –10°C. For this process what are the signs for $\Delta H$, $\Delta S$, and $\Delta G$?

| | $\Delta H$ | $\Delta S$ | $\Delta G$ |
|---|---|---|---|
| Option 1: | + | – | 0 |
| Option 2: | – | + | 0 |
| Option 3: | – | + | – |
| Option 4: | + | – | – |
| Option 5: | – | – | – |

(a) Option 1, (b) Option 2, (c) Option 3, (d) Option 4, (e) Option 5.

25. Consider the following processes:

I. Condensation of a liquid.

II. Increasing the volume of 1.0 mol of an ideal gas at constant temperature.

III. Dissolving an ionic solid in water.

IV. Heating 1.0 mol of an ideal gas at constant volume.

For how many of these is $\Delta S$ positive?

(a) 0, (b) 1, (c) 2, (d) 3, (e) 4.

26. Which of the following is the best reducing agent?

$Cl_2 + 2e^- \rightarrow 2Cl^-$ $\quad E^\circ = 1.36$ V

$Mg^{2+} + 2e^- \rightarrow Mg$ $\quad E^\circ = -2.37$ V

$2H^+ + 2e^- \rightarrow H_2$ $\quad E^\circ = 0.00$ V

(a) $Cl_2$, (b) $H_2$, (c) Mg, (d) $Mg^{2+}$, (e) $Cl^-$.

27. A cell is set up with copper and lead electrodes in contact with $CuSO_4(aq)$ and $Pb(NO_3)_2(aq)$, respectively, at 25°C. The standard reduction potentials are:

$Pb^{2+} + 2e^- \rightarrow Pb \quad E° = -0.13$ V

$Cu^{2+} + 2e^- \rightarrow Cu \quad E° = +0.34$ V

If the $Pb^{2+}$ and $Cu^{2+}$ are each 1.0 M, the potential of the cell, in volts, is:

(a) 0.46, (b) 0.92, (c) 0.22, (d) 0.58, (e) none of these.

28. The galvanic cell described by $Zn(s) \mid Zn^{2+}(aq) \mid\mid Cu^{2+}(aq) \mid Cu(s)$ has a standard cell potential of 1.101 volts. Given that $Zn(s) \rightarrow Zn^{2+}(aq) + 2e^-$ has an oxidation potential of 0.762 volts, determine the reduction potential for $Cu^{2+}$.

(a) –1.863, (b) 1.863, (c) –0.339, (d) 0.339 V, (e) none of these.

29. If $l = 3$, how many electrons can be contained in all the possible orbitals?

(a) 7, (b) 6, (c) 14, (d) 10, (e) 5.

30. Order the elements S, Cl, and F in terms of increasing atomic radii.

(a) S, Cl, F, (b) Cl, F, S, (c) F, S, Cl, (d) F, Cl, S, (e) S, F, Cl.

31. Consider the following orderings.

I. $Al < Si < P < Cl$
II. $Be < Mg < Ca < Sr$
III. $I < Br < Cl < F$
IV. $Na^+ < Mg^{2+} < Al^{3+} < Si^{4+}$

Which of these give(s) a correct trend in ionization energy?

(a) III, (b) I, II, (c) I, IV, (d) I, III, IV, (e) none of them.

32. Given the following information:

| | |
|---|---|
| $Li(s) \rightarrow Li(g)$ | heat of sublimation of Li(s) = 166 kJ/mol |
| $HCl(g) \rightarrow H(g) + Cl(g)$ | bond energy of HCl = 427 kJ/mol |
| $Li(g) \rightarrow Li^+(g) + e^-$ | ionization energy of Li(g) = 520. kJ/mol |
| $Cl(g) + e^- \rightarrow Cl^-(g)$ | electron affinity of Cl(g) = –349 kJ/mol |
| $Li^+(g) + Cl^-(g) \rightarrow LiCl(s)$ | lattice energy of LiCl(s) = –829 kJ/mol |
| $H_2(g) \rightarrow 2H(g)$ | bond energy of $H_2$ = 432 kJ/mol |

Calculate the net change in energy for the reaction $2Li(s) + 2HCl(g) \rightarrow 2LiCl(s) + H_2(g)$

(a) 363, (b) –73, (c) –179, (d) –562 kJ, (e) None of these.

33. The hybridization of the central atom in $ClF_3$ is:

(a) sp, (b) $sp^2$, (c) $sp^3$, (d) $dsp^3$, (e) $d^2sp^3$.

34. Which of the following molecules has a bond order of 1.5?

(a) $O_2^+$, (b) $N_2$, (c) $O_2^-$, (d) $C_2$, (e) none of these.

35-36. The following initial rate data were found for the reaction

$$2MnO_4^- + 5H_2C_2O_4 + 6H^+ \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$$

| $[MnO_4^-]_0$ | $[H_2C_2O_4]_0$ | $[H^+]_0$ | Initial Rate (M/s) |
|---|---|---|---|
| $1 \times 10^{-3}$ | $1 \times 10^{-3}$ | 1.0 | $2 \times 10^{-4}$ |
| $2 \times 10^{-3}$ | $1 \times 10^{-3}$ | 1.0 | $8 \times 10^{-4}$ |
| $2 \times 10^{-3}$ | $2 \times 10^{-3}$ | 1.0 | $1.6 \times 10^{-3}$ |
| $2 \times 10^{-3}$ | $2 \times 10^{-3}$ | 2.0 | $1.6 \times 10^{-3}$ |

35. Which of the following is the correct rate law?

(a) Rate = $k[MnO_4^-]^2[H_2C_2O_4]^5[H^+]^6$
(b) Rate = $k[MnO_4^-]^2[H_2C_2O_4][H^+]$
(c) Rate = $k[MnO_4^-][H_2C_2O_4][H^+]$
(d) Rate = $k[MnO_4^-]^2[H_2C_2O_4]$
(e) Rate = $k[MnO_4^-]^2[H_2C_2O_4]^2$

36. What is the value of the rate constant?
(a) $2 \times 10^5\ M \cdot s^{-1}$, (b) $2 \times 10^5\ M^{-2} \cdot s^{-1}$, (c) $200\ M^{-1} \cdot s^{-1}$, (d) $200\ M^{-2} \cdot s^{-1}$, (e) $2 \times 10^{-4}\ M \cdot s^{-1}$.

37. In any cubic lattice an atom lying at the corner of a unit cell is shared equally by how many unit cells?

(a) 1, (b) 2, (c) 4, (d) 8, (e) 16.

38. A certain metal fluoride crystallizes in such a way that the fluoride ions occupy simple cubic lattice sites, while the metal atoms occupy the body centers of half the cubes. The formula for the metal fluoride is:

(a) MF, (b) $MF_2$, (c) $M_2F$, (d) $MF_4$, (e) $MF_8$.

39. What is the electron configuration of the Mn(II) ion?

(a) $[Ar]4s^23d^5$, (b) $[Ar]4s^13d^5$, (c) $[Ar]4s^23d^3$, (d) $[Ar]3d^5$, (e) none of these.

40. Which of the following is paramagnetic?

(a) $Zn(H_2O)_6^{2+}$, (b) $Co(NH_3)_6^{3+}$ (strong field), (c) $Cu(CN)_3^{2-}$, (d) $Mn(CN)_6^{2-}$ (strong field),

(e) none of these.