AP Chemistry

Syllabus Checklist · 大纲自查表

Tick one box per statement: ☐ not yet ☐ nearly ☐ confident. 每条打一个勾：尚未掌握 / 快会了 / 有把握。

1. Atomic Structure and Properties 原子结构与性质

1.1 Moles and Molar Mass 摩尔与摩尔质量

☐☐☐ Calculate quantities of a substance or its relative number of particles using dimensional analysis and the mole concept.

1.2 Mass Spectra of Elements 元素的质谱

☐☐☐ Explain the quantitative relationship between the mass spectrum of an element and the masses of the element's isotopes.

1.3 Elemental Composition of Pure Substances 纯净物的元素组成

☐☐☐ Explain the quantitative relationship between the elemental composition by mass and the empirical formula of a pure substance.

1.4 Composition of Mixtures 混合物的组成

☐☐☐ Explain the quantitative relationship between the elemental composition by mass and the composition of substances in a mixture.

1.5 Atomic Structure and Electron Configuration 原子结构与电子排布

☐☐☐ Represent the ground-state electron configuration of an atom of an element or its ions using the Aufbau principle.

1.6 Photoelectron Spectroscopy 光电子能谱

☐☐☐ Explain the relationship between the photoelectron spectrum of an atom or ion and:

1.7 Periodic Trends 周期性变化趋势

☐☐☐ Explain the relationship between trends in atomic properties of elements and electronic structure and periodicity.

1.8 Valence Electrons and Ionic Compounds 价电子与离子化合物

☐☐☐ Explain the relationship between trends in the reactivity of elements and periodicity.

2. Compound Structure and Properties 化合物的结构与性质

2.1 Types of Chemical Bonds 化学键的类型

☐☐☐ Explain the relationship between the type of bonding and the properties of the elements participating in the bond.

2.2 Intramolecular Force and Potential Energy 分子内作用力与势能

☐☐☐ Represent the relationship between potential energy and distance between atoms, based on factors that influence the interaction strength.

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2.3 Structure of Ionic Solids 离子固体的结构

☐☐☐ Represent an ionic solid with a particulate model that is consistent with Coulomb's law and the properties of the constituent ions.

2.4 Structure of Metals and Alloys 金属与合金的结构

☐☐☐ Represent a metallic solid and/or alloy using a model to show essential characteristics of the structure and interactions present in the substance.

2.5 Lewis Diagrams 路易斯结构式

☐☐☐ Represent a molecule with a Lewis diagram.

2.6 Resonance and Formal Charge 共振与形式电荷

☐☐☐ Represent a molecule with a Lewis diagram that accounts for resonance between equivalent structures or that uses formal charge to select between nonequivalent structures.

2.7 VSEPR and Bond Hybridization 价层电子对互斥理论与杂化

☐☐☐ Based on the relationship between Lewis diagrams, VSEPR theory, bond orders, and bond polarities:

3. Properties of Substances and Mixtures 物质与混合物的性质

3.1 Intermolecular and Interparticle Forces 分子间与粒子间作用力

☐☐☐ Explain the relationship between the chemical structures of molecules and the relative strength of their intermolecular forces when:

3.2 Properties of Solids 固体的性质

☐☐☐ Explain the relationship among the macroscopic properties of a substance, the particulate-level structure of the substance, and the interactions between these particles.

3.3 Solids, Liquids, and Gases 固体、液体与气体

☐☐☐ Represent the differences between solid, liquid, and gas phases using a particulate-level model.

3.4 Ideal Gas Law 理想气体定律

☐☐☐ Explain the relationship between the macroscopic properties of a sample of gas or mixture of gases using the ideal gas law.

3.5 Kinetic Molecular Theory 分子运动论

☐☐☐ Explain the relationship between the motion of particles and the macroscopic properties of gases with:

3.6 Deviation from Ideal Gas Law 偏离理想气体定律

☐☐☐ Explain the relationship among non-ideal behaviors of gases, interparticle forces, and/or volumes.

3.7 Solutions and Mixtures 溶液与混合物

☐☐☐ Calculate the number of solute particles, volume, or molarity of solutions.

3.8 Representations of Solutions 溶液的表示方法

☐☐☐ Using particulate models for mixtures:

3.9 Separation of Solutions and Mixtures 溶液与混合物的分离

☐☐☐ Explain the results of a separation experiment based on intermolecular interactions.

3.10 Solubility 溶解度

☐☐☐ Explain the relationship between the solubility of ionic and molecular compounds in aqueous and nonaqueous solvents, and the intermolecular interactions between particles.

3.11 Spectroscopy and the Electromagnetic Spectrum 光谱学与电磁波谱

☐☐☐ Explain the relationship between a region of the electromagnetic spectrum and the types of molecular or electronic transitions associated with that region.

3.12 Properties of Photons 光子的性质

☐☐☐ Explain the properties of an absorbed or emitted photon in relationship to an electronic transition in an atom or molecule.

3.13 Beer-Lambert Law 比尔-朗伯定律

☐☐☐ Explain the amount of light absorbed by a solution of molecules or ions in relationship to the concentration, path length, and molar absorptivity.

4. Chemical Reactions 化学反应

4.1 Introduction for Reactions 化学反应导论

☐☐☐ Identify evidence of chemical and physical changes in matter.

4.2 Net Ionic Equations 净离子方程式

☐☐☐ Represent changes in matter with a balanced chemical or net ionic equation:

4.3 Representations of Reactions 反应的表示方法

☐☐☐ Represent a given chemical reaction or physical process with a consistent particulate model.

4.4 Physical and Chemical Changes 物理变化与化学变化

☐☐☐ Explain the relationship between macroscopic characteristics and bond interactions for:

4.5 Stoichiometry 化学计量

☐☐☐ Explain changes in the amounts of reactants and products based on the balanced reaction equation for a chemical process.

4.6 Introduction to Titration 滴定导论

☐☐☐ Identify the equivalence point in a titration based on the amounts of the titrant and analyte, assuming the titration reaction goes to completion.

4.7 Types of Chemical Reactions 化学反应的类型

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☐☐☐ Identify a reaction as acid-base, oxidation-reduction, or precipitation.

4.8 Introduction to Acid-Base Reactions 酸碱反应导论

☐☐☐ Identify species as Brønsted-Lowry acids, bases, and/or conjugate acid-base pairs, based on proton-transfer involving those species.

4.9 Oxidation-Reduction (Redox) Reactions 氧化还原反应

☐☐☐ Represent a balanced redox reaction equation using half-reactions.

5. Kinetics 化学动力学

5.1 Reaction Rates 反应速率

☐☐☐ Explain the relationship between the rate of a chemical reaction and experimental parameters.

5.2 Introduction to Rate Law 速率定律导论

☐☐☐ Represent experimental data with a consistent rate law expression.

5.3 Concentration Changes Over Time 浓度随时间的变化

☐☐☐ Identify the rate law expression of a chemical reaction using data that show how the concentrations of reaction species change over time.

5.4 Elementary Reactions 基元反应

☐☐☐ Represent an elementary reaction as a rate law expression using stoichiometry.

5.5 Collision Model 碰撞模型

☐☐☐ Explain the relationship between the rate of an elementary reaction and the frequency, energy, and orientation of particle collisions.

5.6 Reaction Energy Profile 反应能量图

☐☐☐ Represent the activation energy and overall energy change in an elementary reaction using a reaction energy profile.

5.7 Introduction to Reaction Mechanisms 反应机理导论

☐☐☐ Identify the components of a reaction mechanism.

5.8 Reaction Mechanism and Rate Law 反应机理与速率定律

☐☐☐ Identify the rate law for a reaction from a mechanism in which the first step is rate limiting.

5.9 Pre-Equilibrium Approximation 预平衡近似

☐☐☐ Identify the rate law for a reaction from a mechanism in which the first step is not rate limiting.

5.10 Multistep Reaction Energy Profile 多步反应能量图

☐☐☐ Represent the activation energy and overall energy change in a multistep reaction with a reaction energy profile.

5.11 Catalysis 催化作用

□□□ Explain the relationship between the effect of a catalyst on a reaction and changes in the reaction mechanism.

6. Thermochemistry 热化学

6.1 Endothermic and Exothermic Processes 吸热与放热过程

□□□ Explain the relationship between experimental observations and energy changes associated with a chemical or physical transformation.

6.2 Energy Diagrams 能量图

□□□ Represent a chemical or physical transformation with an energy diagram.

6.3 Heat Transfer and Thermal Equilibrium 热传递与热平衡

□□□ Explain the relationship between the transfer of thermal energy and molecular collisions.

6.4 Heat Capacity and Calorimetry 热容与量热法

□□□ Calculate the heat q absorbed or released by a system undergoing heating/cooling based on the amount of the substance, the heat capacity, and the change in temperature.

6.5 Energy of Phase Changes 相变的能量

□□□ Explain changes in the heat q absorbed or released by a system undergoing a phase transition based on the amount of the substance in moles and the molar enthalpy of the phase transition.

6.6 Introduction to Enthalpy of Reaction 反应焓导论

□□□ Calculate the heat q absorbed or released by a system undergoing a chemical reaction in relationship to the amount of the reacting substance in moles and the molar enthalpy of reaction.

6.7 Bond Enthalpies 键焓

□□□ Calculate the enthalpy change of a reaction based on the average bond energies of bonds broken and formed in the reaction.

6.8 Enthalpy of Formation 生成焓

□□□ Calculate the enthalpy change for a chemical or physical process based on the standard enthalpies of formation.

6.9 Hess's Law 盖斯定律

□□□ Represent a chemical or physical process as a sequence of steps.

□□□ Explain the relationship between the enthalpy of a chemical or physical process and the sum of the enthalpies of the individual steps.

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7. Equilibrium 化学平衡

7.1 Introduction to Equilibrium 化学平衡导论

□□□ Explain the relationship between the occurrence of a reversible chemical or physical process, and the establishment of equilibrium, to experimental observations.

7.2 Direction of Reversible Reactions 可逆反应的方向

□□□ Explain the relationship between the direction in which a reversible reaction proceeds and the relative rates of the forward and reverse reactions.

7.3 Reaction Quotient and Equilibrium Constant 反应商与平衡常数

□□□ Represent the reaction quotient Q_c or Q_p, for a reversible reaction, and the corresponding equilibrium expressions $K_c = Q_c$ or $K_p = Q_p$.

7.4 Calculating the Equilibrium Constant 平衡常数的计算

□□□ Calculate K_c or K_p based on experimental observations of concentrations or pressures at equilibrium.

7.5 Magnitude of the Equilibrium Constant 平衡常数的大小

□□□ Explain the relationship between very large or very small values of K and the relative concentrations of chemical species at equilibrium.

7.6 Properties of the Equilibrium Constant 平衡常数的性质

□□□ Represent a multistep process with an overall equilibrium expression, using the constituent K expressions for each individual reaction.

7.7 Calculating Equilibrium Concentrations 平衡浓度的计算

□□□ Identify the concentrations or partial pressures of chemical species at equilibrium based on the initial conditions and the equilibrium constant.

7.8 Representations of Equilibrium 平衡的表示方法

□□□ Represent a system undergoing a reversible reaction with a particulate model.

7.9 Introduction to Le Chatelier's Principle 勒夏特列原理导论

□□□ Identify the response of a system at equilibrium to an external stress, using Le Châtelier's principle.

7.10 Reaction Quotient and Le Chatelier's Principle 反应商与勒夏特列原理

□□□ Explain the relationships between Q, K, and the direction in which a reversible reaction will proceed to reach equilibrium.

7.11 Introduction to Solubility Equilibria 溶解平衡导论

□□□ Calculate the solubility of a salt based on the value of K_{sp} for the salt.

7.12 Common-Ion Effect 同离子效应

☐☐☐ Identify the solubility of a salt, and/or the value of K_{sp} for the salt, based on the concentration of a common ion already present in solution.

8. Acids and Bases 酸与碱

8.1 Introduction to Acids and Bases 酸碱导论

☐☐☐ Calculate the values of pH and pOH, based on K_w and the concentration of all species present in a neutral solution of water.

8.2 pH and pOH of Strong Acids and Bases 强酸与强碱的 pH 与 pOH

☐☐☐ Calculate pH and pOH based on concentrations of all species in a solution of a strong acid or a strong base.

8.3 Weak Acid and Base Equilibria 弱酸与弱碱的平衡

☐☐☐ Explain the relationship among pH, pOH, and concentrations of all species in a solution of a monoprotic weak acid or weak base.

8.4 Acid-Base Reactions and Buffers 酸碱反应与缓冲溶液

☐☐☐ Explain the relationship among the concentrations of major species in a mixture of weak and strong acids and bases.

8.5 Acid-Base Titrations 酸碱滴定

☐☐☐ Explain results from the titration of a mono- or polyprotic acid or base solution, in relation to the properties of the solution and its components.

8.6 Molecular Structure of Acids and Bases 酸碱的分子结构

☐☐☐ Explain the relationship between the strength of an acid or base and the structure of the molecule or ion.

8.7 pH and pKa pH 与 pKa

☐☐☐ Explain the relationship between the predominant form of a weak acid or base in solution at a given pH and the pK_a of the conjugate acid or the pK_b of the conjugate base.

8.8 Properties of Buffers 缓冲溶液的性质

☐☐☐ Explain the relationship between the ability of a buffer to stabilize pH and the reactions that occur when an acid or a base is added to a buffered solution.

8.9 Henderson-Hasselbalch Equation 亨德森-哈塞尔巴尔赫方程

☐☐☐ Identify the pH of a buffer solution based on the identity and concentrations of the conjugate acid-base pair used to create the buffer.

8.10 Buffer Capacity 缓冲容量

☐☐☐ Explain the relationship between the buffer capacity of a solution and the relative concentrations of the conjugate acid and conjugate base components of the solution.

8.11 pH and Solubility pH 与溶解度

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☐☐☐ Identify the qualitative effect of changes in pH on the solubility of a salt.

9. Thermodynamics and Electrochemistry 热力学与电化学

9.1 Introduction to Entropy 熵导论

☐☐☐ Identify the sign and relative magnitude of the entropy change associated with chemical or physical processes.

9.2 Absolute Entropy and Entropy Change 绝对熵与熵变

☐☐☐ Calculate the standard entropy change for a chemical or physical process based on the absolute entropies (standard molar entropies) of the species involved in the process.

9.3 Gibbs Free Energy and Thermodynamic Favorability 吉布斯自由能与热力学倾向性

☐☐☐ Explain whether a physical or chemical process is thermodynamically favored based on an evaluation of ΔG°.

9.4 Thermodynamic and Kinetic Control 热力学控制与动力学控制

☐☐☐ Explain, in terms of kinetics, why a thermodynamically favored reaction might not occur at a measurable rate.

9.5 Free Energy and Equilibrium 自由能与平衡

☐☐☐ Explain whether a process is thermodynamically favored using the relationships between K, ΔG°, and T.

9.6 Free Energy of Dissolution 溶解的自由能

☐☐☐ Explain the relationship between the solubility of a salt and changes in the enthalpy and entropy that occur in the dissolution process.

9.7 Coupled Reactions 耦合反应

☐☐☐ Explain the relationship between external sources of energy or coupled reactions and their ability to drive thermodynamically unfavorable processes.

9.8 Galvanic (Voltaic) and Electrolytic Cells 原电池与电解池

☐☐☐ Explain the relationship between the physical components of an electrochemical cell and the overall operational principles of the cell.

9.9 Cell Potential and Free Energy 电池电势与自由能

☐☐☐ Explain whether an electrochemical cell is thermodynamically favored, based on its standard cell potential and the constituent half-reactions within the cell.

9.10 Cell Potential Under Nonstandard Conditions 非标准条件下的电池电势

☐☐☐ Explain the relationship between deviations from standard cell conditions and changes in the cell potential.

9.11 Electrolysis and Faraday's Law 电解与法拉第定律

☐☐☐ Calculate the amount of charge flow based on changes in the amounts of reactants and products in an electrochemical cell.