

Unit 1: Basic Chemistry

Chapter 1: Chemical Foundations

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13. Li, lithium; F, fluorine; P, phosphorus; Cu, copper; As, arsenic; Zn, zinc; Cl, chlorine; Pt, platinum; Mg, magnesium; U, uranium; Al, aluminum; Si, silicon; Ne, neon.
15. (a) element (b) compound (c) element (d) compound
21. 3.12 g/mL
25. (a) 386 K (b) 3.10×10^2 K (c) 6.30×10^2 K
27. Using scientific notations can eliminate long strings of zeros that associate with very big and very small numbers. Scientific notations also express these numbers in proper significant digits.
28. Significant Figures are the meaningful digits in a measured or calculated quantity. It is important to use significant figures in reporting and calculating values in sciences because it conveys the margin of errors (precision) of the measuring devices used.
29. (a) 2.7×10^{-8} (b) 3.56×10^2 (c) 4.7764×10^4 (d) 9.6×10^{-2}
35. (a) 10.6 m (b) 0.79 g (c) 16.5 cm^2
41. 8.3 min

Chapter 2: Atoms, Molecules and Ions

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3. α particle: helium ion with a positive charge of +2;
cathode ray: an invisible ray consisting of electrons;
protons: subatomic particle with a charge of +1 and a mass of 1.67×10^{-27} kg
neutron: subatomic particle with no charge and a mass of 1.67×10^{-27} kg
electrons: subatomic particle with a charge of -1 and a mass of 9.11×10^{-31} kg
5. J. J Thomson: Cathode Ray, electrons, Plum-Pudding Model
R.A. Millikan: found the charge and mass of an electron using the Oil-Drop Experiment
E. Rutherford: Gold-Foil Experiment; Nuclear Model
J. Chadwick: discovered neutrons
12. X is the element symbol which can be identified by the atomic number Z, and A is the mass number of the isotope.
20. Answers may vary:
Nonmetals: can be solids, liquids or gases at room temperature, poor heat and electric conductors
Metals: mostly solids at room temperature, excellent conductors of heat and electricity, malleable, ductile, shiny
23. Helium and Selenium are nonmetals whose name ends with *ium*. (Tellurium is a metalloid whose name ends in *ium*.)
33. Elements: N₂, S₈, H₂ Compounds: NH₃, NO, CO, CO₂, SO₂
37. The chemical formula represents the number and the type of atoms that make up the molecule.
(a) 1 N : 1 O (b) 1 N : 3 Cl (c) 2 N : 4 O (d) 4 P : 6 O
40. P₄ signifies a molecular unit consisting of four phosphorus atoms. 4 P means four individual phosphorus atoms.
42. Ionic compounds usually have chemical formulas that are the same as their empirical formulas because they are written as the lowest multiples of cations and anions such that their overall charges cancel each other out.

51. Organic Compounds: consist of hydrocarbons
Inorganic Compounds: does not consist of hydrocarbons
55. HCl can be gaseous molecular compound or it can be $\text{HCl}_{(aq)}$ as an ionic compound dissolved in water that dissociates into ions H^+ and Cl^-
57. (a) potassium dihydrogen phosphate (b) potassium hydrogen phosphate
(c) hydrogen bromide (molecular compound) (d) hydrobromic acid
(e) lithium carbonate (f) potassium dichromate
(g) ammonium nitrite (h) iodic acid
(i) phosphorus pentafluoride (j) tetraphosphorus hexoxide
(k) cadmium iodide (l) strontium sulfate
(m) aluminum hydroxide
59. (a) RbNO_2 (b) K_2S (c) NaHS (d) $\text{Mg}_3(\text{PO}_4)_2$ (e) CaHPO_4
(f) KH_2PO_4 (g) IF_7 (h) $(\text{NH}_4)_2\text{SO}_4$ (i) AgClO_4 (j) BCl_3

Chapter 3: Mass Relationships in Chemical Reactions

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5. 35.45 amu
7. 2.19×10^{-23} g
13. 3.07×10^{24} S atoms
15. 1.93 mol Ca
17. (a) 3.331×10^{-22} g/Hg atom (b) 3.351×10^{-23} g/Ne atom
19. 3.44×10^{-10} g Pb
21. 6.57×10^{23} H atoms and 1.70×10^{23} Cr atoms
(There are more hydrogen atoms than chromium atoms.)
25. 409 g/mol
83. NO is the limiting reagent; it limits the amount of product produced. The amount of product produced is 0.886 mole NO_2 .
85. (a) $\text{C}_3\text{H}_8(g) + 5 \text{O}_2(g) \rightarrow 3 \text{CO}_2(g) + 4 \text{H}_2\text{O}(l)$ (b) 482 g of CO_2

Chapter 4: Reactions in Aqueous Solutions

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2. Nonelectrolytes are solutes that do not conduct electricity when dissolved in a solvent (molecular compound solutes). Electrolytes are solutes that conduct electricity when dissolved in a solvent (ionic compound solutes). When an ionic compound dissolves completely in water, all ions are broken apart from each other. Hence, electricity conduct strongly and these ions are called strong electrolytes. Weak electrolytes are ionic solids that are slightly soluble in water and very small amount of ions are broken apart from the solid solute. Therefore, they can only conduct electricity mildly.
3. Hydration is a process in which an ion or a molecule is surrounded by water molecules arranged in a specific manner. Water is polar so it can attract other polar molecules and ions easily.
4. The symbol, \rightarrow , in a chemical equation means that the reaction goes to completion. That is all the reactants turn into products and at the end there are no original reactants are left. The symbol, \rightleftharpoons , indicates equilibrium where the reaction will achieve a dynamic state in which there are some reactants and products present. Hence, the reaction has a back-flow and it is not 100% forward.

