Tennessee Science

Chemistry II: Grades 9, 10, 11, 12

Adopted 2016

Matter and Its Interactions CHEM2.PS1

1. **Illustrate and explain the arrangement of electrons surrounding atoms and ions (electron configurations and orbital notation of a specific electron in an element) and relate the arrangement of electrons with observed periodic trends.** CHEM2.PS1.1
2. **Gather evidence and perform calculations to determine the composition of a compound.** CHEM2.PS1.2
3. **Compare and contrast crystalline and amorphous solids with respect to particle arrangement, strength of bonds, melting and boiling points, bulk density, and conductivity; provide examples of each type.** CHEM2.PS1.3
4. **Investigate and use mathematical representations to support Dalton's law of partial pressures and to compare and contrast diffusion and effusion.** CHEM2.PS1.4
5. **Obtain data and solve combined and ideal gas law problems and stoichiometry problems at STP and non STP conditions to quantitatively explain the behavior of gases.** CHEM2.PS1.5
6. **Use the Van der Waal's equation to support explanations of how real gases deviate from the ideal gas law.** CHEM2.PS1.6
7. **Investigate, describe, and mathematically determine the effect of solute concentration on vapor pressure using Raoult's Law and of the solute's van 't Hoff factor on freezing point depression and boiling point elevation.** CHEM2.PS1.7
8. **Develop models to show how different types of polymers, such as proteins, nucleic acids, and starches, are formed by repetitive combinations of simple subunits by condensation and addition reactions and to show the diverse bonding characteristics of carbon.** CHEM2.PS1.8
9. **Evaluate different organic molecules by naming and drawing the ten simplest linear hydrocarbons and isomers that contain single, double, and/or triple bonds and by identifying and explaining the properties of functional groups.** CHEM2.PS1.9

10. **Obtain, evaluate, and communicate information about how carbon's structure and function are used and have influenced society.** CHEM2.PS1.10

11. **Conduct a qualitative analysis lab to determine the solubility rules. Use solubility rules to identify spectator ions and write net ionic equations for precipitation reactions.** CHEM2.PS1.11

12. **Analyze oxidation and reduction reactions to identify the substances gaining and losing electrons, distinguish between the cathode and anode, predict reactions, and balance oxidation-reduction reactions in acidic or basic solutions.** CHEM2.PS1.12

13. **Investigate models and explore uses of electrochemistry (batteries and electrochemical cells).** CHEM2.PS1.13

14. **Conduct titrations with standard solutions (monoprotic and diprotic) and an appropriate indicator and/or a pH probe to determine the concentration of an unknown acid or base, and with a weak acid or weak base to determine the Ka or Kb and the pH at the equivalence point.** CHEM2.PS1.14

15. **Explain common chemical reactions, including those found in biological systems, using qualitative and quantitative information.** CHEM2.PS1.15

16. **Create a model of the atomic substructure including electrons, protons, neutrons, quarks, and gluons.** CHEM2.PS1.16

Motion and Stability: Forces and Interactions CHEM2.PS2

1. **Plan and conduct an investigation to compare the properties of the different types of intermolecular forces in pure substances and in components of a mixture.** CHEM2.PS2.1

2. **Make predictions regarding the relative magnitudes of the forces acting within collections of interacting molecules based on the distribution of electrons within the molecules and types of intermolecular forces through which the molecules interact.** CHEM2.PS2.2

3. **Investigate and use mathematical evidence to support that rates of chemical reactions are determined by details of the molecular collisions.** CHEM2.PS2.3

4. **Analyze data and mathematically determine rate equations.** CHEM2.PS2.4

5. **Investigate the parameters of chemical equilibria in the laboratory by A) writing and calculating equilibrium expressions (Kc, Kp, Ksp, Ka, Kb); B) calculating Q and determining the direction the reaction will proceed; and, C) calculating equilibrium concentrations given an equilibrium constant and starting amounts.** CHEM2.PS2.5

6. **Compare and contrast the strength and dissociation of strong and weak acids and bases by calculating the pH and percent ionization of a solution.** CHEM2.PS2.6

7. **Research, investigate, and mathematically explain buffer systems (characteristics and capacities using the Henderson-Hasselbalch equation), including those found in biological systems and polyprotic acids.** CHEM2.PS2.7

Energy CHEM2.PS3

1. **Mathematically determine the enthalpy change for a given reaction using Hess's Law, standard enthalpies of formation, or a given mass of a reactant.** CHEM2.PS3.1
2. **Apply scientific principles and mathematical representations to predict if a chemical reaction is spontaneous using Gibb's Free Energy, $\Delta G = \Delta H - T\Delta S$.** CHEM2.PS3.2
3. **Apply scientific and engineering ideas to build, evaluate, and refine a fuel cell model (e.g., graphical representation or as a project) with specific design constraints.** CHEM2.PS3.3
4. **Collect and use data from the synthesis or decomposition of a compound to confirm the conservation of matter and the law of definite proportions.** CHEM2.PS3.4
5. **Use Coulomb's law and patterns of valence electron configurations to explain trends in ionization energies and reactivity of pure elements.** CHEM2.PS3.5
6. **Explain the relationships between potential energy, distance between approaching atoms, bond length, and bond energy using graphical representations.** CHEM2.PS3.6
7. **Investigate and explain the energy changes in biological systems (such as the combustion of sugar and photosynthesis) both qualitatively and quantitatively.** CHEM2.PS3.7
8. **Research pyrotechnics and use concepts in thermodynamics, stoichiometry, oxidation reduction, and kinetics to design and create a low intensity sparkler.** CHEM2.PS3.8

Waves and Their Applications in Technologies for Information Transfer CHEM2.PS4

1. **Investigate and contrast the mechanism of energy changes and the appearance of absorption and emission spectra.** CHEM2.PS4.1
2. **Apply scientific principles and mathematical representations ($C = \lambda v$ and $E = hv$) to explain that spectral lines are the result of and correspond to transitions between energy levels.** CHEM2.PS4.2