Chemistry AP Unit 4 Outline: Thermochemistry and Nuclear Chemistry

Chapter 6: Thermochemistry

Classes	Topics	Suggested Reading	✓	Assignments	✓
1	Energy, Law of Conservation of Energy (First Law of Thermodynamics), Heat (q), Work (w), Reaction Pathway, State Function (Property), Systems versus Surroundings, Exothermic versus Endothermic, Internal Energy (E), $\Delta E = q + w$, $w = -P\Delta V$, Enthalpy ($H = E + PV$ and $H = n\Delta H_{rxn}$), Energy Diagram and Change in Enthalpy ($\Delta H < 0$ Exothermic, $\Delta H > 0$ Endothermic), Heating Curve, Potential Energy (Phase Changes, $\Delta H = n\Delta H_{fus}$ and $\Delta H = n\Delta H_{vap}$), Kinetic Energy (Temperature Change, Specific Heat Capacity, $\Delta H = mC\Delta T$), Physical Calorimetry (Heat Gained = Heat Lost)	6.1: The Nature of Chemistry (pg. 242 to 248) 6.2: Enthalpy and Calorimetry (pg. 248 to 256)		pg. 281 #21 to 28 pg. 504–505 #81 to 86; pg. 280 #9, 10; pg 281–282 #29 to 44	
2	Hess's Law (Adding ΔH), Molar Heat of Formation (ΔH_f), Theoretical Heat of Reaction ($\Delta H_{rxn} = \Sigma H_{products} - \Sigma H_{reactants}$), Chemical Calorimetry and Experimental Heat of Reaction ($n\Delta H_{rxn} = mC\Delta T$ and $n\Delta H_{sol} = mC\Delta T$), Enthalpies of Combustion	6.3: Hess's Law (pg. 256 to 260) 6.4: Standard Enthalpies of Formation (pg. 260 to 266)		pg. 283 #51 to 58 pg. 284 #59 to 68; pg. 282–283 #45 to 50	
3	Fossil Fuels (Natural Gas, Petroleum, and Coal), Complete and Incomplete Combustions, Fractional Distillation, Cracking and Reforming, Greenhouse Effect (Global Warming), Deforestation, Hydrogen as Fuel, Other Energy Alternatives	6.5: Present Sources of Energy (pg. 267 to 271) 6.6: New Energy Sources (pg. 271 to 277)		pg. 284–285 #69 to 74	
4	**Lab #8: Heat of Solvation and Molar Heat of Fusion (January 11, Friday)**			**Lab Report #8 Due: January 31, Thurs**	
5	**Chapter 6 Quiz (January 15, Tuesday)**				

Chapter 16: Spontaneity, Entropy, and Free Energy

Classes	Topics	Suggested Reading	✓	Assignments	✓
1	Spontaneous Process, Entropy (S), Positional Probability, Change in Entropy ($\Delta S = \Sigma S_{products} - \Sigma S_{reactants}$), Second Law of Thermodynamics ($\Delta S_{univ} = \Delta S_{sys} + \Delta S_{surr}$), Spontaneous ($\Delta S_{univ} > 0$), Non-Spontaneous ($\Delta S_{univ} < 0$)	16.1: Spontaneous Process and Entropy (pg. 784 to 790) 16.2: Entropy and the Second Law of Thermodynamics (pg. 790)		pg. 819 #15 to 17; 19, 20 pg. 818 #9 and 11	
2	Entropy of the Surrounding $\left(\Delta S_{surr} = \frac{-\Delta H}{T}\right)$, Free Energy ($G$), Change in Free Energy ($\Delta G = \Sigma G_{products} - \Sigma G_{reactants}$ and $\Delta G = \Delta H - T\Delta S$), Free Energy and Spontaneity, Free Energy at Equilibrium ($\Delta G = 0$)	16.3: The Effect of Temperature on Spontaneity (pg. 791 to 795) 16.4: Free Energy (pg. 795 to 798)		pg. 819 #21 and 22 pg. 819 #23 to 28	
3	Third Law of Thermodynamics, Change in Entropy in Chemical Reactions ($\Delta S_{rxn} = \Sigma S_{products} - \Sigma S_{reactants}$), Free Energy Change in Chemical Reactions ($\Delta G_{rxn} = \Sigma G_{products} - \Sigma G_{reactants}$), Standard Free Energy of Formation ($\Delta G°_f$)	16.5: Entropy Changes in Chemical Reactions (pg. 798 to 801) 16.6: Free Energy and Chemical Reactions (pg. 802 to 806)		pg. 819–820 #29 to 40 pg. 820 #41 to 50	
4	**Lab #9: Heat of Combustion (January 24, Thursday)**			**Lab Report #9 Due: January 31, Thursday**	
5	**Chapter 16 Quiz (January 31, Thursday)**				

Chapter 18: The Nucleus: A Chemist's View

Classes	Topics	Suggested Reading	✓	Assignments	✓
1	Nucleons (Neutrons and Protons), Thermodynamic and Kinetic Stability, Radioactive Decay, Beta Particle $\left(\beta={}^{0}_{-1}e\right)$, Zone of Stability, Alpha Particle $\left(\alpha={}^{4}_{2}\mathrm{He}\right)$, α and β particles productions, spontaneous fission, gamma $\left(\gamma \text{ or } {}^{0}_{0}\gamma\right)$ ray, positron $\left({}^{0}_{1}e\right)$ and production, Electron Capture, Decay Series, Rate of Decay, Rate Constant of Decay (k), $\ln\left(\frac{N}{N_0}\right) = -kt$, Half-Life $\left(t_{1/2} = \frac{\ln 2}{k}\right)$	18.1: Nuclear Stability and Radioactive Decay (pg. 878 to 883) 18.2: The Kinetics of Radioactive Decay (pg. 883 to 886)		pg. 906–907 #9 to 12, 14 pg. 907 #19 to 26	
2	Nuclear Transformations, Particle Accelerator, Cyclotron, Linear Accelerator, Transuranium Elements, Geiger-Müller (Geiger) Counter, Radioactive Dating, Carbon-14 Dating, Radiotracers	18.3: Nuclear Transformations (pg. 886 to 889) 18.4: Detection and Uses of Radioactivity (pg. 889 to 893)		pg. 907 #17 and 18 pg. 907–908 #27 to 30	
3	Mass Defect (Δm), Binding Energy ($\Delta E = \Delta mc^2$), Nuclear Fission, Chain Reaction (Subcritical, Critical, and Supercritical), Critical Mass, Nuclear Fission Reactors (Reactor Core, Moderator, and Control Rods), Breeder Reactors, Nuclear Fusion, Effects of Radiation (Somatic and Genetic damages) – energy, penetration ability, ionization ability, and chemical properties of radiation	18.5: Thermodynamics Stability of the Nucleus (pg. 894 to 897) 18.6: Nuclear Fission and Nuclear Fusion (pg. 897 to 902) 18.7: Effects of Radiation (pg. 902 to 905)		pg. 908 #31 to 38 pg. 909 #43 and 49	
4	**Unit 4 Test (February 8, Friday)**				