CHEM 311: PHYSICAL CHEMISTRY–I

Instructional objectives for Exam-1 (Chapters 1 & 2)

	Sec. No.	**Objective**	**Bloom's cognitive levels**	**Related problems**
1.	1.3	Define system, and the types of systems.	1	
2.	1.3	Distinguish between intensive and extensive properties	4	1.5
3.	1.4	State the zeroth law of thermodynamics and explain , in terms an elementary school student can understand, the concept of thermal equilibrium	1,2	
4.	1.5	Unit conversions: Pa/bar, L/m^3, resolving J and Pa into more fundamental SI units.	1,2	
5.	1.5	Relate the pressure measured as the height or height difference of a barometric/mano-metric liquid, to Pa, bar, or atm units.	1,3	1.7, 1.8, 1.9, HW1.1
6.	1.5-1.8	P, V, T, n calculations involving ideal gas law.	3	1.10, 1.11, 1.12, 1.13
7.	1.8	Calculation of gas density ρ or molecular mass M from ideal gas law.	3	1.16, 1.17
8.	1.9	Apply Dalton's law of partial pressures.	3	1.18, 1.19, 1.20
9.	1.9	Explain the behavior of gases in terms of kinetic molecular theory of gases, including the relationships between molecular velocity and temperature.	2,3,4	HW1.2, HW2.1, 1.27, 1.28, 1.29.
10.	1.9	Calculations of collision frequency, density, and mean free path.	1,2,3	1.32, 1.37
11.	1.12	List the ways in which real gases violate the assumptions of kinetic molecular theory.	1	
12.	1.12	Explain the critical behavior of real gases using a PV diagram, identify the critical point, and define the critical variables.	1,2,3	1.51
13.	1.13	Explain, to an elementary school student, the role of the two parameters in the van der Waals equation.	1,2	1.53
14.	1.13	Pressure calculation from van der Waals equation of state.	2,3	1.49
15.	1.13	Volume calculation from compressibility factor, Z.	3,4	1.50
16.	1.13	Calculations using the law of corresponding states.	3,4	1.52, 1.57, HW1.3
17.	1.14	Calculations of Boyle temperature from equations of state.		1.54, 1.55

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18.	2.2	State the first law of thermodynamics in a mathematical equation and explain the significance of each term, including the sign conventions adopted in the "system-centered" point of view.	1,2	
19.	2.2	Explain the difference between a state variable and a path-dependent variable, classify given variables as one or the other.	1,2,4	
20.	2.3	Explain, in terms an elementary school student can understand, the difference between a reversible process and an actual process.	1,2	
21.	2.4	Define enthalpy and its relationship to exothermic and endothermic processes.	1,2,3	
22.	2.4, 2.6	Apply the relationship between $C_{P,m}$ and $C_{V,m}$ for an ideal gas.	2,3	2.37–2.46, 2.50
23.	2.4, 2.6	Calculate enthalpy and internal energy changes for a gas.	2,3	2.37–2.46, 2.50, HW2.4
24.	2.5	Apply Hesse's law to calculate reaction enthalpies or enthalpies of formation.	2,3,5	2.16, 2.18, 2.21, 2.23–2.26, 2.31
25.	2.5	Explain to a high school graduate why $\Delta H°$ is obtained directly from constant pressure calorimetry, and $\Delta U°$ from constant volume calorimetry.	1,2	
26.	2.5	Calculate $\Delta_c U°$ and $\Delta_c H°$ from bomb calorimeter data by writing and balancing the combustion equation to obtain Δn, the change in the number of moles of gases during reaction.	2,3,4	2.5, 2.15, 2.17, 2.32, 2.35
27.	2.5	Use the temperature dependence of $C_{P,m}$ to calculate enthalpy changes as a gas is heated.	2,3	2.46, HW2.2
28.	2.5	Combine Hesse's law with the expression for the temperature dependence of $C_{P,m}$ to calculate enthalpy of reaction at temperatures other than 298 K.	2,3,5	2.14
29.	2.3, 2.5	Construct a reversible path from initial to the final state for enthalpy calculations.	2,3,4,5,6	2.4
30.	2.6	Explain, in terms an elementary school student can understand, the processes described as isothermal, isobaric, isochoric, and adiabatic.	1,2	

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31.	2.6	Calculate the work done during reversible and irreversible expansion of an ideal gas.	2,3	2.2, 2.7, 2.37–2.43
32.	21.	Construct reversible paths from given initial and final states of a gas undergoing a process using combinations of isothermal, isobaric, isochoric, and adiabatic processes.	2,3,4,5	2.37, HW2.4
33.	2.6	Calculate heat, work, and change in internal energy during isothermal, isobaric, isochoric, and adiabatic processes.	2,3	2.37–2.43, HW2.4
34.	2.7	Calculate the work done during reversible and irreversible expansion of a real gas (equation of state provided).	2,3,5	2.63, 2.64, HW2.3