

Chemistry 2850 Practice Test 1

Time: 50 min

Marks: 50

Aids permitted: calculator, one 8.5×11 -inch formula sheet

1. Describe the processes in each of the steps of a Carnot cycle. For each step, say whether work is done on or by the system. [4 marks]
2. Using a diagram, explain why a reversible isothermal expansion produces more work than any real isothermal expansion of the same substance. [6 marks]
3. Describe the Joule-Thompson experiment. Explain what is measured in this experiment and what information this gives us. [8 marks]
4. An ideal gas for which $C_{V,m} = 12.5 \text{ J K}^{-1} \text{ mol}^{-1}$ initially at 300 K and 1 bar is heated at constant volume until the pressure reaches 5 bar. Calculate w , q , ΔU , ΔH and ΔS for this process (per mole). [12 marks]
5. (a) What is the enthalpy of combustion of α -D-glucose at 10°C ? [6 marks]
(b) If you burned 1 g of glucose in a bomb calorimeter near 25°C , how much heat would be released? The molar mass of glucose is 180.156 g/mol . [6 marks]
6. Estimate the standard enthalpy of formation of methane from data available on this exam paper. [8 marks]

Useful data $R = 8.314472 \text{ J K}^{-1} \text{ mol}^{-1}$

To convert degrees Celsius to Kelvin, add 273.15.

The gas-phase carbon-hydrogen bond enthalpy is 413 kJ/mol .

Standard thermodynamic data at 1 bar and 25°C

Species	$\frac{\Delta_f H^\circ}{\text{kJ/mol}}$	$\frac{C_{P,m}}{\text{J K}^{-1} \text{ mol}^{-1}}$
$\text{C}_{(g)}$	716.68	20.8
$\text{C}_6\text{H}_{12}\text{O}_6(s)$ (α -D-glucose)	-1274.4	218.16
$\text{CO}_{2(g)}$	-393.51	37.1
$\text{H}_{(g)}$	217.998	20.786
$\text{H}_2\text{O}_{(l)}$	-285.830	75.40
$\text{O}_{2(g)}$	0	29.35