

Quiz: Thermochemistry & Quantum Mechanics (Chapters 5 & 6)

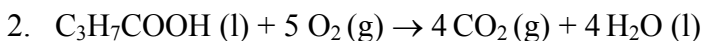
AP Chem

Version B (24 pts)

$$\Delta E = h\nu \qquad c = \lambda\nu \qquad E_n = \frac{-2.178 \times 10^{-18} \text{ joule}}{n^2} \qquad q = mc\Delta T$$
$$c = 3.0 \times 10^8 \text{ m s}^{-1} \qquad h = 6.63 \times 10^{-34} \text{ J s}$$

Complete on a separate sheet of paper. Show your work for all problems involving calculations and be sure to box your final answer and include sensible units.

1. (4 pts) A sample of Ni ($c_{\text{Ni}} = 0.444 \text{ J/g}^\circ\text{C}$) at 400.0°C is added to 500.0 g of 5.0°C water ($c_{\text{water}} = 4.18 \text{ J/g}^\circ\text{C}$). If the final temperature of the Ni and water mixture is 15.0°C , what was the mass of the Ni sample?



(8 pts) The enthalpy change for the (balanced) combustion of butyric acid, $\Delta H^\circ_{\text{combustion}}$, is $-2,183.5$ kilojoules per mole.

Substance	ΔH_f° (kJ mol ⁻¹)
CO ₂ (g)	-393.5
H ₂ O (l)	-285.85
C ₃ H ₇ COOH (l)	?

- a. (2 pts) How mass of butyric acid must be combusted to produce 100.0 kilojoules of heat?
- b. (6 pts) From the above data, calculate the standard heat of formation, ΔH_f° , for butyric acid.
3. (6 pts) A certain line in the spectrum of atomic hydrogen is associated with the electronic transition of the H atom from the fifth energy level ($n = 5$) to the fourth energy level ($n = 4$).
- a. (4 pts) Calculate the change in energy, in J, associated with this electronic transition
- b. (2 pts) Calculate the frequency, in s^{-1} , of the radiation associated with the spectral line.
4. (6 pts) State whether the following quantum number sets are **permissible** (allowed) or **forbidden** (not allowed) and describe how you made your choice.
- a. $n = 2, l = 2, m_l = 1$
- b. $n = 3, l = 2, m_l = -2$
- c. $(2, 0, 0)$