Chemistry [illegible] – Summer [illegible] – Worksheet #[illegible]

1. (a) A [illegible] g sample of benzene at [illegible] °C was cooled to its melting point ([illegible] °C). How much heat was given off in this process? The specific heat capacity of liquid benzene is 1.74 J/g·K, and its heat of fusion is 127 J/g.

$q = m \times c \times \Delta T$ = [illegible] g × 1.74 J/g·K × ([illegible] – [illegible]) K

= [illegible] × 1.74 × ([illegible]) = [illegible] J

(b) The benzene was then frozen at the melting point. How much heat was transferred in this process? Is the heat change exothermic or endothermic. The heat of fusion of benzene is 127 J/g.

The heat change associated with melting is q_{fusion} and is endothermic. In freezing, the heat change is the opposite sign ($-q_{fusion}$) and is exothermic.

$q = m \times (-q_{fusion})$ = [illegible] g × (–127 J/g) = [illegible] kJ

2. Acetic acid (CH_3CO_2H) is made industrially by the reaction of methanol and carbon monoxide.

CH_3OH (l) + CO (g) → CH_3CO_2H (l) ΔH°_{rxn} = [illegible] kJ

If you produce 1.00 L of acetic acid (density = [illegible] g/mL) by this reaction, what quantity of heat is evolved?

The amount of heat generated or consumed in a reaction scales with the amount of material. Here we are given the enthalpy change per mole of acetic acid produced, so we need to convert volume to grams to moles.

mol acetic acid = 1.00 L × (1000 mL / 1 L) × ([illegible] g / mL) × (1 mol / [illegible] g) = [illegible] mol

ΔH° = [illegible] kJ/mol × [illegible] mol = [illegible] kJ

3. Enthalpy changes for the following reactions can be measured experimentally.

(1) $N_2(g) + 3 H_2(g) \rightarrow 2 NH_3(g)$ ΔH° = [illegible] kJ

(2) $4 NH_3(g) + 5 O_2(g) \rightarrow 4 NO(g) + 6 H_2O(g)$ ΔH° = [illegible] kJ

(3) $H_2(g) + ½ O_2(g) \rightarrow H_2O(g)$ ΔH° = [illegible] kJ