Alex Iacob

Prof. Lanzafame

CHMG 142 Section 1

February 9, 2021

**Mastery #1**: I have 50.0 g of ethanol (C2H5OH) at 100 K. I want gaseous ethanol at 373 K. How much energy do I need to add?

q = mcΔT

q = 50.0 g \* 2.44 (J/g K) \* (159 K – 100 K)

q = 7198 J (heating the solid)

q = ΔHf \* m

q = 109 (J / g) \* 50 g

q = 5450 J (fusion of solid)

q = mcΔT

q = 50.0 g \* 2.44 (J/g K) \* (352 K – 159 K)

q = 23546 J (heating the liquid)

q = ΔHv \* m

q = 841 (J / g) \* 50 g

q = 42050 J (evaporation of liquid)

q = mcΔT

q = 50.0 g \* 2.44 (J/g K) \* (373 K – 352 K)

q = 2562 J (heating the steam)

7198 J + 5450 J + 23546 J + 42050 J + 2562 J = 80808 J -> 80.81 kJ

**Mastery #2**: Consider the following reaction for the combustion of natural gas (CH4):

CH4 (g) + 2 O2 (g) → CO2 + 2 H2O ∆Hrxn = -882 kJ/mol

If I use this reaction as the source of heat in Mastery #1, how much methane would I need to burn to get my ethanol to 373 K?

(80.81 kJ) / (882 kJ / mol) = 0.0916 moles of CH4

**Mastery #3:** My driveway is 60 feet long and 10 feet wide. My driveway is coated in ice to an average depth of 1.2 inches. The current temperature is -5 ºC. How much ethanol (g) would I need to throw on the driveway to have an ice-free driveway?

Volume of driveway ice = 60ft \* 10ft \* 1.2in =

1828.8cm \* 304.8cm \* 3.048cm = 1699010.8 = 1.699 \* 106 mL (cm3 -> mL)

1.699 \* 106 mL \* (0.919 g / 1 mL) = 1.56 \* 106 g -> 1.56 \* 103 kg of ice (mL -> kg)

1.56 \* 103 kg \* (2.688 mols ethanol / 1 kg water) = 4193.28 mols of ethanol (kg -> mols)

4193.28 mols ethanol \* (46.07 g / 1 mol of ethanol) = 193184.4096 grams of ethanol

**Mastery #4:** What would the boiling point of ethanol be at the top of Mt. Everest where the average atmospheric pressure is 0.64 atm?

ln(P2 / P1) = (ΔHvap / R) [ (1 / T1) – (1 / T2)]

ln(1 atm / 0.64 atm) = [(0.846 kJ / g) / (8.314 \* 10-3 kJ K mol) ] [ (1 / T1) – (1 / 352 K) ]

0.4463 = 101.756 \* [ (1 / T1) – (1 / 352 K) ]

4.386 \* 10-3= [ (1 / T1) – (1 / 352 K) ]

7.227 \* 10-3 = (1 / T1)

138.375 K = T1

-134.775 °C = T1

Source for heat of vaporization of ethanol:

https://chem.libretexts.org/Ancillary\_Materials/Reference/Reference\_Tables/Bulk\_Properties/B2:\_Heats\_of\_Vaporization\_(Reference\_Table)