Homework #1 Due: 8/25

Show all work for full credit.

10 pts E [20 pts total]

Name: Solution

1. Determine the total heat (BTUs) required to take a 25 lb block of ice that is held in a freezer at 18°F and convert it into steam at 220°F

Sensible Heat 18°F to 32°F solid

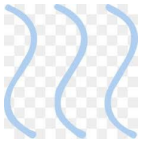
Q = M x C x ΔT = 25 lb x 1 Btu/lb°F x (32°F -18°F) = 350 Btu

Latent Heat 32°F to Melted

Q = 144 Btu/lb x 25 lb = 3,600 Btu

Sensible Heat Melted @32°F to 190°F

Q = M x C x ΔT = 25 lb x 1 Btu/lb°F x (212°F - 32°F) = 4,500 Btu



Latent Heat 212°F to vapor (steam)

Q = 970 Btu/lb x 25 lb = 24,250 Btu

Sensible Heat 212°F to 220°F Steam

Q = M x C x ΔT = 25 lb x 1 Btu/lb°F x (220°F -212°F) = 200 Btu

Total Heat (Enthalpy) = 350 Btu + 3,600 Btu + 4,500 Btu + 24,250 Btu + 200 Btu = 32,900 Btu

METHOD 1

Sensible Heat = 25 lb x 1 Btu/lb°F x (220°F - 18°F) = 5,050 Btu

Latent Heat of Fusion = 144 Btu/lb x 25 lb = 3,600 Btu

Latent Heat of Vaporization = 970 Btu/lb x 25 lb = 24,250 Btu

Total Heat (Enthalpy) = 4,850 Btu + 3,600 Btu + 24,250 Btu= 32,900 Btu

2. Determine the amount of heat (BTUs) released by a 260 ft^2 concrete wall that is 8 in thick that is warmed to 156°F during the day and cools to 54°F overnight.

$Q = M \times C \times \Delta T$

$= (260\ ft^2 \times 8\ in \times 1\ ft/12\ in) \times 144\ lb/ft^3 \times 0.21\ Btu/lb°F \times (156°F - 54°F)$

$= (173.33\ ft^3 \times 144\ lb/ft^3) \times 0.21\ Btu/lb°F \times 102°F$

$= 24{,}960\ lb \times 0.21\ Btu/lb°F \times 102°F$

$= 534{,}643\ Btu$