## FE-Style Questions

**(circle all correct answers; supply supporting reasoning for your answers)**

10-1 What are valid units of the universal gas constant, Ru?  
 a) Btu/(lbm-R)   
 b) kJ/(kg-K)   
 c) kJ/(kgmol-K)   
 d) ft-lbm/(lbmol-R)

10-2 What is the thermodynamic name for a process where enthalpy is constant?   
 a) adiabatic   
 b) aergonic  
 c) isentropic  
 d) isenthalpic

## Practice Problems

1. Solve this problem by hand using your supplemental thermodynamic property tables. You have a rigid, sealed tank with 10.0 ft3 volume that is filled with steam at 100 psia and 500 °F. The tank is then cooled down to 260 °F. Calculate the following:
   1. quality in the container
   2. mass [lbm] of liquid water
   3. mass [lbm] of water vapor
   4. amount of heat transfer [Btu] required for cooling
2. Solve the above problem using **EES.** Additionally, overlay this this process on a P-v diagram that includes lines of constant quality**.**
3. You have gas in a cylinder and the compression process has a polytropic exponent of n = 3 (i.e. the polytropic relationship is p\*V3 = constant). The initial pressure is 10 psia and the initial volume is 10.0 ft3. The final volume is 1.00 ft3. Calculate the moving boundary work for this process [Btu]. You may use EES, or do hand calculations (your choice)
4. You are trying to design a new type of engine and you want the engine cycle to operate like as described below. Calculate the moving boundary work [J] for the whole cycle, and draw the cycle on p-V coordinates. V1 = 0.030 m3, and p1 = 25 kPa.
   1. Isochoric pressurization from p1 to p2 (where p2 = 2\*p1)
   2. Isobaric expansion from V2 to V3 (where V3 = 2\*V2)
   3. Isochoric depressurization from p3 to p4 (where p4 = p1)
   4. Isobaric compression back to the initial state.

## Answers to FE-Style Questions

1. c
2. d

## Answers to Practice Problems

1. Quality at State 2 will be ~47.4%, with 0.848 lbm being vapor and 0.942 lbm being liquid.   
   It will take ~964 Btu removed from the system for this process to happen.
2. If you do this problem with EES you should get nearly the same result. Your p-v diagram should show the process as straight down (since this is a constant specific volume process)
3. Work should be -916 Btu, and it is negative because work would need to be put into the system for this to happen.
4. Net work for this cycle should be ~750 J