

ES 3053 Homework Set #2

Due: September 18, 2020

1. 20 points

- a. Find the work done *by* the system when one mole of an ideal gas is expanded from 200 kPa to 50 kPa at a constant temperature of 300 K. Be sure to check your sign.
- b. Find the work done *by* the system when one mole of an ideal gas is compressed from 5 m³ to 1 m³ at constant temperature of 300 K. Be sure to check your sign.

2. 20 points

A P-H diagram of R-500 (a refrigerant sometimes used in freezers) is attached. Get a highlighting pen and trace the following:

- a. A line of constant pressure at $P = 60$ psia, from 180 to 380°F
- b. A line of constant enthalpy at $H = 130$ BTU/lbm from 220 to 280°F
- c. The process of converting the saturated liquid at 120°F to saturated vapor at constant temperature and pressure.
- d. A constant temperature process beginning with saturated liquid at 30 psia and ending at 10 psia.

Put all the tracings on a single diagram and turn that back in with your homework paper.

3. 20 points

A frictionless piston and cylinder arrangement initially contains one kilogram of pure water at -2°C and 150 kPa. The pressure is maintained by the weight of the piston, and the weight remains constant throughout the process. The arrangement is then heated slowly until the water becomes saturated vapor. Using the water as the system, find Q and W . Use the steam (water) tables in the back of your book for all properties.

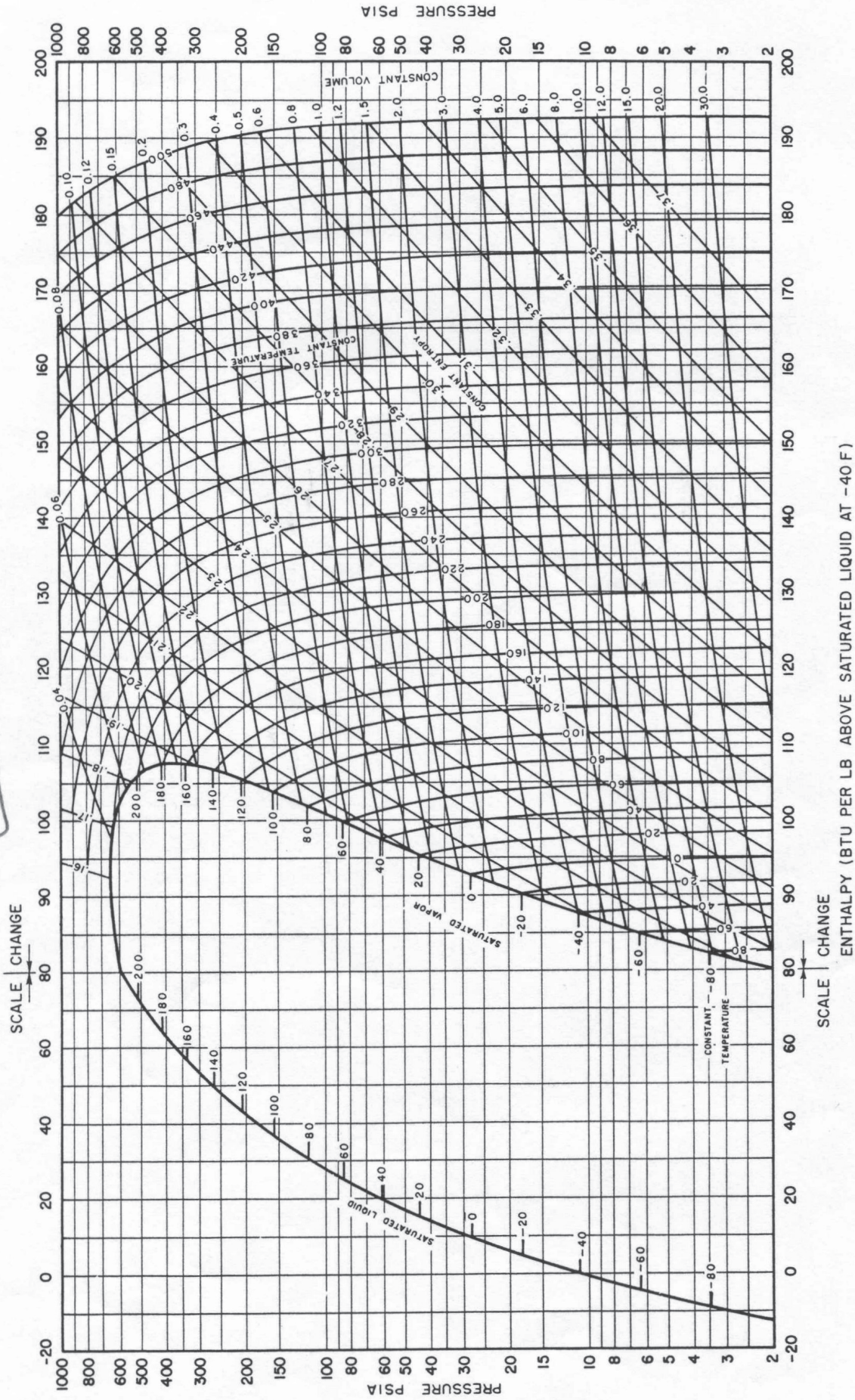
4. 40 points

A rigid container has 2 kg of water vapor at initially at 100 kPa, 300°C that is heated to 500°C. Solve for the amount of heat transferred using:

- a. the heat capacity from Table A-2
- b. the heat capacity equation given in Table A-2
- c. the steam table
- d. CATT3

Which answer is most accurate, and why aren't the answers all the same?

R-500



TEMPERATURE IN °F VOLUME IN CU FT PER LB ENTROPY IN BTU PER LB PER °F

Fig. 9-11. Pressure-enthalpy diagram for refrigerant R-500. Note that 0 of enthalpy scale is taken at -40°F (-40°C). Also note that enthalpy scale changes at 80 Btu per lb. to help technician read superheat values.

