33.54 $20psia$ **saturated liquid water enters a pump and is discharged at** $500psia$**. What is the work done by the pump per unit mass?**

A. $1.5\frac{Btu}{lb_m}$

B. $18.1\frac{Btu}{lb_m}$

C. $19.4\frac{Btu}{lb_m}$

D. $28.7\frac{Btu}{lb_m}$

The work done by a pump is a Constant Volume Process. Neglect the sign for the equation in the handbook which is included to establish reversibility. Work is done by the pump on the fluid. For *total* work, W, the volume wouuld be *extensive* volume, V. However, since the problem is seeking the work done *per unit mass*, use the *specific volume*, v.

$$w = \Delta P v$$

$$w = (P_2 - P_1)\, v_1$$

Look up the specific volume for the entering condition, State 1, because it is fully defined whereas the discharge condition is not fully defined. The discharge is likely to be a compressed liquid. Use the Properties of Saturated Water and Steam table by pressure. Convert psi to psf and $ft \cdot lb_f$ to Btu.

$$w = \left(500\frac{lb_f}{in^2} - 20\frac{lb_f}{in^2}\right)\left(\frac{144in^2}{ft^2}\right)\left(0.0168\frac{ft^3}{lb_m}\right)\left(\frac{1Btu}{778ft \cdot lb_f}\right) = 1.5\frac{Btu}{lb_m}$$

Answer A