Examples (see ppt file)

Example 1: → Gas bottle overnight
(see ppt file)

Example 2:

$$\Delta E_p = -W = \Delta(mgh) = mg\Delta h$$

$$-\frac{W}{m} = g\Delta h$$

$$= \frac{\left(32.2 \frac{ft}{s^2}\right)(40\,ft)}{32.2 \frac{ft\text{-}lbm}{lb_f\text{-}s^2}} = 40 \frac{ft\text{-}lb_f}{lbm}$$

Convert to Btu

$$\left(40 \frac{ft\text{-}lb_f}{lbm}\right)\left(\frac{9.486 \times 10^{-4}\ Btu}{.7376\ ft\text{-}lb_f}\right) = \boxed{0.0514 \frac{Btu}{lbm}}$$

or in kw-hr

$$\left(40 \frac{ft\text{-}lb_f}{lbm}\right)\left(\frac{2.778 \times 10^{-7}\ kw\text{-}h}{.7376\ ft\text{-}lb_f}\right) = 1.51 \times 10^{-5} \frac{kW\text{-}hr}{lbm}$$

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Example 3 (Problem 7.5)

(a) Air
300°C
130 kPa

d = 7 cm
V = 42 m/s

$$\dot{E}_k = \frac{1}{2}\dot{m}v^2 \qquad \dot{m} = \rho A V$$

$$\rho = \frac{PM}{RT} = \frac{(130\times10^3\ Pa)(29\ g/mol)}{\left(8.314\ \frac{Pa\cdot m^3}{g\,mol\cdot K}\right)(573\ K)} \qquad \text{ideal gas law}$$

$$= 791\ g/m^3$$

$$\dot{m} = \rho A V = \left(791\ \frac{g}{m^3}\right)\left(\frac{\pi(.07\ m)^2}{4}\right)\left(42\ m/s\right)$$

$A = 3.85\times10^{-3}\ m^2$

$$= 128\ g/s$$

Therefore

$$\dot{E}_k = \frac{1}{2}\dot{m}v^2 = \left(\frac{1}{2}\right)\left(.128\ \frac{kg}{s}\right)\left(42\ \frac{m}{s}\right)^2$$

$$= 113\ \frac{kg\cdot m^2}{s^3} = 113\ \frac{N\cdot m}{s} = 113\ \frac{J}{s} = 113\ W$$

(b)

$\dot{m}$ = constant

$$\rho_{400°C} = \frac{(130\times10^3)(29)}{(8.314)(673)} = 674\ \frac{g}{m^3}$$

$$V_{new} = \frac{\dot{m}}{\rho A} = \frac{128\ g/s}{\left(674\ \frac{g}{m^3}\right)\left(3.85\times10^{-3}\ m^2\right)} = 49.3\ m/s$$

$$\Delta\dot{E}_k = \left(\frac{1}{2}\right)\left(128\ \frac{g}{s}\right)\left[\left(49.3\ \frac{m}{s}\right)^2 - \left(42\ \frac{m}{s}\right)^2\right]$$

$$= 4.26\times10^4\ \frac{g\cdot m^2}{s^3} = 42.6\ J/s = 42.6\ W$$

(c) ΔU changes as well

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