Pset #3

2.50) Energy Balance indicates

Heat energy removed = energy generated (?)

Heat load for a/c :

$$\dot{Q}_{lights} + \dot{Q}_{people} + \dot{Q}_{walls}$$

$$= \frac{10{,}000\,kW}{1000} + 40 \times \frac{360}{3600}\,kw + \frac{15000}{3600}\,kW$$

$$= (1 + 4 + 4.17)\ kW$$

$$= 9.17\ kW$$

No. of units $= \frac{9.17\ kw}{5} \simeq 2$ units

2.54) $\rho_{air} = 1.18\ kg/m^3$

$$\dot{m}_{air} = (4)(1.18)\ \frac{kg}{s} = 4.72\ kg/s$$

Energy Balance on the fan & air systems indicates $\dot{W}_{shaft} = \Delta E)_{air}$

$$\Delta E_{air} = \frac{\dot{m}_{air}\, V_0^2}{2} = \frac{(4.72)(100)^2}{2}$$

$$= 236W$$

Min energy required = 236W

2.69)

$$\dot{Q}_{Total} = (40W)(1.1)(18) + (56)(100)W$$
$$= \underline{6392\,W}$$

2.75) $\dot{V} = 70\,L/s$
$= 0.07\,m^3/s$

The energy required by pump = $\Delta PE)_{water}$

$= \dot{m}\, g\, \Delta z$

$= (1000)\,\dfrac{(0.07)(9.81)}{1000}(20)\left(\dfrac{kJ}{s} = kW\right)$

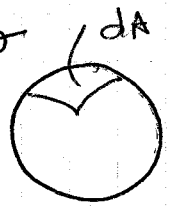
$= \underline{\underline{13.7\,kW}}$

$\dot{W}_{elect} = 20.4\,kW$

$\eta_{system} = \dfrac{13.7}{20.4} = 67.2\%$

(2.35)

Work done in expanding bubble:



$$\sigma \int_{R_1}^{R_2} dA = \sigma (4\pi)(r_2^2 - r_1^2)$$

$$= 4\pi (0.02\ N/m)\left[(0.015m)^2 - (0.005m)^2\right]$$

$$= 5.03 \times 10^{-5}\ N\cdot m$$

$$= 5.03 \times 10^{-8}\ kJ$$

2.41) Level road.

For Constant Velocity

a) 0 → No acceleration & moving ⊥r to gravity

b) $\frac{mg(z_2 - z_1)}{\Delta t} = \underline{mg\ V \sin 30^\circ}$ ↑ against gravity

$$(1200)(9.81)\left(\frac{50{,}000}{3600}\right)\left(\frac{1}{1000}\right) = 81.7\ kW$$

c) $\dot{W}_{total}$ ⇒ only acceleration

$$= \frac{1}{2}\dot{m}\,\frac{(v_2^2 - v_1^2)}{\Delta t}$$

$$= \frac{1}{2}(1200)\left[\left(\frac{90{,}000}{3600}\right)^2 - 0\right]\left(\frac{1}{1000}\right)$$

$$= \underline{31.3\ kW}$$