Equation sheet

- Density $\rho = \frac{m}{v}$
- specific volume $= 1/\rho$
- specific gravity $= \frac{\rho}{\rho_{H_2O}}$
- specific weight $= \rho g$
- Pressure $P = \rho g h$.
- $KE = \frac{mv^2}{2}$
- $PE = mgz$
- $\dot{m} = \rho \dot{V} = \rho A_c V_{avg}$
- $\dot{E} = \dot{m} e$
- $e_{mech} = \frac{P}{\rho} + \frac{v^2}{2} + gz$ (Mechanical energy of flowing fluid)
- Amount of heat transfer $Q = \dot{Q} \Delta t$

Pressure :

$P_{gage} = P_{abs} - P_{atm}$

$P_{vac} = P_{atm} - P_{abs}$

&

$P = \rho g h$

Manometer equation :

$P_1 + \sum_{down} \gamma_i h_i - \sum_{up} \gamma_i h_i = P_2$

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electrical work $W_e = VN$, electric power $= VI$

shaft work $= 2\pi n T$.

$W_b = W_{friction} + W_{atm} + W_{crank}$.

Spring work $= \frac{1}{2} k (x_2^2 - x_1^2)$.

Effeciency $= \frac{\text{Desired output}}{\text{Required input}}$.

for mixture water :: $y_{avg} = y_f + x\, y_{fg}$

Ideal Gas ::
- $PV = ZRT$ ($Z = 1$)
- $Z = \frac{v_{actual}}{v_{ideal}}$
- $P_R = P/P_{cr}$
- $T_R = T/T_{cr}$
- $v_R = \frac{v}{RT_{cr}/P_{cr}}$
- $h = u + RT$

$\Delta u = \int_1^2 C_v(T)\, dT$ kJ/kg

$\Delta h = \int_1^2 C_p(T)\, dT$

$\Delta u = C_{v,avg}(T_2 - T_1)$

$\Delta h = C_{p,avg}(T_2 - T_1)$ any unit

$C_p = C_v + R$, $\bar{C_p} = \bar{C_v} + R_u$

↳ kJ/kg.K

$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T}$ ↓ K or R

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boundary work $W_b = \int_1^2 P\, dv$.

Polytropic process : $P = CV^{-n} \longrightarrow \frac{P_2V_2 - P_1V_1}{1-n} = W_b$

↳ for ideal Gas $W_b = \frac{mR(T_2 - T_1)}{1-n}$

for isothermal Process & ideal Gas $W_b = PV \ln\left(\frac{V_2}{V_1}\right)$.

- $E_{in} - E_{out} = \Delta E \longrightarrow e_{in} - e_{out} = \Delta e_{system}$.

for a cycle :: $W_{net,out} = Q_{net,in}$

- $Q - W = \Delta E \rightarrow Q - W = \Delta KE + \Delta PE + \Delta U$.
- $\Delta U + W_b = \Delta H$

$C_v = \left(\frac{\partial u}{\partial T}\right)_v$

$C_p = \left(\frac{\partial h}{\partial T}\right)_p$

- specific heat Ratio :: $k = \frac{C_p}{C_v}$.
- for solid & liquid $C_p = C_v = C$
- for solids & liquid $\Delta h = C_{avg} \Delta T + v \Delta P$