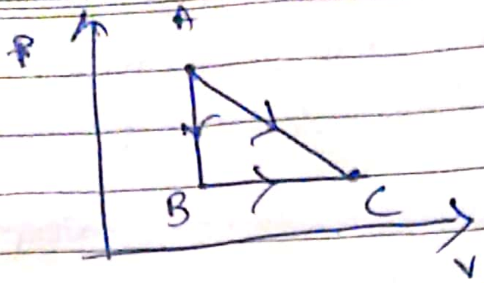
1.)



AC ⇒ work done 100 J
heat Absorbed 150 J

ABC ⇒ $W = 30$ J
$Q = ?$

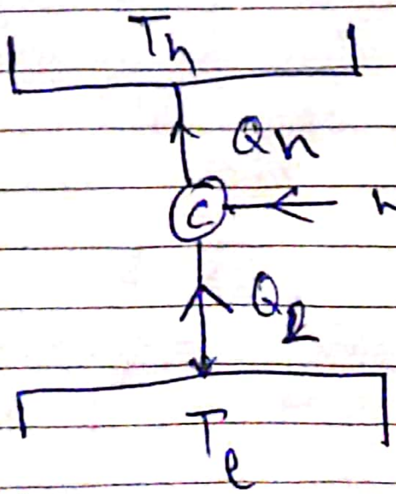
AC

$$dQ = dU - dW$$

$$150 = dU - (-100) \Rightarrow dU = 50\text{ J}$$

ABC ⇒ $dQ = 50 - (-30) = 80\text{ J}$

2. Airconditioner maintains 27°C
outside Temp is 47°C
Heat conducted through the wall 7000 W
What minimum work done by the compresser?



$$Q_2 + W = Q_1$$

$$\eta = $$

$$= \frac{Q_l}{W} = \frac{Q_l}{Q_h - Q_l}$$

$$= \frac{T_l}{T_h - T_l}$$

$$\Rightarrow \frac{300}{20} = \frac{3000}{W}$$

3.) If isothermal compressibility of a solid $K_T = 10^{-10} (Pa)^{-1}$ then pressure required to ~~reduce the~~ increase the density by 1%.

$$\rho = \frac{M}{V} \qquad K_T = -\frac{1}{V}\left(\frac{\partial V}{\partial P}\right)_T$$

$$\ln \rho = \ln M - \ln V$$

$$\Rightarrow \frac{1}{\rho} d\rho = \underbrace{\frac{dM}{M}}_{=0} - \frac{dV}{V}$$

$$\Rightarrow \frac{d\rho}{\rho} = K_T \, dp$$

$$\Rightarrow \frac{1}{100} = 10^{-10} dp \quad \Rightarrow dp = 10^8$$

4) A car tyre at 2 Atm & 15°C and suddenly it bursts. Assuming air is a mixture of O_2 and N_2 & the process adiabatic find the temp after the burst.

$$P^{1-\gamma} T^{\gamma} = \text{const}$$

$$\gamma = ?$$

$$\boxed{C_V = \frac{fR}{2}} \qquad \boxed{C_P = R + \frac{fR}{2}}$$

$$C_P^m = (n_1 C_P^1 + n_2 C_P^2)$$

$$= (n_1 + n_2)$$

$$= n\left(R + \frac{fR}{2}\right) = \frac{7R}{2}$$

$$C_V = \frac{5R}{2} n$$

$$\gamma = \frac{C_P}{C_V} = 7/5$$

$$P_2 = 2P_1$$

$$T_1 = 273 + 15 = 288\,K$$

$$\Rightarrow T_2 = \left(\frac{P_1}{P_2}\right)^{1-\gamma/\gamma} T_1$$

5. If 10% ~~dec~~ decrease in air Pressure in hill, what is change in boiling pt

$L = 2270\ J/kg \cdot K$

$\Delta v = 1.2\ m^3/kg$

$$\frac{dp}{dT} = \frac{L}{T \Delta v}$$

$$\Rightarrow dT = \frac{dp\, T \Delta v}{L} = \frac{10 \times 373 \times 1.2}{2270}$$

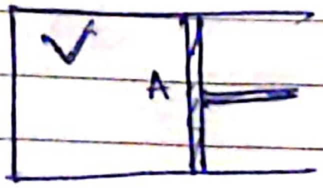
6. ~~A piston~~ A container has 16 g O_2 find W when the gas is compressed to 75% at $T = 27°C$

$$dw = -\int p\,dv = -\int \frac{nRT}{V} dV = nRT \ln \frac{v_2}{v_1}$$

$n = 0.5$

$R =$

$$\frac{v_2}{v_1} = \frac{75}{100}$$

7.)  monoatomic

wall poor conductance of heat

If the piston is pressed ~~shot~~ & released what is the freq of oscillation

$$PV^{\gamma} = \text{const} \Rightarrow (P + \delta P)(v - \delta v)^{\gamma} = Pv^{\gamma}\left(1 + \frac{\delta P}{P}\right)\left(1 - \frac{\delta v}{v}\right)^{\gamma}$$

$$= Pv^{\gamma}\left(1 + \frac{\delta P}{P} - \frac{\gamma \delta v}{v}\right)$$

$$F = PA = A\delta P = AP\gamma \frac{dv}{v} = -\frac{AP\gamma\, A dx}{v} = \omega^2 \delta x.$$

3.) How does α_p behave for ideal gas with respect to T.

$$\alpha_p = \frac{1}{V}\left(\frac{\partial V}{\partial T}\right)_P$$

$$PV = RT$$

$$V = \frac{RT}{P}$$

$$\alpha_p = \frac{1}{V}\left(\frac{\partial V}{\partial T}\right) = \frac{R}{PV} = \frac{R}{RT} \sim \frac{1}{T}$$

4.) In a thermodynamic process volume of a mole of an ideal gas is varied as $V = aT^{-1}$ where a is a const. what is the amount of heat received by the gas if the temp of the gas increases by ΔT. γ is adiabatic exponent.

$$dW = -\int P dV = -\int_{V_1}^{V_2} \frac{c}{V^\gamma} dV$$

$$V = \frac{a}{T} \Rightarrow dV = -\frac{a}{T^2} dT$$

$$dW = +\int_{T_1}^{T_2} c\left(+\frac{a}{T^2}\right) dT \left(\frac{T^\gamma}{a^\gamma}\right) = \frac{c}{a^{\gamma-1}} \int_{T_1}^{T_2} T^{\gamma-2} dT$$

$$= \frac{c}{a^{\gamma-1}} \frac{T_2^{\gamma-1} - T_1^{\gamma-1}}{(\gamma-1)}$$

$PV^\gamma = c$

$$p_1 v_1^\gamma = p_2 v_2^\gamma = C$$

$$dw = \frac{p_2 v_2^\gamma T_2^{\gamma-1} - p_1 v_1^\gamma T_1^{\gamma-1}}{a^{\gamma-1}(\gamma-1)}$$

$$Pv = RT \qquad v = \frac{a}{T}$$

$$\Rightarrow P = \frac{RT^2}{a}$$

$$\Rightarrow a = \frac{RT^2}{P}$$

$$a^{\gamma-1} = \frac{R^{\gamma-1}\, T^{2(\gamma-1)}}{P^{\gamma-1}}$$

$$dw = \frac{P_2 v_2^\gamma T_2^{\gamma-1} P_2^{\gamma-1}}{R^{\gamma-1} T_2^{2(\gamma-1)} (\gamma-1)} -$$

$$= \frac{R^\gamma T_2^\gamma T_2^{\gamma-1}}{R^{\gamma-1} T_2^{2(\gamma-1)} (\gamma-1)} -$$

$$= \frac{R T_2}{T_2^{2\gamma}(\gamma-1)} -$$

$$= \frac{R T_2}{(\gamma-1)}$$

10.) Ideal gas compressed adiabatically from $V \rightarrow \alpha V$, W is work done, what is the final Pressure. $\gamma = C_p/C_v$

$$P_1V_1^\gamma = P_2V_2^\gamma = K \Rightarrow \frac{P_1}{P_2} = \left(\frac{V_2}{V_1}\right)^\gamma = \alpha^\gamma$$

$$W = -\int P\,dV = -\int \frac{K\,dV}{V^\gamma} = -\left(\frac{P_2V_2 - P_1V_1}{1-\gamma}\right)$$

$$(1-\gamma)W = -P_1V_1\left(\frac{P_2V_2}{P_1V_1} - 1\right)$$

$$= -P_1V_1\left(\frac{\alpha}{\alpha^\gamma} - 1\right)$$

$$= -P_1V_1\left(\frac{\alpha - \alpha^\gamma}{\alpha^\gamma}\right)$$

$$\Rightarrow \frac{W(1-\gamma)}{\alpha - \alpha^\gamma} = -\frac{P_1V_1}{\alpha^\gamma} = -\frac{P_2\alpha^\gamma V_1}{\alpha^\gamma}$$

$$\Rightarrow P_2 = -\frac{W(1-\gamma)}{V_1(\alpha - \alpha^\gamma)}$$