finish Concept Q s4.html

#6 $\Delta T = 0 \Rightarrow \Delta U = 0 \Rightarrow \Delta U = Q - W \Rightarrow Q = W$

#7 again $\Delta T = 0$, and here $W < 0$ $\Rightarrow$ if $Q = W$ then $Q < 0$

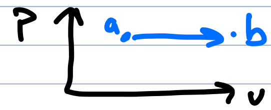
#8 $\Delta T = 0 \Rightarrow \Delta U = 0 \Rightarrow Q_{tot} = W_{tot} > 0$

example

CO_2 $n = 0.250\,mol$
$T_a = 27.0°C$

$T_b = 127.0°C$

a) PV diagram



b) How much work is done by the gas? $a \to b$

$W = p\Delta V = p(V_2 - V_1) = nR\Delta T = (0.250\,mol)\left(8.3145\,\frac{J}{mol \cdot K}\right)(100.0\,K)$

$= 208\,J$

c) On what is this work done? Piston

d) What is ΔU? $\Delta U = n C_v \Delta T$ see Eqn 3.9 and its discussion

$\Delta U = (0.250\,mol)\left(28.93\,\frac{J}{mol \cdot K}\right)(100.0\,K) = 723\,J$

$\hookrightarrow C_v/R = 3.48$ for CO_2 Table 2.3

e) How much heat was supplied?

$Q = \Delta U + W = 931\,J$

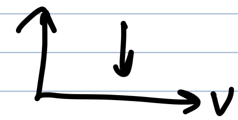
f) What would W have been if $P_a = P_b = 0.50\,atm$?

if ΔT unchanged, then in this case W unchanged concept Q 55.html

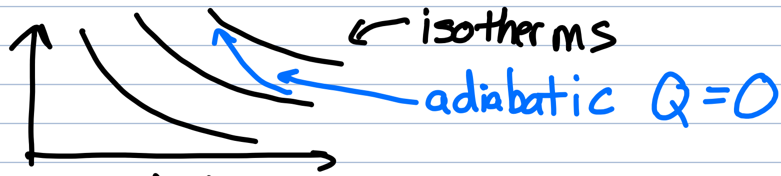
$U \sim \frac{3}{2} nRT = \frac{3}{2} NkT \Rightarrow$ B smallest

more PV fun!

a) Your house gets cold at night.

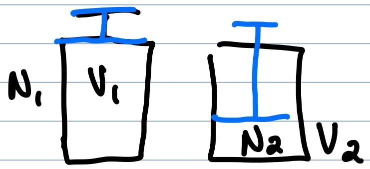


b) Pump your bike tire



$\Delta U = -W$

W here is $< 0 \Rightarrow \Delta U > 0$



$T_2 = T_1 \left(\frac{V_1}{V_2}\right)^{\gamma-1}$ see p. 130 ...

where $\gamma = \frac{C_p}{C_V}$ and $C_p = C_V + R$

monatomic $\gamma = (C_V + R)/\frac{3}{2}R = \left(\frac{3}{2}R + \frac{2}{2}R\right)/\frac{3}{2}R = \frac{5}{3} = 1.67$

diatomic $\gamma = (C_V + R)/\frac{5}{2}R = \left(\frac{5}{2}R + \frac{2}{2}R\right)/\frac{5}{2}R = \frac{7}{5} = 1.4$

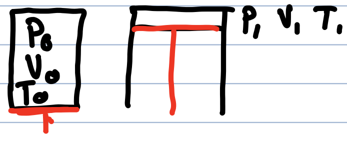
concept Q 56.html

(B) $\Delta U = Q - W \rightarrow Q = \Delta U + W$ and $W > 0$

moreover, total work done on piston is zero

$W_{by\,gas} = -W_{by\,gravity} = --mg\Delta h = mg\Delta h$

Porsche Boxster, this time assuming adiabatic



$W_{0\to 1} = \frac{1}{\gamma - 1}(P_0V_0 - P_1V_1)$ p.131

where $T_0V_0^{\gamma-1} = \text{constant} = T_1V_1^{\gamma-1}$ Eq^n 3.14

and thus $\frac{P_0V_0}{Nk} V_0^{\gamma-1} = \frac{P_1V_1}{Nk} V_1^{\gamma-1} \Rightarrow P_0V_0^{\gamma} = P_1V_1^{\gamma}$

$\Rightarrow P_1 = P_0\left(\frac{V_0}{V_1}\right)^{\gamma}$

$$\rightarrow W_{0\to1} = \frac{1}{\gamma-1}\left(P_0V_0 - P_0\left(\frac{V_0}{V_1}\right)^{\gamma} V_1\right) = \frac{1}{1.4-1}\left(1.01\cdot10^5\,Pa\ 2687\,cm^3 - 1.01\cdot10^5\,Pa\left(\frac{11.3}{1}\right)^{1.4}\frac{2687\,cm^3}{11.3}\right)$$

$$= -1111\ J/stroke \times \frac{7200\ rpm}{60\ sec/min}\cdot\frac{1\,hp}{746\,W} = -178\ hp\ @\ 7200\,rpm$$