Ideal Gas Law

1) $PV = NkT \Rightarrow PV \propto T$ (a) if $T = \text{const}, P_f = 4P_i$; $V_f = ?$ ...

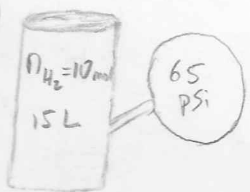
$PV \propto T$

$\Rightarrow (4P_i)(xV_i) \propto T$

$x = \frac{1}{4} \Rightarrow \boxed{V_f = \frac{1}{4}V_i}$

(b) $PV \propto T$, if $V_f = 3V_i$ and $T_f = \frac{1}{2}T_i$ ...

$(xP_i)(3V_i) \propto \frac{1}{2}T_i \Rightarrow x = \frac{1}{6} \Rightarrow \boxed{P_f = \frac{1}{6}P_i}$

2) 

(a) $PV = nRT$ or $PV = Nk_BT$? , $V = 15L$, $P = 65$ psi (convert to atm), $T = ?$

$n = 10$ mol

→ units given are mols and L, use R since it has units of L-atm/mol·K

$\Rightarrow 65 \text{ psi} \times \frac{1 \text{ atm}}{14.7 \text{ psi}} = 4.42 \text{ atm}$

$P_g + 1 \text{ atm} = P \Rightarrow P = 5.42 \text{ atm}$

$\Rightarrow T = \frac{PV}{nR} = \frac{(5.42 \text{ atm})(15L)}{(10 \text{ mol})(0.082 \frac{L\text{atm}}{\text{mol} \cdot K})} \Rightarrow \boxed{T = 99K}$

3) $PV = Nk_BT$ (Nk_B b/c given particle count) $N = 10^{24}$, $T = 20°C = 293K$

(a) $\Delta E_{th} = \frac{3}{2}Nk_B\Delta T$ (D=3 for monatomic) $\Rightarrow \Delta T = \frac{\frac{2}{3}\Delta E_{th}}{Nk_B} = \frac{\frac{2}{3}(1000J)}{10^{24}(1.38 \times 10^{-23})} = 48.3K$

$T_f = T_i + \Delta T \Rightarrow 293K + 48.3K = \boxed{341.3K}$

(b) $P = \text{const}, V_f = 2V_i \Rightarrow PV \propto T$, $(P_i)(2V_i) \propto (xT_i) \Rightarrow T_f = 2T_i \Rightarrow \boxed{T_f = 586K \text{ or } 313°C}$