Ch En 2300
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HW 1

1.) $P_{atm} = 0.8$ bar $= 80$ kPa , $P_{abs} = 1000$ kPa

$P_g = P_{abs} - P_{atm} = (1000-80)$ kPa $\boxed{= 920. \text{ kPa}}$

2.) $P_1 = 90$ kPa $\quad P_2 = ?$
$T_1 = 22°C \quad T_2 = 10°C$

$P_1 V = nRT_1 \rightarrow \frac{V}{n} = \frac{RT_1}{P_1}$ $\quad \therefore \frac{RT_1}{P_1} = \frac{RT_2}{P_2}$

$P_2 V = nRT_2 \rightarrow \frac{V}{n} = \frac{RT_2}{P_2}$

$P_2 T_1 = T_2 P_1 \rightarrow P_2 = \frac{T_2 P_1}{T_1} = \frac{10°C \cdot 90 \text{ kPa}}{22°C} = \frac{900 \text{ kPa}}{22} = \cancel{\boxed{40.9 \text{ kPa}}} \rightarrow 90 \text{ kPa} - 40.9 \text{ kPa}$ $\boxed{= 49.1 \text{ kPa}}$

b) The change would happen more slowly

3.) Temperature (K)	Intensive	Size of system does not influence Temperature
Volume (m^3)	Extensive	Volume depends on mass of system
Specific volume ($\frac{m^3}{kg}$)	Intensive	It's a ratio of volume to mass
Enthalpy (kJ)	Extensive	Product of volume
Porosity (ϕ)	Intensive	Ratio of voids to volume
Specific heat capacity ($\frac{kJ}{kg\,K}$)	Intensive	Heat required to change T of one unit, not whole system
Distance (km)	Extensive	Change size of system, Distance changes

4.) $P_1 = 65$ kPa $\quad \rho = 1.2 \frac{kg}{m^3} \quad P = \rho g h$
$P_2 = 101$ kPa $\quad g = 9.8 \frac{m}{s^2}$

$h_1 = \frac{P_1}{\rho g} = \frac{65000 \text{ Pa}}{1.2 \frac{kg}{m^3} \cdot 9.8 \frac{m}{s^2}} = \frac{65000 \frac{N}{m^2}}{11.76 \frac{kg}{m^2 s^2}} = \frac{6500 \text{ kg m}}{\cancel{s^2}\, \cancel{m^2}} \times \frac{\cancel{m^2}\, \cancel{s^2}}{11.76 \cancel{kg}} = 5527 \text{ m}$

$h_2 = \frac{P_2}{\rho g} = \frac{101000 \frac{\cancel{kg}\, m}{\cancel{s^2}\, m^2}}{11.76 \frac{\cancel{kg}}{m^2 \cancel{s^2}}} = 8588 \text{ m}$

$\Delta h = h_2 - h_1 = (8588 - 5527) \text{ m} \boxed{= 3060 \text{ m}}$

$3060 \text{ m} \times \frac{100 \text{ cm}}{1 \text{ m}} \times \frac{1 \text{ in}}{2.54 \text{ cm}} \times \frac{1 \text{ ft}}{12 \text{ in}} = 10043.39 \text{ ft} \approx \boxed{100 \times 10^2 \text{ ft}}$

5.) $PV = nRT$, $\quad M = \frac{m}{n} \rightarrow n = \frac{m}{M}$ $\qquad M_{He} = 4.002 \frac{g}{mol}$, $M_{N_2} = 28.02 \frac{g}{mol}$

$PV = \frac{m}{M}RT \rightarrow \frac{m}{V} = \frac{PM}{RT} = \rho$ $\qquad M_{C_4H_{10}} = 58.12 \frac{g}{mol}$

$\cancel{T = 25°C = 298.18\,K}$

$\cancel{T = 25°C = 298.15\,K}$

$$\cancel{\rho_{He} = \frac{1\,atm \cdot 4.002\,\frac{g}{mol}}{8.2057\,\frac{m^3\,atm}{mol\,K} \cdot 298.15\,K} = 0.001636\,\frac{g}{m^3}}$$

$$\rho_{He} = \frac{1\,atm \cdot 4.002\,\frac{g}{mol}}{0.0821\,\frac{l\,atm}{mol\,K} \cdot 298.15\,K} = 0.1634\,\frac{g}{l} \times \frac{kg}{g\,1000} \times \frac{1000\,l}{m^3} = \boxed{0.163\,\frac{kg}{m^3}}$$

$$\rho_{N_2} = \frac{1\,atm \cdot 28.02\,\frac{g}{mol}}{0.0821\,\frac{l\,atm}{mol\,K} \cdot 298.15\,K} = 1.14\,\frac{g}{l} = \boxed{1.14\,\frac{kg}{m^3}}$$

$$\rho_{C_4H_{10}} = \frac{1\,atm \cdot 58.12\,\frac{g}{mol}}{0.0821\,\frac{l\,atm}{mol\,K} \cdot 298.15\,K} = 2.374\,\frac{g}{l} = \boxed{2.37\,\frac{kg}{m^3}}$$

- A butane leak would be more dangerous than Helium because it's more dense so it would make it harder to breath, causing asphyxiation.