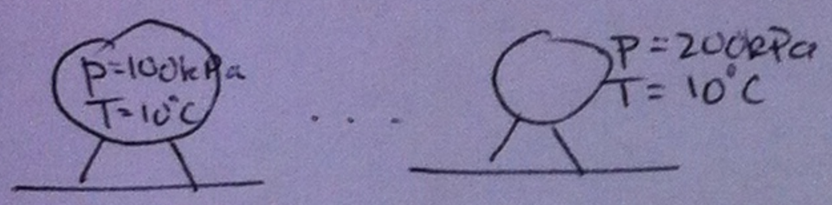
 Name: SOLUTION

CE 3305 Engineering Fluid Mechanics
Exercise Set 1
Summer 2015 – GERMANY

1. (Problem 1.34 pg 26) Natural gas is stored in a spherical tank at a temperature of 10°C. At a given initial time, the pressure in the tank is 100 kPa–gage, and the atmospheric pressure is 100 kPa–absolute. Some time later, after more gas has been compressed into the tank, the pressure in the tank is 200 kPa–gage, and the temperature is still 10°C. What is the mass ratio of gas in the tank when $p = 200$ kPa–gage, to when the pressure was 100 kPa–gage?

SKETCH:



before after

DISCUSSION:
- Illustrates using algebra to find mole ratios.
- Cannot find actual mass unless $\forall_{Tank}$ given

KNOWN:

$p_{before} = 100kPa$, $T_{before} = 10°C$

$p_{after} = 200kPa$, $T_{after} = 10°C$

UNKNOWN:

$$\frac{m_{after}}{m_{before}}$$

SOLUTION:

Use ideal gas law: ← ISOTHERMAL

$$p_{after}\forall_{after} = \frac{m_{after}}{M}RT_{after}$$

$$p_{before}\forall_{before} = \frac{m_{before}}{M}RT_{before}$$

$$\Rightarrow \frac{p_{AFTER}}{p_{before}} = \frac{m_{after}}{m_{before}} = \frac{200kPa}{100kPa} = \underline{\underline{2}}$$

$\frac{m_a}{m_b}$

$\forall_{before}$: constant volume vessel

M, R are constants