GIVEN

"Rigid", "insulated" container

» Initially

* $V_{air} \equiv$ vol of air $= 2\,m^3$
* $T_{air} = 27°C$, $P_{air} = 0.3$ MPa

» The air is separated by membrane from evacuated/vacuum of vol $= V_{vcm} = 3\,m^3$

» eventually membrane bursts.

FIND

(a) mass of air, in kg

(b) final temp, in K

(c) final pressure of air, in MPa.

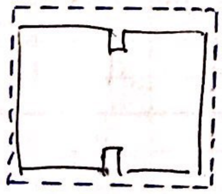
ASSUMP

- closed sys
- ideal gas
- $R = 287$ J/kgK
- vacuum $\Rightarrow U = 0$
- modeled by C_v
- $\Delta PE = \Delta KE = 0$

EQN

- $\cancelto{0}{\frac{dm}{dt}\Big|_{sys}} = \cancelto{0}{\dot{m}_{in}} - \cancelto{0}{\dot{m}_{out}}$
- $Pv = RT$ $\cdot \frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$
- $C_v = \left(\frac{\partial u}{\partial T}\right)_v$

EFD sys. container



SOLN

(a) mass of air, m_{air} is from $P_{air} \frac{V_{air}}{m_{air}} = R T_{air}$

$$m_{air} = \frac{P_{air} V_{air}}{R T_{air}} = \frac{(0.3 \times 10^6\,Pa)(2m^3)}{(.287\,J/kgK)(300K)} \cong \boxed{6.27 \times 10^5\,kg}$$

(b) since the internal energy is conserved and

$$C_v \Delta T = 0$$

$$T_{air} = T_f$$

$$\boxed{T_f = 300\,K}$$

(c) thus

$$P_{air} V_{air} = P_2 V_2$$

$\because V_2 = 5\,m^3$

$$P_2 = \frac{(0.3\,MPa)(2m^3)}{(5m^3)} = 0.12\,MPa$$

$$\boxed{P_2 = 0.12\,MPa}$$

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