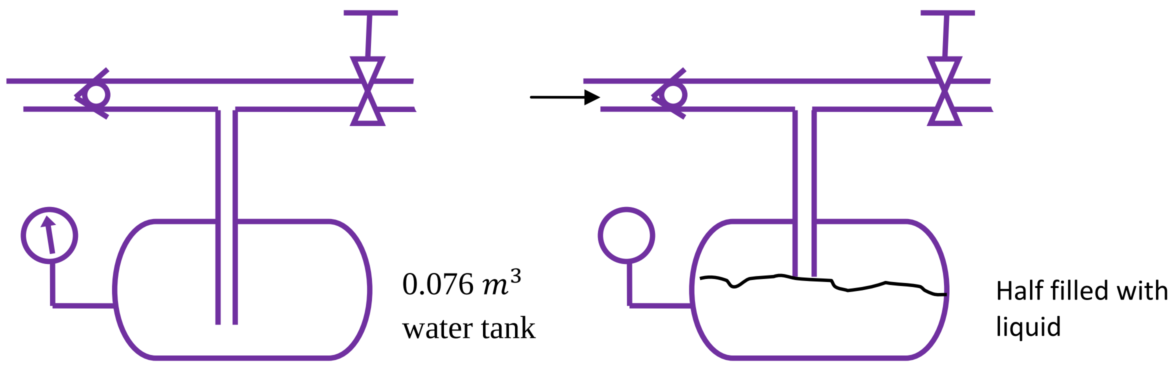
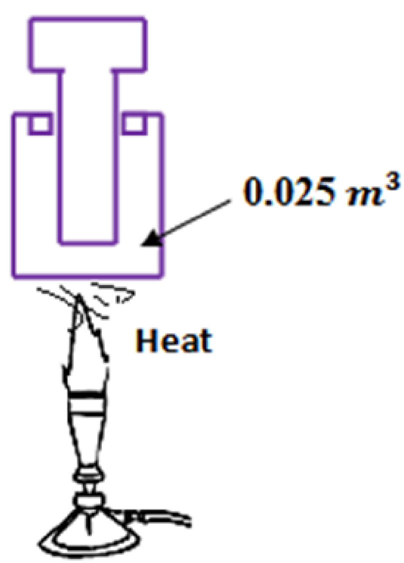
LECTURE 33 – INTRODUCTION TO PNEUMATICS

SELF EVALUATION QUESTIONS AND ANSWERS

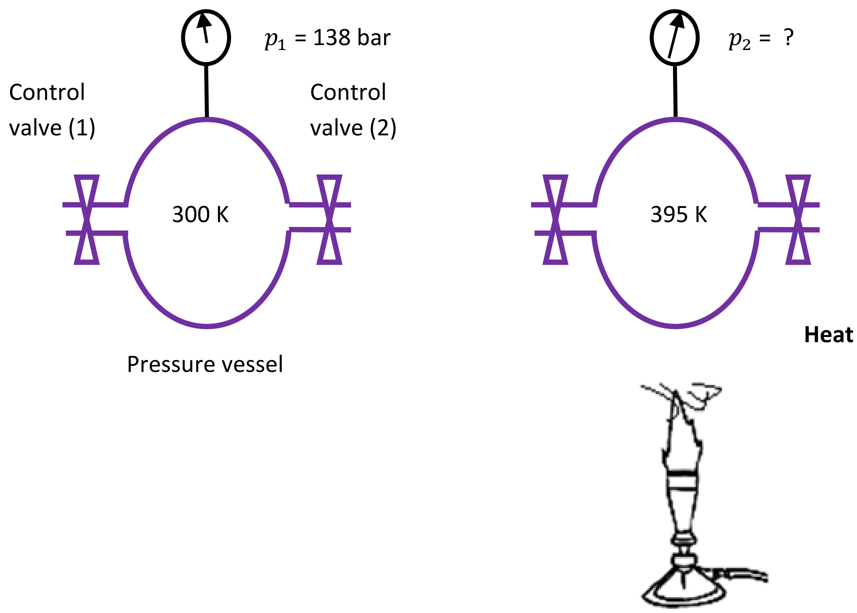
1. If an empty 0.076 m^3 water system tank on which pressure gauge initially reads 1.38 bar is half filled with water, such as that shown in Figure , what will be the pressure reading on a gauge attached to the tank.



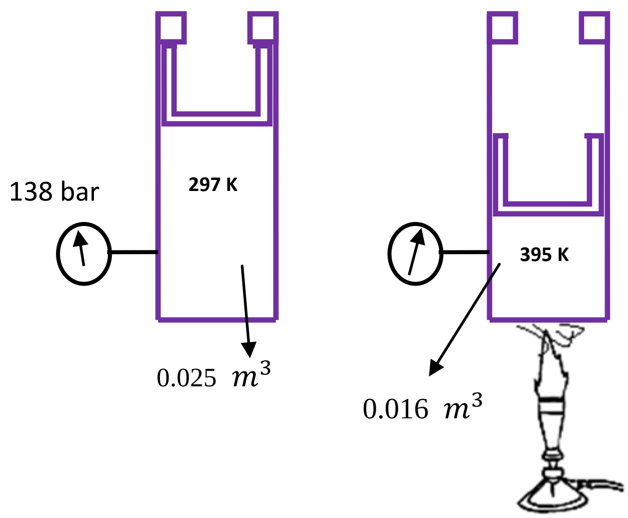
2. If an accumulator using dead weight ballast against an initial volume of 0.025 m^3 of a gas is heated from 300 K to 366 K. what volume will the heated gas occupy?



3. The constant volume vessel shown in Figure on which pressure gauge reads 138 bar is heated from 300 K to 395 K , what will the gauge read ?



4. Gas in a 0.025 m^3 cylinder at 138 bar is reduced in volume to 0.016 m^3. While heated from 297 K to 395 K. what is the final gauge pressure in the cylinder?



5. A fixed quantity of gas, at constant pressure, occupies a volume of 8.50 L and has a temperature of 29 ℃. (a) What volume will the gas occupy if the temperature is increased to 125 ℃? (b) At what temperature will the volume be 5.00 L?

Q1 Solution:

Since the temperature is constant, we can use Boyle's Law

$$p_1V_1 = p_2V_2$$

$$p_2 = p_1 \times \frac{V_1}{V_2}$$

$$p_2 = 2.38 \times \frac{0.076}{0.076/_2} = 4.76\ bar(absoulte)$$

$$p_2 = 3.76\ bar(guage)$$

Q2 Solution:

Since the pressure is constant, From Charles law, we have

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$T_1 = temperature\ in\ Kelvin = 300\ K,\ \ T_2 = 366\ K$

$$\frac{0.025}{300} = \frac{V_2}{366}$$

Solving we get, $V_2 = 0.0305\ m^3 = 30500\ cm^3$

Q3 Solution

Since the volume is constant, by applying Gay –Lussac's law, we get,

$$p_1 = 138bar\ (gauge) = 138 + 1 = 139\ bar(absoute)$$

$T_1 = temperature\ in\ Kelvin = 300\ K,\ \ T_2 = 395\ K$

$$\frac{p}{T} = constant\ or\ \frac{p_1}{T_1} = \frac{p_2}{T_2}$$

$$\frac{139}{300} = \frac{p_2}{395}$$

Solving we get, $p_2 \cong 183\ bar(absoulte) = 182\ bar(gauge)$

Q4 Solution

Using General gas law

$$\frac{p_1 V_1}{T_1} = \frac{p_2 \ V_2}{T_2}$$

$$\frac{139 \times 0.025}{297} = \frac{p_2 \ \ \times 0.016}{395}$$

Solving we get, $p_2 \ \ = 288.85 \ bar \ (absolute) = 287.85 \ \ bar(gauge)$

Q5 Solution

Part a

Since the pressure is constant, From Charles law, we have

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$T_1 = temperature \ in \ Kelvin = 29 + 273 = 302 \ K, \ \ T_2 = 125 + 273 = 398 \ K$

$$\frac{8.5}{302} = \frac{V_2}{398}$$

Solving we get, $V_2 = 11.2 \ \mathrm{L} = 11200 \ cm^3$

Part b

Again rearranging the gas law for constant pressure term, we get

$$\frac{8.5}{302} = \frac{5}{T_2}$$

Solving we get, $T_2 = 177.65 \ \mathrm{K}$