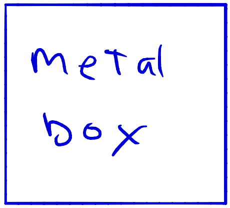
4/15/20

$PV = nRT$ — R: gas constant

variable volume



fixed volume

All gas problems must be worked in Kelvin only!!

Problem 1:

Imagine a balloon is filled to a size of 1.00 L at 25°C at 1 atm pressure and then placed in a freezer at -10°C. What will be the size of the balloon and the pressure inside the balloon?

What is the pressure inside the balloon when it is first filled?

1 atm. ← Because that is the surrounding pressure.

The size of a balloon will automatically change so that the pressure inside and outside the balloon are equal to each other.

Suppose the pressure outside the balloon was greater than inside. The outside pressure would squeeze the balloon, causing it to shrink. This causes the surface area inside the balloon to decrease, causing the pressure inside the balloon to increase. ($P = F/A$; $A\downarrow$ $P\uparrow$) This process continues until the pressure inside and outside the balloon are equal.

In this problem, it is assumed that the pressure inside and outside of the freezer are the same.

The speed that a molecule travels at is related directly to temperature.

When the balloon is placed in the freezer, the average energy of the particles inside the balloon drops, which would result in a drop of pressure inside the balloon. Since the balloon is a variable-volume container, it will decrease in size until the pressure is equal again.

The pressure inside the balloon when in the freezer will be 1.00 atm.

Assuming the balloon does not allow any particles to escape, the number of moles inside the balloon is constant.

$P_1 V_1 = nRT_1$ $\qquad$ $P_2 V_2 = nRT_2$

$\frac{P_1 V_1}{T_1} = nR$ $\qquad$ $\frac{P_2 V_2}{T_2} = nR$

this value is a constant

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$ (general case)

In this problem, pressure doesn't change, so $P_1 = P_2$.

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

V_1 = 1.00 L

T_1 = 298 K

T_2 = 263 K

$V \propto T$

$\propto$ = proportional

$$V_2 = \frac{T_2}{T_1} \cdot V_1 = \frac{263}{298}(1.00) = 0.883 \text{ L}$$