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If you put 12.3 grams of N_2 gas inside a container with a volume of 3.53 L, what will the pressure in that container be if the temperature is 28°C?

$$P = \frac{nRT}{V}$$

$$n = 12.3g\ N_2 \times \frac{1\ mol}{28g} = 0.44\ mol$$

$$T = 301.15\ K$$

$$P = \frac{(0.44\ mol)(0.08206\ \frac{L\,atm}{mol\,K})(301.15\ K)}{3.53L} = 3.08\ atm$$

If you have 35.7 grams of O_2 gas in a container with a volume of 9.35 L, what is the maximum temperature you can be at if the pressure inside the container isn't allowed to exceed 10.0 atm (i.e. it will blow up if P>10atm).

$$35.7g\ O_2 \times \frac{1\ mol}{32g} = 1.12\ mol\ O_2$$

$$T = \frac{PV}{nR} = \frac{(10\ atm)(9.35L)}{(1.12\ mol)(0.08206\ \frac{L\,atm}{mol\,K})} = 1017\ K$$

↳ above this temp $P > 10\ atm$

8.5 grams of a diatomic gas is placed inside a container with a volume of 2.2 L. When the temperature is 292K, the pressure inside the container is 1.31 atm. What is the gas?

$$n = \frac{PV}{RT} = \frac{(1.31\ atm)(2.2L)}{(0.08206\ \frac{L\,atm}{mol\,K})(292\ K)} = 0.12\ moles$$

$$\frac{8.5g}{0.12\ mol} \rightarrow 70.7\ g/mol = Cl_2$$

Air is 20% oxygen on a per mole basis. How many grams of O_2 are there in an average breath (which has a volume of 500 mL) at 298 K at sea level where the atmospheric pressure can be assumed to be 1 atm? What about on top of Mt. Everest where P = 0.34 atm and the temperature is -40 °C?

Sea level

$P_{O_2} = 0.2$ atm

$$n_{O_2} = \frac{(0.2\text{ atm})(0.5\text{ L})}{(298\text{ K})(0.08206 \frac{\text{L atm}}{\text{mol K}})} = 0.0041 \text{ mol } O_2$$

↓

0.13 g O_2

Mt Everest

$P_{O_2} = 0.34 \text{ atm} \times 0.2 = 0.068 \text{ atm}$

$$n_{O_2} = \frac{(0.068\text{ atm})(0.5\text{ L})}{(233\text{ K})(0.08206 \frac{\text{L atm}}{\text{mol K}})} = 0.0018 \text{ mol}$$

↓

0.057 g O_2

The explosive RDX has the chemical formula $C_3H_6N_6O_6$ and when it detonates it forms gaseous nitrogen, gaseous carbon monoxide and gaseous water. If 1.0 grams of RDX is detonated at room temperature (298K), what volume of gas is produced? If this explosion occurred in a sealed vessel with a volume of ~~1.00~~ 100 mL, what would the pressure in the vessel be after the explosion occurred?

$$C_3H_6N_6O_{6(s)} \longrightarrow 3N_{2(g)} + 3CO_{(g)} + 3H_2O_{(g)}$$

$$1.0\text{ g } C_3H_6N_6O_6 \times \frac{1\text{ mol}}{222\text{ g}} \times \frac{9\text{ mol gas}}{1\text{ mol RDX}} = 0.041 \text{ mol gas produced}$$

$$P = \frac{(0.041\text{ mol})(0.08206 \frac{\text{L atm}}{\text{mol K}})(298\text{ K})}{0.1\text{ L}} = 10.0 \text{ atm}$$