

Answer on Question #81994 - Chemistry - Physical Chemistry

Question:

Tractor exhaust has the following composition by volume at 38°C:

N₂ = 73%, H₂O = 13%, CO₂ = 12%, O₂ = 2%

find: apparent mol. weight, composition by weight, R for gas, volume of 1 kg mix.

Solution:

$$R = 8.314 \text{ J}/(\text{mol}\cdot\text{K});$$

$$V(\text{sum}) = 100 \text{ L, so } V(\text{N}_2) = 73 \text{ L, } V(\text{H}_2\text{O}) = 13 \text{ L, } V(\text{CO}_2) = 12 \text{ L, } V(\text{O}_2) = 2 \text{ L;}$$

$$\text{So } n(\text{N}_2) = 73/22.4 = 3.259 \text{ mol;}$$

$$n(\text{H}_2\text{O}) = 13/22.4 = 0.58 \text{ mol;}$$

$$n(\text{CO}_2) = 12/22.4 = 0.536 \text{ mol;}$$

$$n(\text{O}_2) = 2/22.4 = 0.089 \text{ mol;}$$

$$m(\text{N}_2) = 3.259 * 14 = 45.626 \text{ g;}$$

$$m(\text{H}_2\text{O}) = 0.58 * 18 = 10.44 \text{ g;}$$

$$m(\text{CO}_2) = 0.536 * 44 = 23.584 \text{ g;}$$

$$m(\text{O}_2) = 0.089 * 32 = 2.848;$$

$$m(\text{sum}) = 82.498 \text{ g;}$$

$$w(\text{N}_2) = 45.626/82.498 = 55.3 \text{ %;}$$

$$w(\text{H}_2\text{O}) = 10.44/82.498 = 12.7 \text{ %;}$$

$$w(\text{CO}_2) = 23.584/82.498 = 28.6 \text{ %;}$$

$$w(\text{O}_2) = 2.848/82.498 = 3.5 \text{ %;}$$

$$PV = nRT;$$

$$82.498 \text{ g} = 1 \text{ mol, so } 1 \text{ kg} = 12.121 \text{ mol;}$$

$$101000 * V = 12.121 * 8.314 * (275 + 38)$$

$$V = 12.121 * 8.314 * 313 / 101000 = 0.312.$$