



Gas Laws, Molecular Weight & Density



Ideal Gas Law ...Revisited

Substitute for n

$$PV = nRT \quad n = \text{mass}/M \quad M = \text{molar mass}$$

$$PV = \frac{\text{mass} RT}{M}$$

Rearrange...

$$PM = \frac{\text{mass} RT}{V}$$

But....

$$\frac{\text{mass}}{V} = D \quad (\text{Density})$$

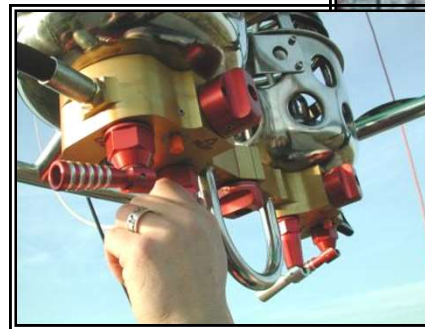
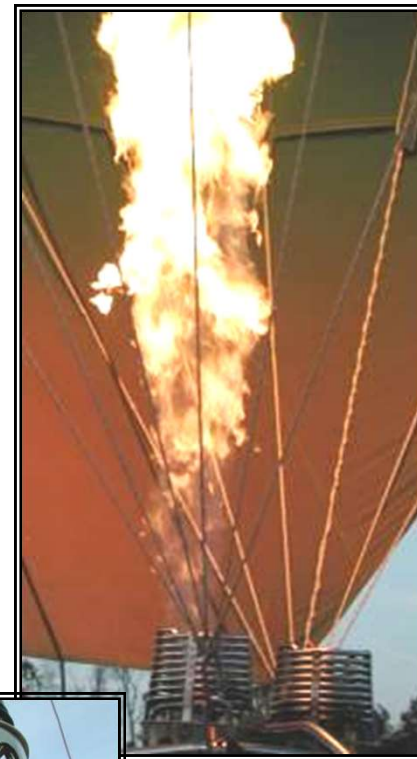
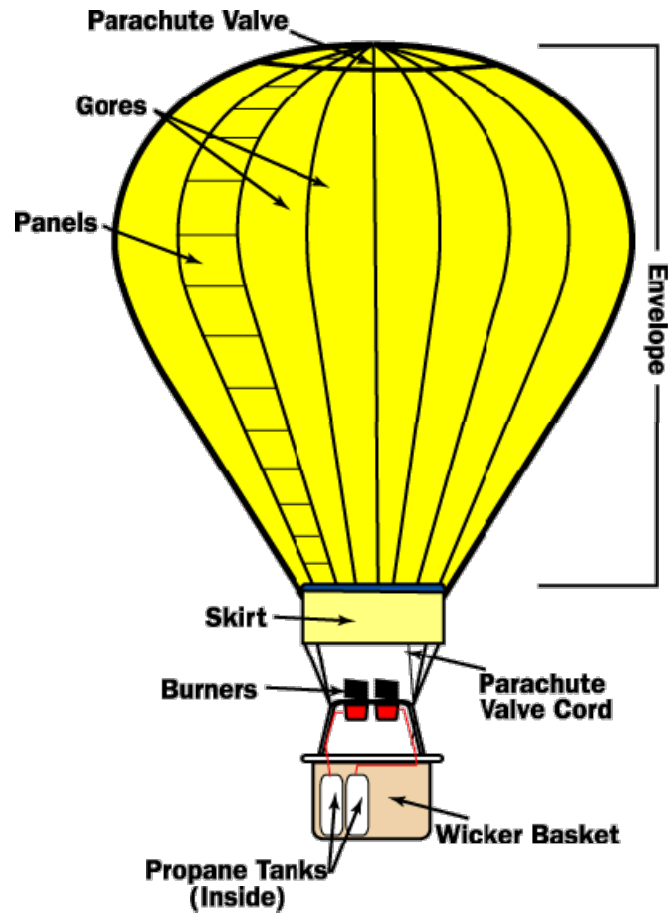
$$PM = DRT$$

Density

$$D = \frac{\text{Pressure} \cdot \text{Molar Mass}}{RT \cdot \text{Temp (K)}}$$



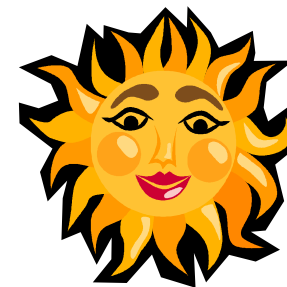
Density: Hot Air Balloons



Graphics: www.howstuffworks.com



More Balloons...



$$M_{\text{air}} = 28.8 \text{ g/mol (Average)}$$



Balloon heated air Density

$$T = 120.0^\circ \text{C (393.15K)}$$

$$D = \frac{PM}{RT} = \frac{0.980 \text{ atm } 28.8 \text{ g/mol}}{0.0820578 \text{ (L atm)/(mol K)} (393.15 \text{ K})}$$

$$D = 0.875 \text{ g/L}$$

Surrounding air Density

$$T = 30.2^\circ \text{C (303.35K)}$$

$$P_{\text{atm}} = 744.8 \text{ torr (0.980 atm)}$$

$$D = \frac{PM}{RT} = \frac{0.980 \text{ atm } 28.8 \text{ g/mol}}{0.0820578 \text{ (L atm)/(mol K)} (303.35 \text{ K})}$$

$$D = 1.13 \text{ g/L}$$

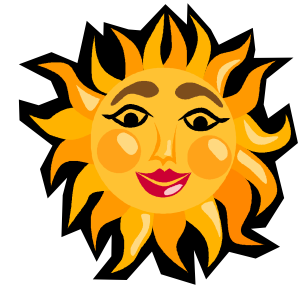
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