

Prelims Solutions**Problem J15T2**

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1

Collision rate $\approx A * \bar{v} * N/V \approx A \sqrt{\frac{k_b T}{m_{O_2}}} \frac{P}{k_b T}$ using equipartition and ideal gas law. Using $P = 10^5 Pa$, $A = (.1m)^2$, $k_b T = 10^{-23} * 300 J$, $m_{O_2} = 32 * 10^{-31} * 2000$ gives $\approx 7 * 10^{25} \frac{molecules}{s * palm}$.

2

We can equate chemical potential at constant T. Or use $\frac{dP}{dz} = -\rho g = -m_{O_2} n g$, $P = n k_b T$ at constant T:

$$\frac{dn}{dz} = -n \frac{m_{O_2} g}{k_b T} \rightarrow n(z) = n(0) e^{-\frac{m_{O_2} g}{k_b T} z}$$

3

Using previous numbers $\frac{k_b T}{m_{O_2} g} \approx 5km$ so $\frac{n(1km)}{n(0km)} = e^{-\frac{1}{5}} \approx \frac{1}{1+.2} = .8$