NPRE200 HW 1

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1. $P_f = \dfrac{800}{800+300} = \boxed{72.73\%}$

2. $\Sigma_f^{235} = \sigma_f^{235} N^{235} = 582 \times 10^{-24} \times 5 \times 10^{21} = 2.91$
   $\Sigma_a^{235} = \sigma_a^{235} N^{235} = 700 \times 10^{-24} \times 5 \times 10^{21} = 3.5$
   $\Sigma_a^{238} = \sigma_a^{238} N^{238} = 2.71 \times 10^{-24} \times 4.35 \times 10^{22} = 0.117885$
   $\eta = \dfrac{\nu\Sigma_f}{\Sigma_a} = \nu \dfrac{\Sigma_f^{235}}{\Sigma_a^{235} + \Sigma_a^{238}} = 2.42 \times \dfrac{2.91}{3.5 + 0.117885} = \boxed{1.9465}$

3. a) $3.5 \times 20^{-24} \times 4.2 \times 10^{23} = \boxed{1.47\ cm^{-1}}$
   b) $\lambda = 1/\Sigma = \boxed{0.680272\text{cm}}$

4. $\rho_{atm} = \frac{\rho_{mas} A}{m} = \frac{0.79 \times 6.023 \times 10^{23}}{22.99} = \boxed{2.6967 \times 10^{22}\text{atom/cm}^3}$

5. a) $1500 \times 0.2 = \boxed{300\text{ kg}}$
   b) ^{235}U : $\frac{19.1 \times 0.2 \times 6.023 \times 10^2 3}{235} = \boxed{9.79058 \times 10^{21}\ \text{cm}^{-3}}$
   ^{238}U : $\frac{19.1 \times 0.8 \times 6.023 \times 10^2 3}{235} = \boxed{3.86687 \times 10^{22}\ \text{cm}^{-3}}$
   $9.79058 \times 10^{21} \div (9.79058 \times 10^{21} + 3.86687 \times 10^{22}) = 20.2037\%$

6. $m = 0.025 \times 235 + 0.975 \times 238 = 237.925$
   $n = 19.0 \div 237.925 \times 6.023 \times 10^{23} = 4.80979 \times 10^{22}$
   $n_{235} = n \times 0.025 = \boxed{1.20245 \times 10^{21}\ \text{cm}^{-3}}$

7. a) $m_u = 0.25 \times 235 + 0.75 \times 238 = \boxed{237.25\text{ g/mol}}$
   b) $m = m_u + m_c = 237.25 + 12 = 249.25$
   $n = \frac{\rho A}{m} = 13.6 \times 6.023 \times 10^{23} \div 237.25 = 3.45459 \times 10^{22}$
   $M_u = n_u \div A \times m_u = 13.6\ \text{g/cm}^3$
   $m_{235} = 0.25 m_u = 3.4$
   $n_{235} = 3.4 \div 235 \times 6.023 \times 10^{23} = \boxed{8.71413 \times 10^{21}}$

8. $m_u = 0.035 \times 235 + 0.965 \times 238 = 237.895$ g/mol
   $m = m_u + 2m_o = 237.895 + 2 \times 16 = 269.895$ g/mol
   $n = \rho \div m = 0.040016$ mol/cm^3
   $M_u = n \times m_u = 0.040016 \times 237.895 = 10.8$ g/cm^3
   $M_{235} = M_u \times 0.035 = 10.8 \times 0.035 = 0.378$ g/cm^3
   $n_{235} = M_{235} \div m_{235} \times A = \boxed{9.68806 \times 10^{20}\text{cm}^{-3}}$

9. Consider first the

10. $n_{Al} = M_{Al} \div m_{Al} = 0.55 \times 2.66 \div 26.9815 = 0.05422$ mol
    $n_{Si} = M_{Si} \div m_{Si} = 0.45 \times 2.66 \div 28.0855 = 0.052091$ mol
    $\Sigma = \sigma_{Al} N_{Al} + \sigma_{Si} N_{Si}$
    $= 6.023 \times 10^{23} \times (0.23 \times 0.05422 + 0.16 \times 0.052091) \times 10^{-24}$
    $= 0.012531$ cm^{-1} $\lambda = \frac{1}{\Sigma} = \boxed{79.8024 \text{ cm}}$

11. $\frac{1.2}{1.2+1.3} = \boxed{48\%}$

12.