Nuclear Engineering 150: Midterm 1 Study Guide

Disclaimer: This is not an official study guide. Stuff ~~might~~ **is** wrong. Use the lecture notes and book!

Note: Everything in this guide is from the text () or lecture, or office hours and should be cited as completely as possible.

Contents

1 Fundamentals

1.1 Masses

- Atomic mass unit (amu): defined by the mass of a neutral carbon-12 atom.

$$m(^{12}\text{C}) = 12\text{amu}$$

- A mixture of an element with various isotopes i with abundances γ_i is:

$$M = \sum_i \gamma_i M_i$$

  You can use this for the natural abundances, or if you just have a mixture of elements in a compound (like enriched uranium). [1, Lec 3]

- To get molecular mass, you can just add the molar masses of the component atoms (multiplied by how many of each atom you have in the molecule).

1.2 Nuclear and Atomic Radii

- The average atomic radii is the same for all atoms, about 2×10^{-10} m. [1, Lec 3]
- The nuclear radii is approximated by:

$$r = r_0 A^{1/3}$$

  Where $r_0 \approx 1.25$ fm. [1, Lec 3]

1.3 Number (Atom) Density

- The mass density (usually in g/cm^3) is given by:

$$\rho(^A X) = \frac{N(^A X) M(^A X)}{N_A}$$

  Where $N(^A X)$ is the atom density (atoms/cm^3), $M(^A X)$ is the molar mass, and N_A is avogadro's number. [1, Lec 3.] This might be useful but the mass density is usually one of the given things in problems.

- The atom density (atoms/cm^3) is given by:

$$N(^AX) = \frac{\rho(^AX)N_A}{M(^AX)}$$

  Where all the terms were defined in the previous part. [1, Lec 3]

- For a molecule of form X_mY_n, the atom density of the components X and Y are:

$$N_X = mN_{X_mY_n}$$
$$N_Y = nN_{X_mY_n}$$

  I think that's kind of obvious but it's there ok. [1, Lec 3]

2 Reactions

2.1 Cross-sections

- Cross-sections are characteristic of the probability of a reaction occurring. They are **not** probabilities, they are **proportional** to probabilities.

- Differential cross-sections

References

[1] Jasmine Vujic. Nuclear engineering class lectures. Spring 2015.