Homework Set 7, Physics 355, Spring 2024. Handed out March 4, due March 18 in class. Please turn in a legible paper copy, with your full name on the paper. A complete solution should be submitted for each problem, with no missing steps. This homework is based on the in-class lectures for Chapter 11 in the text. The problems are taken from the text, and the text is the best reference for the equations needed, along with slides shown in class.

(1) Problem 6.
(2) Problem 12.
(3) Problem 22.

(4) The basic equation for decay of an unstable state in quantum physics is \( \frac{dN}{dt} = -N/\tau \), where \( \tau \) is the average lifetime. At a certain instant we have \( 10^6 \) identical nuclei with half-lives of 1 hour. At that instant, what is the rate of decay? [The answer actually has a standard unit, see question 5!]

(5) Problem 30. [A Curie (Ci) is an obsolete unit of source strength; 1 Ci is equal to 37 billion \( (3.7 \times 10^{10}) \) decays per second. The modern standard unit is the Bequerel (Bq), which is 1 decay per second, so 1 Ci equals 37 billion \( (3.7 \times 10^{10}) \) Bequerels!]

(6) Fission power is so easy to accomplish that at least one fission reactor was formed naturally, in what is now West Africa, about 1.7 billion years ago. Yet, very bright people have been working hard on generating useful energy from fusion reactions for 70 years, without significant success. What makes fusion so difficult?