Name: _____

Class: _____

Due Date: _____

Physics Topic 68 – Half-Life, Activity, and Decay Constant

Answer the following questions.

1. C: Define *half-life*. Units?

2. C: Define *activity*. Units? Use a **pencil and ruler!** Draw an *activity vs. time* graph for a radioactive/unstable element.

3. C: Complete the following sentences:

   a. After one half-life the activity of the radioactive sample will decrease to _____ of the original activity.
   b. After two half-lives the activity of the radioactive sample will decrease to _____ of the original activity.
   c. After three half-lives the activity of the radioactive sample will decrease to _____ of the original activity.
   d. After four half-lives the activity of the radioactive sample will decrease to _____ of the original activity.

4. C: Define *count rate*. Units?

5. C: Define *background radiation.*

6. C: Why do stable nuclei have more neutrons than protons?

7. C: What is the ratio of neutrons to protons for stable nuclei?

8. C: Circle the correct answer: Alpha particles leave the nucleus with *continuous/discrete* energy levels.

9. C: Circle the correct answer: Beta minus particles leave the nucleus with *continuous/discrete* energy levels.

10. C: Circle the correct answer: Beta plus particles leave the nucleus with *continuous/discrete* energy levels.

11. C: Circle the correct answer: Gamma rays leave the nucleus with *continuous/discrete* energy levels.

12.C: What is the meaning and units of the *decay constant* λ?

13.C: Describe and define the variables in the radioactive decay law equation $N(t) = N_0 e^{-\lambda t}$.

14.C: What is the meaning and units for *activity A*? Describe and define the variables in the equation $A(t) = \lambda N(t) = \lambda N_0 e^{-\lambda t}$.

15.C: State the relationship between the half-life and the decay constant.

16.E: Cobalt-60 has a half-life of 5.271 years. Suppose that you have a sample of Co-60 which has a mass of 25.0 grams.

a. How many atoms will this sample contain?

b. What is the decay constant for this isotope (in decays per second)?

c. What will be the initial activity of this sample?

d. How many atoms of this sample will remain after 3.00 years?

e. What will be the activity of this sample after 3.00 years?

f. How many grams of radioactive Co-60 will remain after 3.00 years?

17.E: Strontium-90 has a half-life of 28.8 years. Suppose that you have a sample of Sr-90 which has a mass of 45.5 grams.

a. How many atoms will this sample initially contain?

b. What will be the decay constant of this isotope (in decays per second)?

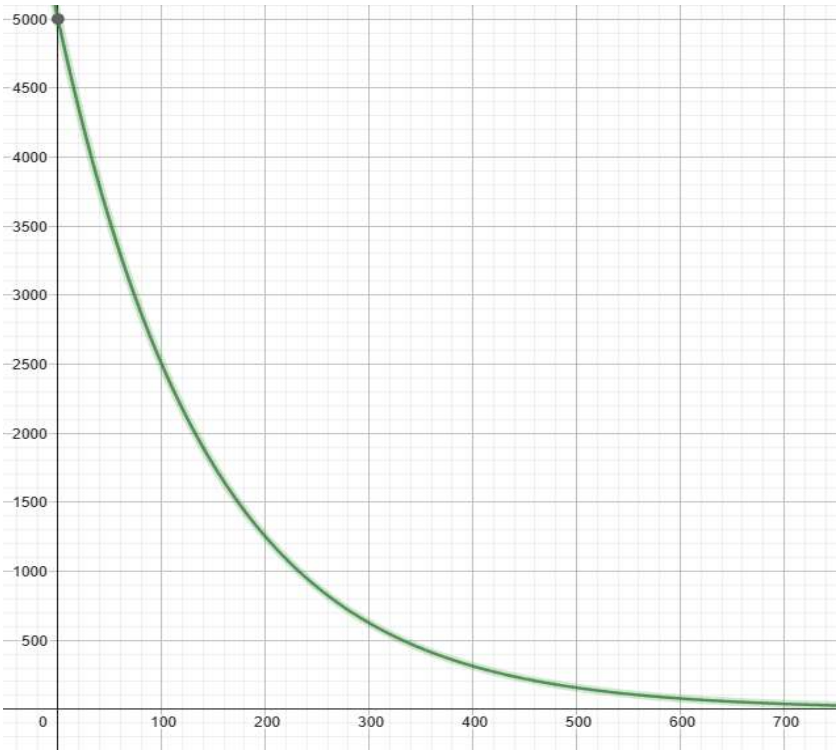
c. What will be the initial activity of this sample?

d. How many radioactive atoms of this isotope will remain after 100. years?

e. What will be the activity of this sample after 100. years?

f. How many grams of Sr-90 will remain after 100. years?

18.E: The graph below plots the activity of a radioactive sample as a function of time.



a. What is the half-life of this radioactive sample?

b. What is the decay constant of this isotope?

c. How many atoms were initially present in this sample?

d. What will be the activity of this sample after 10.0 minutes?

e. How long will it take for the activity of this sample to drop to 1.00% of its initial value?

f. How many radioactive atoms will remain after 10.0 minutes?

g. How many radioactive atoms will have decayed during the first 5.00 minutes?