





**DOE HANDBOOK: NUCLEAR PHYSICS AND REACTOR THEORY-VOLUME  
1 OF 2**

**Module 1 - "Atomic and Nuclear Physics"**

**Topic 5 - "Radioactivity"**

1. Define activity, curie, radioactive decay constant, and radioactive half-life. Include equations where applicable.

2. What is the curie content of 1 mg of Mn-56? The half-life of Mn-56 is 2.578 hrs.

3. A sample of Co-60 in a 250 mL sample bottle is known to have an activity of 3.4 Ci. What is the concentration of Co-60 in the bottle, expressed as g/L ? The half-life of Co-60 is 5.271 yrs.

4. Calculate the activity of 1 Ci of N-16 (half-life is 7.13 sec) after one, two, three, four, five, six, and seven half-lives. At what time (expressed in half-lives and seconds) is the activity essentially zero?

<b>A (Ci)</b>	<b>(t / t<sub>1/2</sub>)</b>	<b>t (sec)</b>
	<b>0</b>	<b>0</b>
	<b>1</b>	<b>7.13</b>
	<b>2</b>	<b>14.26</b>
	<b>3</b>	<b>21.39</b>
	<b>4</b>	<b>28.52</b>
	<b>5</b>	<b>35.65</b>
	<b>6</b>	<b>42.78</b>
	<b>7</b>	<b>49.91</b>

5. Define radioactive equilibrium.

### **Topic 6 – “Neutron Interactions”**

1. Describe scattering of neutrons with nuclei in general. Then describe elastic scattering and inelastic scattering of neutrons.

### **Topic 9 – “Interaction of Radiation with Matter”**

1. What is the difference between charged particle interactions and uncharged particle interactions?
  
  
  
  
  
  
  
  
  
  
2. Describe an alpha particle. How does it interact with matter? Why does it have a short range in matter? What can stop alpha particles? Would a flux of alpha particles incident upon a person be a risk to the person’s internal organs if the source was external? Why or why not? (more space available at top of next page)

3. Describe a beta-minus particle. How does it interact with matter? Compare its range to an alpha particle's range. What can stop beta-minus particles?
4. Describe a neutron. What is the typical source of neutrons? How does a neutron interact with matter? Compare its range to an alpha particle's range. What type of material is more effective at attenuating neutrons?

5. Describe a gamma ray. How does it interact with matter? Compare its range to an alpha particles range. What material can attenuate gamma rays? How much material is required?