Name _____ Date _____ Period _____

Identifying an Unknown Radiation Source

Part I: Open the Lab

In your web browser (mobile phones not recommended), navigate to www.gigaphysics.com, then click **Virtual Labs** in the heading bar and **Geiger-Mueller Tube** from the list of labs. If you're using a computer that someone else just used for this lab, then also click the **New Experiment** button to obtain your own random source.

Part II: Determine the Background Radiation Counts

To account for the radiation that is in the air, building materials, etc. rather than in your radioactive sources, start by setting the **Radiation source** to none (background), the **Type of barrier** to none, and the **Duration of count** to 30 seconds. Then click the **Start Count** button to begin counting the number of background radiation particles that strike the counter in 30 seconds. After the count has finished, record your answer below.

Background: _____ counts/30 seconds

Part III: Investigate Alpha Radiation

In a little while, you will test an unknown source to identify it as alpha, beta, or gamma. But in order to identify your unknown source, you first need to how alpha, beta, and gamma radiation behave. Specifically, you need to know how each is affected by different types of barriers. Begin with the alpha source. To start, set the **Radiation source** to alpha. You may leave the **Type of barrier** as none and the **Duration of count** at 30 seconds. Click **Start Count** to find the number of counts produced by the alpha source and enter it in the "Alpha counts/30 seconds" column in the first line of the data table below.

Remember, however, that some of those counts were from the background, not from the alpha source. Subtract the background counts you found in part II from your alpha count to arrive at a value that is solely from the alpha source, and add that value to the data table.

Type of barrier	Number of barriers	Alpha counts/30 seconds	Alpha counts/30 seconds (excluding background)
None	---		
Cardboard	1		
Cardboard	3		
Cardboard	5		
Plastic	1		
Plastic	3		
Plastic	5		
Lead	1		
Lead	3		
Lead	5		

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To find out how various barriers affect alpha radiation, it's time to begin adding barriers between the alpha source and detector. To find out how well a single piece of cardboard blocks alpha radiation, select the cardboard barrier from the **Type of barrier** menu and set the **Number of barriers** to one. Then click **Start Count**, and as before, subtract the background counts to find the number of counts from just the alpha source; enter your new measurements in the data table.

Continue with the different numbers and types of barriers as shown in the chart. In some cases, you may be able to skip some lines. For example, if three lead barriers reduce the number of alpha counts reaching the counter to near zero, you don't really need to run the count with five lead barriers; you know that it will block all the alpha radiation as well.

In some cases, the number of alpha counts may be even less than the background due to random variation. If this happens, simply write that the number of counts excluding the background radiation is zero; don't try to write a negative number for the alpha counts.

Based on your data, how hard is it to block alpha radiation? Which barriers are more effective? Less effective?

Part IV: Investigate Beta Radiation

Set the **Radiation source** to beta and repeat the procedure from part III.

Type of barrier	Number of barriers	Beta counts/30 seconds	Beta counts/30 seconds (excluding background)
None	---		
Cardboard	1		
Cardboard	3		
Cardboard	5		
Plastic	1		
Plastic	3		
Plastic	5		
Lead	1		
Lead	3		
Lead	5		

Based on your data, how hard is it to block beta radiation? Which barriers are more effective? Less effective?

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Part V: Investigate Gamma Radiation

Set the **Radiation source** to gamma and repeat the procedure from part III.

Type of barrier	Number of barriers	Gamma counts/30 seconds	Gamma counts/30 seconds (excluding background)
None	---		
Cardboard	1		
Cardboard	3		
Cardboard	5		
Plastic	1		
Plastic	3		
Plastic	5		
Lead	1		
Lead	3		
Lead	5		

Based on your data, how hard is it to block beta radiation? Which barriers are more effective? Less effective?

Part VI: Identify the Unknown Source

Now that you know how each type of radiation is affected by different types of barriers, it is time to identify the type of radiation in your unknown source. Change the **Radiation source** to the unknown source. This time, it will be up to you to decide which type of and how many barriers to use in each test after you have determined the number of counts without any barriers. You don't necessarily need to use all ten lines.

Type of barrier	Number of barriers	Counts/30 seconds	Counts/30 seconds (excluding background)
None	---		

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Based on the effects of different barriers on your unknown source, do you believe that the unknown source is emitting alpha, beta, or gamma radiation? Clearly explain your reasoning.

Type of source (alpha, beta, or gamma):_____

Part VII: Apply Your Knowledge

Many smoke detectors contain a small amount of the isotope Americium-241, which emits a small amount of gamma radiation (too little to care about), but more alpha radiation. Should a person walking under such a smoke detector be concerned about being hit by the alpha particles? Explain your answer using something you learned in this lab.

In the medical imaging procedure known as a PET scan (Positron Emission Tomography), radiation is created inside the body when positrons from a radioactive tracer strike electrons from the body's tissues. This radiation is then observed using a detector outside the body. Based on this information, do you think it is alpha, beta, or gamma radiation that is created by the positron-electron collision? Explain your answer using something you learned in this lab.