Name _____ Date _____ Period _____

Identifying an Unknown Radiation Source

Find the Lab

- In your web browser, go to **www.gigaphysics.com**, then click **Virtual Labs**, and then **Geiger-Müller Tube**.
- If someone else used the computer for this lab before you, click **New Experiment**. This will ensure that you have your own random sources for the experiment.

Part I: Measure the Background Radiation

- First we need to account for the radiation in the air, building materials, etc.—things other than the radioactive sources. (Yes, the lab is programmed to simulate these background sources.) To measure the background radiation, set the **Radiation source** to none (background), the **Type of barrier** to none, and the **Count Duration** to 30 seconds.
- Click Start Count to begin counting the number of background particles that hit the counter in 30 seconds. After the count has completed, record your answer below.

  Background: _____ counts in 30 seconds

Part II: Alpha Radiation

- Later you will try to identify an unknown radiation source as alpha, beta, or gamma. In order to do so, you will first need to know how each type of radiation is affected by barriers such as cardboard, lead, etc. To start these tests, change the **Radiation source** to alpha. You may leave the **Type of barrier** and **Count duration** as they were in part I.
- Click **Start Count** to obtain your count, then enter it in the first line of the data table at the top of the next page. This count goes in the including background" column since you have not yet removed the background counts that you measured in part I.
- To determine the counts from just the alpha source, subtract the number of background counts you measured in part I from the count you just measured. Record this figure in the "excluding background" column of the table.
- To find out how a cardboard barrier affects alpha radiation, change the **Type of barrier** to cardboard and the **Number of barriers** to one. Click **Start Count** again to obtain the count with one cardboard barrier between the alpha source and the detector. Record the data.
- Continue with the rest of the rows in the table. Sometimes the alpha count may be less than the background. This happens because this simulation is programmed to randomly vary the counts, just as in the real world. If this happens, write zero for the counts excluding the background.

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Type of barrier	Number of barriers	Alpha counts/30 seconds (including background)	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		

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

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Part III: Beta Radiation

■ Change the **Radiation source** to beta and repeat the previous experiment.

Type of barrier	Number of barriers	Beta counts/30 seconds (including background)	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		

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

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Part IV: Gamma Radiation

- Change the **Radiation source** to gamma and repeat the previous experiment.

Type of barrier	Number of barriers	Gamma counts/30 sec (including background)	Gamma counts/30 sec (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 gamma radiation? Which barriers are more effective? Which are less effective?

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Part V: Identify the Unknown Source

- Now that you know how each type of radiation is affected by different types of barriers, you can use this knowledge to identify an unknown source. To begin this process, change **Radiation source** to the unknown source.

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- The following data table leaves you more freedom to decide what tests you will run. Use what you learned in the previous parts to decide what tests will be most effective at helping you determine whether your unknown source is alpha, beta or gamma. You may or may not need to use all ten lines of the table.

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

Compare the results for your unknown source to your results for alpha, beta, and gamma radiation. Based on these data, what type of source is your unknown most likely to be?

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

Clearly explain your reasoning.

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Part VI: Apply Your Knowledge

Many smoke detectors contain a small amount of the isotope Americium-241, which emits 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.

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

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