Name _____ Date _____ Period _____

Identifying an Unknown Radiation Source

Part I: Introduction

In this lab, you will use a simulated Geiger-Müller tube to investigate properties of alpha, beta, and gamma radiation, then use your knowledge to identify an unknown radiation source. To begin, go to www.gigaphysics.com in your web browser, then to the **Geiger-Müller tube** lab. If you are using a computer that another student has just used for this lab, be sure that the **Alpha/Beta/Gamma** tab is selected, and click the **New Experiment** button to get your own individual data.

Part II: Measure the Background Radiation

There is always radiation around us, from sources in the air, building materials, etc., and this simulation takes this background radiation into account. To measure the background radiation, set both the **Radiation Source** and the **KInd of Barrier** to **None**. Then click the **Start Count** button. Every few seconds, you will see the readout on the G-M apparatus increase, meaning that a background decay has been detected. The count will stop automatically after thirty seconds; you can watch the countdown timer on the **Stop Count** button so you know when it is finished. (The **Stop Count** button is just so you can stop and restart quickly if you make a mistake.) Record your background counts below. (The is some natural random variation in counts, so consider taking more than one measurement and averaging the values.)

Background: _____ counts per 30 seconds

Part III: Alpha Radiation

In this part of the lab, you will see how alpha radiation is affected by various barriers. Set the **Radiation Source** to [Alpha], and leave the **Kind of Barrier** at **None** for now. Click the **Start Count** button, and record your count in the table below. Then subtract the background count you found in Part II so that your count includes only the alpha particles; record this figure as well. columns: (3cm, 4.5cm, 4.5cm, 4.5cm), “Kind of barrier”, “Number of barriers”, “Counts per 30 s”, “Counts per 30 s, excluding background”,

Kind of barrier	# of barriers	Counts/30s	Counts/30s, excluding background
None	---		
Cardboard	1		
Cardboard	3		
Cardboard	5		
Plastic	1		
Plastic	3		
Plastic	5		
Lead	1		
Lead	3		

Lead	5		

To find out how different barriers affect alpha radiation, start by changing the **Kind of Barrier** to **Cardboard** and the **# of Barriers** to 1. As before, click **Start Count**, then record the number of counts before and after subtracting the background counts.

Remember that there is natural random variation in the counts in any given period. Therefore, it is possible that when all radiation is blocked, you will measure fewer alpha counts than background. In this case, assume that the number of counts is zero after excluding the background.

Continue with the remainder of the barrier kinds and counts to complete the chart. You may not have to take all of the counts, however. If, for example, three lead barriers block all of the alpha radiation, then you may safely assume that even more barriers of the same kind will also block all of the alpha radiation.

Based on your data, how hard is it to block alpha radiation?

Part IV: Beta Radiation

Set the **Radiation Source** to **Beta** and repeat the same procedure from part III.

Kind of barrier	# of barriers	Counts/30s	Counts/30s, 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 most effective? Least effective?

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Part V: Gamma Radiation

Set the **Radiation Source** to **Gamma** and repeat the same procedure from part IIE.

Kind of barrier	# of barriers	Counts/30s	Counts/30s, excluding background
None	---		
Cardboard	1		
Cardboard	3		
Cardboard	5		
Plastic	1		
Plastic	3		
Plastic	5		
Lead	1		
Lead	3		
Lead	5		

How hard is it to block gamma radiation? Which barriers are most and least effective?

Part VI: Identify an Unknown Source

Now that you know how different barriers affect different sources, you can identify the radiation in your unknown source. Change your **RAdiation Source** to **Unknown**. This time, it will be up to you to decide what kind of barriers and how many will be most useful to test. You do not necessarily need to use all line of the chart.

Kind of barrier	# of barriers	Counts/30s	Counts/30s, excluding background

Based on your data, what type of radiation is your unknown source emitting? Justify your answer using your data.

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.