Dougherty Valley HS Chemistry
Detecting Ionizing Radiation Using a Cloud Chamber

Worksheet #7

Name: **Period:** **Seat#:**

Required Sections: (Refer to R-5 for guidelines and requirements. Make note of any specific changes given by your teacher in class)

Prelab: Materials, Reagent Table, Procedures, and set up Data Tables before you get to class on a SEPARATE page in your notebook from rest of prelab. - *All written in your lab notebook*

During Lab: Data section - *Add to your pre drawn data tables*

Post-lab: Post Lab Two Pager Worksheet, Discussion Questions - *written in your lab notebook on a new page*

Background

A cloud chamber is a simple device for detecting low levels of nuclear radiation. While the radiation itself is not directly visible, the *path* it travels can be distinguished. A cloud chamber consists of a cooled supersaturated vapor and a radioactive source. In this lab, the radioactive source is a gas camping lantern mantle containing thorium-232, and the vapor source is isopropanol cooled with dry ice. When the radioactive source emits ionizing radiation, it may ionize a molecule of the alcohol vapor by removing an electron. Other vapor molecules can condense on this newly formed ion, making a small droplet. As the ionizing radiation travels through the vapor and ionizes molecules along its path, a visible cloud track forms as a result of the condensation of vapor particles.

In your introduction you will discuss the Thorium – 232 Decay Series. Include in your discussion, the types of radioactive decay it undergoes, at least three of the nuclear reactions within the decay series and the final stable nuclide it becomes. Also describe how a cloud chamber works. Be sure to put everything in your own words.

In the cloud chamber you can expect to see one, some, or all, of the following shapes of cloud tracks during the decay of thorium-232

- Alpha particles: Short, thick, straight cloud tracks
- Beta particles: Thin, slightly long, slightly curved cloud tracks
- Gamma rays: Thin, short, curved tracks indicate gamma rays emitted by radioisotopes in the environment
- Muons: Occasional, long, thin, straight tracks created by cosmic ray bombardment of atmospheric molecules.

Materials

Beral-type pipet, Flashlight, Cloud Chamber (set up for you), Isopropyl alcohol, Gas lantern mantle, dry ice

Procedure:

1) Saturate the two felt squares on the lid of the cloud chamber by dropping isopropyl alcohol on the squares.

2) Bring your plastic bowl and obtain some dry ice from your teacher.

3) Place the Cloud Chamber on top of the dry ice in the plastic bowl.
- DO NOT let the dry ice touch your unprotected skin.

4) Allow the Cloud Chamber to sit on the dry ice for approximately 5 minutes to cool the air and liquid and thus produce "super-cooled" (supersaturated) alcohol vapor inside the chamber.
- There will be a misty layer on the bottom of the cloud chamber, but the chamber should not cloud up completely or the liquid alcohol will be cooled to a solid.

5) Shine the light from a flashlight (or LED light) through the side of the cloud chamber source.
- Sometimes shining the light through the top will work as well.

6) Observe the condensation tails against the dark, black bottom of the cloud chamber. Several Different patterns will be observed and will change over time.
- Hint: The trails may look like wisps of smoke shooting out randomly through the chamber.

7) Observe the thickness, length, and shape of the different kinds of tracks and record all observations in the data table.

8) After your observation is complete, take the piece of silk material and rub it over the chamber lid.
- What happens to the tracks in the Cloud Chamber?

9) Clean up as instructed by your teacher.

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Data Table - *sample table. Yours needs a title and to be drawn big enough to write in, and to draw in!*

Particles	Observations/Track Drawings of Each Individual Particle Track
Alpha	
Beta	
Gamma	
Muon	
One drawing of the entire cloud chamber view	

Discussion Questions: - *To be done AFTER the lab is done*

1) Draw and complete the following table into your lab notebook.

	Alpha	Beta	Gamma
Mass			
Charge			
Symbol (s)			
Penetrating Power			

2) Draw a labeled diagram of your cloud chamber.

3) Making Predictions – draw and complete the following table in your lab notebook.

For each change in conditions of the lab procedure, make a prediction about how the number or direction of the cloud tracks would change. Explain your reasoning.

Change in Condition	Prediction	Reasoning
Covering the mantle with aluminum foil inside the cloud chamber		
Placing a negatively charged plate inside the cloud chamber		
Placing a positively charged plate inside the cloud chamber		
Operating the cloud chamber without the lantern mantle.		

4) Write two balanced nuclear equations for consecutive nuclear decay reactions that occurred in this lab. Label the type of decay for each one.

5) Explain why some cloud tracks are longer than others and some thicker and more pronounced.

6) Cloud chambers were invented in 1911 by Charles Wilson. They were eventually supplanted by "bubble chambers." Research bubble chambers online and describe – a similarity and a difference between them and cloud chambers, and what was better/different about bubble chambers that led to it supplanting the cloud chamber.