**7.2 PhET LAB: Beta Decay** Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**OBJECTIVE**: explain the beta decay processes; complete radioactive decay equations; and analyze the rate of radioactive decay by applying the PhET “Beta Decay” simulation at [http://phet.colorado.edu](http://phet.colorado.edu/).

**Open/Run Beta Decay at** [**http://phet.colorado.edu**](http://phet.colorado.edu/)**.**

**Take 5 minutes to freely explore the sim.**

Investigating Beta-minus Decay

1. Start on the **SINGLE ATOM** tab. Observe the B- decay of Hydrogen-3 and Carbon-14. After each decay, press the RESET NUCLEUS button to watch the process again. **Write a description of beta-minus decay.**

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2. Name the **two particles ejected** from within the nucleus itself during **beta-minus decay**.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3. Why does C-14 decay, but not N-14? (hint: protons and neutrons)

 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

$$$$

p = \_\_\_

n = \_\_\_

$$$$

p = \_\_\_

n = \_\_\_

 **v.** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**Complete the following beta-minus decay equations, using** [**http://www.chemicalelements.com**](http://www.chemicalelements.com/)**:**

4. Hydrogen-3: $\rightarrow ++$ 5. Carbon-14: $\rightarrow ++$

6. Cesium-137: $\rightarrow ++$

Investigating Half-Life for Beta-minus Decay

7. Click the MULTIPLE ATOMS tab. Use 99 *Custom* Nucleus with a half-life of 5 years
to gather the data required for the table below as it decays.

|  |  |  |
| --- | --- | --- |
| **Time (t/yr)** | **Daughter Nuclei(n, decayed nuclei in 5 year span)** | **Beta-minus decay rate(r, decayed nuclei per year)** |
| 5 |  |  |
| 10 |  |  |
| 15 |  |  |
| 20 |  |  |
| 25 |  |  |

8. Describe what happens to the ***rate* of beta-minus decay**. Use values to justify your writing.

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Investigating Beta-minus Decay Rate

9. Execute three more trials, completing a new chart.

|  |  |  |
| --- | --- | --- |
| **Time (t/yr)**$\pm 0.2$ | **Daughter Nuclei(n, decayed nuclei in 5 year interval)** | **Average Beta-minus Decay Rate(r,** $n∙yr^{-1}$**)**$\pm \\_\\_\\_\\_\\_\\_\\_ n∙yr^{-1}$ |
| ***Trial 1*** | ***Trial 2*** | ***Trial 3*** |
| 5 |  |  |  |  |
| 10 |  |  |  |  |
| 15 |  |  |  |  |
| 20 |  |  |  |  |
| 25 |  |  |  |  |

10. Use MS Excel to make a graph of **average rate of beta-minus decay v. time** including vertical uncertainty error bars. Insert the graph below.

11. **Share and discuss** the curve on your graph with another student in the class.

12. How is beta decay used in the real world?

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Differences between Beta-minus and Beta-plus Decays

13. In beta-plus decay, instead of an antineutrino and an electron, a \_\_\_\_\_\_\_\_\_\_\_\_\_\_ and a \_\_\_\_\_\_\_\_\_\_\_\_
are ejected. The nuclei that have yet to decay are called \_\_\_\_\_\_\_\_\_\_\_ nuclei and the nuclei that decayed
are called \_\_\_\_\_\_\_\_\_\_\_\_ nuclei.

**Complete the following beta-plus decay equations, using** [**http://www.chemicalelements.com**](http://www.chemicalelements.com/)**:**

14. Carbon-10: $\rightarrow ++$ 17. Sodium-22: $\rightarrow ++$