## Half-life Review

How to solve half-life

problems

You have an **amount (N) and half-life** – how much exists after X amount of time:

- X amount of time/ Half-life= # of half-lives
- $N * \frac{1}{2}$  (# of half-lives)

You have an **amount** of sample – **how many half-lives** has the initial sample gone through to reach the final sample:

 Initial sample \* ½ (do this until you reach the final sample number) You have the **amount of half-lives** (X) and **the initial** (N) – how much exists after X half-lives:

-  $N * \frac{1}{2} (X \text{ times})$ 

You have the **daughter amount** – **how much parent is left** and **how much time has passed** to have this amount

- Subtract 100 from daughter amount = parent amount
- Calculate number of half-lives and multiply by half-life time to get overall time

## **Examples:**

- 1. Kyropton-83 has a half-life of 4.5 hours.
  - a) How many half-lives have passed after 36 hours?

$$36 \div 4.5 = 8$$

b) An original sample contained 600 g of parent isotope. How much was left after 36 hours?

$$600 \times \frac{1}{2} = 2.34 \text{ g}$$

c) How much daughter isotope is there? Use 1.b) to answer this question

$$600 - 2.34 = 597.66 \,\mathrm{g}$$

d) If the initial sample (600 g) was found to only have 75 g of parent, how old is the sample?

$$600 \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = 75 \text{ g} \rightarrow 3 \text{ half lives}$$

$$3 \times 4.5 \text{ hours} = 13.5 \text{ hours}$$

Date:	Name:

2. A sample of calcium-47 was found to contain only 7 g after it had been sitting for 16 days. It is known to have a half-life of 4 days. How much calcium-47 was there initially?

$$16 \div 4 = 4 \text{ half lives}$$

$$7 \times 2 \times 2 \times 2 \times 2 = 112 \text{ g initial mass}$$

3. A sample contained 75 g of the daughter isotope and 5 g parent isotope. This amount of daughter to parent isotope was found after 64 days. What is the half-life of these radioactive species?

$$\times 75 + 5 = 80 \ g \ total$$

$$80 \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = 5 \ g \rightarrow 4 \ half-lives$$

$$64 \ days \div 4 = 16 \ days \rightarrow half-life$$

4. Gadolinium-164 has a half-life of 12 seconds. An initial sample of 40 g parent was found to contain 37.5 g of daughter. How old is the sample?

$$40 - 37.5 = 2.5 g parent$$

$$40 g \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = 2.5 g \longrightarrow 4 \text{ half-lives}$$

$$12 \text{ seconds } \times 4 = 48 \text{ seconds old}$$