Date: _____ Name: _____

Half-life

Fill in the following chart to help in your understanding of half-life. You may work in pairs.

Number of Half-lives	Amount of Parent Remaining	Amount of Daughter Produced	Total amount (Parent + Daughter)
0	100	0	100
1	50	50	100
2	25	75	100
3	12.5	87.5	100
4	6.25	93.75	100
5	3.125	96.875	100

**Note: the total amount of daughter and parent always equals the same amount. It is equal to 100% or 1.*

How to calculate half-lives:

- Each half-life is represented by ½ and can be used to calculate the amount or fraction of the original sample remaining.

For example, if a 100 g sample goes through 3 half-lives, ½ would be multiplied 3 times.

100 g * ½ * ½ * ½ = 12.5 g

Practice:

1. Iodine-131 has a half-life of eight days. If a sample contained 512 g of iodine-131, what mass of iodine would remain after 32 days?

32 ÷ 8 = 4 (4 half-lives)

$512\ g \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = 32\ g$ or $512 \times 1/2^4 = 32\ g$

2. A sample of rock contains 800 g of a radioactive species. How much of the radioactive species will remain after three half-lives?

$800\ g \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = 100\ g$

Date: _____ Name: _____

3. An initial sample of Uranium-235 was 80 g and it has a half-life of 700 million years. After how many half-lives will the sample of Uranium-235 be reduced to 2.5 g?

80 g $\times \frac{1}{2} =$ 40 g (1 half-life)

40 g $\times \frac{1}{2} =$ 20 g (2 half-lives)

20 g $\times \frac{1}{2} =$ 10 g (3 half-lives)

10 g $\times \frac{1}{2} =$ 5 g (4 half- lives)

5 g $\times \frac{1}{2} =$ 2.5 g (5 half-lives) → 5 half-lives have gone by

4. How much time (in years) has gone by if a sample of Carbon-14 has 12.5% remaining? The half-life for carbon-14 is 5730 years.

100 % $\times \frac{1}{2} =$ 50 % (1 half-life)

50% $\times \frac{1}{2} =$ 25% (2 half-lives)

25% $\times \frac{1}{2} =$ 12.5% (3 half-lives) → 3 half-lives have gone by

3 × 5730 years = 17190 years → 17190 years have gone by

Define **- Activity:** the number of decays per second of a sample; measured in becquerels (Bq)

Example: What is the activity level of a sample of Beryllium-7 which has a half-life of 35 days? A sample was observed for 1 min and there were 26 880 decays.

1 minute = 60 seconds

26 880 decays ÷ 60 seconds = 448 decays/second