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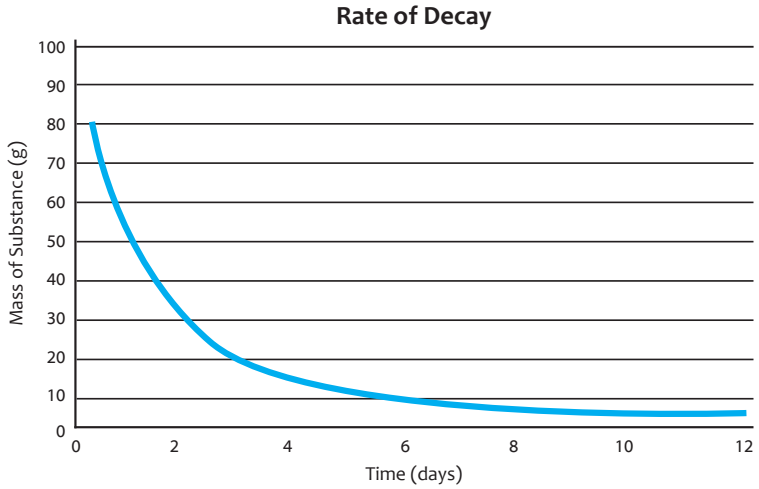
Unit 7D
Half Life
Practice Problems TEACHER

Work each of the following problems. SHOW ALL WORK.

1. **If a radioactive sample has a half-life of one month, how much of the original sample will be left at the end of the second month and the third month?**

After one month, half of the original sample will remain. After two months, one-fourth of the original sample will remain. After three months, one-eighth of the original sample will remain

2. **Using the graph below, determine the half-life of the substance.**



The half-life of this substance is two days. On the graph, you can see that half of the sample decays every two days.

3. **A radioactive substance, fermium-253, has a half-life of three days. How long will it take for this isotope to decay to one-eighth of its original amount?**

After one half-life, half of the sample will remain (3 days). After two half-lives, one-fourth of the sample will remain (6 days). After three half-lives, one-eighth of the sample will remain (9 days).

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Fill in the blanks

4. Seaborgium-266 has a half-life of 30 seconds. If there are initially 30 grams in a sample of seaborgium-266, how many grams will remain after two minutes have elapsed?

Time	# of Half-Lives	Mass of Sample
0	*0*	*30 g*
30 seconds	*1*	*15 g*
1 minute	*2*	*7.5 g*
1.5 minutes	*3*	*3.75 g*
2 minutes	*4*	*1.875 g*

Or:

$$\#\ Half\text{-}Lives = \frac{\text{Total Time}}{\text{Half-Life}} = \frac{2\,\text{min}}{30\,\text{s}} = 4$$

$$mass_{remaining} = mass_{starting}\left(\frac{1}{2}\right)^{\#\ HLs}$$

$$mass_{remaining} = (30\ g)\left(\frac{1}{2}\right)^{4}$$

$$mass_{remaining} = (30\ g)\left(\frac{1}{16}\right)$$

$$mass_{remaining} = 1.875\ g$$

5. The isotope nickel-63 has a half-life of 100 years. If a tested sample has five grams of nickel-63 and is estimated to be 400 years old, how many grams of nickel-63 were initially in the sample?

Time	# of Half-Lives	Mass of Sample
400 years	*0*	*5 g*
300 years	*1*	*10 g*
200 years	*2*	*20 g*
100 years	*3*	*40 g*
0 years	*4*	*80 g*

Or:

$$\#\ Half\text{-}Lives = \frac{\text{Total Time}}{\text{Half-Life}} = \frac{400\,\text{yrs}}{100\,\text{yrs}} = 4$$

$$mass_{remaining} = mass_{starting}\left(\frac{1}{2}\right)^{\#\ HLs}$$

$$5\ g = mass_{starting}\left(\frac{1}{2}\right)^{4}$$

$$5\ g = mass_{starting}\left(\frac{1}{16}\right)$$

$$mass_{starting} = 80\ g$$

6. What is the half-life of a sample that decays from 200 grams to 12.5 grams in eight hours?

Time	# of Half-Lives
200 g	*0*
100 g	*1*
50 g	*2*
25 g	*3*
12.5 g	*4*

Or:

$$\#\ Half\text{-}Lives = \frac{\text{Total Time}}{\text{Half-Life}}$$

$$4 = \frac{8\,\text{hours}}{\text{Half-Life}}$$

$$\text{Half-Life} = 2\,\text{hours}$$

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Work each of the following problems. SHOW ALL WORK.

7. Oxygen-15 is an isotope of oxygen that is used in the medical procedure called a PET scan. The half-life of oxygen-15 is roughly two minutes. If a hospital needs one gram of oxygen-15, and the drive from the medical supply company to the hospital is 16 minutes, how many grams of oxygen-15 should be shipped to the hospital?

Time	# of Half-Lives	Mass of Sample
16 minutes	*0*	*5 g*
14 minutes	*1*	*1 g*
12 minutes	*2*	*4 g*
10 minutes	*3*	*8 g*
8 minutes	*4*	*8 g*
6 minutes	*5*	*16 g*
4 minutes	*6*	*32 g*
2 minutes	*7*	*128 g*
0 minutes	*8*	*256 g*

Or:

$$\#\ Half\text{-}Lives = \frac{\text{Total Time}}{\text{Half-Life}} = \frac{16\,\text{min}}{2\,\text{min}} = 8$$

$$mass_{remaining} = mass_{starting}\left(\frac{1}{2}\right)^{\#\ HLs}$$

$$1\,g = mass_{starting}\left(\frac{1}{2}\right)^{8}$$

$$1\,g = mass_{starting}\left(\frac{1}{256}\right)$$

$$mass_{starting} = 256\,g$$

8. A naturally occurring isotope of hydrogen called tritium has a half-life of 12.3 years. If a sample of tritium is one-sixty-fourth of its original amount, how much time has elapsed?

If one hundred sixty-fourth of the original amount of tritium is left, then six half-lives have occurred.

$$6\ Half\text{-}Lives \times 12.3\ years = 73.8\ years$$