

# Half Life Problems Worksheet And Answers

**KEY**

## Radioactive Half-Life Problems

1.) Calculate the number of half lives it would take for 100 grams of Radium-223 to decay into 3.125 grams of Radon-219.

$$100 \xrightarrow{\text{11 days}} 50 \xrightarrow{\text{11 days}} 25 \xrightarrow{\text{11 days}} 12.5 \xrightarrow{\text{11 days}} 6.25 \xrightarrow{\text{11 days}} 3.125$$

11 days      11 days      11 days      11 days      11 days = 55

2.) How long would it take for 100 grams of Radium-223 to decay into 3.125 grams of Radon-219 if the half life of Radium-223 is 11 days?

$$100g \longrightarrow 3.125g \text{ TAKES } 5 \text{ HALF-LIVES}$$

$$5 \times 11 \text{ days} = 55 \text{ DAYS}$$

3.) Astatine-217 has a half life of 20 milliseconds. If you start with a 30 gram sample of Astatine-217 how much will be left after 100 milliseconds? Hint: how many half lives in 100 milliseconds.

$$100 \text{ ms} = 5 \text{ HALF-LIVES} \quad 20 \overline{) 100} = 5$$

$$30g \xrightarrow{\text{1}} 15g \xrightarrow{\text{2}} 7.5g \xrightarrow{\text{3}} 3.75g \xrightarrow{\text{4}} 1.875g \xrightarrow{\text{5}} .9375g$$

4.) Carbon-14 has a half life of 5730 years. An archeologist discovers a piece of cloth in an old cave. If it could be determined that 3.5 half lives had passed since the cloth was made how old would the cloth be?

$$5730 \text{ YRS} \times 3.5 \text{ HL} = 20,055 \text{ years}$$

5.) If you start with a sample of 100 atoms and determine the half life to be 10 days would the half life be any different if you then repeated your measurement using 10,000 atoms? Explain

NO - IT WOULD JUST TAKE LONGER FOR THE SUBSTANCE TO COMPLETELY DECAY.

6.) Thorium-232 decays into Radium-228 with a half-life of 1.9 years. If you start with a 60gram sample of Thorium-232 how much would you have left after 5.7 years?

$$1.9 \overline{) 5.7} = 3 \text{ HALF-LIVES}$$

$$60g \xrightarrow{\text{1}} 30g \xrightarrow{\text{2}} 15g \xrightarrow{\text{3}} 7.5g$$

7.) Lead-212 decays into Bismuth-212 with a half-life of 11 hours. If you start with 200 atoms of Lead-212 how many atoms of Bismuth-212 would you have after 22 hours.

$$11 \overline{) 22} = 2 \text{ HALF-LIVES}$$

$$\text{lead atoms} = 200 \xrightarrow{\text{1}} 100 \xrightarrow{\text{2}} 50 = \text{lead atoms}$$

$$100 \xrightarrow{\text{1}} 50 \xrightarrow{\text{2}} 25 = \text{BISMUTH-212}$$

Half life problems worksheet and answers are essential tools for students and professionals alike who seek to understand the intricacies of radioactive decay and the behavior of substances over time. Half-life, the time required for half of a sample of a radioactive substance to decay, is a fundamental concept in nuclear chemistry, biology, and environmental science. This article will explore various aspects of half-life problems, provide sample questions, and offer detailed answers, enhancing comprehension of this vital topic.

## Understanding Half-Life

## Definition of Half-Life

Half-life is defined as the time it takes for half of the radioactive atoms in a sample to decay. This concept is not only applicable to radioactive isotopes but also to various chemical reactions and biological processes. The half-life can be calculated using the following formula:

$$N(t) = N_0 \times \left( \frac{1}{2} \right)^{\frac{t}{t_{1/2}}}$$

Where:

- $N(t)$  = the remaining quantity of the substance at time  $t$
- $N_0$  = the initial quantity of the substance
- $t$  = time elapsed
- $t_{1/2}$  = half-life of the substance

## Importance of Half-Life

Understanding half-life is crucial for various fields, including:

1. Nuclear Medicine: Determining the safe usage and disposal of radioactive materials.
2. Environmental Science: Assessing the longevity and impact of pollutants.
3. Archaeology: Utilizing radiocarbon dating to determine the age of ancient artifacts.

## Half-Life Problems Worksheet

To effectively grasp the concept of half-life, students can work on problems that require calculations based on the half-life of different substances. Below is a sample worksheet with problems designed to challenge and develop understanding.

### Sample Problems

1. Problem 1: A sample of Carbon-14 has an initial mass of 100 grams. If the half-life of Carbon-14 is 5730 years, how much of the sample remains after 11,460 years?
2. Problem 2: A radioactive isotope has a half-life of 3 years. If you start with 80 grams, how much will remain after 9 years?
3. Problem 3: A certain radioactive material has a half-life of 10 days. If you have a 200-gram sample, how much will remain after 30 days?
4. Problem 4: If 25 grams of a substance remains after 12 hours and its half-life is 4 hours, what was the initial amount of the substance?
5. Problem 5: A material decays such that after 24 hours, 12.5% of the original sample remains. What is the half-life of this material?

# Answers to Half-Life Problems

Now, let's solve the above problems step by step.

## Solutions

1. Solution to Problem 1:

- After 5730 years (1 half-life), 50 grams remain.
- After 11,460 years (2 half-lives), 25 grams remain.
- Answer: 25 grams.

2. Solution to Problem 2:

- After 3 years (1 half-life), 40 grams remain.
- After 6 years (2 half-lives), 20 grams remain.
- After 9 years (3 half-lives), 10 grams remain.
- Answer: 10 grams.

3. Solution to Problem 3:

- After 10 days (1 half-life), 100 grams remain.
- After 20 days (2 half-lives), 50 grams remain.
- After 30 days (3 half-lives), 25 grams remain.
- Answer: 25 grams.

4. Solution to Problem 4:

- After 4 hours (1 half-life), 50 grams remain.
- After 8 hours (2 half-lives), 25 grams remain.
- After 12 hours (3 half-lives), 12.5 grams remain.
- The initial amount must have been 100 grams.
- Answer: 100 grams.

5. Solution to Problem 5:

- If 12.5% remains, this indicates 3 half-lives ( $100\% > 50\% > 25\% > 12.5\%$ ).
- Therefore, the half-life is  $24 \text{ hours} / 3 = 8 \text{ hours}$ .
- Answer: 8 hours.

## Practical Applications of Half-Life Calculations

Half-life calculations have various practical applications in multiple fields. Here are some notable examples:

### Nuclear Medicine

In nuclear medicine, half-life is crucial for determining dosage and timing for treatments involving radioactive isotopes. For instance, Iodine-131, used in treating thyroid conditions, has a half-life of 8 days. Understanding this allows medical professionals to plan treatments effectively.

## **Radiocarbon Dating**

Radiocarbon dating uses the half-life of Carbon-14 (approximately 5730 years) to estimate the age of organic materials. By measuring the remaining Carbon-14 in a sample, scientists can determine how long it has been since the organism's death.

## **Environmental Monitoring**

In environmental science, half-life helps assess the persistence of pollutants in ecosystems. For example, knowing the half-life of a pesticide can inform regulations and cleanup efforts, ensuring that harmful substances do not linger in the environment longer than necessary.

## **Conclusion**

The concept of half-life is a fundamental aspect of various scientific disciplines, from chemistry to medicine and environmental science. Engaging with half life problems worksheets and answers not only improves mathematical skills but also enhances understanding of real-world applications. By practicing these problems, students can build a solid foundation in the principles of radioactive decay and its implications across multiple fields. The ability to calculate and interpret half-life is invaluable for anyone pursuing a career in science, engineering, or related areas.

## **Frequently Asked Questions**

### **What are half-life problems in chemistry?**

Half-life problems in chemistry involve calculating the time required for a substance to reduce to half its initial amount, commonly used in radioactive decay and pharmacokinetics.

### **What types of questions are typically included in a half-life problems worksheet?**

A half-life problems worksheet typically includes questions that ask students to calculate the remaining amount of a substance after a certain number of half-lives, determine the half-life of a substance based on decay data, and apply half-life concepts to real-world scenarios.

### **How can I effectively solve half-life problems?**

To effectively solve half-life problems, identify the initial quantity, the number of half-lives that have passed, and use the formula: Remaining amount = Initial amount  $\times (1/2)^{(\text{number of half-lives})}$ .

### **Where can I find half-life problems worksheets and**

## answers?

Half-life problems worksheets and answers can be found on educational websites, teacher resource portals, and in chemistry textbooks or online platforms that offer practice problems and solutions.

## What are some common pitfalls when solving half-life problems?

Common pitfalls include miscalculating the number of half-lives, forgetting to convert units appropriately, and not correctly applying the formula for remaining quantity, leading to inaccurate results.

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## Half Life Problems Worksheet And Answers

### **Good Sources of Mono-Black Ramp - MTG Salvation**

Dec 11, 2016 · Coffers is far and away the best ramp in mono-B and is worth including a dedicated tutor for. I've definitely built mono-B lists around that card. Coffers, Deserted Temple, Petrified Field, Vesuva, Thespian's Stage, Grim Discovery, etc. You're probably not going for all of those on a budget, but Coffers at least is worth saving up for.

### **Ramp cards that also draw cards - MTG Salvation**

Nov 8, 2017 · Ramp and card draw are two important functions in EDH, we are \*supposed\* to run 10 sources of each. But if there are enough cards that can do double duty these twenty slots could produce 15 of each (albeit 10 hybrid slightly less efficiently) with the 5 other slots being able to be of the more efficient variety.

### **Anything better than Cultivate? - Magic General - MTG Salvation**

Oct 30, 2014 · Hello everyone. Looking for an instant or sorcery green ramp card that is better or similar to Cultivate. Any suggestions are appreciated, any set, any format.

### **How Much? (Draw, Tutors, Ramp) - MTG Salvation**

Mar 28, 2012 · Of course, you also have to make sure in addition to ramp/draw/tutor, you have threats and wincons that you can ramp into, draw into, and tutor for. For a practical example, Here's the draw/ramp/card quality from a deck I'm currently working on:

### **Red/white draw/ramp - Commander (EDH) - The Game - MTG ...**

Jan 26, 2014 · Mind Stone, Boros Cluestone and Dreamstone Hedron double as both acceleration and card draw. Inheritance is lower on the curve and provides card draw. Tower of Fortunes and Book of Rass are decent card draw at higher CC if you're running enough ramp.

### Drawing, Ramping, and Fixing in Orzhov - MTG Salvation

Jun 19, 2013 · Ramps and completely fixes. Coalition Relic. Beautiful card. Darksteel Ingot. Great vs. O-Stone effects Gilded Lotus. Ramps like crazy. Orzhov Cluestone. I honestly put this in because I

need more Sun Titan Targets. Lets just say this card blew me out of the water with how well it's performed. Run it if you have Sun Titan (which you should).

*What are some mana ramp options for Blue/Black decks?*

Sep 28, 2015 · thada adel is a great "ramp" card. Steal everyone's sol rings/mana crypts/fellwar stones/etc. "I think EDH would be more fun for the majority of participants if players just showed eachother their decks rather than actually playing games out." To post a comment, please login or register a new account.

*Mana Ramp vs. Card Draw? - Commander (EDH) - MTG Salvation*

Mar 18, 2013 · I have three slots that are currently dedicated to card draw creatures, that I am considering swapping for more mana ramp creatures. I understand that without knowing the rest of the deck, you can't give me your advice on my list. In general, when constructing your lists, do you lean more towards card draw or mana ramp? Card Draw: Elvish Visionary

**Cube Card and Archetype Discussion - MTG Salvation**

Jan 7, 2013 · This is the best green ramp card in the cube. Absolute staple. Uncuttable. And it is nothing like Rampant Growth. Well, the cost and the fixing part is, obviously. But Elder gains you 2-3 life on a regular basis and/or becomes an actual win condition if drawn late. Ever tried dealing some damage with Rampant Growth? Or gaining some life?

Cards That COULD Fix Boros in EDH - Custom Card Creation

Dec 19, 2019 · 2. Lacks ramp aside from artifacts, and will fall behind in the game if unable to ramp well 3. Lacks card draw, though artifacts can solve it again 4. Simply just overall much worse than other faction decks simply because it relies on having a good board state while others either screw up board states, rush everyone, or pillowfort themselves

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