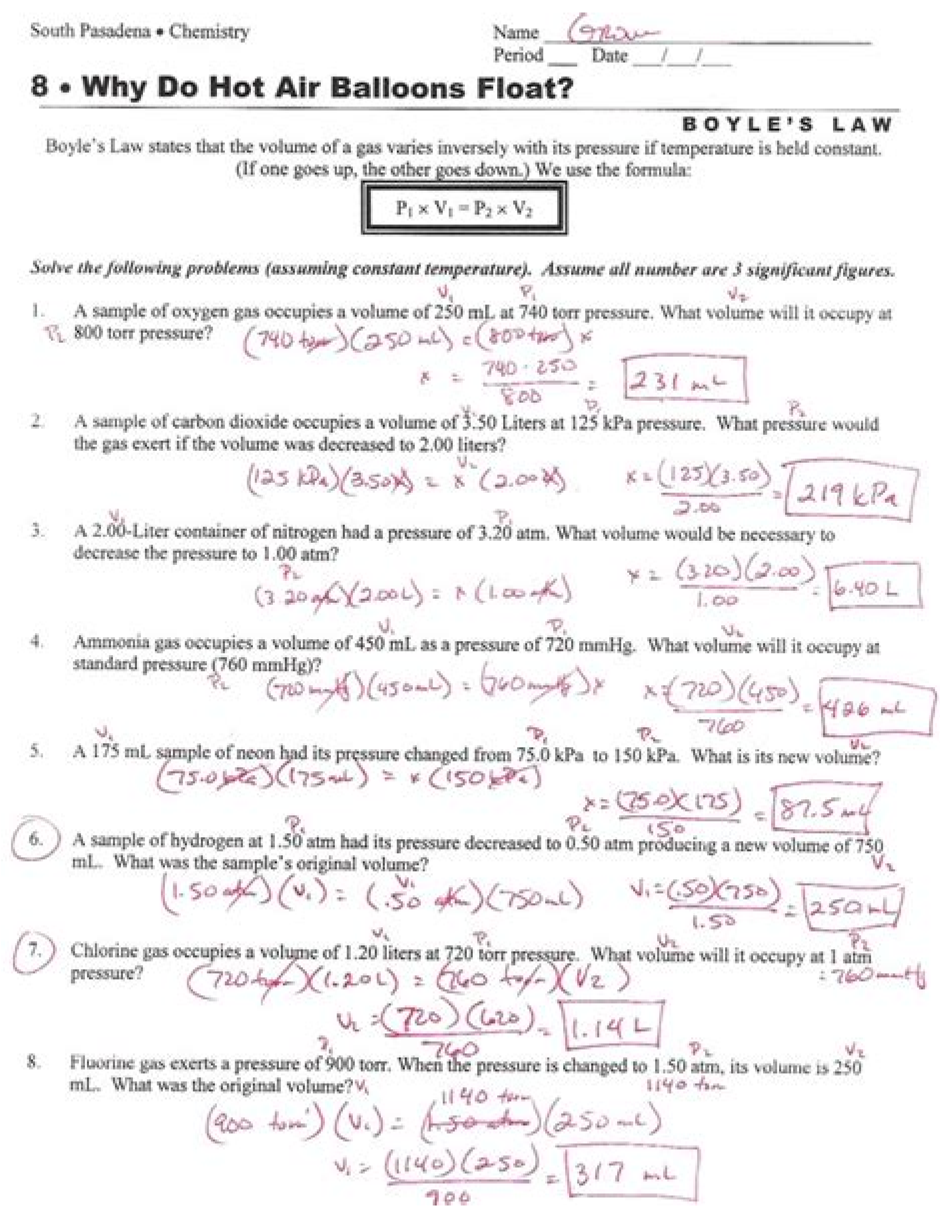
Half Life Problems And Answers Worksheet


South Pasadena • Chemistry

Name ____ Period ___ Date ___/___/___

8 • Why Do Hot Air Balloons Float?

BOYLE'S LAW

Boyle's Law states that the volume of a gas varies inversely with its pressure if temperature is held constant. (If one goes up, the other goes down.) We use the formula:

$$P_1 \times V_1 = P_2 \times V_2$$

Solve the following problems (assuming constant temperature). Assume all number are 3 significant figures.

1. A sample of oxygen gas occupies a volume of 250 mL at 740 torr pressure. What volume will it occupy at 800 torr pressure?
2. A sample of carbon dioxide occupies a volume of 3.50 Liters at 125 kPa pressure. What pressure would the gas exert if the volume was decreased to 2.00 liters?
3. A 2.00-Liter container of nitrogen had a pressure of 3.20 atm. What volume would be necessary to decrease the pressure to 1.00 atm?
4. Ammonia gas occupies a volume of 450 mL as a pressure of 720 mmHg. What volume will it occupy at standard pressure (760 mmHg)?
5. A 175 mL sample of neon had its pressure changed from 75.0 kPa to 150 kPa. What is its new volume?
6. A sample of hydrogen at 1.50 atm had its pressure decreased to 0.50 atm producing a new volume of 750 mL. What was the sample's original volume?
7. Chlorine gas occupies a volume of 1.20 liters at 720 torr pressure. What volume will it occupy at 1 atm pressure?
8. Fluorine gas exerts a pressure of 900 torr. When the pressure is changed to 1.50 atm, its volume is 250 mL. What was the original volume?

Half life problems and answers worksheet are essential tools for students and educators alike, especially in the fields of chemistry, physics, and environmental science. Understanding half-life—a concept that describes the time required for half of a substance to decay or be eliminated—can be crucial for grasping a variety of scientific principles. This article explores half-life problems, offers a range of example questions, and provides detailed answers to enhance comprehension.

Understanding Half-Life

What is Half-Life?

Half-life is defined as the time taken for the quantity of a substance to reduce to half its initial value. This concept is widely applicable in various scientific domains, including:

- Radioactive decay: Understanding how unstable isotopes decay over time.
- Pharmacokinetics: Studying how drugs are metabolized in the body.
- Environmental science: Analyzing how pollutants diminish in ecosystems.

The Half-Life Formula

The half-life of a substance can be calculated using the formula:

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

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

This formula can be rearranged to solve for different variables depending on the information given in a problem.

Common Half-Life Problems

Half-life problems often require students to apply the half-life formula in various contexts. Below are several types of half-life problems along with examples.

1. Radioactive Decay Problems

In radioactive decay problems, students are typically asked to determine the remaining quantity of a radioactive substance after a specific period.

Example Problem 1:
A radioactive isotope has a half-life of 5 years. If you start with 80 grams, how much will remain after 15 years?

Solution:
1. Identify half-lives: 15 years is 3 half-lives (15 / 5 = 3).
2. Calculate remaining quantity:

$$
N(t) = 80 \left(\frac{1}{2} \right)^{3} = 80 \times \frac{1}{8} = 10 \text{ grams}
$$

Example Problem 2:
If a sample of a radioactive material weighs 200 grams and has a half-life of 10 years, how much will be left after 30 years?

Solution:
1. Identify half-lives: 30 years is 3 half-lives (30 / 10 = 3).
2. Calculate remaining quantity:
$$
N(t) = 200 \left(\frac{1}{2} \right)^{3} = 200 \times \frac{1}{8} = 25 \text{ grams}
$$

2. Pharmacokinetics Problems

Pharmacokinetics problems focus on how drugs are eliminated from the body and often involve calculating the remaining concentration of a drug after a certain time.

Example Problem 3:
A medication has a half-life of 4 hours. If a patient takes a dose of 100 mg, how much of the medication remains in the body after 12 hours?

Solution:
1. Identify half-lives: 12 hours is 3 half-lives (12 / 4 = 3).
2. Calculate remaining quantity:
$$
N(t) = 100 \left(\frac{1}{2} \right)^{3} = 100 \times \frac{1}{8} = 12.5 \text{ mg}
$$

Example Problem 4:
If a drug is eliminated from the body with a half-life of 6 hours, what will be the concentration of the drug after 18 hours if the initial dose was 150 mg?

Solution:
1. Identify half-lives: 18 hours is 3 half-lives (18 / 6 = 3).
2. Calculate remaining quantity:
$$
N(t) = 150 \left(\frac{1}{2} \right)^{3} = 150 \times \frac{1}{8} = 18.75 \text{ mg}
$$

3. Environmental Science Problems

In environmental science, half-life can be used to understand the degradation of pollutants in ecosystems.

Example Problem 5:
A toxic chemical in a lake has a half-life of 2 years. If the initial concentration of the chemical is 400 ppb (parts per billion), what will the concentration be after 6 years?

Solution:
1. Identify half-lives: 6 years is 3 half-lives (6 / 2 = 3).
2. Calculate remaining concentration:
$$
N(t) = 400 \left(\frac{1}{2} \right)^{3} = 400 \times \frac{1}{8} = 50 \text{ ppb}
$$

Example Problem 6:
If a pollutant has a half-life of 5 years and an initial concentration of 1000 ppb, what will be its concentration after 15 years?

Solution:
1. Identify half-lives: 15 years is 3 half-lives (15 / 5 = 3).
2. Calculate remaining concentration:
$$
N(t) = 1000 \left(\frac{1}{2} \right)^{3} = 1000 \times \frac{1}{8} = 125 \text{ ppb}
$$

Creating Your Own Half-Life Problems

Creating half-life problems can be a great exercise for students. Here are some steps to follow:

1. Choose a substance: Select a radioactive isotope, medication, or pollutant.
2. Determine the half-life: Use real-life values or create hypothetical ones.
3. Set an initial quantity: Decide how much of the substance will be present at the beginning.
4. Decide on a time frame: Choose how long you want to observe the substance.
5. Ask the question: Frame the problem by asking how much of the substance remains after the specified time.

Conclusion

Understanding half-life problems is crucial for students in various scientific fields. Through practice with half life problems and answers worksheets, learners can develop a solid grasp of how substances decay or diminish over time. By working through problems related to radioactive decay, pharmacokinetics, and environmental science, students can apply their knowledge to real-world scenarios. The formula for half-life serves as a powerful tool in these calculations, allowing for a deeper understanding of the principles at play. By creating and solving their own problems, students can further solidify their understanding and prepare for more advanced studies in science.

Frequently Asked Questions

What is a half-life problem in the context of radioactive decay?

A half-life problem involves calculating the time it takes for half of a radioactive substance to decay, which is a key concept in nuclear physics and chemistry.

How can I create a worksheet for half-life problems?

You can create a worksheet by including various problems that require calculating the remaining quantity of a substance after a given number of half-lives, along with word problems and real-world examples.

What are some common mistakes to avoid when solving half-life problems?

Common mistakes include miscalculating the number of half-lives, confusing decay with growth, and forgetting to use the correct units when measuring time.

What types of questions are typically included in half-life worksheets?

Typical questions include calculating the remaining mass of a substance after multiple half-lives, determining the time required for a substance to decay to a certain amount, and solving word problems related to real-life scenarios.

Where can I find online resources for half-life problems and answers?

You can find online resources for half-life problems and answers on educational websites, online tutoring platforms, and resources like Khan Academy or educational YouTube channels.

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