

Chemical Science Half-life Worksheet

1. How long does it take a 100-gram sample of arsenic-81 (half-life of arsenic-81 = 33 seconds) to decay to 6.25 grams?
2. The half-life of potassium-42 is 12.4 hours. How much of a 500-gram sample of potassium-42 is left after 62 hours?
3. If the half-life of a sample is 30 minutes, how many hours does it take to decay from 3,360 atoms to 210 atoms?
4. How many atoms of an isotope, made up of 4,000 radioactive atoms, would remain after 5 half-lives?
5. Fluorine-21 has a half-life of 5 seconds. What fraction of the original nuclei remains after a minute?
6. If 10 grams of a radioactive isotope are present at 4:00 PM and 5 grams remain at 5:00 PM, what is the isotope's half-life?

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Answers

1. How long does it take a 100-gram sample of arsenic-81 (half-life of arsenic-81 = 33 seconds) to decay to 6.25 grams?

132 seconds

For a sample of arsenic-81 weighing 100 grams to decay to 6.25 grams, it must pass through 4 half-lives ($100 \times \frac{1}{2} = 50 \times \frac{1}{2} = 25 \times \frac{1}{2} = 12.5 \times \frac{1}{2} = 6.25$). So the time taken for the sample to decay is $= 4 \times 33 \text{ seconds} = 132 \text{ seconds}$.

2. The half-life of potassium-42 is 12.4 hours. How much of a 500-gram sample of potassium-42 is left after 62 hours?

15.625 grams

After 62 hours, the potassium-42 sample has passed through $= 62/12.4 = 5$ half-lives. So the amount of the sample left after 62 hours is $= 500 \times (\frac{1}{2})^5 = 15.625 \text{ grams}$.

3. If the half-life of a sample is 30 minutes, how many hours does it take to decay from 3,360 atoms to 210 atoms?

2 hours

For the sample to decay to 210 atoms from 3360 atoms, it passes through 4 half-lives ($3360/210 = 16 = 2^4$). So, the time taken for the sample to decay is $= 4 \times 30 \text{ minutes} = 120 \text{ minutes} = 2 \text{ hours}$.

4. How many atoms of an isotope, made up of 4,000 radioactive atoms, would remain after 5 half-lives?

125 atoms

For an isotope of 4000 atoms, we would be left with $= (\frac{1}{2})^5 \times 4000 = 125 \text{ atoms}$ after five half-lives.

5. Fluorine-21 has a half-life of 5 seconds. What fraction of the original nuclei remains after a minute?

$1/4096^{\text{th}}$

After a minute, fluorine-21 has gone through $= 60/5 = 12$ half-lives. So the fraction of fluorine-21 left is $= (\frac{1}{2})^{12} = 1/4096$.

6. If 10 grams of a radioactive isotope are present at 4:00 PM and 5 grams remain at 5:00 PM, what is the isotope's half-life?

1 hour

If the isotope's mass halved in 60 minutes, its half-life must be an hour.