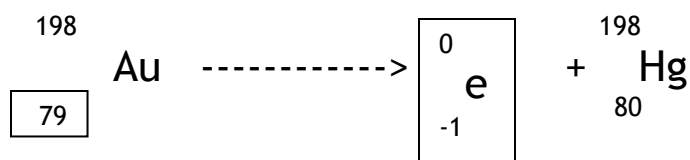


Referring to **Table N**

Nuclide: Au-198 **Decay mode:** β^- eta

Write the nuclear equation for the radioactive decay of Au-198.



Half-life: 2.695 days

Aim: How do we solve half life problems?

1) **Half-life** – the time it takes for half the mass of a radioactive sample to decay

(There is no way to predict when a single atom (nucleus) of a radio isotope will decay. However, it is possible to determine what fraction of nuclei in a sample will decay within any given time. The number of atoms that disintegrate is a constant fraction (1/2) of the total number of atoms.)

- Half life isn't affected by changes in temperature, pressure, etc...
- Different radioisotopes have different half lives.

2) **“Just keep halving what you have.”**

Again, for Au-198, half-life = 2.695 d. Therefore,

$$100\text{g} \xrightarrow{2.695 \text{ d}} 50\text{g} \xrightarrow{2.695 \text{ d}} 25\text{g}$$

The # times you chop it in half depends on the total time it decays.

Problem: Starting with 100 grams radioactive gold, how much will remain after 13.475 days?

$$\# = \frac{t}{T}$$

= number of half life periods T = half life time
t = total time elapsed

$$\# = \frac{13.475 \text{ d}}{2.695 \text{ d}}$$

$$\# = 5$$

This means “chop” the given mass five times in half.

$$100\text{g} \rightarrow 50\text{g} \rightarrow 25\text{g} \rightarrow 12.5 \text{ g} \rightarrow 6.25\text{g} \rightarrow 3.125 \text{ g}$$

GO TO HANDOUT FOR MORE EXAMPLES

KEEP HALVING IT!!

1) What will happen to the half-life of Fr-220 if its temperature is raised?

Nothing happens; Half-life is a constant.

2) What is the number of years required for Sr-90 to undergo two half-life periods?

Sr-90 $T = 28.1 \text{ y}$ $28.1 \text{ y} \times 2 = 56.2 \text{ y}$

3) How much of a 64.0 gram sample of K-42 will remain unchanged after 37.08 hours?

Starting \rightarrow $T = 12.36 \text{ h}$

$64.0 \text{ g} \rightarrow 32 \rightarrow 16 \rightarrow 8 \text{ g}$

$\frac{t}{T} = \#$ $\frac{37.08 \text{ h}}{12.36 \text{ h}} = 3$

4) If 48.0 grams of Na-24 decays to 3.00 grams in 60.0 hours, what is the half-life of Na-24?

Starting

$48.0 \text{ g} \rightarrow 24 \rightarrow 12 \rightarrow 6 \rightarrow 3 \text{ g}$

$\frac{t}{T} = \#$ $\frac{60.0 \text{ h}}{T} = 4$ $\frac{60.0}{4} = 15 \text{ h}$

5) What fraction of I-131 sample will remain unchanged after 3 half-life periods? (HINT: start with any amount you like)

$1 \text{ g} \rightarrow \frac{1}{2} \text{ g} \rightarrow \frac{1}{4} \text{ g} \rightarrow \frac{1}{8} \text{ g}$

OR

fraction remaining = $\left(\frac{1}{2}\right)^{\frac{t}{T}}$ $\left(\frac{1}{2}\right)^3 = \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} = \frac{1}{8}$