

# **GET OUT YOUR CALCULATORS!**

**Turn your phone into  
the pockets on wall -  
get calculator based  
on your seat #**

# Half Life Calculations



$\alpha$   $\beta$   $\gamma$

# Rates of Decay & Half Life

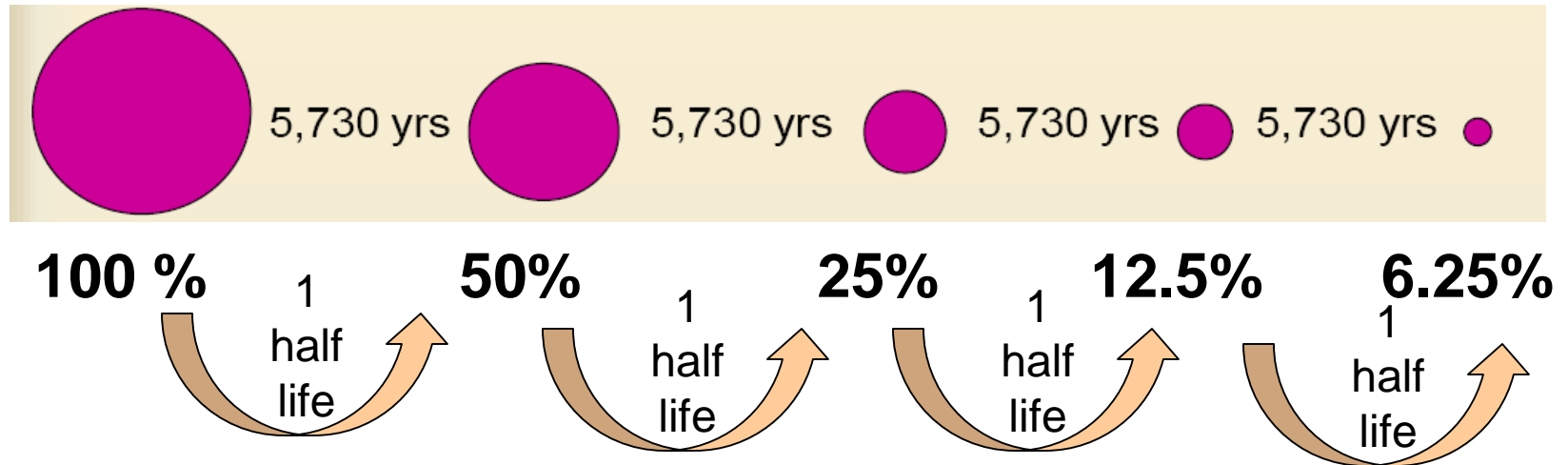


- Atoms are radioactive when too many neutrons. Strong force cant hold nucleus together.
- **Radioactive elements** have different stabilities and decay at ***different rates.***

# Half Life

- The length of time it takes for 50% of the material to have undergone radioactive decay.
- Example: Carbon-14, half life = 5,730 years

# Half Life



**Oetzi, the “ice man” was found by hikers in the Alps between Switzerland and Italy. He was carbon dated to 5,300 yrs old! One of the oldest frozen humans ever found – and the best preserved.**



# How much is left?

- If I start with 20 grams of Carbon-14 and the half life is 5,730 years...how many grams am I left with after 5,730 years?

5,730 years = 1 half life

20 grams/2 = 10 grams

***But what if the problem is harder??? What if you started with 17.4 grams, and 12,901 years went by? How much would you be left with???***

# We have a handy-dandy equation we can use!!!

$$A_E = A_S \times 0.5^{\left(\frac{t}{h}\right)}$$

# of half lives

$A_E$  = amount ending with

$A_S$  = amount starting with

$t$  = time gone by (time elapsed)

$h$  = length of the half life



# Let's give it a try!

- You start with 157 grams of carbon-14 and the half-life of carbon-14 is 5730 years. How much would be left after 2000 years?

$A_E$  = amount ending with = ???

$A_S$  = amount starting with = 157 grams

$t$  = time gone by = 2000 years

$h$  = half life = 5730 years

$A_E$  = amount ending with = ???

$A_S$  = amount starting with = 157 grams

$t$  = time gone by = 2000 years

$h$  = half life = 5730 years

$$A_E = 157 \times 0.5^{\left(\frac{2000}{5730}\right)} = 123.26 \text{ grams}$$
$$A_E = A_S \times 0.5^{\left(\frac{t}{h}\right)} \text{ is still radioactive!}$$

# How much is stabilized?

**157 g**  
**radioactive**  
**to start**    **−**    **123.26**  
**grams still**    **=**  
**radioactive**

**33.74 g has stabilized –**  
**no longer radioactive**

# Fraction left over?

## Percent left over?

$$\frac{A_E}{A_S} = 0.5 \left( \frac{t}{h} \right)$$

Fraction Left Over

$$0.5 \frac{\left( \frac{A_E}{A_S} \right)}{A_S} \times 100 = \% \text{ left over}$$