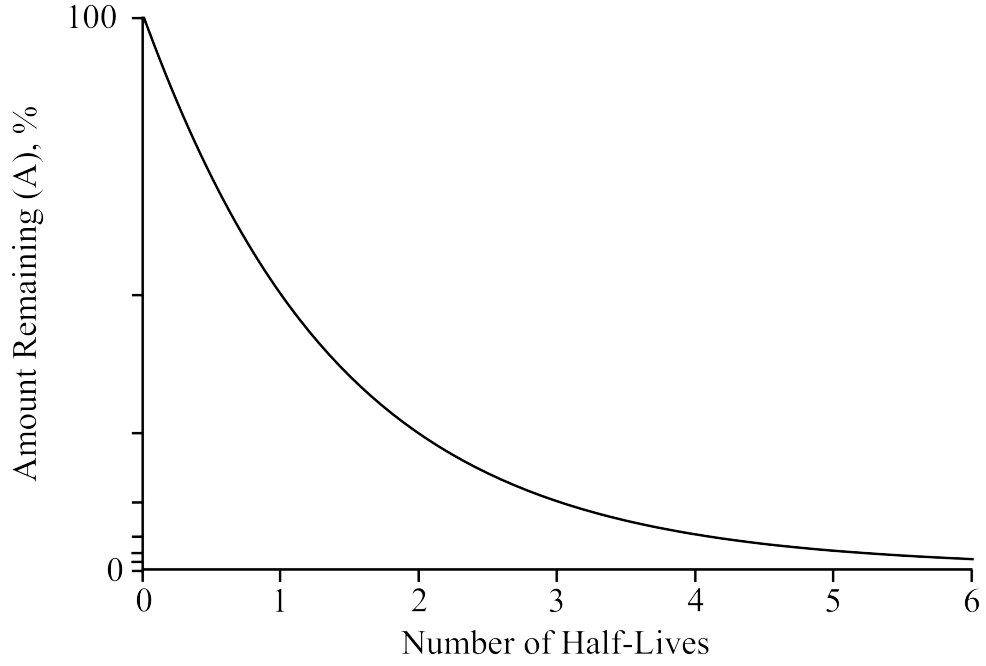
Notes 5-3: Radioactive Decay Rates, Half Life and Radiochemical Dating

- Half-life: $t_{½}$ = time for ½ of any radioactive isotope to undergo decay.
  - Shorter half-life means more rapid decay, higher radioactivity
    - Each isotope has unique ½-life.
  - After each half-life, half of the previous amount remains: ½, ¼, ⅛, 1/16, 1/32, etc.




- _____: Y decreases, X is an exponent in the equation
- _____, where A = final amount, $A_0$ = initial amount, n = # of half lives = elapsed time/$t_{½}$
- Must solve either _____ to find n

- **Half-Life Problems**
  - **Type 1: given time and $t_{½}$, use A or $A_0$ to find the other (time first)**
    - The half-life of radium-226 is 1600 years. How many grams of a 0.25g sample will remain after 4800 years?
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    - The half-life of thorium-227 is 18.72 days. How many grams were initially present if 10.0 g remain after 37.44 days?
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– **Type 2: Know A and $A_0$, use time or $t_{½}$ to find the other (mass first)**
  - A bone contains 12.5% of the original amount of C-14 ($t_{½}$ = 5730 yr). How old is the bone?
    - Know _____
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    -

– Isotopic dating using C-14
  - C-14 constantly formed in atmosphere: _____
    - Absorbed by living organisms (C cycle)
    - Decays at steady rate: _____
    - Level stays constant while organism is alive (about 1 in $1\times10^{12}$ C atoms)
      - ♦ Steady state reached: _____
  - Decreases after death (decaying but no longer absorbed)
    - can give age to about _____
  - Use isotopes with longer half-lives for longer times (e.g. U-238 $t_{½}=4.5\times10^{9}$ yr) or non-organic materials
    - Well-known decay series