Section 9.2 Exponential Decay

ex 1 iodine - 131

(0, 20)

(8, 10)

↑

8 days

8 days is the half-life of iodine-131 because in 8 days the amount was halved.

a) $A = A_0 e^{kt}$

$A = 20e^{kt}$

$10 = 20e^{k \cdot 8}$

$0.5 = e^{8k}$

$\frac{\ln 0.5}{8} = \frac{8k}{8}$

$k = -.0866$

$\underbrace{A = 20e^{-.0866t}}_{\text{mathematical model}}$

b) In 2 weeks

$t = 14$ days

$A = 20e^{-.0866 \cdot 14}$

$A = 5.95$ grams

Common Half-Lives

Substance	Half-Life
Krypton-91	10 seconds
silicon-31	2.6 hrs
cobalt-55	18.2 hrs
magnesium-28	21.0 hrs
iodine-124	4.5 days
iodine-131	8.0 days
cobalt-60	5.3 yrs
plutonium-241	13 yrs
Carbon-14	5,730 yrs
plutonium-239	24,400 yrs
plutonium-238	86 yrs

ex: You have 128 oz of magnesium-28. How much is left after

a) 21.0 hrs? 64 oz

b) 42.0 hrs? 32 oz

c) 63.0 hrs? 16 oz

If you know half-life, $k = \frac{\ln 0.5}{\text{half-life}}$

ex: (0, 8.2) How much is left after 1 year?

plutonium-241

half-life = 13 yrs

$k = \frac{\ln 0.5}{13} = -.0533$

$A = .2e^{-.05331}$

Radio-carbon dating

carbon-14
half-life = 5730 yrs

$$k = \frac{\ln 0.5}{5730} = -.00012097$$

$-1.29097E-4$

ex22 Ohlone
88% of carbon-14 remaining

$$A = A_0 e^{-.00012097t}$$
$$0.88 = 1e^{-.00012097t}$$
$$0.88 = e^{-.00012097t}$$
$$\frac{\ln 0.88}{-.00012097} = \frac{\cancel{-.00012097}t}{\cancel{-.00012097}}$$

$t = 1057$ yrs in 1989

p684-685
7, 8, 9-33 multiples of 3

7, 8, 9, 12, 15, 18, 21, 24, 27, 30, 33