Some worked questions from Pg. 78.

1) $A_0 = 1000$, $d = 1\text{hr}$ ↳ a) $A = 1000(2)^{t/1} = 1000(2)^t$

b) $t = 8$, $A = 1000(2)^8 = 256\,000$ bacteria

c) $t = 6.35$, $A = 1000(2)^{6.35} = 81\,571.88 \doteq 81\,572$ bacteria (Round up)

d) $t = 3$ hrs before midnight, means, $t = -3$, $A = 1000(2)^{-3} = 125$ bacteria

3) use $A = A_0(m)^t$, $A_0 = 2500$, $m = 2.7$, a) $A = 2500(2.7)^t$

b) $t = 3$, $A = 2500(2.7)^3 = 49207.5 \doteq 49\,208$ bacteria

d) 1.7 days ago, means $t = -1.7$, $A = 2500(2.7)^{-1.7} = 461.978 \doteq 462$ bacteria

4) use $A = A_0(1+r)^n$, $A_0 = 30$ million, $r = 5\% = 0.05$,

a) $A = 30(1+0.05)^n = 30(1.05)^n$

b) $n = 1$, $A = 30(1.05)^1 = 31.5$ millions

c) $n = 2.7$, $A = 30(1.05)^{2.7} = 34.22$ millions

d) $n = 10$, $A = 30(1.05)^{10} = 48.87$ millions

7) use $A = A_0(1-r)^n$ ↳ exponential decay ; $r = 3\% = 0.03$, $A_0 = 500\,g$

a) $A = 500(1-0.03)^n$ ↳ $A = 500(0.97)^n$, century = 100 yrs = n

b) $n = 1000$ yrs, you must express n using century, $n = \frac{1000}{100} = 10$ centurie

$A = 500(0.97)^{10} = 368.7\,g$

c) $10\,000$ yrs $\div 100 = 100$ centuries, $A = 500(0.97)^{100} = 23.776 \doteq 23.8\,g$

notice that the amount of radioactive is decaying more as time Increas

d) $\frac{1}{2}$ substance $= \frac{500}{2} = 250 = A$, find n, where $A_0 = 500$

$A = 500(0.97)^n$

$250 = 500(0.97)^n$, divide equation by 500

$\frac{250}{500} = \frac{500}{500}(0.97)^n$

$\frac{1}{2} = 0.97^n$

$0.5 = 0.97^n$

to solve for the exponent, use Log

$n = \frac{\log 0.5}{\log 0.97}$

$n = 22.7566$ centuries, but you need the answer in years, so multiply by 100

$n = 22.7566 \times 10$

$= 2275.66$

$n \doteq 2275.7$ yrs.

Try e) on your own

Some worked questions from Page 79

1) use doubling time formula, $A = A_0(2)^{t/d}$, $A_0 = 1000$, $t = 47$ min, $d = 30$ min
notice t, d must have same units.
$A = 1000(2)^{(\frac{47}{30})} = 2962.195 \doteq 2962$ bacteria

4) If bacteria triples, then use $A = A_0(3)^{t/d}$, $d = 2$ hrs, $t = 28$ min.
d, t must have same units, change 2hrs to min ↳ $2 \times 60 = 120$ min.
$\therefore A = 600(3)^{(\frac{28}{120})} = 775.32 \doteq 775$ bacteria

7) $A = A_0(2)^{t/d}$, $A_0 = 1000$, $A = 256000$, $t = 4$ h, $d = ?$

$\frac{256000}{1000} = \frac{1000}{1000}(2)^{4/d}$ ÷1000

$256 = 2^{4/d}$, express 256 as a power with base 2

$2^8 = 2^{\frac{4}{d}}$, ∵ bases are equal, then exponents must be equal

$\therefore 8 = \frac{4}{d}$, cross multiply,

$8d = 4$
$d = \frac{4}{8}$
$d = 0.5$ h

∴ the bacteria doubles every $\frac{1}{2}$ h or every 30 min.

8) $A_0 = 500$, $A = 64000$, $d = 1$ h, $t = ?$, use $A = A_0(2)^{t/d}$

$64000 = 500(2)^{\frac{t}{1}}$ ÷500

$\frac{64000}{500} = \frac{500}{500}(2)^t$

$128 = 2^t$

$2^7 = 2^t$

∴ $t = 7$ ↳ It will take 7 hrs for the culture to grow from 500 to 64000 bacteria.

12) This is half life formula: $A = A_0(\frac{1}{2})^{\frac{t}{h}}$, $A_0 = 100$g, $h = 1500$yrs, $t = 10000$ yr

$A = 100(0.5)^{\frac{10000}{1500}}$ ← simplify

$= 100(0.5)^{100}$

$= 7.889$

∴ After 10000 yrs, the amount left will be about 7.9 g.

* You will have an assignment tomorrow, based on Exponential Fn's up to Page 79