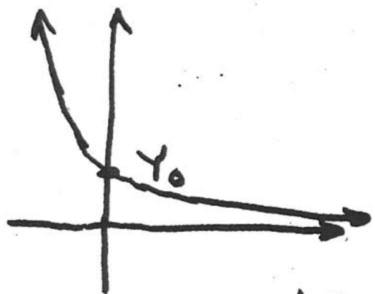
DECAY EQUATION (Y DECREASES)

$\boxed{Y = Y_0 e^{-kt}}$

LIKE 13, 14, 21 HWORK



EXAMPLE 3, p. 332
C-14 10% GONE
HOW OLD IS IT?

10% GONE = 90% THERE
HALF-LIFE = 5700 YEARS

$$.5Y_0 = Y_0 e^{-k5700} \rightarrow .5 = e^{-k5700}$$

$$\ln .5 = \ln e^{-k5700} \rightarrow \ln .5 = -5700k$$

$$k = \frac{\ln .5}{-5700} \rightarrow k = .000121604$$

$$.9Y_0 = Y_0 e^{-.000121604t} \rightarrow .9 = e^{-.000121604t}$$

$$\ln .9 = \ln e^{-.000121604t} \rightarrow \ln .9 = -.000121604t$$

$$t = \frac{\ln .9}{-.000121604} \qquad \boxed{t = 866 \text{ YEARS}}$$

NEWTON'S LAW OF COOLING

$\boxed{T - T_s = (T_0 - T_s)e^{-kt}}$

SEE PROOF p.333
LIKE HWORK 18, 19, 20

T_s = SURROUNDING TEMP. T_0 = TEMP AT $t = 0$

EXAMPLE 4 p.333 $T_0 = 98$ $T_s = 18$ $\boxed{t = 5,\ T = 38}$

HOW MUCH LONGER WILL IT TAKE TO COOL TO 20°C

EX. 4 p. 563 CONT'D.

$$38-18=(98-18)e^{-k5} \rightarrow 20=80e^{-5k}$$

$$\frac{20}{80}=e^{-5k} \rightarrow .25=e^{-5k} \rightarrow \ln .25=\ln e^{-5k}$$

$$\ln .25=-5k \rightarrow k=\frac{\ln .25}{-5} \rightarrow k=.27726$$

$$T-T_s=(T_0-T_s)e^{-kt} \rightarrow 20-18=(98-18)e^{-.27726t}$$

$$2=80e^{-.27726t} \rightarrow \frac{2}{80}=e^{-.27726t} \rightarrow \ln\frac{2}{80}=\ln e^{-.27726t}$$

$$\ln\frac{1}{40}=-.27726t \rightarrow t=\frac{\ln\frac{1}{40}}{-.27726} \quad t=13.3 \text{ MINUTES}$$

OR $\boxed{\text{8.3 MORE MINUTES}}$

(13.3−5)

EXPONENTIALS – A GENERAL APPROACH (MAKING YOUR OWN EQUATION)

1) WRITE AN EQUATION FOR THE CONSTANT RATE.
2) SEPERATE DIFFERENTIALS AND SOLVE.

LIKE 2, 28, 29 HWORK

$$\frac{dY}{dt}=kY \rightarrow \frac{dY}{Y}=k\,dt \rightarrow \int\frac{dY}{Y}=\int k\,dt$$

$$\ln Y=kt+c \rightarrow e^{\ln Y}=e^{kt+c}$$

$$Y=e^{kt}\cdot e^{c} \quad \text{AT } t=0 \quad e^{c}=Y_{(0)} \quad \boxed{Y=Y_0e^{kt}}$$

AND PLUG IN SPECIFIC VALUES.

HOMEWORK p. 338-339

13, 14, 21, 18, 19, 20, 2, 28, 29

DECAY	NEWTON	GENERAL APPROACH
13, 14, 21	18, 19, 20	2, 28, 29