snowball

$V = \frac{4}{3}\pi r^3$ $\quad \frac{dV}{dt} = -k(4\pi r^2)$ $\Big\}$ $\frac{dV}{dt} \propto$ surface area.

$V = V_0$ at $t=0$

$V = \frac{3}{4}V_0$ at $t = 2\,hr$

Get t when $V=0$

① $\frac{dV}{dt} = 4\pi r^2 \frac{dr}{dt}$

② $\frac{dV}{dt} = -k(4\pi r^2)$

$\Rightarrow \frac{dr}{dt} = -k$ $\Big\}$ radius changes at a constant rate.

$\frac{dr}{dt} = -k$ constant. Since constant, AVG CHANGE = INSTANT CHANGE

so $\frac{dr}{dt} = \frac{\Delta r}{\Delta t} = \frac{\text{TOT CHANGE}}{\text{TOT TIME}}$

$\frac{dr}{dt} = \frac{r_0 - r_2}{2}$ } If RHS is known num, then have k.

EQ 3 $k = \frac{r_0 - r_2}{2}$] 2 UNKS ⇒ need 2 EQNS

$$V = \frac{4}{3}\pi r^3 \Rightarrow r = \left[\frac{3V}{4\pi}\right]^{\frac{1}{3}}$$

$$r_0 = \left(\frac{3V_0}{4\pi}\right)^{\frac{1}{3}}$$

$$r_2 = \left(\frac{3V_2}{4\pi}\right)^{\frac{1}{3}}$$

$$= \left(\frac{3}{4\pi}\left(\frac{3}{4}V_0\right)\right)^{\frac{1}{3}}$$

$$= \left(\frac{9V_0}{16\pi}\right)^{\frac{1}{3}}$$

Then $\frac{r_2}{r_0} = \left[\frac{\frac{9}{16}}{\frac{3}{4}}\right]^{\frac{1}{3}} = \left(\frac{3}{4}\right)^{\frac{1}{3}} = .422 = C$

EQ 4 and $\boxed{r_2 = C r_0 = .908\, r_0}$ 2nd EQN

$$k = \frac{r_0 - C r_0}{2} = \frac{(1-C)r_0}{2}$$

$$r(t) = \frac{dr}{dt}\, t$$

but $\frac{dr}{dt} = k$

so $r(t) = \frac{(1-c)r_0}{2}\, t$ or $r(t) = kt$ = amt decreased as $f(t)$

Now, snowball is melted when $r(t) = r_0$ } * must be clear.

when $V(t) = V_0$ }

then melted when

$$r_0 = kt$$

$$= \frac{(1-c)r_0}{2}\, t$$

$$\Rightarrow \quad 1 = \frac{1-c}{2}\, t$$

$$\Rightarrow \quad t = \frac{2}{1-c}$$

$$= \frac{2}{1-.908}$$

$$= \frac{2}{.091}$$

ALTERNATIVE CALC

melted when $r_0 = r(t)$

i.e. when

$$r_0 - kt = 0$$

so $r_0 = \frac{(1-c)\, r_0}{2}\, t$

$$1 = \frac{1-c}{2}\, t$$

$$t = \frac{2}{1-c}$$

$$t = \frac{2}{.091}$$

$t \approx 22$ HRS

$= 21.97$ HRS TO MELT

≈ 22 HRS

∴ If in 2 HRS a snowball melts to $\frac{3}{4}$ of its size 2 HRS Earlier, then it will take ≈22 hrs to completely melt.