**Answer on Question #50740-Physics-Other**

The rate at which a spherical pill (tablet) dissolves in the body after being consumed is described by the rate of change of its volume with time $\frac{dV}{dt}$. Given that the rate of change of volume is directly proportional to its surface area, compute the time in which 80% of a pill of size 4 cm would dissolve, given that it dissolves completely in 2 hrs.

**Solution**

$$\frac{dV}{dt} = -kA.$$

$$A = 4\pi r^2, \;\; V = \frac{4}{3}\pi r^3.$$

$$\frac{dV}{dt} = \frac{d}{dt}\left(\frac{4}{3}\pi r^3\right) = \frac{d}{dr}\left(\frac{4}{3}\pi r^3\right)\frac{dr}{dt} = 4\pi r^2 \cdot \frac{dr}{dt}.$$

So, $k = -\frac{dr}{dt} > 0$.

We know,

$$\frac{dr}{dt} = -k \to r = r_0 - kt.$$

Thus,

$$0 = 4cm - k \cdot 2 \text{ hrs} \to \text{k} = 2\frac{\text{cm}}{\text{hrs}}.$$

$$\frac{V(T)}{V_0} = (1 - 0.8) = 0.2 \to \frac{\left(\frac{4}{3}\pi r(T)^3\right)}{\left(\frac{4}{3}\pi r_0^3\right)} = \left(\frac{r(T)}{r_0}\right)^3 = \left(\frac{r_0 - kT}{r_0}\right)^3 = 0.2.$$

$$\frac{r_0 - kT}{r_0} = \sqrt[3]{0.2} \to T = \frac{r_0}{k}\left(1 - \sqrt[3]{0.2}\right) = \frac{4\ cm}{2\frac{\text{cm}}{\text{hrs}}}\left(1 - \sqrt[3]{0.2}\right) = 0.83 \text{ hrs} \approx 50 \text{ min}.$$

**Answer: $\mathbf{0.83\ hrs \approx 50\ min}$.**