If the growth of a population P is proportional to it's size then

$$\frac{dP}{dt} = kP$$

Likewise if the rate of change of Y is proportional to Y

$$\frac{dy}{dt} = kY$$

As discussed in $\boxed{E1}$ of § 7.3

$$\boxed{Y(t) = Y_o e^{kt} \quad \text{where } Y_o = Y(0).}$$

Likewise $P(t) = P_o e^{kt}$ where $P_o = P(0)$. Both follow simply from sep. of variables. By the way:

$$\frac{dP}{dt} = kP \iff \frac{1}{P}\frac{dP}{dt} = k \iff \text{relative growth rate constant}.$$

So $k \equiv$ the relative growth rate.

$\boxed{E1}$ If the population doubles every 10 yrs what is k?

$$P(0) = P_o \quad \text{and} \quad P(10) = 2P_o = P_o e^{10k}$$

$$\Rightarrow \ln(2) = 10k \Rightarrow k = \frac{\ln(2)}{10\,yr.} = 0.0693\,\frac{1}{yr.}$$

The relative growth rate is 6.93%.

$\boxed{E2}$ Let $Y(t) = m(t)$ be the mass of some radioactive substance then as the mass destabalizes via radiation we have

$$\frac{dm}{dt} = km \qquad (k < 0 \text{ since } m \text{ is decreasing})$$

$$\Rightarrow m(t) = m_o e^{kt}$$

If balonium has a half-life of 1yr. then what percentage of the balonium is still in the fridge after $\frac{1}{10}$ yr.?

$$m(1) = \frac{m_o}{2} = m_o e^k \therefore k = \ln(1/2) = \underline{-0.693 = k}$$

$$\therefore m(\tfrac{1}{10}) = m_o e^{-0.693(\frac{1}{10})} = (0.933)m_o \Rightarrow \boxed{93.3\% \text{ remains}}$$