1. temperature at time t $\longrightarrow \theta(t) - \theta_s$ $= H(t)$

difference between

temperature of the surroundings

$H(t)$ is an exponential function: $H(t) = H_0\, b^t$

initial quantity of H $\longrightarrow H_0 = \theta_0 - \theta_S \longleftarrow$ temperature of the surroundings

initial temperature of the object

difference between

a) $H(t) = (\theta_0 - \theta_S)\, e^{-ct}$

exponential decay

material constant

b) $\theta_0 = 20°C$ initial temperature

θ_S = temperature of mount doom

$c = \ln(2/\sqrt{3})$

$$\theta(t) = \theta_S + (20 - \theta_S)\, e^{-\ln(2/\sqrt{3})\, t}$$

$\theta(2) = 1015°C$ after 2 seconds the one ring reaches melting point

we have 2 equations: $H(2) = \theta(2) - \theta_S = 1015 - \theta_S$

$H(2) = (20 - \theta_S)\, e^{-\ln(2/\sqrt{3}) \cdot 2}$

so:

$$1015 - \theta_S = (20 - \theta_S)\left(\tfrac{2}{\sqrt{3}}\right)^{-2} = (20 - \theta_S)\,\frac{3}{4}$$

$$\Leftrightarrow \quad 1015 - \theta_S = 15 - \frac{3}{4}\theta_S$$

$$\Leftrightarrow \quad \theta_S = 4 \cdot (1015 - 15) = \boxed{4000°C}$$