Q1

$$\frac{dT}{dt} = -kT^4 \rightarrow \int \frac{dT}{T^4} = \int -k\,dt$$

$$\int T^{-4}\,dT = -k\int dt$$

$$\frac{T^{-3}}{-3} = -kt + C$$

$$-\frac{1}{3T^3} = -kt + C$$

$T(0)$

$$-\frac{1}{3T_0^3} = C$$

$$-\frac{1}{3T^3} = -kt - \frac{1}{3T_0^3}$$

$$-\frac{1}{T^3} + \frac{1}{T_0^3} = -3kt \qquad \frac{1}{T^3} = \frac{3ktT_0^3 + 1}{T_0^3}$$

$$-\frac{T_0^3}{T^3} = -3ktT_0^3 - 1$$

$$T(t) = \left(\frac{3ktT_0^3 + 1}{T_0^3}\right)^{\frac{1}{3}}$$

$$\left(\frac{T_0}{2}\right)^3 = \frac{T_0^3}{\left(1 + 3k\, t_{1/2}\, T_0^3\right)^{1/3}}$$

Q1b

$$2^3 = 1 + 3k\, t_{1/2} \cdot T_0^3$$

$$8 = 1 + 3k\, t_{1/2} \cdot T_0^3$$

$$\frac{7}{3k \cdot T_0^3} = t_{1/2}$$

Q1c

$$t_{1/2} = \frac{1}{3kT_0^3}$$ → if T_0 increase $t_{1/2}$ decrease

Q 1.d

$$\int \frac{1}{T}\,dT = -k\int dt$$

$$\ln|T| = -kt + c$$

$$\ln|T_0| = C$$

$$\ln|T| = -kt + \ln|T_0|$$

$$T(t) = T_0 e^{-kt}$$

$$T(t_{1/2}) = \frac{1}{2}T_0$$

$$T_0 e^{-k t_{1/2}} = \frac{1}{2}T_0$$

$$e^{-k t_{1/2}} = \frac{1}{2}$$

$$-k t_{1/2} = \ln\frac{1}{2}$$

$$t_{1/2} = \frac{\ln|\frac{1}{2}|}{-k}$$

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