Analytical Result

$$\frac{dT(t)}{dt} = -\alpha A_s [T(t) - T_f]$$

given,

$\alpha = 0.001$

A_s = surface area of the asteoid.

$d = 2\text{Km}$

$\therefore r = 1\text{ km}$

and $T_f = 10^\circ C$

Surface area of the sphere $= 4\pi (1\text{km})^2$

$A_s = 4\pi\ \text{km}^2$

$$\frac{dT(t)}{dt} = -\alpha A_s [T(t) - T_f]$$

$$\int \frac{dT(t)}{[T(t) - T_f]} = -\int \alpha A_s\, dt$$

$$\Rightarrow \ln [T(t) - T_f] = -\alpha A_s t + C$$

$$\Rightarrow T(t) - T_f = e^{-\alpha A_s t + c}$$

$$\Rightarrow T(t) - T_f = c' e^{-\alpha A_s t}$$

at $T(0) = 1350^\circ C$

$$\Rightarrow 1350 - 10 = c' e^{-0}$$

$$\Rightarrow \boxed{c' = 1340^\circ C}$$

$\therefore$ Analytical Result

$$T(t) = e^{-\alpha A_s t} [1340] + T_f$$