

Y12 Lesson 2 Solutions

Newton's Cooling Law

1) $\frac{dT}{dt} = -k(T - T_A)$ where LHS = rate of change of temperature w.r.t. time, RHS = difference in temperature multiplied by a constant of proportionality.

2) $T = T_A + Ce^{-kt}$ is the general solution for some arbitrary constant C .

3)

a) $k = 0.201$

b) $t = 3.45h$

c) $C = 14$ hence $T = 12.8^\circ\text{C}$

d) $C = 0.2$ hence $T = 10.5^\circ\text{C}$

4) Ground surface temperatures do cool more slowly than air surface temperatures due to specific heat capacity/density etc. Model could be improved if the ambient temperature could be a function of time to reflect this cooling, however this would make the 1st order ODE more complex and difficult to solve.