6. You are a forensic scientist working for the police.

The murdered body of a girl has just been found in a forest where the temperature has been 00C for several hours.

As soon as you arrive at the scene you take the temperature of the body and make a note of the time. Her temperature is 310C.

One hour later, you take the temperature again. It has dropped to 290C.

***Newton’s Law of Cooling states that the rate of cooling of an object is proportional to the difference in the temperature of its surroundings.***

***The differential equation for this law is dT = kT***

 ***dt***

**T is the difference in temperature, but since the ground is at 00C then T is the actual temperature of the body.**

***The initial conditions are : at t = 0, T = 310C and at t = 1 hour, T = 290C.***

***Use this information to find an equation for the temperature, T of the body at***

***t hours after she was found.***

**The normal temperature of person is 370C so we use the equation for T at any time t to calculate how long before she was found that she was murdered.**

***dT***

***T***

***Solution: dT = kT so* ∫ = ∫ k dt**

 ***dt***

 ***ln(T) = kt + c***

***subs t = 0, T = 31 so ln(31) = 0 + c***

***ln(T) = kt + ln(31)***

***ln(T) – ln(31) = kt***

***ln T = kt***

 ***31***

***Now we subs t = 1, T = 29***

***ln 29 = k***

 ***31***

***k = - 0.06669***

***ln T = - 0.06669t EQU 1***

 ***31***

 ***T = e - 0.06669t***

 ***31***

 ***T = 31 e - 0.06668t EQU 2***

***To find the time her temperature was a normal 37 we subs t = 37 in EQU 1***

***ln 37 = - 0.06669t so t = -2.653 hours (before she was found at t = 0)***

 ***31***

***She was murdered 2.653 hours = 2 hours 39 mins before she was found.***

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