**11. HOT COFFEE**

A cup of coffee is poured from a pot whose contents are 950C into a non-insulated cup in a room at 200C.

After 1 minute, the coffee has cooled to 900C.

How much time is required before the coffee reaches a drinkable temperature of 650C?

***Newton’s Law of Cooling says that the rate at which a body cools is proportional to the difference between its temperature and its surroundings.***

**(Basically, a hot coffee cools faster than a warm coffee!)**

***Let T = temperature of the soup and T0 = the temperature of the surroundings.***

***The difference D = T – T0 . In this case T0 = 20***

***Newton’s Law says dD = kD***

***dt***

***dD***

***D***

**∫ = ∫ *kdt***

***ln D = kt + c***

***at t = 0, T = 95 so D = 95 – 20 = 75***

***ln(75) = 0 + c***

***ln(D) = kt + ln(75)***

***ln(D) – ln(75) = kt***

***ln D = kt***

***75***

***At t = 1 min, T = 90 so D = 70***

***ln 70 = k***

***75***

***k = - 0.06899***

***ln D = - 0.06899t EQU 1***

***75***

***D = e - 0.06899t***

***75***

***D = 75 e - 0.06899t EQU 2***

***Coffee is drinkable when T = 65 so D = 45 (subs in EQU 1)***

***ln 45 = - 0.06899t so t = 7.4 mins ≈ 7 min 24 sec***

***75***

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