5

Some athletes abuse human growth hormone and/or steroids to build muscle and strength. More and more sophisticated tests are needed to detect people who have these in their system. The best tests involve urine samples.

***It is a well-established fact that the body will eliminate such substances at a rate proportional to the amount present at any particular time.***

After taking such a substance several weeks ago, an athlete decides to have his urine tested and the amount detected was 120 μg/100mL of urine.

He did not take any more of the substance.

Two months later he was tested again and the reading was 95 μg/100mL.

(a) Find a formula for the amount of the substance in his urine at any time t

 months.

(b) Find what the reading would be expected to be after t = 6 months.

(c) If the substance can still be detected when the reading is as low as

 20 μg/100mL find how long it will be before he can enter competitions

 without being detected.

**dS = kS so that ∫ = ∫kdt**

**dS**

**S**

**dt**

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

**subs t = 0 , S = 120 so ln(120) = 0 + c**

**ln S = kt**

 **120**

**Subs t = 2, S = 95**

**ln 95 = 2k so k = *- 0.1168***

 **120**

**Equ becomes:**

***ln S = - 0.1168t EQU 1***

 ***120***

 ***S = 120 e - 0. 1168t EQU 2***

***(b) subs t = 6 in EQU 2 so S = 120 e - 0. 1168×6 ≈ 59.5 μg***

***(c) subs S = 20 μg in EQU 1 so ln 20 = - 0.1168t***

 ***120***

 ***t ≈ 15.3 months!***

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