UNIVERSITI MALAYSIA PERLIS

CENTER FOR DIPLOMA STUDIES

DQT 203 MATHEMATICS 3

ASSIGNMENT

Title	ASSIGNMENT 1

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ASSIGNMENT 1

DIT 203: MATHEMATICS III

1. A Newton's law of cooling is given by the equation, $\frac{dT}{dt} = -k(T - T_s)$ where $T(t)$ is the temperature of an object at time t, T_s is surrounding temperature and k is a constant. Show that the general solution to the equation is $T(t) = T_s + Ae^{-kt}$ where A and k are constants.

$$\frac{dT}{dt} = -k(T - T_s)$$

$$\frac{1}{T - T_s}\, dT = -k\, dt$$

$$\int \frac{1}{T - T_s}\, dT = \int -k\, dt$$

$$\ln|T - T_s| = -kt + c$$

$$e^{\ln|T - T_s|} = e^{-kt} \cdot e^{c}$$

$$T - T_s = e^{-kt} \cdot e^{c}$$

$$T - T_s = Ae^{-kt}, \quad A = e^{c}$$

$$T = T_s + Ae^{-kt} \quad \star$$

2. At 2 00 pm, initial temperature of a chocolate cake is 300°F. After 10 minute, the chocolate cake cools to 200°F. Suppose that the room temperature is 60°F. Determine when will be the chocolate cake cool to 62°F.

$T_0 = 300°F$

$T_1 = 200°F$

$T_s = 60°F$

$T = T_s + Ae^{-kt}$

$T = 60 + 240e^{-0.0539t}$

① At $t = 0$

$300 = 60 + Ae^{-k(0)}$

$300 = 60 + Ae^{0}$

$300 = 60 + A$

$A = 240$

$T = T_s + Ae^{-kt}$

$T = T_s + 240e^{-kt}$

② At $t = 10$

$200 = 60 + Ae^{-k(10)}$

$200 = 60 + Ae^{-k10}$

$200 = 60 + 240e^{-k10}$

$140 = 240e^{-k10}$

$\frac{140}{240} = e^{-k10}$

$\frac{7}{12} = e^{-k10}$

$\ln\left|\frac{7}{12}\right| = \ln\left|e^{-k10}\right|$

$-0.5390 = -k10$

$-0.5390 = -10k$

$k = 0.0539$

③ At $T = 62°F$

$62 = 60 + 240e^{-0.0539t}$

$2 = 240e^{-0.0539t}$

$\frac{2}{240} = e^{-0.0539t}$

$\frac{1}{120} = e^{-0.0539t}$

$\ln\left|\frac{1}{120}\right| = \ln\left|e^{-0.0539t}\right|$

$-4.7875 = -0.0539t$

$t = 88.82$ minutes

88.82 minutes = 1 hour 28 minutes

14	00
+ 1	28
15	28

$= 3:28$ pm #

3. According to Forestry Department of Peninsular Malaysia, the number of forest herbs population in Pahang in 2012 was 0.94 million. In 2014, the population was 0.97 million. Assume that the population of forest herbs in Pahang is growing, estimate the population in 2018.

$P = A_0 e^{kt}$

in 2012 = 0.94 m , P(0)

in 2014 = 0.97 m , P(2)

in 2018 = ? , P(6)

① At $t = 0$

$P(0) = A_0 e^{kt}$

$= 0.94 e^{kt}$

② At $t = 2$

$P(2) = A_0 e^{kt}$

$0.97 = 0.94 e^{kt}$

$0.97 = 0.94 e^{k2}$

$e^{k2} = \frac{0.97}{0.94}$

$e^{k2} = 1.0357$

$k = \frac{\ln 1.0357}{2}$

$k = 0.0175$

③ At $t = 6$

$P(6) = A_0 e^{kt}$

$= 0.94 e^{(0.0175)(6)}$

$= 0.94 e^{0.105}$

$= 0.94(1.1107)$

$= 0.93$ million

4. The half-life of toxic in your body is about 3 hours. How much the toxic left after 6 hours?

① $P(3) = \frac{1}{2} P(0)$

$A e^{3k} = \frac{1}{2} A e^{k0}$

$e^{3k} = \frac{1}{2}$

$\ln e^{3k} = \ln \frac{1}{2}$

$3k = -0.693$

$k = -0.231$

② $P(0) = 100\%$

$= 1$

$P = A e^{kt}$

$1 = A e^{(-0.231)(0)}$

$1 = A$

$A = 1$

③ $P(6) = A e^{kt}$

$= 1 e^{(-0.231)(6)}$

$= e^{-1.386}$

$= 0.25$