Index No. : ______________

UNIVERSITI SAINS MALAYSIA

Second Semester Examination
Academic Session 2007/2008

April 2008

MAT 122 – Differential Equations I
[Persamaan Pembezaan I]

Duration : 3 hours
[Masa : 3 jam]

Please check that this examination paper consists of **FIFTEEN** pages of printed material before you begin the examination.

*[Sila pastikan bahawa kertas peperiksaan ini mengandungi **LIMA BELAS** muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]*

Instructions: Answer all **twenty** (20) questions in Section I using the objective answer paper (OMR answer paper) provided. For this section, answers should be written in 2B pencil only. **The OMR answer paper together with the question paper of Section I** will be collected 1½ hours after the examination starts.

Answer all **two** (2) questions in Section II. All answers in this section must be written on the answer script papers provided.

*[**Arahan**: Jawab semua **dua puluh** (20) soalan dalam Bahagian I dengan menggunakan kertas jawapan soalan objektif (kertas jawapan OMR) yang disediakan. Bagi bahagian ini, jawapan perlu dituliskan dengan pensel 2B sahaja. **Kertas jawapan OMR ini berserta kertas soalan Bahagian I** akan dikutip 1½ jam setelah peperiksaan bermula.*

*Jawab semua **dua** (2) soalan dalam Bahagian II. Semua jawapan dalam bahagian ini mestilah dituliskan pada kertas skrip jawapan yang disediakan.]*

Section 1: Answer ALL 20 questions. Each correct answer will be given 2 ½ marks [50/100].

1. Choose the **non linear** differential equation from the following:

   (a) $\frac{dy}{dt} = t^2 y + \cos t$

   (b) $(1+t^2)\frac{d^2u}{dt^2} + \frac{du}{dt} + u = e^t$

   (c) $\frac{dz}{dt} = t \sin z$

   (d) $e^x y'' + (\cos x)y' + (1+\sqrt{x})y = \tan^{-1} x$

   (e) $\frac{dP}{dt} = e^{2t} P - \sin t$

2. Choose the **false** statement regarding the following differential equation:

$$\frac{d^2\rho}{d\theta^2} = \sqrt[4]{\rho + \left(\frac{d\rho}{d\theta}\right)^2}$$

   (a) is an ordinary differential equation
   (b) ρ is dependent variable
   (c) θ is the independent variable
   (d) a 2^{nd} order differential equation
   (e) a 2^{nd} degree differential equation

3. Given the initial value problem $\frac{dy}{dx} = 2\sqrt{y}$, $y(x_0) = y_0$. The existence and uniqueness theorem guarantees a unique solution exists when $(x_0, y_0) =$

   (a) (0, 1)
   (b) (- 1, 0)
   (c) (0, 0)
   (d) (- 1, 0)
   (e) (1, 0)

Bahagian 1: Jawab SEMUA 20 soalan. Setiap jawapan betul diberi 2 ½ markah [50/100].

1. *Pilih persamaan pembezaan yang **tak linear** daripada yang berikut:*

   (a) $\dfrac{dy}{dt} = t^2 y + \cos t$

   (b) $(1+t^2)\dfrac{d^2u}{dt^2} + \dfrac{du}{dt} + u = e^t$

   (c) $\dfrac{dz}{dt} = t \sin z$

   (d) $e^x y'' + (\cos x)y' + (1+\sqrt{x})y = \tan^{-1} x$

   (e) $\dfrac{dP}{dt} = e^{2t} P - \sin t$

2. Pilih pernyataan yang **tidak benar** bagi persamaan pembezaan berikut:

$$\frac{d^2\rho}{d\theta^2} = \sqrt[4]{\rho + \left(\frac{d\rho}{d\theta}\right)^2}$$

   (a) *satu persamaan pembezaan biasa*
   (b) *ρ merupakan pembolehubah bersandar*
   (c) *θ merupakan pembolehubah tak bersandar*
   (d) *satu persamaan pembezaan berperingkat* 2
   (e) *satu persamaan pembezaan berdarjah* 2

3. *Diberi masalah nilai awal* $\dfrac{dy}{dx} = 2\sqrt{y}$, $y(x_0) = y_0$. *Teorem kewujudan dan keunikan menjamin penyelesaian unik wujud apabila* $(x_0, y_0) =$

   (a) (0, 1)
   (b) (- 1, 0)
   (c) (0, 0)
   (d) (- 1, 0)
   (e) (1, 0)

4. In the transformation of the homogeneous differential equation

$$(1+2e^{y/x})dy+2e^{y/x}(1-\frac{y}{x})dx=0, \qquad \text{(A)}$$

by substituting $v = y/x$, we obtain $\frac{dx}{x}+f(v)dv=0$ where $f(v)=$

(a) $-\frac{1+2e^v}{v+2e^v}$

(b) $\frac{1+e^v}{v+2e^v}$

(c) $\frac{v+2e^v}{1+2e^v}$

(d) $\frac{1-2e^v}{v+2e^v}$

(e) $\frac{1+2e^v}{v+2e^v}$

5. The general solution for the differential equation (A) is (C an arbitrary constant)

(a) $y-2xe^{y/x}=C$

(b) $x-2ye^{y/x}=C$

(c) $x+2ye^{y/x}=C$

(d) $x(v+2e^v)=C$

(e) $y+2xe^{y/x}=C$

6. The differential equation

$$y(2xy+1)dx+x(1+2xy-x^3y^3)dy=0 \qquad \text{(B)}$$

has an integrating factor in the form of $1/(xy)^k$. Determine the value of k.

(a) $k=5$
(b) $k=4$
(c) $k=1$
(d) $k=3$
(e) $k=2$

4. *Dalam penjelmaan persamaan pembezaan homogen*

$$(1+2e^{y/x})dy + 2e^{y/x}(1-\frac{y}{x})dx = 0, \qquad (A)$$

dengan gantian $v = y/x$, *kita akan dapat* $\frac{dx}{x} + f(v)dv = 0$ *di mana* $f(v) =$

(a) $-\dfrac{1+2e^v}{v+2e^v}$

(b) $\dfrac{1+e^v}{v+2e^v}$

(c) $\dfrac{v+2e^v}{1+2e^v}$

(d) $\dfrac{1-2e^v}{v+2e^v}$

(e) $\dfrac{1+2e^v}{v+2e^v}$

5. *Penyelesaian am bagi persamaan pembezaan (A) ialah (C adalah pemalar sebarangan)*

(a) $y-2xe^{y/x} = C$

(b) $x-2ye^{y/x} = C$

(c) $x+2ye^{y/x} = C$

(d) $x(v+2e^v) = C$

(e) $y+2xe^{y/x} = C$

6. Persamaan pembezaan

$$y(2xy+1)dx + x(1+2xy-x^3y^3)dy = 0 \qquad (B)$$

mempunyai suatu faktor pengamir dalam bentuk $1/(xy)^k$. Tentukan nilai k.

(a) $k=5$
(b) $k=4$
(c) $k=1$
(d) $k=3$
(e) $k=2$

7. The general solution for the differential equation (B) is (C is an arbitrary constant)

(a) $y = Ce^{(3xy+1)/(3x^3y^3)}$

(b) $y = Ce^{-(3xy+1)/(3x^3y^3)}$

(c) $y = Ce^{(3xy-1)/(3x^3y^3)}$

(d) $y = e^{-1/x^2y^2} + e^{-1/3x^3y^3} + C$

(e) $\ln y = Ce^{-1/x^2y^2}\, e^{-1/3x^3y^3}$

8. Given the differential equation $y'' + y' - 12y = \sinh 4x$, where $\sinh 4x = \dfrac{(e^{4x} - e^{-4x})}{2}$, the particular solution, y_p, is given by

(a) $y_p = \frac{1}{16}e^{4x} + \frac{1}{14}xe^{-4x}$

(b) $y_p = \frac{1}{16}xe^{4x} + \frac{1}{14}xe^{-4x}$

(c) $y_p = \frac{1}{16}e^{4x} + \frac{1}{14}x^2e^{-4x}$

(d) $y_p = \frac{1}{16}xe^{4x} + \frac{1}{14}xe^{-4x}$

(e) $y_p = \frac{1}{16}x^2e^{4x} + \frac{1}{14}xe^{-4x}$

9. A general solution for the differential equation $y'' - 3y' + 2y = -\dfrac{e^{2x}}{e^x + 1}$ is given by

(a) $y = c_1e^x + c_2e^{2x} + e^x(e^x + 1) + e^{2x}(1 + e^{-x})$

(b) $y = c_1e^x + c_2e^{2x} + e^x\ln(e^x) + e^{2x}\ln(e^{-x})$

(c) $y = c_1e^x + c_2e^{2x} + e^x\ln(e^x + 1) + e^{2x}\ln(1 - e^{-x})$

(d) $y = c_1e^x + c_2e^{2x} + e^{2x}\ln(e^x + 1) + e^x\ln(1 + e^{-x})$

(e) $y = c_1e^x + c_2e^{2x} + e^x\ln(e^x + 1) + e^{2x}\ln(1 + e^{-x})$

7. *Penyelesaian am bagi persamaan pembezaan (B) ialah (C adalah pemalar sebarangan)*

(a) $y = Ce^{(3xy+1)/(3x^3y^3)}$

(b) $y = Ce^{-(3xy+1)/(3x^3y^3)}$

(c) $y = Ce^{(3xy-1)/(3x^3y^3)}$

(d) $y = e^{-1/x^2y^2} + e^{-1/3x^3y^3} + C$

(e) $\ln y = Ce^{-1/x^2y^2}\,e^{-1/3x^3y^3}$

8. *Diberikan persamaan pembezaan* $y'' + y' - 12y = \sinh 4x$, *di mana* $\sinh 4x = \dfrac{(e^{4x} - e^{-4x})}{2}$, *penyelesaian khusus,* y_p, *diberikan oleh*

(a) $y_p = \dfrac{1}{16}e^{4x} + \dfrac{1}{14}xe^{-4x}$

(b) $y_p = \dfrac{1}{16}xe^{4x} + \dfrac{1}{14}xe^{-4x}$

(c) $y_p = \dfrac{1}{16}e^{4x} + \dfrac{1}{14}x^2e^{-4x}$

(d) $y_p = \dfrac{1}{16}xe^{4x} + \dfrac{1}{14}xe^{-4x}$

(e) $y_p = \dfrac{1}{16}x^2e^{4x} + \dfrac{1}{14}xe^{-4x}$

9. *Penyelesaian am bagi persamaan pembezaan* $y'' - 3y' + 2y = -\dfrac{e^{2x}}{e^x + 1}$ *diberikan oleh*

(a) $y = c_1e^x + c_2e^{2x} + e^x(e^x + 1) + e^{2x}(1 + e^{-x})$

(b) $y = c_1e^x + c_2e^{2x} + e^x\ln(e^x) + e^{2x}\ln(e^{-x})$

(c) $y = c_1e^x + c_2e^{2x} + e^x\ln(e^x + 1) + e^{2x}\ln(1 - e^{-x})$

(d) $y = c_1e^x + c_2e^{2x} + e^{2x}\ln(e^x + 1) + e^x\ln(1 + e^{-x})$

(e) $y = c_1e^x + c_2e^{2x} + e^x\ln(e^x + 1) + e^{2x}\ln(1 + e^{-x})$

10. Given the initial value problem

$$(1+x^3)dy - x^2 y dx = 0, \quad y(1) = 2 \qquad \text{(C)}$$

Choose the **false** statement for the differential equation (C)

(a) All functions $a_0(x), a_1(x)$ dan $g(x)$ are continuous for all values of x in the interval $(-\infty, \infty)$.
(b) The existence and uniqueness theorem guarantees a unique solution exists for all values of x in the interval $(-\infty, \infty)$.
(c) The existence and uniqueness theorem guarantees a unique solution exists for all values of x in the interval $(-1, \infty)$.
(d) The general solution for the differential equation (C) is given by $y^3 = C(1+x^3)$, where C is an arbitrary constant.
(e) The particular solution for the differential equation (C) is given by $y^3 = 4(1+x^3)$.

11. Given $y' = 2xy, y(1) = 1$, with $h = 0.1$, the approximate value of y (1.2) by Euler's method is
(a) 1.5479
(b) 1.9832
(c) 2.5908
(d) 3.4509
(e) None of the above

12. For the above equation (in Question 11) with h = 0.05, the approximate value of y (1.1) by Euler's method is
(a) 1.1077
(b) 1.2332
(c) 1.3798
(d) 1.5514
(e) 1.0

13. Given $y' = 2x + y, y(0) = 1$, using $h = 0.2$, the approximate value of y (0.4) by the improved Euler method is
(a) 1.0
(b) 1.2332
(c) 1.6652
(d) 1.1
(e) 1.2

10. *Diberikan masalah nilai awal*

$$(1+x^3)dy - x^2 y dx = 0, \qquad \qquad (C)$$
$$y(1) = 2$$

*Pilih pernyataan yang **tidak benar** bagi persamaan pembezaan (C).*

(a) *Semua fungsi* $a_0(x), a_1(x)$ dan $g(x)$ *selanjar bagi semua nilai x dalam selang* $(-\infty, \infty)$.

(b) *Teorem Kewujudan dan Keunikan menjamin suatu penyelesaian unik wujud bagi semua nilai x dalam selang* $(-\infty, \infty)$.

(c) *Teorem Kewujudan dan Keunikan menjamin suatu penyelesaian unik wujud bagi semua nilai x dalam selang* $(-1, \infty)$.

(d) *Penyelesaian am bagi persamaan pembezaan (C) ialah* $y^3 = C(1+x^3)$, *di mana C adalah pemalar sebarangan.*

(e) *Penyelesaian khusus bagi persamaan pembezaan (C) ialah* $y^3 = 4(1+x^3)$.

11. *Diberikan* $y' = 2xy, y(1) = 1$, *dengan* $h = 0.1$, *nilai hampiran bagi* $y\,(1.2)$ *dengan menggunakan kaedah Euler ialah*

(a) 1.5479
(b) 1.9832
(c) 2.5908
(d) 3.4509
(e) *Bukan semua di atas*

12. *Bagi persamaan di atas (dalam Soalan 11) dengan* $h = 0.05$, *nilai hampiran bagi* $y\,(1.1)$ *dengan menggunakan Kaedah Euler ialah*

(a) 1.1077
(b) 1.2332
(c) 1.3798
(d) 1.5514
(e) 1.0

13. *Diberikan* $y' = 2x + y, y(0) = 1$, *menggunakan* $h = 0.2$, *nilai hampiran bagi* y (0.4) *dengan menggunakan Kaedah Euler diperbaiki ialah*

(a) 1.0
(b) 1.2332
(c) 1.6652
(d) 1.1
(e) 1.2

14. For the equation $y' = y + \frac{1}{10}xy^2, y(0) = 2$ with $h = 0.1$, the approximate value of y at $x = 0.2$ by the improved Euler's method is
(a) 1.0
(b) 1.2002
(c) 2.3798
(d) 2.4533
(e) 2.2

15. The singular points for the equation $(1-x^2)y'' - 2xy' + k(k+1)y = 0$ are
(a) 1, -1
(b) 0,1
(c) 2, -2
(d) 2, -1
(e) None of the above

16. A lower bound for the radius of convergence of power series solutions of the equation $(1+x^2)y'' + xy' + 2y = 0$ about the ordinary point $x_0 = 0$ is
(a) $|x| < 1$ (ans)
(b) $|x| < 0$
(c) $|x| > 1$
(d) $|x| > 2$
(e) $|x| < -1$

17. A lower bound for the radius of convergence about the ordinary point $x_0 = 2$ of power series solutions of the equation in Question 16 is
(a) $|x-2| < 5$
(b) $|x+2| < 5$
(c) $|x-2| > 5$
(d) $|x-2| < \sqrt{5}$
(e) $|x+2| < \sqrt{5}$

14. *Bagi persamaan* $y' = y + \frac{1}{10}xy^2, y(0) = 2$ *dengan* $h = 0.1$, *nilai hampiran bagi y pada* $x = 0.2$ *dengan menggunakan kaedah Euler diperbaiki ialah*
(a) 1.0
(b) 1.2002
(c) 2.3798
(d) 2.4533
(e) 2.2

15. *Titik-titik singular bagi persamaan* $(1-x^2)y'' - 2xy' + k(k+1)y = 0$ *ialah*
(a) 1, -1
(b) 0,1
(c) 2, -2
(d) 2, -1
(e) *None of the above*

16. *Suatu batas bawah bagi jejari penumpuan penyelesaian siri kuasa persamaan* $(1+x^2)y'' + xy' + 2y = 0$ *sekitar titik biasa* $x_0 = 0$ *ialah*
(a) $|x| < 1$ (ans)
(b) $|x| < 0$
(c) $|x| > 1$
(d) $|x| > 2$
(e) $|x| < -1$

17. *Suatu batas bawah bagi jejari penumpuan sekitar titik biasa* $x_0 = 2$ *bagi penyelesaian siri kuasa persamaan dalam Soalan 16 ialah*
(a) $|x-2| < 5$
(b) $|x+2| < 5$
(c) $|x-2| > 5$
(d) $|x-2| < \sqrt{5}$
(e) $|x+2| < \sqrt{5}$

18. The power series solution of Airy's equation $y'' = xy, (-\infty < x < \infty)$ about the ordinary point $x_0 = 1$ is (a_0 and a_1 are arbitrary constants)

(a) $y = a_0(1 + x + x^2 + ...) + a_1(1 - x + x^2 - ...)$

(b) $y = a_0(1 + \frac{(x-1)^2}{2} + \frac{(x-1)^3}{6} + ...) + a_1((x-1) + \frac{(x-1)^3}{6} + \frac{(x-1)^4}{12} + ...)$

(c) $y = a_0(1 + \frac{(x+1)^2}{2} + \frac{(x+1)^3}{6} + ...) + a_1((x+1) + \frac{(x+1)^3}{6} + \frac{(x+1)^4}{12} + ...)$

(d) $y = a_0(1 + \frac{(x-1)^2}{2!} + \frac{(x-1)^3}{6!} + ...) + a_1((x-1) + \frac{(x-1)^3}{6!} + \frac{(x-1)^4}{12!} + ...)$

(e) None of the above

INSTRUCTION: Consider the system $x' = Ax, A = \begin{bmatrix} 1 & 1 \\ 4 & 1 \end{bmatrix}$

Choose the correct answers for questions 19 and 20.

19. The characteristic values of A are

(a) -1, 3
(b) 1, -3
(c) 1, 3
(d) 1, 2
(e) -1, 2

20. The general solution of the system is

(a) $y(x) = c_1e^{-t}\begin{bmatrix} 1 \\ 2 \end{bmatrix} + c_2e^{-t}\begin{bmatrix} 1 \\ 3 \end{bmatrix}$

(b) $y(x) = c_1e^{-t}\begin{bmatrix} 1 \\ -2 \end{bmatrix} + c_2e^{-t}\begin{bmatrix} 1 \\ 3 \end{bmatrix}$

(c) $y(x) = c_1e^{-t}\begin{bmatrix} 1 \\ 2 \end{bmatrix} + c_2e^{3t}\begin{bmatrix} 1 \\ 3 \end{bmatrix}$

(d) $y(x) = c_1e^{-t}\begin{bmatrix} 1 \\ 2 \end{bmatrix} + c_2e^{-3t}\begin{bmatrix} 1 \\ -2 \end{bmatrix}$

(e) $y(x) = c_1e^{-t}\begin{bmatrix} 1 \\ 2 \end{bmatrix} + c_2e^{3t}\begin{bmatrix} 1 \\ -2 \end{bmatrix}$

18. *Penyelesaian siri kuasa bagi persamaan Airy* $y'' = xy, (-\infty < x < \infty)$ *sekitar titik biasa* $x_0 = 1$ *ialah (* a_0 *adalah* a_1 *adalah pemalar sebarangan)*

(a) $y = a_0(1 + x + x^2 + \ldots) + a_1(1 - x + x^2 - \ldots)$

(b) $y = a_0(1 + \frac{(x-1)^2}{2} + \frac{(x-1)^3}{6} + \ldots) + a_1((x-1) + \frac{(x-1)^3}{6} + \frac{(x-1)^4}{12} + \ldots)$

(c) $y = a_0(1 + \frac{(x+1)^2}{2} + \frac{(x+1)^3}{6} + \ldots) + a_1((x+1) + \frac{(x+1)^3}{6} + \frac{(x+1)^4}{12} + \ldots)$

(d) $y = a_0(1 + \frac{(x-1)^2}{2!} + \frac{(x-1)^3}{6!} + \ldots) + a_1((x-1) + \frac{(x-1)^3}{6!} + \frac{(x-1)^4}{12!} + \ldots)$

(e) *Bukan semua di atas*

ARAHAN: Pertimbangkan sistem $x' = Ax, A = \begin{bmatrix} 1 & 1 \\ 4 & 1 \end{bmatrix}$

Pilih jawapan yang sesuai bagi soalan 19 dan 20.

19. *Nilai-nilai cirian bagi A ialah*

(a) -1, 3

(b) 1, -3

(c) 1, 3

(d) 1,2

(e) -1, 2

20. *Penyelesaian am bagi sistem tersebut ialah*

(a) $y(x) = c_1 e^{-t} \begin{bmatrix} 1 \\ 2 \end{bmatrix} + c_2 e^{-t} \begin{bmatrix} 1 \\ 3 \end{bmatrix}$

(b) $y(x) = c_1 e^{-t} \begin{bmatrix} 1 \\ -2 \end{bmatrix} + c_2 e^{-t} \begin{bmatrix} 1 \\ 3 \end{bmatrix}$

(c) $y(x) = c_1 e^{-t} \begin{bmatrix} 1 \\ 2 \end{bmatrix} + c_2 e^{3t} \begin{bmatrix} 1 \\ 3 \end{bmatrix}$

(d) $y(x) = c_1 e^{-t} \begin{bmatrix} 1 \\ 2 \end{bmatrix} + c_2 e^{-3t} \begin{bmatrix} 1 \\ -2 \end{bmatrix}$

(e) $y(x) = c_1 e^{-t} \begin{bmatrix} 1 \\ 2 \end{bmatrix} + c_2 e^{3t} \begin{bmatrix} 1 \\ -2 \end{bmatrix}$

Section II: Answer both questions [50/100].

21. (a) (i) Show that both the parabola $y = x^2$ and the line $y = 2x - 1$ are solutions of the equation

$$y' = 2x - 2\sqrt{x^2 - y} \text{ with } y(1) = 1.$$

(ii) Does the above fact contradict with the existence and uniqueness theorem? Explain your answer.

(b) Consider the homogeneous differential equatiom

$$(x-1)y'' - xy' + y = 0$$

(i) Show that $y = e^x$ is a solution for the above differential equation. Hence, find the second linearly independent solution.

(ii) Use the results in (i) to obtain the general solution for the non homogeneous differential equation

$$(x-1)y'' - xy' + y = 1.$$

22. (a) A body of temperature 80°F is placed in a room of constant temperature 50°F at time $t = 0$; and at the end of 5 minutes, the body has cooled to a temperature of 70°F. Determine the temperature of the body as a function of time for $t > 0$.
In particular answer the following questions:

(i) What is the temperature of the body at the end of 10 minutes?
(ii) When will the temperature of the body be 60°F?
(iii) After how many minutes will the temperature of the body be within 1°F of the constant temperature of the room (50° F)?

(b) Find the general solution of Hermite's equation (p is a parameter) $y'' - 2xy' + 2py = 0, -\infty < x < \infty$ of the form $y = \sum_{n=0}^{\infty} a_n x^n$.

(c) Solve the following system of equations:

$$\frac{dx}{dt} = 2x + 3y$$
$$\frac{dy}{dt} = 2x + y.$$

Bahagian II: Jawab kedua-dua soalan [50/100].

21. *(a)* *(i)* *Tunjukkan bahawa parabola* $y = x^2$ *dan garis* $y = 2x - 1$ *kedua-duanya adalah penyelesaian bagi persamaan*

$$y' = 2x - 2\sqrt{x^2 - y} \text{ dengan } y(1) = 1.$$

(ii) *Adakah hal ini bercanggah dengan dengan teorem kewujudan dan keunikan? Jelaskan jawapan anda.*

(b) *Pertimbangkan persamaan pembezaan homogen*

$$(x-1)y'' - xy' + y = 0$$

(i) *Tunjukkan bahawa* $y = e^x$ *adalah suatu penyelesaian bagi persamaan ini. Seterusnya, dapatkan penyelesaian tak bersandar kedua.*

(ii) *Gunakan keputusan dalam (i) untuk mencari penyelesaian am bagi persamaan pembezaan tak homogen*

$$(x-1)y'' - xy' + y = 1.$$

22. *(a)* *Suatu benda yang mempunyai suhu 80°F diletakkan di dalam suatu bilik yang mempunyai suhu malar 50°F pada masa* $t = 0$; *dan pada akhir 5 minit, benda tersebut menjadi sejuk kepada suhu 70°F. Tentukan suhu benda tersebut sebagai suatu fungsi masa bagi* $t > 0$.

Seterusnya jawab soalan-soalan berikut:

(i) *Apakah suhu benda tersebut pada akhir 10 minit?*

(ii) *Bilakah suhu benda tersebut menjadi 60°F?*

(iii) *Setelah berapa minitkah suhu benda tersebut akan menjadi dalam lingkungan 1°F daripada suhu malar bilik (50° F)?*

(b) *Dapatkan penyelesaian am bagi persamaan Hermite (p adalah suatu parameter)* $y'' - 2xy' + 2py = 0, -\infty < x < \infty$ *dalam bentuk* $y = \sum_{n=0}^{\infty} a_n x^n$.

(c) *Selesaikan sistem persamaan berikut:*

$$\frac{dx}{dt} = 2x + 3y$$

$$\frac{dy}{dt} = 2x + y.$$

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