

NOT OK to post

Anusha Nagar, Homework 17, 10.30.2021

$$\textcircled{1} \quad x'(t) = 3x(t) - y(t)$$

$$y'(t) = 2x(t)$$

$$x(0) = 2, y(0) = 3$$

$$\text{(i)} \quad x''(t) = 3x'(t) - y'(t)$$

$$x(0) = 2$$

$$y'(t) = 2x(t)$$

$$x'(0) = 3x(0) - y(0)$$

$$x''(t) = 3x'(t) - 2x(t)$$

$$= 6 - 3 = 3$$

$$x''(t) - 3x'(t) + 2x(t) = 0$$

$$r^2 - 3r + 2 = 0$$

$$(r-2)(r-1)$$

$$r = 1, 2$$

$$x(t) = Ae^t + Be^{2t} \Rightarrow 2 = A + B$$

$$x'(t) = Ae^t + 2Be^{2t} \Rightarrow 3 = A + 2B$$

$$\hookrightarrow B = 1$$

$$A = 1$$

$$x(t) = e^t + e^{2t}$$

$$y(t) = 3x(t) - x'(t)$$

$$= 3e^t + 3e^{2t} - e^t - 2e^{2t}$$

$$\boxed{\begin{cases} y(t) = 2e^t + e^{2t} \\ x(t) = e^t + e^{2t} \end{cases}}$$

$$\text{(ii)} \quad x'(t) = 3x(t) - y(t)$$

$$y'(t) = 2x(t) + 0 \cdot y(t)$$

$$x(0) = 2, y(0) = 3$$

$$\vec{x}(t) = \begin{bmatrix} x(t) \\ y(t) \end{bmatrix}$$

$$\vec{x}'(t) = \begin{bmatrix} 3 & -1 \\ 2 & 0 \end{bmatrix} \vec{x}(t)$$

$$\vec{x}(0) = \begin{bmatrix} 2 \\ 3 \end{bmatrix} \rightarrow A$$

$$\det(A - \lambda I) = \det \begin{bmatrix} 3-\lambda & -1 \\ 2 & -\lambda \end{bmatrix} = (3-\lambda)(-\lambda) + 2$$

$$\lambda^2 - 3\lambda + 2$$

$$(\lambda-1)(\lambda-2)$$

$$\lambda = 1, 2$$

$$V_1 = \begin{bmatrix} a \\ b \end{bmatrix} \Rightarrow \lambda = 1 \Rightarrow \begin{bmatrix} 2 & -1 \\ 2 & -1 \end{bmatrix} \begin{bmatrix} a \\ b \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

$$2a - b = 0$$

$$V_1 = \begin{bmatrix} 1 \\ 2 \end{bmatrix}$$

$$V_2 = \begin{bmatrix} a \\ b \end{bmatrix} \Rightarrow \lambda = 2 \Rightarrow \begin{bmatrix} 1 & -1 \\ 2 & -2 \end{bmatrix} \begin{bmatrix} a \\ b \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

$$a - b = 0$$

$$V_2 = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

$$\vec{x}(t) = A \begin{bmatrix} 1 \\ 2 \end{bmatrix} e^t + B \begin{bmatrix} 1 \\ 1 \end{bmatrix} e^{2t}$$

$$\vec{x}(0) = A \begin{bmatrix} 1 \\ 2 \end{bmatrix} + B \begin{bmatrix} 1 \\ 1 \end{bmatrix} = \begin{bmatrix} 2 \\ 3 \end{bmatrix}$$

$$\begin{bmatrix} A+B \\ 2A+B \end{bmatrix} = \begin{bmatrix} 2 \\ 3 \end{bmatrix} \quad \begin{array}{l} A+B=2 \\ 2A+B=3 \end{array}$$

$$A=B=1$$

$$\vec{x}(t) = \begin{bmatrix} 1 \\ 2 \end{bmatrix} e^t + \begin{bmatrix} 1 \\ 1 \end{bmatrix} e^{2t}$$

OR

$$x(t) = e^t + e^{2t}$$

$$y(t) = 2e^t + e^{2t}$$

(iii) dsolve ($\{ \text{diff}(x(t), t) = 3x(t) - y(t),$
 $\text{diff}(y(t), t) = 2x(t) + y(t), x(0) = 2, y(0) = 3\},$
 $\{x(t), y(t)\}$);

$$x'(t) = 3x(t) - y(t)$$

$$y'(t) = 2x(t) + y(t)$$

$$x(0) = 2, y(0) = 3$$

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$$\begin{cases} x'(t) = x(t) + 8y(t) \\ y'(t) = 5x(t) \end{cases}$$

$$\begin{aligned} x'(0) &= x(0) - 8y(0) \\ &= 3 - 48 = -45 \end{aligned}$$

$$x(0) = 3, y(0) = 6$$

$$x''(t) = x'(t) + 8y'(t)$$

$$x''(t) = x'(t) + 40x(t)$$

$$x''(t) - x'(t) - 40x(t) = 0$$

$$r^2 - r - 40 = 0$$

$$\frac{1 \pm \sqrt{1 - 4(1)(-40)}}{2} = \frac{1 \pm \sqrt{161}}{2}$$

$$x(t) = A e^{\frac{1+\sqrt{161}}{2}t} + B e^{\frac{1-\sqrt{161}}{2}t} \Rightarrow x'(t) = \frac{1+\sqrt{161}}{2} A e^{\frac{1+\sqrt{161}}{2}t} + \frac{1-\sqrt{161}}{2} B e^{\frac{1-\sqrt{161}}{2}t}$$

$$x(0) = 3 = A + B$$

$$x'(0) = -45 = \frac{1+\sqrt{161}}{2} A + \frac{1-\sqrt{161}}{2} B \quad \left. \begin{array}{l} A = -2.165 \\ B = 5.165 \end{array} \right\}$$

$$x(t) = -2.165 e^{\frac{1+\sqrt{161}}{2}t} + 5.165 e^{\frac{1-\sqrt{161}}{2}t}$$

$$y(t) = \frac{1+\sqrt{161}}{2} (-2.165) e^{\frac{1+\sqrt{161}}{2}t} + \left(\frac{1-\sqrt{161}}{2} \right) (5.165) e^{\frac{1-\sqrt{161}}{2}t} + 2.165 e^{\frac{1+\sqrt{161}}{2}t} - 5.165 e^{\frac{1-\sqrt{161}}{2}t}$$

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ii

$$\begin{cases} x'(t) = x(t) + 8y(t) \\ y'(t) = 5x(t) \end{cases}$$

$$x(0) = 3, y(0) = 6$$

$$\vec{x}'(t) = \begin{bmatrix} 1 & 8 \\ 5 & 8 \end{bmatrix} \vec{x}(t)$$

$$\vec{x}(0) = \begin{bmatrix} 3 \\ 6 \end{bmatrix}$$

$$\lambda = \frac{1}{2} + \frac{\sqrt{161}}{2}, \frac{1}{2} - \frac{\sqrt{161}}{2}$$

$$\vec{v}_1 = \begin{bmatrix} \frac{8}{-\frac{1}{2} + \frac{\sqrt{161}}{2}} \\ 1 \end{bmatrix}, \vec{v}_2 = \begin{bmatrix} \frac{8}{-\frac{1}{2} - \frac{\sqrt{161}}{2}} \\ 1 \end{bmatrix}$$

$$\vec{x}(t) = A \begin{bmatrix} \frac{8}{-\frac{1}{2} + \frac{\sqrt{161}}{2}} \\ 1 \end{bmatrix} e^{\left(\frac{1}{2} + \frac{\sqrt{161}}{2}\right)t} + B \begin{bmatrix} \frac{8}{-\frac{1}{2} - \frac{\sqrt{161}}{2}} \\ 1 \end{bmatrix} e^{\left(\frac{1}{2} - \frac{\sqrt{161}}{2}\right)t}$$

$$\vec{x}(b) = \begin{bmatrix} 3 \\ 6 \end{bmatrix} = A \begin{bmatrix} 8 \\ -\frac{1}{2} + \frac{\sqrt{161}}{2} \\ 1 \end{bmatrix} + B \begin{bmatrix} 8 \\ -\frac{1}{2} - \frac{\sqrt{161}}{2} \\ 1 \end{bmatrix}$$

$$\begin{cases} A+B=6 \\ 3 = \frac{8}{-\frac{1}{2} + \frac{\sqrt{161}}{2}} A + \frac{8}{-\frac{1}{2} - \frac{\sqrt{161}}{2}} B \end{cases}$$

$$A = 3 + \frac{12\sqrt{161}}{161}, \quad B = 3 - \frac{12\sqrt{161}}{161}$$

$$\vec{x}(t) = \begin{bmatrix} 8 \\ -\frac{1}{2} + \frac{\sqrt{161}}{2} \\ 1 \end{bmatrix} \left[3 + \frac{12\sqrt{161}}{161} \right] e^{\left(\frac{1}{2} + \frac{\sqrt{161}}{2}\right)t} + \begin{bmatrix} 8 \\ -\frac{1}{2} - \frac{\sqrt{161}}{2} \\ 1 \end{bmatrix} \left[3 - \frac{12\sqrt{161}}{161} \right] e^{\left(\frac{1}{2} - \frac{\sqrt{161}}{2}\right)t}$$

$$\textcircled{3} \quad x_1'(t) = x_1(t) + x_2(t) + x_3(t)$$

$$x_2'(t) = x_1(t) + x_2(t)$$

$$x_3'(t) = x_1(t)$$

$$x_1(b) = 1, \quad x_2(b) = 2, \quad x_3(b) = -1$$

$$\vec{x}'(t) = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 0 \\ 1 & 0 & 0 \end{bmatrix} \vec{x}(t), \quad \vec{x}(b) = \begin{bmatrix} 1 \\ 2 \\ -1 \end{bmatrix}$$

$$\vec{x}(b) = \begin{bmatrix} 1 \\ 2 \\ -1 \end{bmatrix} = A \begin{bmatrix} v_2[1] \end{bmatrix} + B \begin{bmatrix} v_2[2] \end{bmatrix} + C \begin{bmatrix} v_2[3] \end{bmatrix}$$

Column(E, 1) Column(E, 2), ...

$$I = v_2[1,1] \cdot F + v_2[1,2] \cdot G + v_2[1,3] \cdot H$$

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> #Problem 1 part iii

> $dsolve(\{diff(x(t), t) = 3 \cdot x(t) - y(t), diff(y(t), t) = 2 \cdot x(t), x(0) = 2, y(0) = 3\}, \{x(t), y(t)\})$
 $\{x(t) = e^{2t} + e^t, y(t) = e^{2t} + 2e^t\}$ (1)

> #Problem 2 part iii

> $dsolve(\{diff(x(t), t) = x(t) + 8 \cdot y(t), diff(y(t), t) = 5 \cdot x(t), x(0) = 3, y(0) = 6\}, \{x(t), y(t)\})$
 $\left\{x(t) = \left(\frac{\sqrt{161}}{10} + \frac{1}{10}\right) \left(3 + \frac{12\sqrt{161}}{161}\right) e^{\frac{(1+\sqrt{161})t}{2}} + \left(-\frac{\sqrt{161}}{10} + \frac{1}{10}\right) \left(3 - \frac{12\sqrt{161}}{161}\right) e^{-\frac{(-1+\sqrt{161})t}{2}}, y(t) = \left(3 + \frac{12\sqrt{161}}{161}\right) e^{\frac{(1+\sqrt{161})t}{2}} + \left(3 - \frac{12\sqrt{161}}{161}\right) e^{-\frac{(-1+\sqrt{161})t}{2}}\right\}$ (2)

> with(LinearAlgebra) :

>

$A := Matrix([[1, 8], [5, 0]])$

$$A := \begin{bmatrix} 1 & 8 \\ 5 & 0 \end{bmatrix} \quad (3)$$

> $e, v := Eigenvectors(A)$

$$e, v := \begin{bmatrix} \frac{1}{2} + \frac{\sqrt{161}}{2} \\ \frac{1}{2} - \frac{\sqrt{161}}{2} \end{bmatrix}, \begin{bmatrix} \frac{8}{-\frac{1}{2} + \frac{\sqrt{161}}{2}} & \frac{8}{-\frac{1}{2} - \frac{\sqrt{161}}{2}} \\ 1 & 1 \end{bmatrix} \quad (4)$$

> $sys := \left\{ \left(\frac{8}{-\frac{1}{2} + \frac{\sqrt{161}}{2}} \right) \cdot C + \left(\frac{8}{-\frac{1}{2} - \frac{\sqrt{161}}{2}} \right) \cdot D = 3, C + D = 6 \right\}$
 $sys := \left\{ C + D = 6, \frac{8C}{-\frac{1}{2} + \frac{\sqrt{161}}{2}} + \frac{8D}{-\frac{1}{2} - \frac{\sqrt{161}}{2}} = 3 \right\}$ (5)

> $solve(sys, \{C, D\})$

$$\left\{ C = 3 + \frac{12\sqrt{161}}{161}, D = 3 - \frac{12\sqrt{161}}{161} \right\} \quad (6)$$

> #Problem3

> $E := Matrix([[1, 1, 1], [1, 1, 0], [1, 0, 0]])$

(7)

$$E := \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 0 \\ 1 & 0 & 0 \end{bmatrix} \quad (7)$$

> e2, v2 := Eigenvectors(E)

$$e2, v2 := \left[\left[\frac{(28 + 84 I \sqrt{3})^{1/3}}{6} + \frac{14}{3 (28 + 84 I \sqrt{3})^{1/3}} + \frac{2}{3} \right], \quad (8) \right.$$

$$\left[\begin{aligned} & - \frac{(28 + 84 I \sqrt{3})^{1/3}}{12} - \frac{7}{3 (28 + 84 I \sqrt{3})^{1/3}} + \frac{2}{3} \\ & + \frac{I \sqrt{3} \left(\frac{(28 + 84 I \sqrt{3})^{1/3}}{6} - \frac{14}{3 (28 + 84 I \sqrt{3})^{1/3}} \right)}{2} \end{aligned} \right],$$

$$\left[\begin{aligned} & - \frac{(28 + 84 I \sqrt{3})^{1/3}}{12} - \frac{7}{3 (28 + 84 I \sqrt{3})^{1/3}} + \frac{2}{3} \\ & - \frac{I \sqrt{3} \left(\frac{(28 + 84 I \sqrt{3})^{1/3}}{6} - \frac{14}{3 (28 + 84 I \sqrt{3})^{1/3}} \right)}{2} \end{aligned} \right], \left[\begin{array}{l} -1 \\ / \end{array} \right]$$

$$\left(\left(\frac{(28 + 84 I \sqrt{3})^{1/3}}{6} + \frac{14}{3 (28 + 84 I \sqrt{3})^{1/3}} + \frac{2}{3} \right)^2 - \frac{(28 + 84 I \sqrt{3})^{1/3}}{3} \right)$$

$$-\frac{28}{3(28+84I\sqrt{3})^{1/3}} - \frac{7}{3}, -1 \Big/ \left(\left(-\frac{(28+84I\sqrt{3})^{1/3}}{12} \right. \right.$$

$$\left. -\frac{7}{3(28+84I\sqrt{3})^{1/3}} + \frac{2}{3} \right.$$

$$\left. + \frac{I\sqrt{3} \left(\frac{(28+84I\sqrt{3})^{1/3}}{6} - \frac{14}{3(28+84I\sqrt{3})^{1/3}} \right)}{2} \right)^2 + \frac{(28+84I\sqrt{3})^{1/3}}{6}$$

$$+ \frac{14}{3(28+84I\sqrt{3})^{1/3}} - \frac{7}{3} - I\sqrt{3} \left(\frac{(28+84I\sqrt{3})^{1/3}}{6} \right.$$

$$\left. - \frac{14}{3(28+84I\sqrt{3})^{1/3}} \right), -1 \Big/ \left(\left(-\frac{(28+84I\sqrt{3})^{1/3}}{12} \right. \right.$$

$$\left. -\frac{7}{3(28+84I\sqrt{3})^{1/3}} + \frac{2}{3} \right.$$

$$\left. - \frac{I\sqrt{3} \left(\frac{(28+84I\sqrt{3})^{1/3}}{6} - \frac{14}{3(28+84I\sqrt{3})^{1/3}} \right)}{2} \right)^2 + \frac{(28+84I\sqrt{3})^{1/3}}{6}$$

$$\left. \left[\begin{aligned} &+ \frac{14}{3(28 + 84I\sqrt{3})^{1/3}} - \frac{7}{3} + I\sqrt{3} \left(\frac{(28 + 84I\sqrt{3})^{1/3}}{6} \right. \right. \\ &\left. \left. - \frac{14}{3(28 + 84I\sqrt{3})^{1/3}} \right) \right] \right\}$$

$$\left[- \left(\left(\frac{(28 + 84I\sqrt{3})^{1/3}}{6} + \frac{14}{3(28 + 84I\sqrt{3})^{1/3}} + \frac{2}{3} \right)^2 \right. \right.$$

$$\left. \left. - \frac{(28 + 84I\sqrt{3})^{1/3}}{6} - \frac{14}{3(28 + 84I\sqrt{3})^{1/3}} - \frac{8}{3} \right) \right] /$$

$$\left(\left(\frac{(28 + 84I\sqrt{3})^{1/3}}{6} + \frac{14}{3(28 + 84I\sqrt{3})^{1/3}} + \frac{2}{3} \right)^2 - \frac{(28 + 84I\sqrt{3})^{1/3}}{3} \right.$$

$$\left. \left. - \frac{28}{3(28 + 84I\sqrt{3})^{1/3}} - \frac{7}{3} \right) \right\} - \left(\left(- \frac{(28 + 84I\sqrt{3})^{1/3}}{12} \right. \right.$$

$$- \frac{7}{3 (28 + 84 I\sqrt{3})^{1/3}} + \frac{2}{3}$$

$$+ \frac{I\sqrt{3} \left(\frac{(28 + 84 I\sqrt{3})^{1/3}}{6} - \frac{14}{3 (28 + 84 I\sqrt{3})^{1/3}} \right)^2}{2} + \frac{(28 + 84 I\sqrt{3})^{1/3}}{12}$$

$$+ \frac{7}{3 (28 + 84 I\sqrt{3})^{1/3}} - \frac{8}{3}$$

$$- \frac{I\sqrt{3} \left(\frac{(28 + 84 I\sqrt{3})^{1/3}}{6} - \frac{14}{3 (28 + 84 I\sqrt{3})^{1/3}} \right)^2}{2} \Big/ \left(\left(\right. \right)$$

$$-\frac{(28 + 84 I\sqrt{3})^{1/3}}{12} - \frac{7}{3(28 + 84 I\sqrt{3})^{1/3}} + \frac{2}{3}$$

$$+ \frac{I\sqrt{3} \left(\frac{(28 + 84 I\sqrt{3})^{1/3}}{6} - \frac{14}{3(28 + 84 I\sqrt{3})^{1/3}} \right)^2}{2} + \frac{(28 + 84 I\sqrt{3})^{1/3}}{6}$$

$$+ \frac{14}{3(28 + 84 I\sqrt{3})^{1/3}} - \frac{7}{3} - I\sqrt{3} \left(\frac{(28 + 84 I\sqrt{3})^{1/3}}{6} \right.$$

$$\left. - \frac{14}{3(28 + 84 I\sqrt{3})^{1/3}} \right), - \left(\left(-\frac{(28 + 84 I\sqrt{3})^{1/3}}{12} \right. \right.$$

$$\left. - \frac{7}{3(28 + 84 I\sqrt{3})^{1/3}} + \frac{2}{3} \right.$$

$$\left. - \frac{I\sqrt{3} \left(\frac{(28 + 84 I\sqrt{3})^{1/3}}{6} - \frac{14}{3(28 + 84 I\sqrt{3})^{1/3}} \right)^2}{2} + \frac{(28 + 84 I\sqrt{3})^{1/3}}{12} \right)$$

$$\begin{aligned}
& + 343348346880 (28 + 84 I\sqrt{3})^{23/3} \sqrt{3} - 98058240 (28 + 84 I\sqrt{3})^{28/3} \sqrt{3} \\
& - 182236817129472 (28 + 84 I\sqrt{3})^{20/3} \sqrt{3} + 31238258688 (28 + 84 I\sqrt{3})^{25/3} \sqrt{3} \\
& + 38004342053142528 (28 + 84 I\sqrt{3})^{17/3} \sqrt{3} - 5139292225536 (28 \\
& + 84 I\sqrt{3})^{22/3} \sqrt{3} - 3564463846343049216 (28 + 84 I\sqrt{3})^{14/3} \sqrt{3} \\
& + 6127765235215368192 (28 + 84 I\sqrt{3})^{13/3} \sqrt{3} \\
& + 642276335245043372654592 (28 + 84 I\sqrt{3})^{7/3} \sqrt{3} \\
& - 3319028998750768988160 (28 + 84 I\sqrt{3})^{10/3} \sqrt{3} \\
& + 14124989936209118625792 (28 + 84 I\sqrt{3})^{8/3} \sqrt{3} \\
& - 3246306668603490749644800 (28 + 84 I\sqrt{3})^{5/3} \sqrt{3} \\
& - 45099592402312964673110016 (28 + 84 I\sqrt{3})^{4/3} \sqrt{3} + 410915602169856 (28 \\
& + 84 I\sqrt{3})^{19/3} \sqrt{3} - 19063743442845696 (28 + 84 I\sqrt{3})^{16/3} \sqrt{3} \\
& + 111184137028733239296 (28 + 84 I\sqrt{3})^{11/3} \sqrt{3} \\
& - 39169157149769254547434242048 I - 4684489268112525225659203584 I (28 \\
& + 84 I\sqrt{3})^{2/3} + 294174720 I (28 + 84 I\sqrt{3})^{28/3} - 93714776064 I (28
\end{aligned}$$

$$\begin{aligned}
& + 84 I\sqrt{3})^{25/3} - 54917357000196096 I (28 + 84 I\sqrt{3})^{17/3} \\
& + 15417876676608 I (28 + 84 I\sqrt{3})^{22/3} - 52288831881216 I (28 + 84 I\sqrt{3})^{20/3} \\
& + 62124659142819840 I (28 + 84 I\sqrt{3})^{16/3} + 468202291200 I (28 + 84 I\sqrt{3})^{23/3} \\
& - 1232746806509568 I (28 + 84 I\sqrt{3})^{19/3} - 387072 I (28 + 84 I\sqrt{3})^{31/3} \\
& + 18270869711845588992 I (28 + 84 I\sqrt{3})^{14/3} - 21067080980615921664 I (28 \\
& + 84 I\sqrt{3})^{13/3} - 2191573793216284065792 I (28 + 84 I\sqrt{3})^{11/3} \\
& + 7887414940084406845440 I (28 + 84 I\sqrt{3})^{10/3} \\
& - 115855958172487234093056 I (28 + 84 I\sqrt{3})^{8/3} \\
& - 1264599621565777811865600 I (28 + 84 I\sqrt{3})^{7/3} \\
& + 58043963234630414603649024 I (28 + 84 I\sqrt{3})^{5/3} \\
& + 79475598926429385941581824 I (28 + 84 I\sqrt{3})^{4/3}) / (9 (-526848 (28 \\
& + 84 I\sqrt{3})^{4/3} - 14751744 (28 + 84 I\sqrt{3})^{2/3} - 672 (28 + 84 I\sqrt{3})^{8/3} \\
& - 24 (28 + 84 I\sqrt{3})^{10/3} + 60928 I (28 + 84 I\sqrt{3})^{5/3} \sqrt{3} - 224 I (28 \\
& + 84 I\sqrt{3})^{8/3} \sqrt{3} - 2176 I (28 + 84 I\sqrt{3})^{7/3} \sqrt{3} + 6528 (28 + 84 I\sqrt{3})^{7/3}
\end{aligned}$$

$$\begin{aligned}
& + 182784 (28 + 84 I\sqrt{3})^{5/3} + 175616 I (28 + 84 I\sqrt{3})^{4/3} \sqrt{3} - 4917248 I (28 \\
& + 84 I\sqrt{3})^{2/3} \sqrt{3} + 8 I (28 + 84 I\sqrt{3})^{10/3} \sqrt{3}) (13429889549991936 \sqrt{3} (28 \\
& + 84 I\sqrt{3})^{2/3} - 16785408 I (28 + 84 I\sqrt{3})^{17/3} + 1025310720 I (28 + 84 I\sqrt{3})^{14/3} \\
& + 35876241408 I (28 + 84 I\sqrt{3})^{11/3} + 17454735556608 I (28 + 84 I\sqrt{3})^{8/3} \\
& - 6156997468618752 I (28 + 84 I\sqrt{3})^{5/3} + 496905913349701632 I (28 \\
& + 84 I\sqrt{3})^{2/3} - 192 I (28 + 84 I\sqrt{3})^{23/3} + 93696 I (28 + 84 I\sqrt{3})^{20/3} \\
& + 611784327168 (28 + 84 I\sqrt{3})^{8/3} \sqrt{3} - 166405336989696 (28 + 84 I\sqrt{3})^{5/3} \\
& \sqrt{3}), G = - \left((-255451170078720 I (28 + 84 I\sqrt{3})^{20/3} \sqrt{3} + 387072 I (28 \\
& + 84 I\sqrt{3})^{31/3} \sqrt{3} + 93714776064 I (28 + 84 I\sqrt{3})^{25/3} \sqrt{3} \\
& + 749123665920 I (28 + 84 I\sqrt{3})^{23/3} \sqrt{3} + 1232746806509568 I (28 \\
& + 84 I\sqrt{3})^{19/3} \sqrt{3} - 294174720 I (28 + 84 I\sqrt{3})^{28/3} \sqrt{3} \\
& - 15417876676608 I (28 + 84 I\sqrt{3})^{22/3} \sqrt{3} + 5585466053099520 I (28 \\
& + 84 I\sqrt{3})^{17/3} \sqrt{3} - 62124659142819840 I (28 + 84 I\sqrt{3})^{16/3} \sqrt{3} \\
& + 8981525301213265920 I (28 + 84 I\sqrt{3})^{14/3} \sqrt{3} \right)
\end{aligned}$$

$$\begin{aligned}
& + 21067080980615921664 I (28 + 84 I\sqrt{3})^{13/3} \sqrt{3} \\
& - 1455032604959126323200 I (28 + 84 I\sqrt{3})^{11/3} \sqrt{3} \\
& - 1378604169394372214784 I (28 + 84 I\sqrt{3})^{10/3} \sqrt{3} \\
& - 30432651567418526662656 I (28 + 84 I\sqrt{3})^{8/3} \sqrt{3} \\
& - 505796908061911607672832 I (28 + 84 I\sqrt{3})^{7/3} \sqrt{3} \\
& + 28210404950164334614413312 I (28 + 84 I\sqrt{3})^{5/3} \sqrt{3} \\
& + 63405815111758254270578688 I (28 + 84 I\sqrt{3})^{4/3} \sqrt{3} \\
& - 179110975573403061815976394752 - 387072 (28 + 84 I\sqrt{3})^{31/3} \\
& - 187280916480 (28 + 84 I\sqrt{3})^{23/3} + 294174720 (28 + 84 I\sqrt{3})^{28/3} \\
& - 93714776064 (28 + 84 I\sqrt{3})^{25/3} - 73851444904673300369620598784 I\sqrt{3} \\
& + 1564116383144953892460036096 (28 + 84 I\sqrt{3})^{2/3} \\
& - 845113247946895521742848 (28 + 84 I\sqrt{3})^{7/3} \\
& + 5980190827913209184256 (28 + 84 I\sqrt{3})^{10/3} \\
& + 182943643778962151178240 (28 + 84 I\sqrt{3})^{8/3}
\end{aligned}$$

$$\begin{aligned}
& - 19380450811562839775379456 (28 + 84 I\sqrt{3})^{5/3} \\
& + 47997952519559019547852800 (28 + 84 I\sqrt{3})^{4/3} - 1232746806509568 (28 \\
& + 84 I\sqrt{3})^{19/3} + 57191230328537088 (28 + 84 I\sqrt{3})^{16/3} \\
& - 2276745623036792181822062592 I (28 + 84 I\sqrt{3})^{2/3} \sqrt{3} \\
& - 148165873738186752 (28 + 84 I\sqrt{3})^{17/3} - 18383295705646104576 (28 \\
& + 84 I\sqrt{3})^{13/3} + 15417876676608 (28 + 84 I\sqrt{3})^{22/3} + 333659680800768 (28 \\
& + 84 I\sqrt{3})^{20/3} + 29560434240377585664 (28 + 84 I\sqrt{3})^{14/3} \\
& - 2858126071361483833344 (28 + 84 I\sqrt{3})^{11/3} \sqrt{3}) / (27 (-526848 (28 \\
& + 84 I\sqrt{3})^{4/3} - 14751744 (28 + 84 I\sqrt{3})^{2/3} - 672 (28 + 84 I\sqrt{3})^{8/3} \\
& - 24 (28 + 84 I\sqrt{3})^{10/3} + 60928 I (28 + 84 I\sqrt{3})^{5/3} \sqrt{3} - 224 I (28 \\
& + 84 I\sqrt{3})^{8/3} \sqrt{3} - 2176 I (28 + 84 I\sqrt{3})^{7/3} \sqrt{3} + 6528 (28 + 84 I\sqrt{3})^{7/3} \\
& + 182784 (28 + 84 I\sqrt{3})^{5/3} + 175616 I (28 + 84 I\sqrt{3})^{4/3} \sqrt{3} - 4917248 I (28 \\
& + 84 I\sqrt{3})^{2/3} \sqrt{3} + 8 I (28 + 84 I\sqrt{3})^{10/3} \sqrt{3}) (13429889549991936 \sqrt{3} (28 \\
& + 84 I\sqrt{3})^{2/3} - 16785408 I (28 + 84 I\sqrt{3})^{17/3} + 1025310720 I (28 + 84 I\sqrt{3})^{14/3}
\end{aligned}$$

$$\begin{aligned}
& + 35876241408 I (28 + 84 I\sqrt{3})^{11/3} + 17454735556608 I (28 + 84 I\sqrt{3})^{8/3} \\
& - 6156997468618752 I (28 + 84 I\sqrt{3})^{5/3} + 496905913349701632 I (28 \\
& + 84 I\sqrt{3})^{2/3} - 192 I (28 + 84 I\sqrt{3})^{23/3} + 93696 I (28 + 84 I\sqrt{3})^{20/3} \\
& + 611784327168 (28 + 84 I\sqrt{3})^{8/3} \sqrt{3} - 166405336989696 (28 + 84 I\sqrt{3})^{5/3} \\
& \sqrt{3}), H = -(\sqrt{3} (-647897339322125254656 + 73883969623425024 I (28 \\
& + 84 I\sqrt{3})^{5/3} \sqrt{3} - 483476023799709696 (28 + 84 I\sqrt{3})^{2/3} \\
& + 13239712022003712 (28 + 84 I\sqrt{3})^{7/3} - 84501149515776 (28 + 84 I\sqrt{3})^{10/3} \\
& - 22024235778048 (28 + 84 I\sqrt{3})^{8/3} + 5990592131629056 (28 + 84 I\sqrt{3})^{5/3} \\
& - 736725369599557632 (28 + 84 I\sqrt{3})^{4/3} + 201424896 I (28 + 84 I\sqrt{3})^{17/3} \sqrt{3} \\
& - 209456826679296 I (28 + 84 I\sqrt{3})^{8/3} \sqrt{3} - 1124352 I (28 + 84 I\sqrt{3})^{20/3} \sqrt{3} \\
& + 1103309335166976 I (28 + 84 I\sqrt{3})^{7/3} \sqrt{3} - 430514896896 I (28 \\
& + 84 I\sqrt{3})^{11/3} \sqrt{3} - 61393780799963136 I (28 + 84 I\sqrt{3})^{4/3} \sqrt{3} \\
& - 12303728640 I (28 + 84 I\sqrt{3})^{14/3} \sqrt{3} + 2304 I (28 + 84 I\sqrt{3})^{23/3} \sqrt{3} \\
& + 15606743040 I (28 + 84 I\sqrt{3})^{13/3} \sqrt{3} - 5962870960196419584 I (28 \\
& + 84 I\sqrt{3})^{2/3} \sqrt{3} - 7041762459648 I (28 + 84 I\sqrt{3})^{10/3} \sqrt{3} \\
& - 436904455792880517120 I\sqrt{3} + 187280916480 (28 + 84 I\sqrt{3})^{13/3})) / (108 (\\
& -13429889549991936 \sqrt{3} (28 + 84 I\sqrt{3})^{2/3} - 611784327168 (28 + 84 I\sqrt{3})^{8/3} \sqrt{3} \\
& + 166405336989696 (28 + 84 I\sqrt{3})^{5/3} \sqrt{3} - 93696 I (28 + 84 I\sqrt{3})^{20/3} \\
& + 16785408 I (28 + 84 I\sqrt{3})^{17/3} - 1025310720 I (28 + 84 I\sqrt{3})^{14/3} \\
& - 35876241408 I (28 + 84 I\sqrt{3})^{11/3} - 17454735556608 I (28 + 84 I\sqrt{3})^{8/3} \\
& + 6156997468618752 I (28 + 84 I\sqrt{3})^{5/3} - 496905913349701632 I (28 \\
& + 84 I\sqrt{3})^{2/3} + 192 I (28 + 84 I\sqrt{3})^{23/3})) \}
\end{aligned}$$

> #Final answer is of form : $X(t) = F \cdot \text{Column}(v2, 1) \cdot e^{\text{Row}(e2, 1) \cdot t} + G \cdot \text{Column}(v2, 2) \cdot e^{\text{Row}(e2, 2) \cdot t} + H \cdot \text{Column}(v2, 3) \cdot e^{\text{Row}(e2, 3) \cdot t}$

> $dsolve(\{diff(x1(t), t) = x1(t) + x2(t) + x3(t), diff(x2(t), t) = x1(t) + x2(t), diff(x3(t), t) = x1(t), x1(0) = 1, x2(0) = 2, x3(0) = -1\}, \{x1(t), x2(t), x3(t)\})$

$$\left\{ \begin{aligned} x1(t) = & - \left((1008 I (28 + 84 I \sqrt{3})^{5/3} \sqrt{3} + 18 I (28 + 84 I \sqrt{3})^{8/3} \sqrt{3} + 6 (28 \right. \\ & + 84 I \sqrt{3})^{8/3} - 24192 I (28 + 84 I \sqrt{3})^{4/3} \sqrt{3} + 338688 I (28 + 84 I \sqrt{3})^{1/3} \sqrt{3} \\ & + 76608 (28 + 84 I \sqrt{3})^{4/3} - 193536 I (28 + 84 I \sqrt{3})^{2/3} \sqrt{3} - 4368 (28 \\ & + 84 I \sqrt{3})^{5/3} + 24385536 I \sqrt{3} - 105670656 + 8015616 (28 + 84 I \sqrt{3})^{1/3} \\ & \left. - 2585856 (28 + 84 I \sqrt{3})^{2/3} \right) \\ & \left. e^{-\frac{(I(28 + 84 I \sqrt{3})^{2/3} \sqrt{3} + (28 + 84 I \sqrt{3})^{2/3} - 28 I \sqrt{3} - 8(28 + 84 I \sqrt{3})^{1/3} + 28)t}{12(28 + 84 I \sqrt{3})^{1/3}}} \right) / \end{aligned} \right.$$

$$\left(3 \left(I (28 + 84 I \sqrt{3})^{4/3} \sqrt{3} + 56 I (28 + 84 I \sqrt{3})^{1/3} \sqrt{3} - 840 I \sqrt{3} + 504 \right) \left(\right.$$

$$\left. - 18 (28 + 84 I \sqrt{3})^{4/3} + 2 I (28 + 84 I \sqrt{3})^{4/3} \sqrt{3} - 1568 I (28 + 84 I \sqrt{3})^{1/3} \right)$$

$$\left. \left(\sqrt{3} \right) \right) - \left((105670656 + 1008 I (28 + 84 I \sqrt{3})^{5/3} \sqrt{3} + 18 I (28 + 84 I \sqrt{3})^{8/3} \sqrt{3} - 20160 (28 + 84 I \sqrt{3})^{4/3} \right)$$

$$+ 84 I\sqrt{3})^{1/3} + 6 (28 + 84 I\sqrt{3})^{8/3} - 4368 (28 + 84 I\sqrt{3})^{5/3} + 24192 I (28$$

$$+ 84 I\sqrt{3})^{4/3} \sqrt{3} + 3048192 I (28 + 84 I\sqrt{3})^{1/3} \sqrt{3} + 1257984 I (28$$

$$+ 84 I\sqrt{3})^{2/3} \sqrt{3} - 24385536 I\sqrt{3})$$

$$e \left(\frac{(I(28 + 84 I\sqrt{3})^{2/3} \sqrt{3} - (28 + 84 I\sqrt{3})^{2/3} - 28 I\sqrt{3} + 8(28 + 84 I\sqrt{3})^{1/3} - 28)_t}{12 (28 + 84 I\sqrt{3})^{1/3}} \right) /$$

$$\left(3 (I(28 + 84 I\sqrt{3})^{4/3} \sqrt{3} + 56 I (28 + 84 I\sqrt{3})^{1/3} \sqrt{3} - 840 I\sqrt{3} + 504) ($$

$$- 18 (28 + 84 I\sqrt{3})^{4/3} + 2 I (28 + 84 I\sqrt{3})^{4/3} \sqrt{3} - 1568 I (28 + 84 I\sqrt{3})^{1/3}$$

$$^3 \sqrt{3}) \left. \right) + \left((-16128 I\sqrt{3} + 2 I (28 + 84 I\sqrt{3})^{4/3} \sqrt{3} - 18 (28 + 84 I\sqrt{3})^{4/3}$$

$$+ 32256 - 288 I (28 + 84 I\sqrt{3})^{2/3} \sqrt{3} - 1568 I (28 + 84 I\sqrt{3})^{1/3} \sqrt{3}$$

$$- 1440 (28 + 84 I\sqrt{3})^{2/3}) e \left(\frac{((28 + 84 I\sqrt{3})^{2/3} + 4(28 + 84 I\sqrt{3})^{1/3} + 28)_t}{6(28 + 84 I\sqrt{3})^{1/3}} \right) / \left(3 ($$

$$\begin{aligned}
& -18 (28 + 84 I\sqrt{3})^{4/3} + 2 I (28 + 84 I\sqrt{3})^{4/3} \sqrt{3} - 1568 I (28 + 84 I\sqrt{3})^{1/3} \\
& \sqrt{3} \Big), x_2(t) = - \left(I (28 + 84 I\sqrt{3})^{4/3} \sqrt{3} - (28 + 84 I\sqrt{3})^{4/3} + 56 I (28 \right. \\
& + 84 I\sqrt{3})^{1/3} \sqrt{3} - 48 (28 + 84 I\sqrt{3})^{2/3} - 1008 I\sqrt{3} - 56 (28 + 84 I\sqrt{3})^{1/3} \\
& - 336 \Big) \left(1008 I (28 + 84 I\sqrt{3})^{5/3} \sqrt{3} + 18 I (28 + 84 I\sqrt{3})^{8/3} \sqrt{3} + 6 (28 \right. \\
& + 84 I\sqrt{3})^{8/3} - 24192 I (28 + 84 I\sqrt{3})^{4/3} \sqrt{3} + 338688 I (28 + 84 I\sqrt{3})^{1/3} \sqrt{3} \\
& + 76608 (28 + 84 I\sqrt{3})^{4/3} - 193536 I (28 + 84 I\sqrt{3})^{2/3} \sqrt{3} - 4368 (28 \\
& + 84 I\sqrt{3})^{5/3} + 24385536 I\sqrt{3} - 105670656 + 8015616 (28 + 84 I\sqrt{3})^{1/3} \\
& - 2585856 (28 + 84 I\sqrt{3})^{2/3} \Big) \\
& \left. - \frac{(I(28 + 84 I\sqrt{3})^{2/3} \sqrt{3} + (28 + 84 I\sqrt{3})^{2/3} - 28 I\sqrt{3} - 8(28 + 84 I\sqrt{3})^{1/3} + 28)_t}{12(28 + 84 I\sqrt{3})^{1/3}} \right) / e
\end{aligned}$$

$$\begin{aligned}
& (216 (28 + 84 I\sqrt{3})^{2/3} (I(28 + 84 I\sqrt{3})^{4/3} \sqrt{3} + 56 I(28 + 84 I\sqrt{3})^{1/3} \sqrt{3} \\
& - 840 I\sqrt{3} + 504) (-18 (28 + 84 I\sqrt{3})^{4/3} + 2 I(28 + 84 I\sqrt{3})^{4/3} \sqrt{3} \\
& - 1568 I(28 + 84 I\sqrt{3})^{1/3} \sqrt{3})) + \left((I(28 + 84 I\sqrt{3})^{4/3} \sqrt{3} + (28 + 84 I\sqrt{3})^{4/3} + 56 I(28 + \right. \\
& + 1344) (105670656 + 1008 I(28 + 84 I\sqrt{3})^{5/3} \sqrt{3} + 18 I(28 + 84 I\sqrt{3})^{8/3} \sqrt{3} \\
& - 20160 (28 + 84 I\sqrt{3})^{4/3} + 607488 (28 + 84 I\sqrt{3})^{2/3} + 2596608 (28 \\
& + 84 I\sqrt{3})^{1/3} + 6 (28 + 84 I\sqrt{3})^{8/3} - 4368 (28 + 84 I\sqrt{3})^{5/3} + 24192 I(28 \\
& + 84 I\sqrt{3})^{4/3} \sqrt{3} + 3048192 I(28 + 84 I\sqrt{3})^{1/3} \sqrt{3} + 1257984 I(28 \\
& + 84 I\sqrt{3})^{2/3} \sqrt{3} - 24385536 I\sqrt{3}) \\
& \left. \frac{(I(28 + 84 I\sqrt{3})^{2/3} \sqrt{3} - (28 + 84 I\sqrt{3})^{2/3} - 28 I\sqrt{3} + 8(28 + 84 I\sqrt{3})^{1/3} - 28)_t}{12(28 + 84 I\sqrt{3})^{1/3}} \right) // \\
& e
\end{aligned}$$

$$\begin{aligned}
& (216 (28 + 84 I\sqrt{3})^{2/3} (I(28 + 84 I\sqrt{3})^{4/3} \sqrt{3} + 56 I(28 + 84 I\sqrt{3})^{1/3} \sqrt{3} \\
& - 840 I\sqrt{3} + 504) (-18 (28 + 84 I\sqrt{3})^{4/3} + 2 I(28 + 84 I\sqrt{3})^{4/3} \sqrt{3} \\
& - 1568 I(28 + 84 I\sqrt{3})^{1/3} \sqrt{3})) + \left((28 + 84 I\sqrt{3})^{4/3} - 24 (28 + 84 I\sqrt{3})^{2/3} + 168 I\sqrt{3} + 5 \right. \\
& \left. + 84 I\sqrt{3})^{4/3} + 32256 - 288 I(28 + 84 I\sqrt{3})^{2/3} \sqrt{3} - 1568 I(28 \right. \\
& \left. + 84 I\sqrt{3})^{1/3} \sqrt{3} - 1440 (28 + 84 I\sqrt{3})^{2/3} \right) \\
& e^{\frac{((28 + 84 I\sqrt{3})^{2/3} + 4(28 + 84 I\sqrt{3})^{1/3} + 28)t}{6(28 + 84 I\sqrt{3})^{1/3}}} \Bigg/ (108 (28 + 84 I\sqrt{3})^{2/3} (\\
& -18 (28 + 84 I\sqrt{3})^{4/3} + 2 I(28 + 84 I\sqrt{3})^{4/3} \sqrt{3} - 1568 I(28 + 84 I\sqrt{3})^{1/3} \\
& \sqrt{3})), x3(t) = \left((I(28 + 84 I\sqrt{3})^{4/3} \sqrt{3} - (28 + 84 I\sqrt{3})^{4/3} \right. \\
& \left. - 112 I(28 + 84 I\sqrt{3})^{1/3} \sqrt{3} - 24 (28 + 84 I\sqrt{3})^{2/3} - 336 I\sqrt{3} + 112 (28 \right.
\end{aligned}$$

$$+ 84 I \sqrt{3})^{1/3} - 1680) (1008 I (28 + 84 I \sqrt{3})^{5/3} \sqrt{3} + 18 I (28 + 84 I \sqrt{3})^8 /$$

$$^3 \sqrt{3} + 6 (28 + 84 I \sqrt{3})^{8/3} - 24192 I (28 + 84 I \sqrt{3})^{4/3} \sqrt{3} + 338688 I (28$$

$$+ 84 I \sqrt{3})^{1/3} \sqrt{3} + 76608 (28 + 84 I \sqrt{3})^{4/3} - 193536 I (28 + 84 I \sqrt{3})^{2/3} \sqrt{3}$$

$$- 4368 (28 + 84 I \sqrt{3})^{5/3} + 24385536 I \sqrt{3} - 105670656 + 8015616 (28$$

$$+ 84 I \sqrt{3})^{1/3} - 2585856 (28 + 84 I \sqrt{3})^{2/3})$$

$$e \frac{(I(28 + 84 I \sqrt{3})^{2/3} \sqrt{3} + (28 + 84 I \sqrt{3})^{2/3} - 28 I \sqrt{3} - 8(28 + 84 I \sqrt{3})^{1/3} + 28)_t}{12(28 + 84 I \sqrt{3})^{1/3}} \Bigg/$$

$$(216 (28 + 84 I \sqrt{3})^{2/3} (I(28 + 84 I \sqrt{3})^{4/3} \sqrt{3} + 56 I (28 + 84 I \sqrt{3})^{1/3} \sqrt{3}$$

$$- 840 I \sqrt{3} + 504) (-18 (28 + 84 I \sqrt{3})^{4/3} + 2 I (28 + 84 I \sqrt{3})^{4/3} \sqrt{3}$$

$$- 1568 I (28 + 84 I \sqrt{3})^{1/3} \sqrt{3})) - \left((I(28 + 84 I \sqrt{3})^{4/3} \sqrt{3} + (28 + 84 I \sqrt{3})^{4/3} - 112 I (28 +$$

$$- 336) (105670656 + 1008 I(28 + 84 I\sqrt{3})^{5/3} \sqrt{3} + 18 I(28 + 84 I\sqrt{3})^{8/3} \sqrt{3}$$

$$- 20160 (28 + 84 I\sqrt{3})^{4/3} + 607488 (28 + 84 I\sqrt{3})^{2/3} + 2596608 (28$$

$$+ 84 I\sqrt{3})^{1/3} + 6 (28 + 84 I\sqrt{3})^{8/3} - 4368 (28 + 84 I\sqrt{3})^{5/3} + 24192 I(28$$

$$+ 84 I\sqrt{3})^{4/3} \sqrt{3} + 3048192 I(28 + 84 I\sqrt{3})^{1/3} \sqrt{3} + 1257984 I(28$$

$$+ 84 I\sqrt{3})^{2/3} \sqrt{3} - 24385536 I\sqrt{3})$$

$$e \left(\frac{(I(28 + 84 I\sqrt{3})^{2/3} \sqrt{3} - (28 + 84 I\sqrt{3})^{2/3} - 28 I\sqrt{3} + 8(28 + 84 I\sqrt{3})^{1/3} - 28)_t}{12(28 + 84 I\sqrt{3})^{1/3}} \right) //$$

$$(216 (28 + 84 I\sqrt{3})^{2/3} (I(28 + 84 I\sqrt{3})^{4/3} \sqrt{3} + 56 I(28 + 84 I\sqrt{3})^{1/3} \sqrt{3}$$

$$- 840 I\sqrt{3} + 504) (-18 (28 + 84 I\sqrt{3})^{4/3} + 2 I(28 + 84 I\sqrt{3})^{4/3} \sqrt{3}$$

$$- 1568 I(28 + 84 I\sqrt{3})^{1/3} \sqrt{3})) - \left((28 + 84 I\sqrt{3})^{4/3} - 12 (28 + 84 I\sqrt{3})^{2/3} - 336 I\sqrt{3} - 1$$

$$+ 84 I\sqrt{3})^{4/3} + 32256 - 288 I(28 + 84 I\sqrt{3})^{2/3} \sqrt{3} - 1568 I(28$$

$$e^{\frac{\left((28 + 84I\sqrt{3})^{2/3} + 4(28 + 84I\sqrt{3})^{1/3} + 28 \right) t}{6(28 + 84I\sqrt{3})^{1/3}}} \left(\frac{+ 84I\sqrt{3}^{1/3} \sqrt{3} - 1440(28 + 84I\sqrt{3})^{2/3}}{(108(28 + 84I\sqrt{3})^{2/3} (-18(28 + 84I\sqrt{3})^{4/3} + 2I(28 + 84I\sqrt{3})^{4/3} \sqrt{3} - 1568I(28 + 84I\sqrt{3})^{1/3} \sqrt{3}))} \right) \}$$

```
>
>
> read "C://Users/an646/Documents/M17.txt"
> #Problem 4 part i
> M := Matrix([[1, 1, 1], [1, 1, 1], [1, 1, 1]])
```

$$M := \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix} \tag{11}$$

```
> L := HW2g(.5, .5, M) :
```

```
> Orb2(L, u, v, [5, 5], 1, 5)
[[5, 5], [0.5625000000, 0.3750000000], [0.5625000000, 0.3750000000], [0.5625000000,
0.3750000000], [0.5625000000, 0.3750000000]] \tag{12}
```

```
> Orb2(L, u, v, [8, 12], 1, 5)
[[8, 12], [0.5625000000, 0.3750000000], [0.5625000000, 0.3750000000], [0.5625000000,
0.3750000000], [0.5625000000, 0.3750000000]] \tag{13}
```

```
> Orb2(L, u, v, [1000, 16], 1, 5)
[[1000, 16], [0.5625000000, 0.3750000000], [0.5625000000, 0.3750000000],
[0.5625000000, 0.3750000000], [0.5625000000, 0.3750000000]] \tag{14}
```

```
> M2 := Matrix([[1, 0.5, 0.7], [.42, .13, 0.6], [0.04, 0.92, 0.83]])
M2 := \begin{bmatrix} 1 & 0.5 & 0.7 \\ 0.42 & 0.13 & 0.6 \\ 0.04 & 0.92 & 0.83 \end{bmatrix} \tag{15}
```

```
> N := HW2g(.5, .5, M2)
N := [0.7280487804, 0.2560975610] \tag{16}
```

```
> Orb2(N, u, v, [5, 5], 1, 5)
[[5, 5], [0.7280487804, 0.2560975610], [0.7280487804, 0.2560975610], [0.7280487804,
0.2560975610], [0.7280487804, 0.2560975610]] \tag{17}
```

$M3 := \text{RandomMatrix}(3, \text{generator} = 0 \dots 1.00)$

$$M3 := \begin{bmatrix} 0.959743958516081075 & 0.162611735194630569 & 0.276025076998578367 \\ 0.498364051982142953 & 0.655098003973840659 & 0.754686681982360885 \\ 0.118997681558376645 & 0.679702676853674803 & 0.709364830858072559 \end{bmatrix} \quad (18)$$

> $M4 := \text{RandomMatrix}(3, \text{generator} = 0 \dots 1.00)$

$$M4 := \begin{bmatrix} 0.959291425205444304 & 0.505957051665142377 & 0.223811939491136980 \\ 0.890903252535798496 & 0.255095115459269106 & 0.585267750979777346 \\ 0.699076722656685967 & 0.751267059305652851 & 0.340385726666133204 \end{bmatrix} \quad (19)$$

> $N3 := \text{HW2g}(.5, .5, M3)$

$$N3 := [0.6388940210, 0.2891430545] \quad (20)$$

> $\text{Orb2}(N3, u, v, [5, 5], 1, 5)$

$$[[5, 5], [0.6388940210, 0.2891430545], [0.6388940210, 0.2891430545], [0.6388940210, 0.2891430545], [0.6388940210, 0.2891430545]] \quad (21)$$

> $N4 := \text{HW2g}(.5, .5, M4)$

$$N4 := [0.6592618233, 0.3163154458] \quad (22)$$

> $\text{Orb2}(N4, u, v, [5, 5], 1, 5)$

$$[[5, 5], [0.6592618233, 0.3163154458], [0.6592618233, 0.3163154458], [0.6592618233, 0.3163154458], [0.6592618233, 0.3163154458]] \quad (23)$$

> $M5 := \text{RandomMatrix}(3, \text{generator} = 0 \dots 1.00)$

$$M5 := \begin{bmatrix} 0.929263623187227772 & 0.254282178971531048 & 0.149294005559057474 \\ 0.243524968724989299 & 0.840717255983662537 & 0.138624442828679140 \\ 0.814284826068816359 & 0.257508254123736458 & 0.547215529963803071 \end{bmatrix} \quad (24)$$

> $M6 := \text{RandomMatrix}(3, \text{generator} = 0 \dots 1.00)$

$$M6 := \begin{bmatrix} 0.549723608291139532 & 0.351659507062996757 & 0.251083857976031055 \\ 0.585264091152724264 & 0.473288848902729264 & 0.196595250431208179 \\ 0.830828627896290861 & 0.616044676146639159 & 0.349983765984808737 \end{bmatrix} \quad (25)$$

> $M7 := \text{RandomMatrix}(3, \text{generator} = 0 \dots 1.00)$

$$M7 := \begin{bmatrix} 0.530797553008972689 & 0.567821640725221122 & 0.757200229110721268 \\ 0.0539501186666071497 & 0.380445846975356661 & 0.285839018820373547 \\ 0.0758542895630636149 & 0.753729094278495326 & 0.917193663829810046 \end{bmatrix} \quad (26)$$

> $M8 := \text{RandomMatrix}(3, \text{generator} = 0 \dots 1.00)$

$$M8 := \begin{bmatrix} 0.794284540683906970 & 0.0119020695012413968 & 0.129906208473730134 \\ 0.162182308193242752 & 0.469390641058205826 & 0.934010684229182986 \\ 0.337122644398881510 & 0.568823660872192716 & 0.779167230102011166 \end{bmatrix} \quad (27)$$

> $M9 := \text{RandomMatrix}(3, \text{generator} = 0 \dots 1.00)$

$$M9 := \begin{bmatrix} 0.450541598502497753 & 0.654079098476782250 & 0.165648729499780933 \\ 0.748151592823709466 & 0.262971284540144290 & 0.528533135506212726 \\ 0.689214503140007761 & 0.601981941401636522 & 0.311215042044804879 \end{bmatrix} \quad (28)$$

> $M10 := \text{RandomMatrix}(3, \text{generator} = 0..1.00)$

$$M10 := \begin{bmatrix} 0.442678269775446331 & 0.538342435260057095 & 0.913337361501669553 \\ 0.0781755287531836762 & 0.825816977489547410 & 0.228976968716818829 \\ 0.996134716626885464 & 0.152378018969222984 & 0.0838213779969325667 \end{bmatrix} \quad (29)$$

> $M11 := \text{RandomMatrix}(3, \text{generator} = 0..1.00)$

$$M11 := \begin{bmatrix} 0.259870402850654214 & 0.868694705363509678 & 0.00463422413406744393 \\ 0.399782649098896492 & 0.817303220653432971 & 0.961898080855053683 \\ 0.0844358455109103234 & 0.774910464711502378 & 0.106652770180584389 \end{bmatrix} \quad (30)$$

> $N5 := \text{HW2g}(.5, .5, M5)$

$$N5 := [0.6122029460, 0.2951167366] \quad (31)$$

> $N6 := \text{HW2g}(.5, .5, M6)$

$$N6 := [0.5798697444, 0.3597598102] \quad (32)$$

> $N7 := \text{HW2g}(.5, .5, M7)$

$$N7 := [0.6110799939, 0.3268779179] \quad (33)$$

> $N8 := \text{HW2g}(.5, .5, M8)$

$$N8 := [0.6946045903, 0.2237769919] \quad (34)$$

> $N9 := \text{HW2g}(.5, .5, M9)$

$$N9 := [0.5754004314, 0.3935264169] \quad (35)$$

> $N10 := \text{HW2g}(.5, .5, M10)$

$$N10 := [0.5078964383, 0.3825795313] \quad (36)$$

> $N11 := \text{HW2g}(.5, .5, M11)$

$$N11 := [0.4682857319, 0.4446059100] \quad (37)$$

> $\text{Orb2}(N5, u, v, [5, 5], 1, 5)$

$$[[5, 5], [0.6122029460, 0.2951167366], [0.6122029460, 0.2951167366], [0.6122029460, 0.2951167366], [0.6122029460, 0.2951167366]] \quad (38)$$

> $\text{Orb2}(N6, u, v, [5, 5], 1, 5)$

$$[[5, 5], [0.5798697444, 0.3597598102], [0.5798697444, 0.3597598102], [0.5798697444, 0.3597598102], [0.5798697444, 0.3597598102]] \quad (39)$$

> $\text{Orb2}(N7, u, v, [5, 5], 1, 5)$

$$[[5, 5], [0.6110799939, 0.3268779179], [0.6110799939, 0.3268779179], [0.6110799939, 0.3268779179], [0.6110799939, 0.3268779179]] \quad (40)$$

> $\text{Orb2}(N8, u, v, [5, 5], 1, 5)$

$$[[5, 5], [0.6946045903, 0.2237769919], [0.6946045903, 0.2237769919], [0.6946045903, 0.2237769919], [0.6946045903, 0.2237769919]] \quad (41)$$

$$\begin{aligned} &> \text{Orb2}(N9, u, v, [5, 5], 1, 5) \\ &[[5, 5], [0.5754004314, 0.3935264169], [0.5754004314, 0.3935264169], [0.5754004314, \\ &0.3935264169], [0.5754004314, 0.3935264169]] \end{aligned} \quad (42)$$

$$\begin{aligned} &> \text{Orb2}(N10, u, v, [5, 5], 1, 5) \\ &[[5, 5], [0.5078964383, 0.3825795313], [0.5078964383, 0.3825795313], [0.5078964383, \\ &0.3825795313], [0.5078964383, 0.3825795313]] \end{aligned} \quad (43)$$

$$\begin{aligned} &> \text{Orb2}(N11, u, v, [5, 5], 1, 5) \\ &[[5, 5], [0.4682857319, 0.4446059100], [0.4682857319, 0.4446059100], [0.4682857319, \\ &0.4446059100], [0.4682857319, 0.4446059100]] \end{aligned} \quad (44)$$

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