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> restart
> Ecua := y'' + 3·y' + 2·y = 0

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$$Ecua := \frac{d^2}{dx^2} y(x) + 3 \frac{d}{dx} y(x) + 2 y(x) = 0 \quad (1)$$

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> EcuaCarac := m^2 + 3·m + 2 = 0

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$$EcuaCarac := m^2 + 3 m + 2 = 0 \quad (2)$$

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> Raiz := solve(EcuaCarac)

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$$Raiz := -1, -2 \quad (3)$$

CASO 1

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> SolGral := y(x) = _C1·exp(Raiz[1]·x) + _C2·exp(Raiz[2]·x)

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$$SolGral := y(x) = _C1 e^{-x} + _C2 e^{-2x} \quad (4)$$

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> Comprobar := simplify(eval(subs(y(x) = rhs(SolGral), Ecua)))

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$$Comprobar := 0 = 0 \quad (5)$$

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> restart
> Ecua := y'' + y' + y = 0

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$$Ecua := \frac{d^2}{dx^2} y(x) + \frac{d}{dx} y(x) + y(x) = 0 \quad (6)$$

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> EcuaCarac := m^2 + m + 1 = 0

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$$EcuaCarac := m^2 + m + 1 = 0 \quad (7)$$

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> Raiz := solve(EcuaCarac); evalf(%, 3)

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$$Raiz := -\frac{1}{2} + \frac{I\sqrt{3}}{2}, -\frac{1}{2} - \frac{I\sqrt{3}}{2} \\ -0.500 + 0.865 I, -0.500 - 0.865 I \quad (8)$$

CASO III

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> yy[1] := exp(Re(Raiz[1])·x)·cos(Im(Raiz[1])·x)

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$$yy_1 := e^{-\frac{x}{2}} \cos\left(\frac{\sqrt{3} x}{2}\right) \quad (9)$$

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> yy[2] := exp(Re(Raiz[1])·x)·sin(Im(Raiz[1])·x)

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$$yy_2 := e^{-\frac{x}{2}} \sin\left(\frac{\sqrt{3} x}{2}\right) \quad (10)$$

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> SolGral := y(x) = _C1·yy[1] + _C2·yy[2]

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$$SolGral := y(x) = _C1 e^{-\frac{x}{2}} \cos\left(\frac{\sqrt{3} x}{2}\right) + _C2 e^{-\frac{x}{2}} \sin\left(\frac{\sqrt{3} x}{2}\right) \quad (11)$$

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> Comprobar := simplify(eval(subs(y(x) = rhs(SolGral), Ecua)))

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$$Comprobar := 0 = 0 \quad (12)$$

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> Solucion := dsolve(Ecua)

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$$Solucion := y(x) = c_1 e^{-\frac{x}{2}} \sin\left(\frac{\sqrt{3} x}{2}\right) + c_2 e^{-\frac{x}{2}} \cos\left(\frac{\sqrt{3} x}{2}\right) \quad (13)$$

$$\begin{aligned} &> \text{CondIni} := y(0) = -7, D(y)(0) = 9 \\ &\quad \text{CondIni} := y(0) = -7, D(y)(0) = 9 \end{aligned} \quad (14)$$

$$\begin{aligned} &> \text{SolPartUno} := \text{simplify}(\text{subs}(x=0, \text{rhs}(\text{SolGral}) = -7)) \\ &\quad \text{SolPartUno} := c_1 = -7 \end{aligned} \quad (15)$$

$$\begin{aligned} &> \text{SolPartDos} := \text{simplify}(\text{subs}(x=0, \text{rhs}(\text{diff}(\text{SolGral}, x)) = 9)) \\ &\quad \text{SolPartDos} := -\frac{c_1}{2} + \frac{c_2 \sqrt{3}}{2} = 9 \end{aligned} \quad (16)$$

$$\begin{aligned} &> \text{Para} := \text{solve}(\{\text{SolPartUno}, \text{SolPartDos}\}, \{c_1, c_2\}) \\ &\quad \text{Para} := \left\{ c_1 = -7, c_2 = \frac{11\sqrt{3}}{3} \right\} \end{aligned} \quad (17)$$

$$\begin{aligned} &> \text{SolPart} := y(x) = \text{subs}(c_1 = \text{rhs}(\text{Para}[1]), c_2 = \text{rhs}(\text{Para}[2]), \text{rhs}(\text{SolGral})) \\ &\quad \text{SolPart} := y(x) = -7 e^{-\frac{x}{2}} \cos\left(\frac{\sqrt{3}x}{2}\right) + \frac{11\sqrt{3} e^{-\frac{x}{2}} \sin\left(\frac{\sqrt{3}x}{2}\right)}{3} \end{aligned} \quad (18)$$

$$\begin{aligned} &> \text{SolGral} \\ &\quad y(x) = c_1 e^{-\frac{x}{2}} \cos\left(\frac{\sqrt{3}x}{2}\right) + c_2 e^{-\frac{x}{2}} \sin\left(\frac{\sqrt{3}x}{2}\right) \end{aligned} \quad (19)$$

$$\begin{aligned} &> \text{SolucionParticular} := \text{expand}(\text{dsolve}(\{\text{CondIni}, \text{Ecua}\})) \\ &\quad \text{SolucionParticular} := y(x) = -7 e^{-\frac{x}{2}} \cos\left(\frac{\sqrt{3}x}{2}\right) + \frac{11\sqrt{3} e^{-\frac{x}{2}} \sin\left(\frac{\sqrt{3}x}{2}\right)}{3} \end{aligned} \quad (20)$$

> restart

$$\begin{aligned} &> \text{Ecua} := y'' - 4 \cdot y' + 4 \cdot y = 0 \\ &\quad \text{Ecua} := \frac{d^2}{dx^2} y(x) - 4 \frac{d}{dx} y(x) + 4 y(x) = 0 \end{aligned} \quad (21)$$

$$\begin{aligned} &> \text{EcuaCarac} := m^2 - 4 \cdot m + 4 = 0 \\ &\quad \text{EcuaCarac} := m^2 - 4m + 4 = 0 \end{aligned} \quad (22)$$

$$\begin{aligned} &> \text{Raiz} := \text{solve}(\text{EcuaCarac}) \\ &\quad \text{Raiz} := 2, 2 \end{aligned} \quad (23)$$

CASO II

$$\begin{aligned} &> \text{yy}[1] := \exp(\text{Raiz}[1] \cdot x) \\ &\quad \text{yy}_1 := e^{2x} \end{aligned} \quad (24)$$

$$\begin{aligned} &> \text{yy}[2] := x \cdot \exp(\text{Raiz}[1] \cdot x) \\ &\quad \text{yy}_2 := x e^{2x} \end{aligned} \quad (25)$$

$$\begin{aligned} &> \text{SolGral} := y(x) = _C1 \cdot \text{yy}[1] + _C2 \cdot \text{yy}[2] \\ &\quad \text{SolGral} := y(x) = _C1 e^{2x} + _C2 x e^{2x} \end{aligned} \quad (26)$$

$$\begin{aligned} &> \text{SolucionGeneral} := \text{dsolve}(\text{Ecua}) \\ &\quad \text{SolucionGeneral} := y(x) = _C1 e^{2x} + _C2 x e^{2x} \end{aligned} \quad (27)$$

$$\text{SolucionGeneral} := y(x) = c_1 e^{2x} + c_2 x e^{2x} \quad (27)$$

> restart

> Ecua := y'' = 0

$$\text{Ecua} := \frac{d^2}{dx^2} y(x) = 0 \quad (28)$$

> EcuaCarac := m² = 0

$$\text{EcuaCarac} := m^2 = 0 \quad (29)$$

> Raiz := solve(EcuaCarac)

$$\text{Raiz} := 0, 0 \quad (30)$$

> SolGral := y(x) = _C1·exp(Raiz[1]·x) + _C2·x·exp(Raiz[1]·x)

$$\text{SolGral} := y(x) = _C2 x + _C1 \quad (31)$$

> SolucionGeneral := dsolve(Ecua)

$$\text{SolucionGeneral} := y(x) = c_1 x + c_2 \quad (32)$$

> restart

> Ecua := y'' + 9·y = 0

$$\text{Ecua} := \frac{d^2}{dx^2} y(x) + 9 y(x) = 0 \quad (33)$$

> EcuaCarac := m² + 9 = 0

$$\text{EcuaCarac} := m^2 + 9 = 0 \quad (34)$$

> Raiz := solve(EcuaCarac)

$$\text{Raiz} := 3 I, -3 I \quad (35)$$

CASO III

> yy[1] := exp(Re(Raiz[1])·x)·cos(Im(Raiz[1])·x)

$$yy_1 := \cos(3 x) \quad (36)$$

> yy[2] := exp(Re(Raiz[1])·x)·sin(Im(Raiz[1])·x)

$$yy_2 := \sin(3 x) \quad (37)$$

> SolGral := y(x) = _C1·yy[1] + _C2·yy[2]

$$\text{SolGral} := y(x) = _C1 \cos(3 x) + _C2 \sin(3 x) \quad (38)$$

> Comprobar := simplify(eval(subs(y(x) = rhs(SolGral), Ecua)))

$$\text{Comprobar} := 0 = 0 \quad (39)$$

> restart

> Ecua := y''' + y'' + y' + y = 0

$$\text{Ecua} := \frac{d^3}{dx^3} y(x) + \frac{d^2}{dx^2} y(x) + \frac{d}{dx} y(x) + y(x) = 0 \quad (40)$$

> EcuaCarac := m³ + m² + m + 1 = 0

$$\text{EcuaCarac} := m^3 + m^2 + m + 1 = 0 \quad (41)$$

> Raiz := solve(EcuaCarac)

$$\text{Raiz} := -1, I, -I \quad (42)$$

$$\begin{aligned} > yy[1] := \exp(Raiz[1] \cdot x) \\ & \quad yy_1 := e^{-x} \end{aligned} \quad (43)$$

$$\begin{aligned} > yy[2] := \cos(\text{Im}(Raiz[2]) \cdot x) \\ & \quad yy_2 := \cos(x) \end{aligned} \quad (44)$$

$$\begin{aligned} > yy[3] := \sin(\text{Im}(Raiz[2]) \cdot x) \\ & \quad yy_3 := \sin(x) \end{aligned} \quad (45)$$

$$\begin{aligned} > Solgral := y(x) = _C1 \cdot yy[1] + _C2 \cdot yy[2] + _C3 \cdot yy[3] \\ & \quad Solgral := y(x) = _C1 e^{-x} + _C2 \cos(x) + _C3 \sin(x) \end{aligned} \quad (46)$$

$$\begin{aligned} > restart \\ > SolGral := y(x) = \exp(3 \cdot x) \cdot (_C1 + _C2 \cdot \cos(2x) + _C3 \cdot \sin(3x)) \\ & \quad SolGral := y(x) = e^{3x} (_C1 + _C2 \cos(2x) + _C3 \sin(3x)) \end{aligned} \quad (47)$$

$$\begin{aligned} > EcuaCarac := \text{expand}((m - 3) \cdot (m - (3 + 2 \cdot I)) \cdot (m - (3 - 2 \cdot I))) = 0 \\ & \quad EcuaCarac := m^3 - 9m^2 + 31m - 39 = 0 \end{aligned} \quad (48)$$

$$\begin{aligned} > Ecua := y''' - 9 \cdot y'' + 31 \cdot y' - 39y = 0 \\ & \quad Ecua := \frac{d^3}{dx^3} y(x) - 9 \frac{d^2}{dx^2} y(x) + 31 \frac{d}{dx} y(x) - 39y(x) = 0 \end{aligned} \quad (49)$$

$$\begin{aligned} > SolucionGeneral := \text{dsolve}(Ecua) \\ & \quad SolucionGeneral := y(x) = c_1 e^{3x} + c_2 e^{3x} \sin(2x) + c_3 e^{3x} \cos(2x) \end{aligned} \quad (50)$$

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