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> restart
> EDO := diff(y(x), x, x) + diff(y(x), x) + y(x) = 0

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

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> EcuaCarac := m·2 + m + 1 = 0

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

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> Raiz := solve(EcuaCarac)

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

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> evalf(% , 2)

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$$-0.50 + 0.85 I, -0.50 - 0.85 I \quad (4)$$

```

> Raiz[1]

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$$-\frac{1}{2} + \frac{1}{2} I\sqrt{3} \quad (5)$$

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> Raiz[2]

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$$-\frac{1}{2} - \frac{1}{2} I\sqrt{3} \quad (6)$$

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> a := Re(Raiz[1])

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$$a := -\frac{1}{2} \quad (7)$$

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> b := Im(Raiz[1])

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$$b := \frac{1}{2} \sqrt{3} \quad (8)$$

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> SolGral := y(x) = C1·exp(a·x)·cos(b·x) + C2·exp(a·x)·sin(b·x)

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$$SolGral := y(x) = C1 e^{-\frac{1}{2}x} \cos\left(\frac{1}{2} \sqrt{3} x\right) + C2 e^{-\frac{1}{2}x} \sin\left(\frac{1}{2} \sqrt{3} x\right) \quad (9)$$

```

> evalf(% , 2)

```

$$y(x) = C1 e^{-0.50x} \cos(0.85 x) + C2 e^{-0.50x} \sin(0.85 x) \quad (10)$$

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> Comprobacion := eval(subs(y(x) = rhs(SolGral), EDO))

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$$Comprobacion := 0 = 0 \quad (11)$$

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> Condiciones := y(0) = 10, D(y)(0) = 20

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$$Condiciones := y(0) = 10, D(y)(0) = 20 \quad (12)$$

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> ParametroUno := simplify(subs(x=0, y(0) = 10, SolGral))

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$$ParametroUno := 10 = C1 \quad (13)$$

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> Derivada := diff(SolGral, x)

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$$Derivada := \frac{d}{dx} y(x) = -\frac{1}{2} C1 e^{-\frac{1}{2}x} \cos\left(\frac{1}{2} \sqrt{3} x\right) - \frac{1}{2} C1 e^{-\frac{1}{2}x} \sin\left(\frac{1}{2} \sqrt{3} x\right) \sqrt{3} \\ - \frac{1}{2} C2 e^{-\frac{1}{2}x} \sin\left(\frac{1}{2} \sqrt{3} x\right) + \frac{1}{2} C2 e^{-\frac{1}{2}x} \cos\left(\frac{1}{2} \sqrt{3} x\right) \sqrt{3} \quad (14)$$

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> ParametroDos := isolate(simplify(subs(C1 = 10, x=0, rhs(Derivada) = 20)), C2)

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$$ParametroDos := C2 = \frac{50}{3} \sqrt{3} \quad (15)$$

$$\begin{aligned} &> \text{ParametroUnoUno} := \text{rhs}(\text{ParametroUno}) = \text{lhs}(\text{ParametroUno}) \\ &\quad \text{ParametroUnoUno} := C1 = 10 \end{aligned} \quad (16)$$

$$\begin{aligned} &> \text{SolPart} := \text{subs}(C1 = \text{rhs}(\text{ParametroUnoUno}), C2 = \text{rhs}(\text{ParametroDos}), \text{SolGral}) \\ &\quad \text{SolPart} := y(x) = 10 e^{-\frac{1}{2}x} \cos\left(\frac{1}{2} \sqrt{3} x\right) + \frac{50}{3} e^{-\frac{1}{2}x} \sin\left(\frac{1}{2} \sqrt{3} x\right) \sqrt{3} \end{aligned} \quad (17)$$

$$\begin{aligned} &> \text{evalf}(\%, 2) \\ &\quad y(x) = 10. e^{-0.50x} \cos(0.85 x) + 29. e^{-0.50x} \sin(0.85 x) \end{aligned} \quad (18)$$

$$\begin{aligned} &> \text{ComprobacionDos} := \text{eval}(\text{subs}(y(x) = \text{rhs}(\text{SolPart}), \text{EDO})) \\ &\quad \text{ComprobacionDos} := 0 = 0 \end{aligned} \quad (19)$$

$$\begin{aligned} &> \text{SatisfaceCondUno} := \text{eval}(\text{subs}(x = 0, \text{SolPart})) \\ &\quad \text{SatisfaceCondUno} := y(0) = 10 \end{aligned} \quad (20)$$

$$\begin{aligned} &> \text{Der} := \text{diff}(\text{SolPart}, x) \\ &\quad \text{Der} := \frac{d}{dx} y(x) = 20 e^{-\frac{1}{2}x} \cos\left(\frac{1}{2} \sqrt{3} x\right) - \frac{40}{3} e^{-\frac{1}{2}x} \sin\left(\frac{1}{2} \sqrt{3} x\right) \sqrt{3} \end{aligned} \quad (21)$$

$$\begin{aligned} &> \text{SatisfaceCondDos} := \text{D}(y)(0) = \text{eval}(\text{subs}(x = 0, \text{rhs}(\text{Der}))) \\ &\quad \text{SatisfaceCondDos} := \text{D}(y)(0) = 20 \end{aligned} \quad (22)$$

> restart

$$\begin{aligned} &> \text{SolGral} := y(x) = C1 \cdot \exp(2 \cdot x) \cdot \cos(3 \cdot x) + C2 \cdot \exp(2 \cdot x) \cdot \sin(3 \cdot x) + C3 \cdot x \cdot \exp(2 \cdot x) \cdot \cos(3 \cdot x) \\ &\quad + C4 \cdot x \cdot \exp(2 \cdot x) \cdot \sin(3 \cdot x) \\ &\quad \text{SolGral} := y(x) = C1 e^{2x} \cos(3 x) + C2 e^{2x} \sin(3 x) + C3 x e^{2x} \cos(3 x) + C4 x e^{2x} \sin(3 x) \end{aligned} \quad (23)$$

ME HABÍA FALTADO EN LA EXPRESIÓN PREVIA ESTABLECER QUE LA INCÓGNITA ERA: $y(x)$

$$\begin{aligned} &> \text{DerUno} := \text{diff}(\text{SolGral}, x) \\ &\quad \text{DerUno} := \frac{d}{dx} y(x) = 2 C1 e^{2x} \cos(3 x) - 3 C1 e^{2x} \sin(3 x) + 2 C2 e^{2x} \sin(3 x) \\ &\quad + 3 C2 e^{2x} \cos(3 x) + C3 e^{2x} \cos(3 x) + 2 C3 x e^{2x} \cos(3 x) - 3 C3 x e^{2x} \sin(3 x) \\ &\quad + C4 e^{2x} \sin(3 x) + 2 C4 x e^{2x} \sin(3 x) + 3 C4 x e^{2x} \cos(3 x) \end{aligned} \quad (24)$$

$$\begin{aligned} &> \text{DerDos} := \text{diff}(\text{SolGral}, x, x) \\ &\quad \text{DerDos} := \frac{d^2}{dx^2} y(x) = -5 C1 e^{2x} \cos(3 x) - 12 C1 e^{2x} \sin(3 x) - 5 C2 e^{2x} \sin(3 x) \\ &\quad + 12 C2 e^{2x} \cos(3 x) + 4 C3 e^{2x} \cos(3 x) - 6 C3 e^{2x} \sin(3 x) - 5 C3 x e^{2x} \cos(3 x) \\ &\quad - 12 C3 x e^{2x} \sin(3 x) + 4 C4 e^{2x} \sin(3 x) + 6 C4 e^{2x} \cos(3 x) - 5 C4 x e^{2x} \sin(3 x) \\ &\quad + 12 C4 x e^{2x} \cos(3 x) \end{aligned} \quad (25)$$

$$\begin{aligned} &> \text{DerTres} := \text{diff}(\text{SolGral}, x, x, x) \\ &\quad \text{DerTres} := \frac{d^3}{dx^3} y(x) = -46 C1 e^{2x} \cos(3 x) - 46 C2 e^{2x} \sin(3 x) - 46 C3 x e^{2x} \cos(3 x) \\ &\quad - 46 C4 x e^{2x} \sin(3 x) - 15 C3 e^{2x} \cos(3 x) - 9 C3 x e^{2x} \sin(3 x) - 15 C4 e^{2x} \sin(3 x) \\ &\quad + 9 C4 x e^{2x} \cos(3 x) - 9 C1 e^{2x} \sin(3 x) + 9 C2 e^{2x} \cos(3 x) + 36 C4 e^{2x} \cos(3 x) \\ &\quad - 36 C3 e^{2x} \sin(3 x) \end{aligned} \quad (26)$$

$$> \text{DerCuatro} := \text{diff}(\text{SolGral}, x, x, x, x)$$

$$\begin{aligned}
DerCuatro := \frac{d^4}{dx^4} y(x) = & -119 C1 e^{2x} \cos(3x) - 119 C2 e^{2x} \sin(3x) - 119 C3 x e^{2x} \cos(3x) \\
& - 119 C4 x e^{2x} \sin(3x) - 184 C3 e^{2x} \cos(3x) + 120 C3 x e^{2x} \sin(3x) \\
& - 184 C4 e^{2x} \sin(3x) - 120 C4 x e^{2x} \cos(3x) + 120 C1 e^{2x} \sin(3x) \\
& - 120 C2 e^{2x} \cos(3x) + 36 C4 e^{2x} \cos(3x) - 36 C3 e^{2x} \sin(3x)
\end{aligned} \tag{27}$$

$\triangleright Parametro := simplify(solve(\{DerUno, DerDos, DerTres, DerCuatro\}, \{C1, C2, C3, C4\}))$

$$\begin{aligned}
Parametro := \left\{ C1 = \frac{1}{9126} e^{-2x} \left(78 \left(\frac{d^4}{dx^4} y(x) \right) \cos(3x) x - 117 \left(\frac{d^4}{dx^4} y(x) \right) \sin(3x) x \right. \right. \\
- 117 \left(\frac{d^3}{dx^3} y(x) \right) \cos(3x) x + 936 \left(\frac{d^3}{dx^3} y(x) \right) \sin(3x) x \\
+ 234 \left(\frac{d^2}{dx^2} y(x) \right) \cos(3x) x - 3393 \left(\frac{d^2}{dx^2} y(x) \right) \sin(3x) x \\
+ 2535 \left(\frac{d}{dx} y(x) \right) \cos(3x) x + 6084 \left(\frac{d}{dx} y(x) \right) \sin(3x) x - 54 \left(\frac{d^4}{dx^4} y(x) \right) \cos(3x) \\
- 62 \left(\frac{d^4}{dx^4} y(x) \right) \sin(3x) + 432 \left(\frac{d^3}{dx^3} y(x) \right) \cos(3x) + 327 \left(\frac{d^3}{dx^3} y(x) \right) \sin(3x) \\
- 2268 \left(\frac{d^2}{dx^2} y(x) \right) \cos(3x) - 1590 \left(\frac{d^2}{dx^2} y(x) \right) \sin(3x) + 5616 \left(\frac{d}{dx} y(x) \right) \cos(3x) \\
- 143 \left(\frac{d}{dx} y(x) \right) \sin(3x) \Big), C2 = \frac{1}{9126} e^{-2x} \left(117 \left(\frac{d^4}{dx^4} y(x) \right) \cos(3x) x \right. \\
+ 78 \left(\frac{d^4}{dx^4} y(x) \right) \sin(3x) x - 936 \left(\frac{d^3}{dx^3} y(x) \right) \cos(3x) x \\
- 117 \left(\frac{d^3}{dx^3} y(x) \right) \sin(3x) x + 3393 \left(\frac{d^2}{dx^2} y(x) \right) \cos(3x) x \\
+ 234 \left(\frac{d^2}{dx^2} y(x) \right) \sin(3x) x - 6084 \left(\frac{d}{dx} y(x) \right) \cos(3x) x \\
+ 2535 \left(\frac{d}{dx} y(x) \right) \sin(3x) x + 62 \left(\frac{d^4}{dx^4} y(x) \right) \cos(3x) - 54 \left(\frac{d^4}{dx^4} y(x) \right) \sin(3x) \\
- 327 \left(\frac{d^3}{dx^3} y(x) \right) \cos(3x) + 432 \left(\frac{d^3}{dx^3} y(x) \right) \sin(3x) + 1590 \left(\frac{d^2}{dx^2} y(x) \right) \cos(3x) \\
- 2268 \left(\frac{d^2}{dx^2} y(x) \right) \sin(3x) + 143 \left(\frac{d}{dx} y(x) \right) \cos(3x) + 5616 \left(\frac{d}{dx} y(x) \right) \sin(3x) \Big) \\
, C3 = -\frac{1}{234} e^{-2x} \left(2 \left(\frac{d^4}{dx^4} y(x) \right) \cos(3x) - 3 \left(\frac{d^4}{dx^4} y(x) \right) \sin(3x) \right. \\
- 3 \left(\frac{d^3}{dx^3} y(x) \right) \cos(3x) + 24 \left(\frac{d^3}{dx^3} y(x) \right) \sin(3x) + 6 \left(\frac{d^2}{dx^2} y(x) \right) \cos(3x)
\end{aligned} \tag{28}$$

$$\begin{aligned}
& -87 \left(\frac{d^2}{dx^2} y(x) \right) \sin(3x) + 65 \left(\frac{d}{dx} y(x) \right) \cos(3x) + 156 \left(\frac{d}{dx} y(x) \right) \sin(3x) \Bigg), C4 \\
& = -\frac{1}{234} e^{-2x} \left(3 \left(\frac{d^4}{dx^4} y(x) \right) \cos(3x) + 2 \left(\frac{d^4}{dx^4} y(x) \right) \sin(3x) \right. \\
& \quad - 24 \left(\frac{d^3}{dx^3} y(x) \right) \cos(3x) - 3 \left(\frac{d^3}{dx^3} y(x) \right) \sin(3x) + 87 \left(\frac{d^2}{dx^2} y(x) \right) \cos(3x) \\
& \quad \left. + 6 \left(\frac{d^2}{dx^2} y(x) \right) \sin(3x) - 156 \left(\frac{d}{dx} y(x) \right) \cos(3x) + 65 \left(\frac{d}{dx} y(x) \right) \sin(3x) \right) \Bigg\}
\end{aligned}$$

> lhs(Parametro[1]); lhs(Parametro[2]); lhs(Parametro[3]); lhs(Parametro[4])

C1

C2

C3

C4

(29)

> EcuacionInicial := simplify(subs(C1 = rhs(Parametro[1]), C2 = rhs(Parametro[2]), C3 = rhs(Parametro[3]), C4 = rhs(Parametro[4]), SolGral))

$$\begin{aligned}
EcuacionInicial := y(x) = & -\frac{1}{169} \frac{d^4}{dx^4} y(x) + \frac{8}{169} \frac{d^3}{dx^3} y(x) - \frac{42}{169} \frac{d^2}{dx^2} y(x) \\
& + \frac{8}{13} \frac{d}{dx} y(x)
\end{aligned}$$

(30)

> EcuacionSiguiente := isolate(EcuacionInicial, diff(y(x), x, x, x, x))

$$\begin{aligned}
EcuacionSiguiente := & \frac{d^4}{dx^4} y(x) = -169 y(x) + 8 \left(\frac{d^3}{dx^3} y(x) \right) - 42 \left(\frac{d^2}{dx^2} y(x) \right) \\
& + 104 \left(\frac{d}{dx} y(x) \right)
\end{aligned}$$

(31)

> EcuacionDiferencialFinal := lhs(EcuacionSiguiente) - rhs(EcuacionSiguiente) = 0

$$\begin{aligned}
EcuacionDiferencialFinal := & \frac{d^4}{dx^4} y(x) + 169 y(x) - 8 \left(\frac{d^3}{dx^3} y(x) \right) + 42 \left(\frac{d^2}{dx^2} y(x) \right) \\
& - 104 \left(\frac{d}{dx} y(x) \right) = 0
\end{aligned}$$

(32)

> ecua := m·4 - 8·m·3 + 42·m·2 - 104·m + 169 = 0

$$ecua := m^4 - 8 m^3 + 42 m^2 - 104 m + 169 = 0$$

(33)

> raiz := solve(ecua)

$$raiz := 2 - 3 I, 2 + 3 I, 2 - 3 I, 2 + 3 I$$

(34)

> restart

>