>

FACULTAD DE INGENIERIA
DIVISION DE CIENCIAS BASICAS
ECUACIONES DIFERENCIALES
GRUPO 10 SEMESTRE 2025-2
SERIE 2

> *restart*

1)

> $Ecua := 3\cdot y'' + 27\cdot y = \sec(3\cdot x)$

$$Ecua := 3\,\frac{d^2}{dx^2}\,y(x) + 27\,y(x) = \sec(3\,x) \quad (1)$$

RESPUESTA

> $EcuaDos := \frac{lhs(Ecua)}{3} = \frac{rhs(Ecua)}{3}$

$$EcuaDos := \frac{d^2}{dx^2}\,y(x) + 9\,y(x) = \frac{\sec(3\,x)}{3} \quad (2)$$

> $EcuaHom := lhs(EcuaDos) = 0$

$$EcuaHom := \frac{d^2}{dx^2}\,y(x) + 9\,y(x) = 0 \quad (3)$$

> $Q := rhs(EcuaDos)$

$$Q := \frac{\sec(3\,x)}{3} \quad (4)$$

> $EcuaCarac := m^2 + 9 = 0$

$$EcuaCarac := m^2 + 9 = 0 \quad (5)$$

> $Raiz := solve(EcuaCarac)$

$$Raiz := 3\,I,\ -3\,I \quad (6)$$

> $yy[1] := \cos(\mathrm{Im}(Raiz[1])\cdot x); yy[2] := \sin(\mathrm{Im}(Raiz[1])\cdot x)$

$$yy_1 := \cos(3\,x)$$

$$yy_2 := \sin(3\,x) \quad (7)$$

> *with(linalg) :*

> $WW := wronskian([yy[1], yy[2]], x)$

$$WW := \begin{bmatrix} \cos(3\,x) & \sin(3\,x) \\ -3\sin(3\,x) & 3\cos(3\,x) \end{bmatrix} \quad (8)$$

> $BB := array([0, Q])$

$$BB := \begin{bmatrix} 0 & \frac{\sec(3\,x)}{3} \end{bmatrix} \quad (9)$$

> $ParaVar := simplify(linsolve(WW, BB))$

$$ParaVar := \begin{bmatrix} -\frac{\tan(3\,x)}{9} & \frac{1}{9} \end{bmatrix} \quad (10)$$

> $Aprima := ParaVar[1]; Bprima := ParaVar[2]$

$$Aprima := -\frac{\tan(3x)}{9}$$

$$Bprima := \frac{1}{9} \quad (11)$$

> $SolPart := y(x) = simplify(int(Aprima, x)\cdot yy[1] + int(Bprima, x)\cdot yy[2])$

$$SolPart := y(x) = -\frac{\ln(\sec(3x)^2)\cos(3x)}{54} + \frac{x\sin(3x)}{9} \quad (12)$$

> $SolGralHom := y(x) = \_C1\cdot yy[1] + \_C2\cdot yy[2]$

$$SolGralHom := y(x) = \_C1\cos(3x) + \_C2\sin(3x) \quad (13)$$

> $SolGralNoHom := y(x) = rhs(SolGralHom) + rhs(SolPart)$

$$SolGralNoHom := y(x) = \_C1\cos(3x) + \_C2\sin(3x) - \frac{\ln(\sec(3x)^2)\cos(3x)}{54} + \frac{x\sin(3x)}{9} \quad (14)$$

> $Comprobar := simplify(eval(subs(y(x) = rhs(SolGralNoHom), lhs(Ecua) - rhs(Ecua) = 0)))$

$$Comprobar := 0 = 0 \quad (15)$$

> $restart$

2)

> $Ecua := y'' - 4\cdot y' + 4\cdot y = x\cdot\exp(2x)$

$$Ecua := \frac{d^2}{dx^2}y(x) - 4\frac{d}{dx}y(x) + 4y(x) = x e^{2x} \quad (16)$$

RESPUESTA

> $EcuaHom := lhs(Ecua) = 0$

$$EcuaHom := \frac{d^2}{dx^2}y(x) - 4\frac{d}{dx}y(x) + 4y(x) = 0 \quad (17)$$

> $Q := rhs(Ecua)$

$$Q := x e^{2x} \quad (18)$$

> $EcuaCarac := m^2 - 4\cdot m + 4 = 0$

$$EcuaCarac := m^2 - 4m + 4 = 0 \quad (19)$$

> $Raiz := solve(EcuaCarac)$

$$Raiz := 2, 2 \quad (20)$$

Caso II = RAICES IGUALES

> $yy[1] := \exp(2\cdot x); yy[2] := x\cdot\exp(2\cdot x)$

$$yy_1 := e^{2x}$$

$$yy_2 := x e^{2x} \quad (21)$$

> $with(linalg):$

> $WW := wronskian([yy[1], yy[2]], x)$

(22)

$$WW := \begin{bmatrix} e^{2x} & x\,e^{2x} \\ 2\,e^{2x} & e^{2x} + 2\,x\,e^{2x} \end{bmatrix} \quad (22)$$

> $BB := array([0, Q])$

$$BB := \begin{bmatrix} 0 & x\,e^{2x} \end{bmatrix} \quad (23)$$

> $ParaVar := linsolve(WW, BB)$

$$ParaVar := \begin{bmatrix} -x^2 & x \end{bmatrix} \quad (24)$$

> $Aprima := ParaVar[1]; Bprima := ParaVar[2]$

$$Aprima := -x^2$$

$$Bprima := x \quad (25)$$

> $SolPart := y(x) = int(Aprima, x) \cdot yy[1] + int(Bprima, x) \cdot yy[2]$

$$SolPart := y(x) = \frac{x^3\,e^{2x}}{6} \quad (26)$$

> $SolGralHom := y(x) = \_C1 \cdot yy[1] + \_C2 \cdot yy[2]$

$$SolGralHom := y(x) = \_C1\,e^{2x} + \_C2\,x\,e^{2x} \quad (27)$$

> $SolGralNoHom := y(x) = rhs(SolGralHom) + rhs(SolPart)$

$$SolGralNoHom := y(x) = \_C1\,e^{2x} + \_C2\,x\,e^{2x} + \frac{x^3\,e^{2x}}{6} \quad (28)$$

> $restart$

3)

> $Ecua := diff(y(t), t\$2) - 2 \cdot diff(y(t), t) + y(t) = \frac{\exp(t)}{t}$

$$Ecua := \frac{d^2}{dt^2} y(t) - 2\,\frac{d}{dt} y(t) + y(t) = \frac{e^t}{t} \quad (29)$$

RESPUESTA

> $EcuaHom := lhs(Ecua) = 0$

$$EcuaHom := \frac{d^2}{dt^2} y(t) - 2\,\frac{d}{dt} y(t) + y(t) = 0 \quad (30)$$

> $Q := rhs(Ecua)$

$$Q := \frac{e^t}{t} \quad (31)$$

> $EcuaCarac := m^2 - 2 \cdot m + 1 = 0$

$$EcuaCarac := m^2 - 2\,m + 1 = 0 \quad (32)$$

> $Raiz := solve(EcuaCarac)$

$$Raiz := 1, 1 \quad (33)$$

> $yy[1] := \exp(Raiz[1] \cdot t); yy[2] := t \cdot \exp(Raiz[1] \cdot t)$

$$yy_1 := e^t$$

$$yy_2 := t\,e^t \quad (34)$$

```
> with(linalg) :
> WW := wronskian([yy[1], yy[2]], t)
```

$$WW := \begin{bmatrix} e^{t} & t\,e^{t} \\ e^{t} & e^{t} + t\,e^{t} \end{bmatrix} \tag{35}$$

```
> BB := array([0, Q])
```

$$BB := \begin{bmatrix} 0 & \frac{e^{t}}{t} \end{bmatrix} \tag{36}$$

```
> ParaVar := linsolve(WW, BB)
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$$ParaVar := \begin{bmatrix} -1 & \frac{1}{t} \end{bmatrix} \tag{37}$$

```
> Aprima := ParaVar[1]; Bprima := ParaVar[2]
```

$$Aprima := -1$$

$$Bprima := \frac{1}{t} \tag{38}$$

```
> SolPart := y(t) = simplify(int(Aprima, t)·yy[1] + int(Bprima, t)·yy[2])
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$$SolPart := y(t) = t\,e^{t}\,(-1 + \ln(t)) \tag{39}$$

```
> SolGralHom := y(t) = _C1·yy[1] + _C2·yy[2]
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$$SolGralHom := y(t) = \_C1\,e^{t} + \_C2\,t\,e^{t} \tag{40}$$

```
> SolGralNoHom := y(t) = rhs(SolGralHom) + rhs(SolPart)
```

$$SolGralNoHom := y(t) = \_C1\,e^{t} + \_C2\,t\,e^{t} + t\,e^{t}\,(-1 + \ln(t)) \tag{41}$$

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> Ecua
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$$\frac{d^2}{dt^2}\,y(t) - 2\,\frac{d}{dt}\,y(t) + y(t) = \frac{e^{t}}{t} \tag{42}$$

```
> Comprobar := simplify(eval(subs(y(t) = rhs(SolGralNoHom), lhs(Ecua) - rhs(Ecua) = 0)))
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$$Comprobar := 0 = 0 \tag{43}$$

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> restart
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4)

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> Ecua := y'' + 5·y' + 6·y = sin(x)^2
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$$Ecua := \frac{d^2}{dx^2}\,y(x) + 5\,\frac{d}{dx}\,y(x) + 6\,y(x) = \sin(x)^2 \tag{44}$$

RESPUESTA

```
> EcuaHom := lhs(Ecua) = 0
```

$$EcuaHom := \frac{d^2}{dx^2}\,y(x) + 5\,\frac{d}{dx}\,y(x) + 6\,y(x) = 0 \tag{45}$$

```
> Q := rhs(Ecua)
```

$$Q := \sin(x)^2 \tag{46}$$

```
> EcuaCarac := m^2 + 5·m + 6 = 0
```

$$EcuaCarac := m^2 + 5\,m + 6 = 0 \tag{47}$$

> $Raiz := solve(EcuaCarac)$

$$Raiz := -2, -3 \tag{48}$$

> $yy[1] := \exp(Raiz[1]\cdot x); yy[2] := \exp(Raiz[2]\cdot x)$

$$yy_1 := e^{-2x}$$

$$yy_2 := e^{-3x} \tag{49}$$

> $with(linalg) :$

> $WW := wronskian([yy[1], yy[2]], x)$

$$WW := \begin{bmatrix} e^{-2x} & e^{-3x} \\ -2e^{-2x} & -3e^{-3x} \end{bmatrix} \tag{50}$$

> $BB := array([0, Q])$

$$BB := \begin{bmatrix} 0 & \sin(x)^2 \end{bmatrix} \tag{51}$$

> $ParaVar := linsolve(WW, BB)$

$$ParaVar := \begin{bmatrix} \frac{\sin(x)^2}{e^{-2x}} & -\frac{\sin(x)^2}{e^{-3x}} \end{bmatrix} \tag{52}$$

> $Aprima := ParaVar[1]; Bprima := ParaVar[2]$

$$Aprima := \frac{\sin(x)^2}{e^{-2x}}$$

$$Bprima := -\frac{\sin(x)^2}{e^{-3x}} \tag{53}$$

> $SolPart := y(x) = simplify(int(Aprima, x)\cdot yy[1] + int(Bprima, x)\cdot yy[2])$

$$SolPart := y(x) = -\frac{5\sin(x)\cos(x)}{52} - \frac{\cos(x)^2}{52} + \frac{29}{312} \tag{54}$$

> $SolGralHom := y(x) = \_C1\cdot yy[1] + \_C2\cdot yy[2]$

$$SolGralHom := y(x) = \_C1\, e^{-2x} + \_C2\, e^{-3x} \tag{55}$$

> $SolGralNoHom := y(x) = rhs(SolGralHom) + rhs(SolPart)$

$$SolGralNoHom := y(x) = \_C1\, e^{-2x} + \_C2\, e^{-3x} - \frac{5\sin(x)\cos(x)}{52} - \frac{\cos(x)^2}{52} + \frac{29}{312} \tag{56}$$

> $Comprobar := simplify(eval(subs(y(x) = rhs(SolGralNoHom), lhs(Ecua) - rhs(Ecua) = 0)))$

$$Comprobar := 0 = 0 \tag{57}$$

> $restart$

5)

> $Ecua := y'' - y' = 3 + \exp(x)$

$$Ecua := \frac{d^2}{dx^2} y(x) - \frac{d}{dx} y(x) = 3 + e^x \tag{58}$$

RESPUESTA

> $EcuaHom := lhs(Ecua) = 0$

(59)

$$EcuaHom := \frac{d^2}{dx^2} y(x) - \frac{d}{dx} y(x) = 0 \quad (59)$$

> $Q := rhs(Ecua)$

$$Q := 3 + e^x \quad (60)$$

> $EcuaCarac := m^2 - m = 0$

$$EcuaCarac := m^2 - m = 0 \quad (61)$$

> $Raiz := solve(EcuaCarac)$

$$Raiz := 0, 1 \quad (62)$$

> $yy[1] := \exp(Raiz[1] \cdot x); yy[2] := \exp(Raiz[2] \cdot x)$

$$yy_1 := 1$$

$$yy_2 := e^x \quad (63)$$

> $with(linalg) :$

> $WW := wronskian([yy[1], yy[2]], x)$

$$WW := \begin{bmatrix} 1 & e^x \\ 0 & e^x \end{bmatrix} \quad (64)$$

> $BB := array([0, Q])$

$$BB := \begin{bmatrix} 0 & 3 + e^x \end{bmatrix} \quad (65)$$

> $ParaVar := linsolve(WW, BB)$

$$ParaVar := \begin{bmatrix} -e^x - 3 & \frac{3 + e^x}{e^x} \end{bmatrix} \quad (66)$$

> $Aprima := ParaVar[1]; Bprima := ParaVar[2]$

$$Aprima := -e^x - 3$$

$$Bprima := \frac{3 + e^x}{e^x} \quad (67)$$

> $SolPart := y(x) = simplify(int(Aprima, x) \cdot yy[1] + int(Bprima, x) \cdot yy[2])$

$$SolPart := y(x) = e^x \ln(e^x) - 3 - e^x - 3x \quad (68)$$

> $SolGralHom := y(x) = \_C1 \cdot yy[1] + \_C2 \cdot yy[2]$

$$SolGralHom := y(x) = \_C1 + \_C2\, e^x \quad (69)$$

> $SolGralNoHom := y(x) = rhs(SolGralHom) + rhs(SolPart)$

$$SolGralNoHom := y(x) = \_C1 + \_C2\, e^x + e^x \ln(e^x) - 3 - e^x - 3x \quad (70)$$

> $SolGralNoHomFinal := y(x) = \_C10 + \_C20 \cdot \exp(x) - 3 + \exp(x) \cdot \ln(e^x) - 3 \cdot x$

$$SolGralNoHomFinal := y(x) = \_C10 + \_C20\, e^x - 3 + e^x \ln(e^x) - 3x \quad (71)$$

> $Ecua$

$$\frac{d^2}{dx^2} y(x) - \frac{d}{dx} y(x) = 3 + e^x \quad (72)$$

> $Comprobar := simplify(eval(subs(y(x) = rhs(SolGralNoHomFinal), lhs(Ecua) - rhs(Ecua)$

$= 0)))$

$$Comprobar := 0 = 0 \quad (73)$$

> restart

6)

> $yy[1] := \exp(4\cdot x); yy[2] := 2\cdot x; yy[3] := 2$

$$yy_1 := e^{4x}$$

$$yy_2 := 2x$$

$$yy_3 := 2 \quad (74)$$

> $yp := y(x) = \exp(-4\cdot x)$

$$yp := y(x) = e^{-4x} \quad (75)$$

> $EcuaCarac := expand((m-4)\cdot m^2) = 0$

$$EcuaCarac := m^3 - 4m^2 = 0 \quad (76)$$

> $EcuaHom := y''' - 4\cdot y'' = 0$

$$EcuaHom := \frac{d^3}{dx^3} y(x) - 4\frac{d^2}{dx^2} y(x) = 0 \quad (77)$$

> $Q := simplify(eval(subs(y(x) = rhs(yp), lhs(EcuaHom))))$

$$Q := -128\, e^{-4x} \quad (78)$$

> $Ecua := lhs(EcuaHom) = Q$

$$Ecua := \frac{d^3}{dx^3} y(x) - 4\frac{d^2}{dx^2} y(x) = -128\, e^{-4x} \quad (79)$$

> $SolGral := dsolve(Ecua)$

$$SolGral := y(x) = \frac{e^{4x} c_1}{16} + e^{-4x} + c_2 x + c_3 \quad (80)$$

> restart

7)

> $Ecua := t^2\cdot diff(y(t), t\$2) - 2\cdot t\cdot diff(y(t), t) + 2\cdot y(t) = t\cdot\log(t)$

$$Ecua := t^2\left(\frac{d^2}{dt^2} y(t)\right) - 2t\left(\frac{d}{dt} y(t)\right) + 2y(t) = t\ln(t) \quad (81)$$

> $yy[1] := t^2; yy[2] := t$

$$yy_1 := t^2$$

$$yy_2 := t \quad (82)$$

> $EcuaHom := lhs(Ecua) = 0$

$$EcuaHom := t^2\left(\frac{d^2}{dt^2} y(t)\right) - 2t\left(\frac{d}{dt} y(t)\right) + 2y(t) = 0 \quad (83)$$

RESPUESTA

> $SolGralHom := y(t) = \_C1\cdot yy[1] + \_C2\cdot yy[2]$

$$SolGralHom := y(t) = \_C1\, t^2 + \_C2\, t \quad (84)$$

> $ComprobarUno := simplify(eval(subs(y(t) = rhs(SolGralHom), EcuaHom)))$

$$ComprobarUno := 0 = 0 \tag{85}$$

> $EcuaStand := expand\left(\frac{lhs(Ecua)}{t^2}\right) = \frac{rhs(Ecua)}{t^2}$

$$EcuaStand := \frac{d^2}{dt^2}y(t) - \frac{2\left(\frac{d}{dt}y(t)\right)}{t} + \frac{2\,y(t)}{t^2} = \frac{\ln(t)}{t} \tag{86}$$

> $Q := rhs(EcuaStand)$

$$Q := \frac{\ln(t)}{t} \tag{87}$$

> $with(linalg):$

> $WW := wronskian([yy[1], yy[2]], t)$

$$WW := \begin{bmatrix} t^2 & t \\ 2\,t & 1 \end{bmatrix} \tag{88}$$

> $BB := array([0, Q])$

$$BB := \begin{bmatrix} 0 & \frac{\ln(t)}{t} \end{bmatrix} \tag{89}$$

> $ParaVal := linsolve(WW, BB)$

$$ParaVal := \begin{bmatrix} \frac{\ln(t)}{t^2} & -\frac{\ln(t)}{t} \end{bmatrix} \tag{90}$$

> $Aprima := ParaVal[1]$

$$Aprima := \frac{\ln(t)}{t^2} \tag{91}$$

> $Bprima := ParaVal[2]$

$$Bprima := -\frac{\ln(t)}{t} \tag{92}$$

> $SolPart := y(t) = simplify(int(Aprima, t)\cdot yy[1] + int(Bprima, t)\cdot yy[2])$

$$SolPart := y(t) = t\left(-1 - \ln(t) - \frac{\ln(t)^2}{2}\right) \tag{93}$$

> $SolGralHom := y(t) = \_C1\cdot yy[1] + \_C2\cdot yy[2]$

$$SolGralHom := y(t) = \_C1\,t^2 + \_C2\,t \tag{94}$$

> $SolGralNoHom := y(t) = rhs(SolGralHom) + rhs(SolPart)$

$$SolGralNoHom := y(t) = \_C1\,t^2 + \_C2\,t + t\left(-1 - \ln(t) - \frac{\ln(t)^2}{2}\right) \tag{95}$$

> $ComprobarDos := simplify(eval(subs(y(t) = rhs(SolGralNoHom), lhs(Ecua) - rhs(Ecua) = 0)))$

$$ComprobarDos := 0 = 0 \tag{96}$$

> $restart$

8)

> $Ecua := y'' + 2\cdot y' + 2\cdot y = \exp(-x)\cdot\sec(x)$

$$Ecua := \frac{d^2}{dx^2} y(x) + 2 \frac{d}{dx} y(x) + 2\, y(x) = e^{-x} \sec(x) \quad (97)$$

RESPUESTA

> $EcuaHom := lhs(Ecua) = 0$

$$EcuaHom := \frac{d^2}{dx^2} y(x) + 2 \frac{d}{dx} y(x) + 2\, y(x) = 0 \quad (98)$$

> $Q := rhs(Ecua)$

$$Q := e^{-x} \sec(x) \quad (99)$$

> $EcuaCarac := m^2 + 2\cdot m + 2 = 0$

$$EcuaCarac := m^2 + 2\, m + 2 = 0 \quad (100)$$

> $Raiz := solve(EcuaCarac)$

$$Raiz := -1 + I, -1 - I \quad (101)$$

Caso III Raíces complejas

> $yy[1] := \exp(\mathrm{Re}(Raiz[1])\cdot x)\cdot\cos(\mathrm{Im}(Raiz[1])\cdot x)$

$$yy_1 := e^{-x} \cos(x) \quad (102)$$

> $yy[2] := \exp(\mathrm{Re}(Raiz[1])\cdot x)\cdot\sin(\mathrm{Im}(Raiz[1])\cdot x)$

$$yy_2 := e^{-x} \sin(x) \quad (103)$$

> $with(linalg) :$

> $WW := wronskian([yy[1], yy[2]], x)$

$$WW := \begin{bmatrix} e^{-x}\cos(x) & e^{-x}\sin(x) \\ -e^{-x}\cos(x) - e^{-x}\sin(x) & -e^{-x}\sin(x) + e^{-x}\cos(x) \end{bmatrix} \quad (104)$$

> $BB := array([0, Q])$

$$BB := \begin{bmatrix} 0 & e^{-x}\sec(x) \end{bmatrix} \quad (105)$$

> $ParaVar := simplify(linsolve(WW, BB))$

$$ParaVar := \begin{bmatrix} -\tan(x) & 1 \end{bmatrix} \quad (106)$$

> $Aprima := ParaVar[1]; Bprima := ParaVar[2]$

$$Aprima := -\tan(x)$$

$$Bprima := 1 \quad (107)$$

> $SolPart := y(x) = int(Aprima, x)\cdot yy[1] + int(Bprima, x)\cdot yy[2]$

$$SolPart := y(x) = \ln(\cos(x))\, e^{-x}\cos(x) + x\, e^{-x}\sin(x) \quad (108)$$

> $SolGralHom := y(x) = \_C1\cdot yy[1] + \_C2\cdot yy[2]$

$$SolGralHom := y(x) = \_C1\, e^{-x}\cos(x) + \_C2\, e^{-x}\sin(x) \quad (109)$$

> $SolGralNoHom := y(x) = simplify(rhs(SolGralHom) + rhs(SolPart))$

$$SolGralNoHom := y(x) = (\cos(x)\ln(\cos(x)) + \cos(x)\, \_C1 + \sin(x)\, (\_C2 + x))\, e^{-x} \quad (110)$$

> $Ecua$

(111)

$$\frac{d^2}{dx^2}\,y(x) + 2\,\frac{d}{dx}\,y(x) + 2\,y(x) = e^{-x}\sec(x) \tag{111}$$

> $Comprobar := simplify(eval(subs(y(x) = rhs(SolGralNoHom), lhs(Ecua) - rhs(Ecua) = 0)))$

$$Comprobar := 0 = 0 \tag{112}$$

> $restart$

9)

> $Ecua := 27\cdot y''' - 27\cdot y'' + 9\cdot y' - y = 162\cdot\exp\left(\frac{x}{3}\right)$

$$Ecua := 27\,\frac{d^3}{dx^3}\,y(x) - 27\,\frac{d^2}{dx^2}\,y(x) + 9\,\frac{d}{dx}\,y(x) - y(x) = 162\,e^{\frac{x}{3}} \tag{113}$$

RESPUESTA

> $EcuaDos := \frac{lhs(Ecua)}{27} = \frac{rhs(Ecua)}{27}$

$$EcuaDos := \frac{d^3}{dx^3}\,y(x) - \frac{d^2}{dx^2}\,y(x) + \frac{\frac{d}{dx}\,y(x)}{3} - \frac{y(x)}{27} = 6\,e^{\frac{x}{3}} \tag{114}$$

> $EcuaDosHom := lhs(EcuaDos) = 0$

$$EcuaDosHom := \frac{d^3}{dx^3}\,y(x) - \frac{d^2}{dx^2}\,y(x) + \frac{\frac{d}{dx}\,y(x)}{3} - \frac{y(x)}{27} = 0 \tag{115}$$

> $Q := rhs(EcuaDos)$

$$Q := 6\,e^{\frac{x}{3}} \tag{116}$$

> $EcuaCarac := m^3 - m^2 + \frac{m}{3} - \frac{1}{27} = 0$

$$EcuaCarac := m^3 - m^2 + \frac{1}{3}\,m - \frac{1}{27} = 0 \tag{117}$$

> $Raiz := solve(EcuaCarac)$

$$Raiz := \frac{1}{3}, \frac{1}{3}, \frac{1}{3} \tag{118}$$

CASO II RAICES IGUALES

> $yy[1] := \exp(Raiz[1]\cdot x); yy[2] := x\cdot\exp(Raiz[1]\cdot x); yy[3] := x^2\cdot\exp(Raiz[1]\cdot x)$

$$yy_1 := e^{\frac{x}{3}}$$

$$yy_2 := x\,e^{\frac{x}{3}}$$

$$yy_3 := x^2\,e^{\frac{x}{3}} \tag{119}$$

> $with(linalg):$

> $WW := wronskian([yy[1], yy[2], yy[3]], x)$

$$WW := \begin{bmatrix} e^{\frac{x}{3}} & x\,e^{\frac{x}{3}} & x^2\,e^{\frac{x}{3}} \\ \frac{e^{\frac{x}{3}}}{3} & e^{\frac{x}{3}} + \frac{x\,e^{\frac{x}{3}}}{3} & 2\,x\,e^{\frac{x}{3}} + \frac{x^2\,e^{\frac{x}{3}}}{3} \\ \frac{e^{\frac{x}{3}}}{9} & \frac{2\,e^{\frac{x}{3}}}{3} + \frac{x\,e^{\frac{x}{3}}}{9} & 2\,e^{\frac{x}{3}} + \frac{4\,x\,e^{\frac{x}{3}}}{3} + \frac{x^2\,e^{\frac{x}{3}}}{9} \end{bmatrix} \quad (120)$$

> $BB := array([0, 0, Q])$

$$BB := \begin{bmatrix} 0 & 0 & 6\,e^{\frac{x}{3}} \end{bmatrix} \quad (121)$$

> $ParaVar := linsolve(WW, BB)$

$$ParaVar := \begin{bmatrix} 3\,x^2 & -6\,x & 3 \end{bmatrix} \quad (122)$$

> $Aprima := ParaVar[1]; Bprima := ParaVar[2]; Dprima := ParaVar[3]$

$$Aprima := 3\,x^2$$
$$Bprima := -6\,x$$
$$Dprima := 3 \quad (123)$$

> $SolPart := y(x) = int(Aprima, x) \cdot yy[1] + int(Bprima, x) \cdot yy[2] + int(Dprima, x) \cdot yy[3]$

$$SolPart := y(x) = x^3\,e^{\frac{x}{3}} \quad (124)$$

> $SolGralHom := y(x) = \_C1 \cdot yy[1] + \_C2 \cdot yy[2] + \_C3 \cdot yy[3]$

$$SolGralHom := y(x) = \_C1\,e^{\frac{x}{3}} + \_C2\,x\,e^{\frac{x}{3}} + \_C3\,x^2\,e^{\frac{x}{3}} \quad (125)$$

> $SolGralNoHom := y(x) = rhs(SolGralHom) + rhs(SolPart)$

$$SolGralNoHom := y(x) = \_C1\,e^{\frac{x}{3}} + \_C2\,x\,e^{\frac{x}{3}} + \_C3\,x^2\,e^{\frac{x}{3}} + x^3\,e^{\frac{x}{3}} \quad (126)$$

> $Ecua$

$$27\,\frac{d^3}{dx^3}\,y(x) - 27\,\frac{d^2}{dx^2}\,y(x) + 9\,\frac{d}{dx}\,y(x) - y(x) = 162\,e^{\frac{x}{3}} \quad (127)$$

> $Comprobar := simplify(eval(subs(y(x) = rhs(SolGralNoHom), lhs(Ecua) - rhs(Ecua) = 0)))$

$$Comprobar := 0 = 0 \quad (128)$$

> $restart$

>

FIN SERIE

>