

FACULTAD DE INGENIERIA
DIVISION DE CIENCIAS BASICAS
ECUACIONES DIFERENCIALES
GRUPO 11
SEMESTRE 2027-1
SERIE 1
SOLUCIÓN

> restart

> restart

1. Resuelva el problema de valor inicial

>

$$e^x \ln(y(x)) + \frac{e^{2x} \left(\frac{d}{dx} y(x) \right)}{2 y(x)} = 0$$

$$y(0) = e \quad (1)$$

RESPUESTA

>

> with(DEtools):

> odeadvisor(Ecua)

$[_{separable}]$ (2)

> M := $e^x \ln(y)$

$M := e^x \ln(y)$ (3)

> N := $\frac{e^{2x}}{2y}$

$N := \frac{e^{2x}}{2y}$ (4)

> P := e^x ; Q := $\ln(y)$; R := e^{2x} ; S := $\frac{1}{2y}$

$P := e^x$
 $Q := \ln(y)$
 $R := e^{2x}$
 $S := \frac{1}{2y}$ (5)

> SolGral := simplify($\int \left(\frac{P}{R}, x \right) + \int \left(\frac{S}{Q}, y \right)$) = _C1

$SolGral := -e^{-x} + \frac{\ln(\ln(y))}{2} = _C1$ (6)

> Para := simplify(subs($x=0, y=\exp(1)$), SolGral)

$Para := -1 = _C1$ (7)

> SolPart := simplify(subs($_C1 = lhs(Para)$), SolGral)

(8)

$$SolPart := -e^{-x} + \frac{\ln(\ln(y))}{2} = -1 \quad (8)$$

$$> SolPartFinal := -e^{-x} + \frac{\ln(\ln(y(x)))}{2} = -1$$

$$SolPartFinal := -e^{-x} + \frac{\ln(\ln(y(x)))}{2} = -1 \quad (9)$$

$$> DerSolPart := simplify(isolate(diff(SolPartFinal, x), diff(y(x), x)))$$

$$DerSolPart := \frac{d}{dx} y(x) = -2 y(x) \ln(y(x)) e^{-x} \quad (10)$$

$$> DerEcua := simplify(isolate(Ecua, diff(y(x), x)))$$

$$DerEcua := \frac{d}{dx} y(x) = -2 y(x) \ln(y(x)) e^{-x} \quad (11)$$

$$> Comprobar := simplify(rhs(DerEcua) - rhs(DerSolPart)) = 0$$

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

>

> restart

2. Verifique que la solución general satisface la ecuación diferencial

>

$$4x^2 - y(x)^2 = _CI$$

$$y(x) \left(\frac{d}{dx} y(x) \right) - 4x = 0 \quad (13)$$

y grafique las curvas solución particular para

>

$$\begin{aligned} _CI &= 0 \\ _CI &= 1 \\ _CI &= -1 \end{aligned} \quad (14)$$

RESPUESTA

$$> DerSolGral := isolate(diff(SolGral, x), diff(y(x), x))$$

$$DerSolGral := \frac{d}{dx} y(x) = \frac{4x}{y(x)} \quad (15)$$

$$> DerEcua := isolate(Ecua, diff(y(x), x))$$

$$DerEcua := \frac{d}{dx} y(x) = \frac{4x}{y(x)} \quad (16)$$

$$> Comprobar := simplify(rhs(DerEcua) - rhs(DerSolGral)) = 0$$

$$Comprobar := 0 = 0 \quad (17)$$

$$> SolPartUno := subs(_CI = 0, SolGral)$$

$$SolPartUno := 4x^2 - y(x)^2 = 0 \quad (18)$$

$$> SolPartOnce := isolate(SolPartUno, y(x)^2)$$

$$SolPartOnce := y(x)^2 = 4x^2 \quad (19)$$

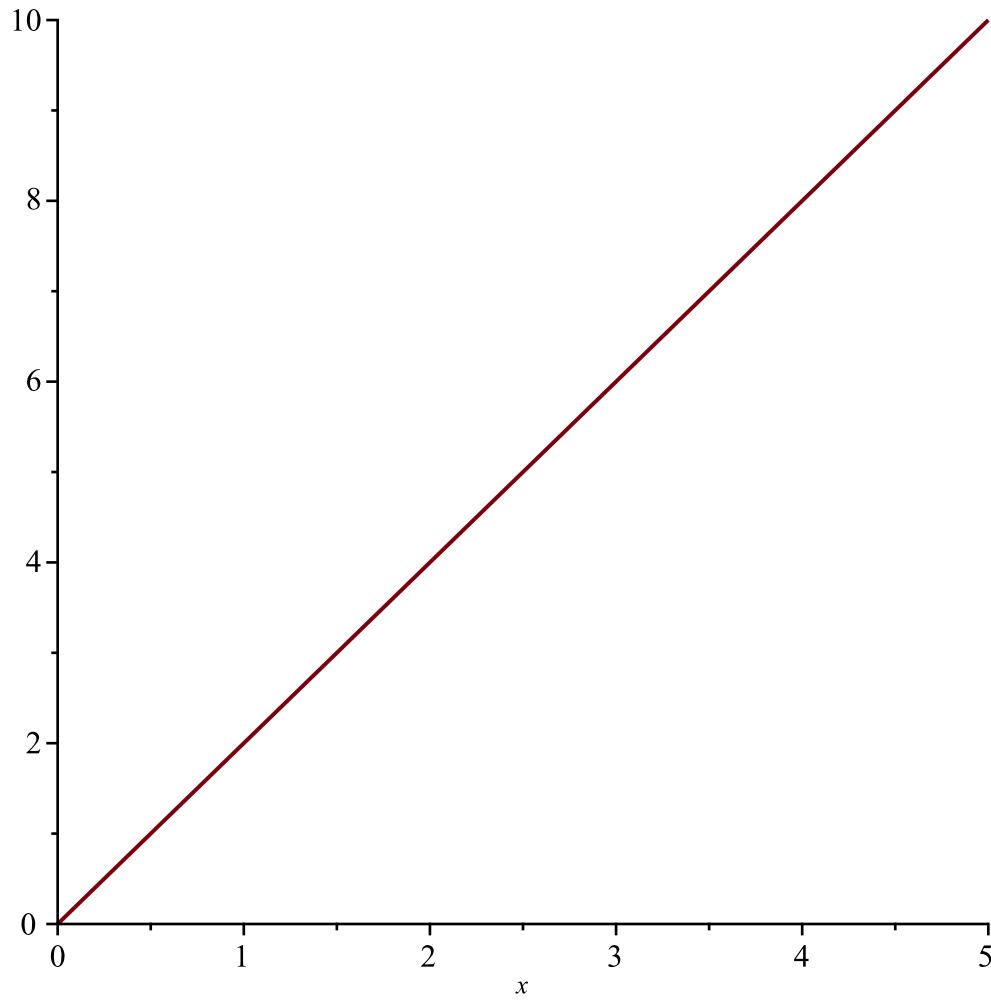
$$> SolPartOnceDos := y(x) = 2 \cdot x$$

com

$$\text{SolPartOnceDos} := y(x) = 2x$$

(20)

```
> plot(rhs(SolPartOnceDos), x = 0 .. 5)
```



```
> SolPartDos := subs(_C1 = 1, SolGral)
```

$$\text{SolPartDos} := 4x^2 - y(x)^2 = 1$$

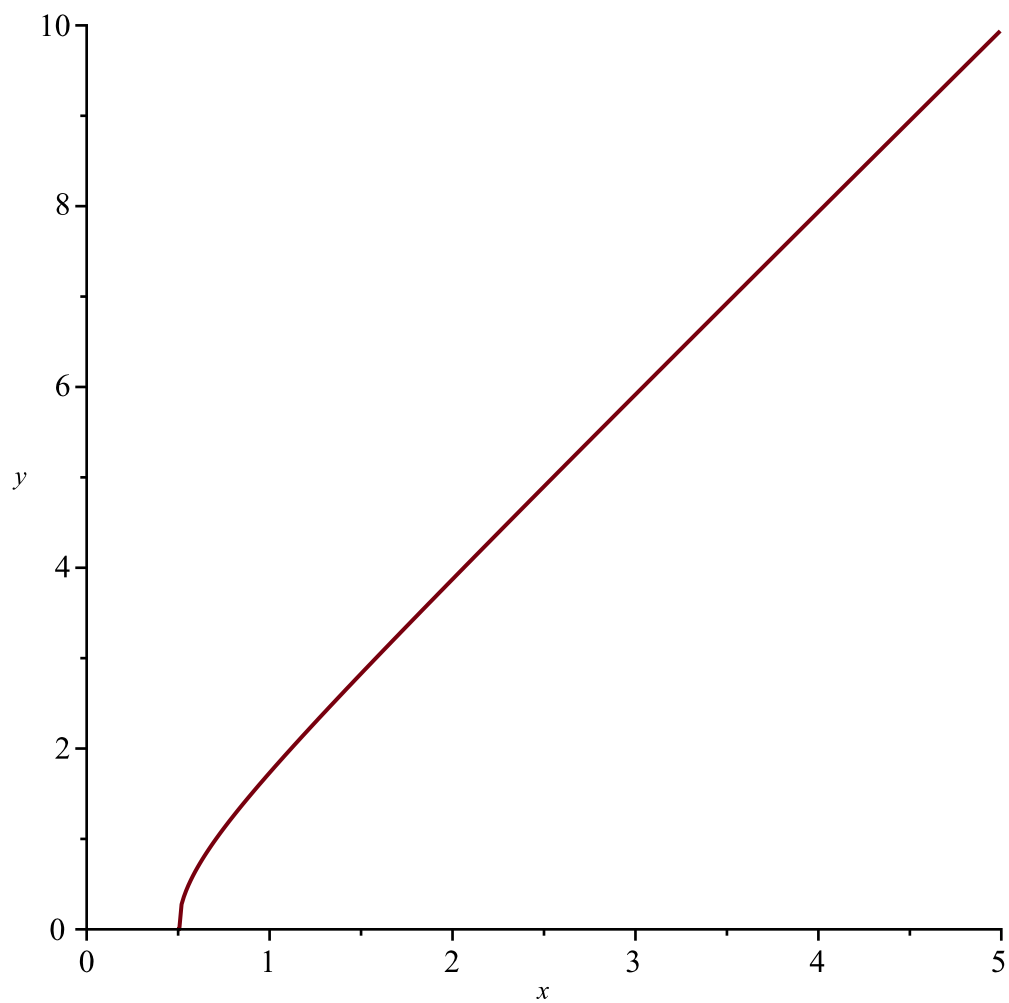
(21)

```
> SolPartDosDoce := y(x) = sqrt(-1 + 4x^2)
```

$$\text{SolPartDosDoce} := y(x) = \sqrt{4x^2 - 1}$$

(22)

```
> plot(rhs(SolPartDosDoce), x = 0 .. 5, y = 0 .. 10)
```



```
> SolPartTres := subs(_C1=-1, SolGral)
```

$$\text{SolPartTres} := 4x^2 - y(x)^2 = -1$$

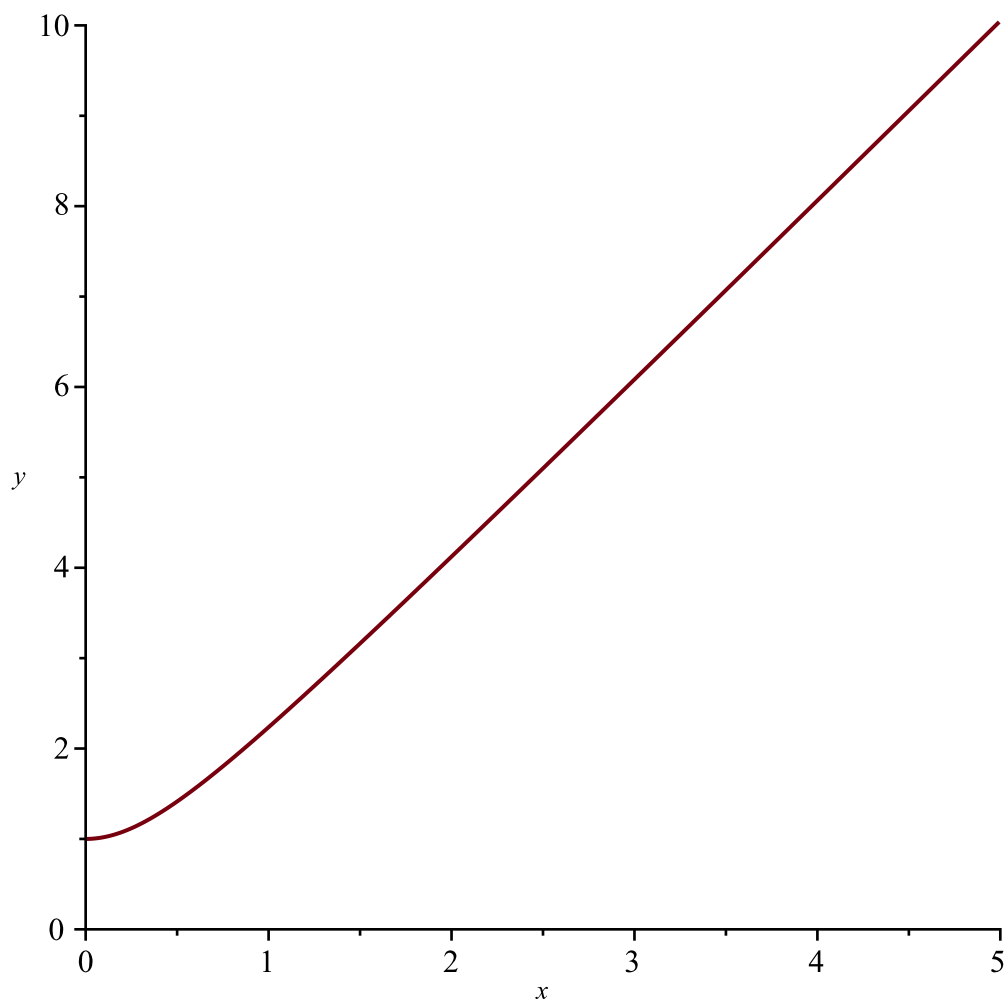
(23)

```
> SolPartTresTrece := y(x) = sqrt(4x^2 + 1)
```

$$\text{SolPartTresTrece} := y(x) = \sqrt{4x^2 + 1}$$

(24)

```
> plot(rhs(SolPartTresTrece), x=0..5, y=0..10)
```



```
> restart
```

```
3. Resolver la ecuación diferencial
```

```
>
```

$$e^{y(x)} + e^{-x} + (e^{y(x)} + 2y(x)e^{-x}) \left(\frac{d}{dx} y(x) \right) = 0 \quad (25)$$

```
>
```

```
RESPUESTA
```

```
> with(DEtools):
```

```
> odeadvisor(Ecua)
```

$$[y=_G(x,y')] \quad (26)$$

```
> FI := intfactor(Ecua)
```

```
>
```

$$FI := e^x \quad (27)$$

```
> M := e^y + e^{-x}
```

$$M := e^y + e^{-x} \quad (28)$$

```
> N := (e^y + 2y e^{-x})
```

$$N := e^y + 2y e^{-x} \quad (29)$$

$$\begin{aligned} &> \text{diff}(M, y) \neq \text{diff}(N, x) \\ &e^y \neq -2y e^{-x} \end{aligned} \quad (30)$$

No es exacta

$$\begin{aligned} &> MM := \text{expand}(M \cdot FI) \\ &MM := e^y e^x + 1 \end{aligned} \quad (31)$$

$$\begin{aligned} &> NN := \text{expand}(N \cdot FI) \\ &NN := e^y e^x + 2y \end{aligned} \quad (32)$$

$$\begin{aligned} &> \text{diff}(MM, y) = \text{diff}(NN, x) \\ &e^y e^x = e^y e^x \end{aligned} \quad (33)$$

Es exacta

$$\begin{aligned} &> \text{IntMMx} := \text{int}(MM, x) \\ &\text{IntMMx} := x + e^y e^x \end{aligned} \quad (34)$$

$$\begin{aligned} &> \text{SolGral} := \text{IntMMx} + \text{int}((NN - \text{diff}(\text{IntMMx}, y)), y) = _C1 \\ &\text{SolGral} := x + e^y e^x + y^2 = c_I \end{aligned} \quad (35)$$

$$\begin{aligned} &> \text{SolGralFinal} := x + e^{y(x)} e^x + y(x)^2 = c_I \\ &\text{SolGralFinal} := x + e^{y(x)} e^x + y(x)^2 = c_I \end{aligned} \quad (36)$$

$$\begin{aligned} &> \text{DerSolGral} := \text{simplify}(\text{isolate}(\text{diff}(\text{SolGralFinal}, x), \text{diff}(y(x), x))) \\ &\text{DerSolGral} := \frac{d}{dx} y(x) = \frac{-1 - e^{y(x)+x}}{e^{y(x)+x} + 2y(x)} \end{aligned} \quad (37)$$

$$\begin{aligned} &> \text{DerEcua} := \text{isolate}(\text{Ecua}, \text{diff}(y(x), x)) \\ &\text{DerEcua} := \frac{d}{dx} y(x) = \frac{-e^{y(x)} - e^{-x}}{e^{y(x)} + 2y(x) e^{-x}} \end{aligned} \quad (38)$$

$$\begin{aligned} &> \text{Comprueba} := \text{simplify}(\text{rhs}(\text{DerEcua}) - \text{rhs}(\text{DerSolGral})) = 0 \\ &\text{Comprueba} := 0 = 0 \end{aligned} \quad (39)$$

>

> restart

4. Resuelva el problema de valor inicial

$$\begin{aligned} &> \\ &-y(x) + (x - 2x^2 y(x)^2) \left(\frac{d}{dx} y(x) \right) = 0 \\ &y(-1) = 2 \end{aligned} \quad (40)$$

RESPUESTA

>

> with(DEtools):

$$\begin{aligned} &> \text{odeadvisor}(\text{Ecua}) \\ &[[_homogeneous, \text{class } G], _rational] \end{aligned} \quad (41)$$

$$\begin{aligned} &> M := -y; N := x - 2x^2 y^2 \\ &M := -y \end{aligned} \quad (42)$$

$$N := -2x^2y^2 + x \quad (42)$$

> diff(M, y)

$$-1 \quad (43)$$

> diff(N, x)

$$-4xy^2 + 1 \quad (44)$$

No es exacta

> FI := intfactor(Ecua)

$$FI := \frac{1}{x^2} \quad (45)$$

> MM := M·FI

$$MM := -\frac{y}{x^2} \quad (46)$$

> NN := simplify(N·FI)

$$NN := \frac{-2xy^2 + 1}{x} \quad (47)$$

> diff(MM, y)

$$-\frac{1}{x^2} \quad (48)$$

> simplify(diff(NN, x))

$$-\frac{1}{x^2} \quad (49)$$

Es exacta

> IntMMx := int(MM, x)

$$IntMMx := \frac{y}{x} \quad (50)$$

> SolGral := IntMMx + int((NN - diff(IntMMx, y)), y) = _C1

$$SolGral := \frac{y}{x} - \frac{2y^3}{3} = _C1 \quad (51)$$

> Para := subs(x=-1, y=2, SolGral)

$$Para := -\frac{22}{3} = _C1 \quad (52)$$

> SolPart := subs(c1=lhs(Para), SolGral)

$$SolPart := \frac{y}{x} - \frac{2y^3}{3} = _C1 \quad (53)$$

> SolPartDos := lhs(SolPart)·3 = rhs(SolPart)·3

$$SolPartDos := \frac{3y}{x} - 2y^3 = 3_C1 \quad (54)$$

> SolPartFinal := $\frac{3y(x)}{x} - 2y(x)^3 = -22$

$$\text{SolPartFinal} := \frac{3 y(x)}{x} - 2 y(x)^3 = -22 \quad (55)$$

> DerEcua := isolate(Ecua, diff(y(x), x))

$$\text{DerEcua} := \frac{d}{dx} y(x) = \frac{y(x)}{x - 2 x^2 y(x)^2} \quad (56)$$

> DerSolPart := simplify(isolate(diff(SolPartFinal, x), diff(y(x), x)))

$$\text{DerSolPart} := \frac{d}{dx} y(x) = -\frac{y(x)}{2 x^2 y(x)^2 - x} \quad (57)$$

> ComprobarUno := simplify(rhs(DerSolPart) - rhs(DerEcua)) = 0

$$\text{ComprobarUno} := 0 = 0 \quad (58)$$

> CondIni

$$y(-1) = 2 \quad (59)$$

> ComprobarDos := isolate(subs(y=2, SolPartFinal), x)

$$\text{ComprobarDos} := x = -1 \quad (60)$$

>

> restart

5. Resuelva la ecuación diferencial

>

$$y(x)^2 + x y(x)^3 + (5 y(x)^2 - x y(x) + y(x)^3 \sin(y(x))) \left(\frac{d}{dx} y(x) \right) = 0 \quad (61)$$

RESPUESTA

>

> with(DEtools):

> odeadvisor(Ecua)

$$[x=_G(y,y')] \quad (62)$$

> M := (y^2 + x·y^3)

$$M := x y^3 + y^2 \quad (63)$$

> N := (5·y^2 - x·y + y^3·sin(y))

$$N := 5 y^2 - x y + y^3 \sin(y) \quad (64)$$

> diff(M, y)

$$3 x y^2 + 2 y \quad (65)$$

> diff(N, x)

$$-y \quad (66)$$

No es exacta

> intfactor(Ecua)

$$\frac{1}{y(x)^3} \quad (67)$$

> FI := $\frac{1}{y^3}$

$$FI := \frac{1}{y^3} \quad (68)$$

> $MM := \text{expand}(\text{simplify}(M \cdot FI))$

$$MM := x + \frac{1}{y} \quad (69)$$

> $NN := \text{expand}(\text{simplify}(N \cdot FI))$

$$NN := \sin(y) - \frac{x}{y^2} + \frac{5}{y} \quad (70)$$

> $\text{diff}(MM, y)$

$$-\frac{1}{y^2} \quad (71)$$

> $\text{diff}(NN, x)$

$$-\frac{1}{y^2} \quad (72)$$

Es exacta

> $\text{IntMMx} := \text{expand}(\text{int}(MM, x))$

$$\text{IntMMx} := \frac{x^2}{2} + \frac{x}{y} \quad (73)$$

> $\text{SolGral} := \text{IntMMx} + \text{int}((NN - \text{diff}(\text{IntMMx}, y)), y) = _C1$

$$\text{SolGral} := \frac{x^2}{2} + \frac{x}{y} + 5 \ln(y) - \cos(y) = c_1 \quad (74)$$

> $\text{SolGralFinal} := \frac{x^2}{2} + \frac{x}{y(x)} + 5 \ln(y(x)) - \cos(y(x)) = c_1$

$$\text{SolGralFinal} := \frac{x^2}{2} + \frac{x}{y(x)} + 5 \ln(y(x)) - \cos(y(x)) = c_1 \quad (75)$$

> $\text{DerSolGral} := \text{simplify}(\text{isolate}(\text{diff}(\text{SolGralFinal}, x), \text{diff}(y(x), x)))$

$$\text{DerSolGral} := \frac{d}{dx} y(x) = \frac{y(x) (x y(x) + 1)}{-\sin(y(x)) y(x)^2 + x - 5 y(x)} \quad (76)$$

> $\text{DerEcua} := \text{factor}(\text{isolate}(\text{Ecua}, \text{diff}(y(x), x)))$

$$\text{DerEcua} := \frac{d}{dx} y(x) = - \frac{y(x) (x y(x) + 1)}{\sin(y(x)) y(x)^2 - x + 5 y(x)} \quad (77)$$

> $\text{Comprobar} := \text{simplify}(\text{rhs}(\text{DerEcua}) - \text{rhs}(\text{DerSolGral})) = 0$

$$\text{Comprobar} := 0 = 0 \quad (78)$$

>

> restart

6. Resuelva la ecuación diferencial

>

$$y(x)^2 \sin(x) + (1 + 5 y(x) \cos(x)) \left(\frac{d}{dx} y(x) \right) = 0 \quad (79)$$

RESPUESTA

```

>
with(DEtools) :
odeadvisor(Ecua)
[[_1st_order, _with_symmetry_[F(x)*G(y),0]], [_Abel, 2nd type, class B]]

```

(80)

```

> M := y^2*sin(x); N := (1 + 5*y*cos(x))
      M := y^2 sin(x)
      N := 1 + 5 y cos(x)

```

(81)

```

> diff(M, y); diff(N, x)
      2 sin(x) y
      - 5 sin(x) y

```

(82)

No es exacta

```

> intfactor(Ecua)
      1
      y(x)^7

```

(83)

```

> FI := 1/y^7
      FI := 1/y^7

```

(84)

```

> MM := M*FI
      MM := sin(x)/y^5

```

(85)

```

> NN := expand(N*FI)
      NN := 1/y^7 + 5 cos(x)/y^6

```

(86)

```

> diff(MM, y); diff(NN, x)
      - 5 sin(x)/y^6
      - 5 sin(x)/y^6

```

(87)

Es exacta

```

> IntMMx := int(MM, x)
      IntMMx := - cos(x)/y^5

```

(88)

```

> SolGral := IntMMx + int((NN - diff(IntMMx, y)), y) = _C1
      SolGral := - cos(x)/y^5 - 1/(6 y^6) = c1

```

(89)

```

> SolGralFinal := - cos(x)/y(x)^5 - 1/(6 y(x)^6) = c1

```

(90)

$$\text{SolGralFinal} := -\frac{\cos(x)}{y(x)^5} - \frac{1}{6 y(x)^6} = c_1 \quad (90)$$

> *DerEcua* := isolate(*Ecua*, diff(*y*(*x*), *x*))

$$\text{DerEcua} := \frac{d}{dx} y(x) = -\frac{y(x)^2 \sin(x)}{1 + 5 y(x) \cos(x)} \quad (91)$$

> *DerSolGral* := simplify(isolate(diff(*SolGralFinal*, *x*), diff(*y*(*x*), *x*)))

$$\text{DerSolGral} := \frac{d}{dx} y(x) = -\frac{y(x)^2 \sin(x)}{1 + 5 y(x) \cos(x)} \quad (92)$$

> *Comprobar* := simplify(rhs(*DerEcua*) - rhs(*DerSolGral*)) = 0

$$\text{Comprobar} := 0 = 0 \quad (93)$$

>

> restart

7. Resolver la ecuación diferencial lineal sujeta a la condición inicial

>

$$\frac{\frac{d}{dx} y(x)}{x} - \frac{2 y(x)}{x^2} = x \cos(x)$$

$$y\left(\frac{\pi}{2}\right) = 3 \quad (94)$$

RESPUESTA

>

> with(DEtools):

> odeadvisor(*Ecua*)

$$[_linear] \quad (95)$$

> *FI* := intfactor(*Ecua*)

$$FI := \frac{1}{x} \quad (96)$$

> *M* := $-\frac{2 y}{x^2} - x \cos(x)$

$$M := -\frac{2 y}{x^2} - x \cos(x) \quad (97)$$

> *N* := $\frac{1}{x}$

$$N := \frac{1}{x} \quad (98)$$

> diff(*M*, *y*) ≠ diff(*N*, *x*)

$$-\frac{2}{x^2} = -\frac{1}{x^2} \quad (99)$$

No es exacta

> *MM* := expand(simplify(*M*·*FI*))

$$MM := -\cos(x) - \frac{2y}{x^3} \quad (100)$$

$$> NN := N \cdot FI$$

$$NN := \frac{1}{x^2} \quad (101)$$

$$> \text{diff}(MM, y) = \text{diff}(NN, x)$$

$$-\frac{2}{x^3} = -\frac{2}{x^3} \quad (102)$$

Es exacta

$$> \text{IntMMx} := \text{int}(MM, x)$$

$$\text{IntMMx} := \frac{y}{x^2} - \sin(x) \quad (103)$$

$$> \text{SolGral} := \text{IntMMx} + \text{int}((NN - \text{diff}(\text{IntMMx}, y)), y) = _CI$$

$$\text{SolGral} := \frac{y}{x^2} - \sin(x) = _CI \quad (104)$$

$$> \text{Para} := \text{subs}\left(x = \frac{\text{Pi}}{2}, y = 3, \text{SolGral}\right)$$

$$\text{Para} := \frac{12}{\pi^2} - \sin\left(\frac{\pi}{2}\right) = _CI \quad (105)$$

$$> \text{SolPart} := \text{subs}(_CI = \text{lhs}(\text{Para}), \text{SolGral})$$

$$\text{SolPart} := \frac{y}{x^2} - \sin(x) = \frac{12}{\pi^2} - 1 \quad (106)$$

$$> \text{SolPartFinal} := \frac{y(x)}{x^2} - \sin(x) = \frac{12}{\pi^2} - 1$$

$$\text{SolPartFinal} := \frac{y(x)}{x^2} - \sin(x) = \frac{12}{\pi^2} - 1 \quad (107)$$

$$> \text{DerSolPart} := \text{simplify}(\text{isolate}(\text{diff}(\text{SolPartFinal}, x), \text{diff}(y(x), x)))$$

$$\text{DerSolPart} := \frac{d}{dx} y(x) = \frac{x^3 \cos(x) + 2y(x)}{x} \quad (108)$$

$$> \text{DerEcua} := \text{simplify}(\text{isolate}(\text{Ecua}, \text{diff}(y(x), x)))$$

$$\text{DerEcua} := \frac{d}{dx} y(x) = \frac{x^3 \cos(x) + 2y(x)}{x} \quad (109)$$

$$> \text{Comprobar} := \text{simplify}(\text{rhs}(\text{DerSolPart}) - \text{rhs}(\text{DerEcua})) = 0$$

$$\text{Comprobar} := 0 = 0 \quad (110)$$

>

> restart

8. Resuelva la ecuación diferencial lineal

$$> \text{Ecua} := \frac{d}{dx} y(x) - \frac{y(x)}{x} = \ln(x)$$

$$Ecua := \frac{d}{dx} y(x) - \frac{y(x)}{x} = \ln(x) \quad (111)$$

RESPUESTA

>

$$> P := -\frac{1}{x}; Q := \log(x)$$

$$P := -\frac{1}{x}$$

$$Q := \ln(x)$$

(112)

$$> ExpIntP := \exp(\text{int}(P, x))$$

$$ExpIntP := \frac{1}{x}$$

(113)

$$> ExpIntPNeg := \exp(-\text{int}(P, x))$$

$$ExpIntPNeg := x$$

(114)

$$> SolGral := y(x) = _C1 \cdot ExpIntPNeg + \text{simplify}(ExpIntPNeg \cdot \text{int}(ExpIntP \cdot Q, x))$$

$$SolGral := y(x) = _C1 x + \frac{x \ln(x)^2}{2}$$

(115)

$$> Ecua$$

$$\frac{d}{dx} y(x) - \frac{y(x)}{x} = \ln(x)$$

(116)

$$> Comprobar := \text{simplify}(\text{eval}(\text{subs}(y(x) = \text{rhs}(SolGral), \text{lhs}(Ecua) - \text{rhs}(Ecua) = 0)))$$

$$Comprobar := 0 = 0$$

(117)

>

> restart

9. Determine la solución particular de la ecuación diferencial lineal sujeta a la condición inicial

>

$$-x \left(\frac{d}{dx} y(x) \right) - x = -y(x)$$

$$y(1) = -1$$

(118)

RESPUESTA

>

$$> EcuaDos := \text{lhs}(Ecua) + x + y(x) = \text{rhs}(Ecua) + x + y(x)$$

$$EcuaDos := -x \left(\frac{d}{dx} y(x) \right) + y(x) = x$$

(119)

$$> EcuaTres := \text{expand}\left(\frac{\text{lhs}(EcuaDos)}{-x}\right) = \frac{\text{rhs}(EcuaDos)}{-x}$$

$$EcuaTres := \frac{d}{dx} y(x) - \frac{y(x)}{x} = -1$$

(120)

$$> p := -\frac{1}{x}$$

(121)

$$p := -\frac{1}{x} \quad (121)$$

> $q := -1$

$$q := -1 \quad (122)$$

> $SolGral := y(x) = _C1 \cdot \exp(-\text{int}(p, x)) + \exp(-\text{int}(p, x)) \cdot \text{int}(\exp(\text{int}(p, x)) \cdot q, x)$

$$SolGral := y(x) = _C1 x - x \ln(x) \quad (123)$$

> $ComprobarUno := \text{simplify}(\text{eval}(\text{subs}(y(x) = \text{rhs}(SolGral), \text{lhs}(Ecua) - \text{rhs}(Ecua) = 0)))$

$$ComprobarUno := 0 = 0 \quad (124)$$

> $CondIni$

$$y(1) = -1 \quad (125)$$

> $Para := \text{simplify}(\text{isolate}(-1 = \text{subs}(x = 1, \text{rhs}(SolGral)), _C1))$

$$Para := _C1 = -1 \quad (126)$$

> $SolPart := \text{subs}(_C1 = \text{rhs}(Para), SolGral)$

$$SolPart := y(x) = -x - x \ln(x) \quad (127)$$

> $ComprobarDos := \text{simplify}(\text{eval}(\text{subs}(y(x) = \text{rhs}(SolPart), \text{lhs}(Ecua) - \text{rhs}(Ecua) = 0)))$

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

>

> $restart$

10. Obtenga la solución general de la ecuación diferencial lineal

>

$$(x + 3)^2 \left(\frac{d}{dx} y(x) \right) = 4 - 9 y(x) - 3 x y(x) \quad (129)$$

RESPUESTA

>

> $with(DEtools):$

> $odeadvisor(Ecua)$

$$[_{linear}] \quad (130)$$

> $IntFact := \text{intfactor}(Ecua)$

$$IntFact := x + 3 \quad (131)$$

> $M := -(4 - 9 y - 3 x y)$

$$M := 3 x y + 9 y - 4 \quad (132)$$

> $N := (x + 3)^2$

$$N := (x + 3)^2 \quad (133)$$

> $MM := IntFact \cdot M$

$$MM := (x + 3) (3 x y + 9 y - 4) \quad (134)$$

> $NN := IntFact \cdot N$

$$NN := (x + 3)^3 \quad (135)$$

> $\text{expand}(\text{diff}(MM, y))$

$$3 x^2 + 18 x + 27 \quad (136)$$

> $\text{expand}(\text{diff}(NN, x))$

$$3x^2 + 18x + 27 \quad (137)$$

> *IntMMx* := *expand(int(MM, x)*

$$IntMMx := yx^3 + 9yx^2 - 2x^2 + 27xy - 12x \quad (138)$$

> *SolGral* := *simplify(IntMMx + int((NN - diff(IntMMx, y)), y)) = _CI*

$$SolGral := yx^3 + (9y - 2)x^2 + (27y - 12)x + 27y = _CI \quad (139)$$

> *SolFinal* := *isolate(y(x) x^3 + (9 y(x) - 2) x^2 + (27 y(x) - 12) x + 27 y(x) = _CI, y(x))*

$$SolFinal := y(x) = \frac{2x^2 + _CI + 12x}{x^3 + 9x^2 + 27x + 27} \quad (140)$$

> *Ecua*

$$(x + 3)^2 \left(\frac{d}{dx} y(x) \right) = 4 - 9y(x) - 3xy(x) \quad (141)$$

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

$$Comprobar := 0 = 0 \quad (142)$$

>

> *restart*

>