

MAT250 Assignment 1  
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1.

$$\boxed{> p := \text{piecewise}\left(0 \leq x \leq 1, 2, x \geq 1, -\frac{2}{x}\right)}$$

$$p := \begin{cases} 2 & 0 \leq x \leq 1 \\ -\frac{2}{x} & 1 \leq x \end{cases} \quad (1)$$

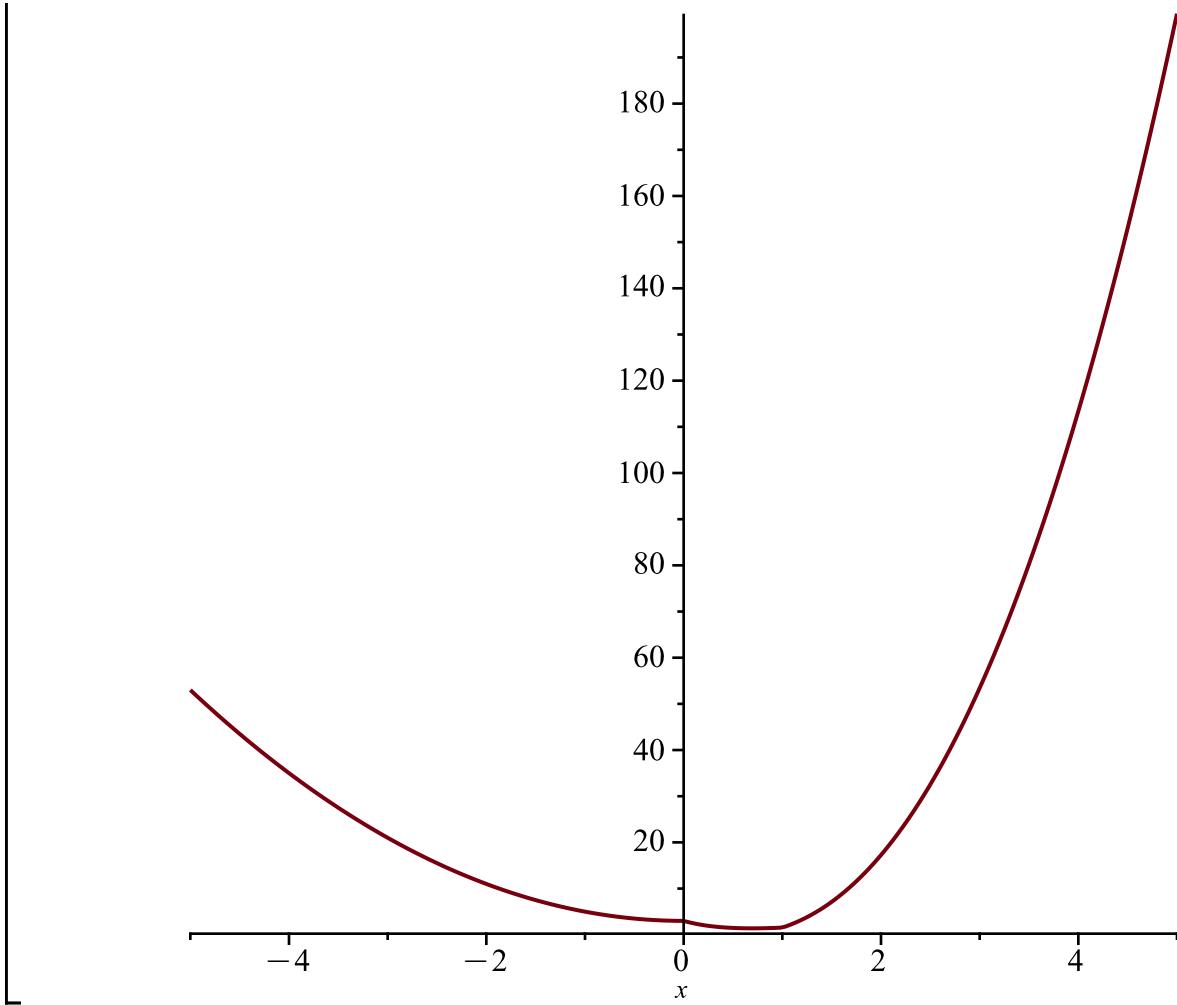
$$\boxed{> sol := \text{diff}(y(x), x) + p \cdot y(x) = 4 \cdot x}$$

$$sol := \frac{d}{dx} y(x) + \left( \begin{cases} 2 & 0 \leq x \leq 1 \\ -\frac{2}{x} & 1 \leq x \end{cases} \right) y(x) = 4x \quad (2)$$

$$\boxed{> A := \text{dsolve}(\{y(0) = 3, sol\})}$$

$$A := y(x) = \begin{cases} 2x^2 + 3 & x < 0 \\ 2x + 4e^{-2x} - 1 & x < 1 \\ x^2(1 + 4\ln(x) + 4e^{-2}) & 1 \leq x \end{cases} \quad (3)$$

$$\boxed{> \text{plot}(\text{rhs}(A), x = -5 .. 5)}$$



2.

(4)

$$> sol2 := x \cdot \text{diff}(y(x), x, x) - (x + 10) \cdot \text{diff}(y(x), x) + 10 y(x) = 0$$

$$sol2 := x \left( \frac{d^2}{dx^2} y(x) \right) - (x + 10) \left( \frac{d}{dx} y(x) \right) + 10 y(x) = 0 \quad (5)$$

$$> B := \text{dsolve}(sol2)$$

$$B := y(x) = c_1 e^x + c_2 (x^{10} + 10x^9 + 90x^8 + 720x^7 + 5040x^6 + 30240x^5 + 151200x^4 + 604800x^3 + 1814400x^2 + 3628800x + 3628800) \quad (6)$$

$$> eval((6), [c_1 = 1, c_2 = 0])$$

$$y(x) = e^x \quad (7)$$

therefore, shown

3.

$$\begin{aligned} > \text{sol3} &:= \text{diff}(y(x), x, x) + \text{diff}(y(x), x) = x \\ &\quad \text{sol3} := \frac{d^2}{dx^2} y(x) + \frac{d}{dx} y(x) = x \end{aligned} \tag{8}$$

$$\begin{aligned} > C &:= \text{dsolve}(\{ \text{sol3}, y(0) = 1, D(y)(0) = 2 \}) \\ &\quad C := y(x) = \frac{x^2}{2} - 3 e^{-x} - x + 4 \end{aligned} \tag{9}$$

4.

$$\begin{aligned} > \text{sol4} &:= (2 \cdot y(x) + 2 \cdot x^2) \cdot \text{diff}(y(x), x) + (4 \cdot x \cdot y(x) + 3 \cdot x^2) = 0 \\ &\quad \text{sol4} := (2 y(x) + 2 x^2) \left( \frac{d}{dx} y(x) \right) + 4 x y(x) + 3 x^2 = 0 \end{aligned} \tag{10}$$

$$\begin{aligned} > E &:= (2 * y(x) + 2 * x^2) * \text{diff}(y(x), x) + 4 * x * y(x) + 3 * x^2 = 0; \\ E0 &:= (E) + (-3 * x^2); \\ EI &:= (E0) + (-4 * x * y(x)); \\ E2 &:= (EI) * (1 / (2 * y(x) + 2 * x^2)); \\ &\quad E := (2 y(x) + 2 x^2) \left( \frac{d}{dx} y(x) \right) + 4 x y(x) + 3 x^2 = 0 \\ E0 &:= (2 y(x) + 2 x^2) \left( \frac{d}{dx} y(x) \right) + 4 x y(x) = -3 x^2 \\ EI &:= (2 y(x) + 2 x^2) \left( \frac{d}{dx} y(x) \right) = -3 x^2 - 4 x y(x) \\ E2 &:= \frac{d}{dx} y(x) = \frac{-3 x^2 - 4 x y(x)}{2 y(x) + 2 x^2} \end{aligned} \tag{11}$$

$$\begin{aligned} > E &:= x^3 + 2 x^2 y + y^2 = c \\ &\quad E := x^3 + 2 x^2 y + y^2 = c \end{aligned} \tag{12}$$

$$\begin{aligned} > \text{isolate}(\text{diff}(\text{subs}(y=y(x), E), x), \text{diff}(y(x), x)) \\ &\quad \frac{d}{dx} y(x) = \frac{-3 x^2 - 4 x y(x)}{2 y(x) + 2 x^2} \end{aligned} \tag{13}$$

$$\begin{aligned} > \text{eval}(E, [x=1, y=1]) \\ &\quad 4 = c \end{aligned} \tag{14}$$

$$\begin{aligned} > \text{eval}(E, [x=0, y=-2]) \\ &\quad 4 = c \end{aligned} \tag{15}$$

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> F := dsolve( {y(0) = -2, sol4})
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$$F := y(x) = -x^2 - \sqrt{x^4 - x^3 + 4}$$

(16)

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> plot( rhs(F), x = -10 .. 10)
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