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 Mechanical

$$f(y) = e^{x^2 + x}$$

$$y' = (2x + 1) e^{x^2 + x}$$

$$y'' = 2e^{x^2 + x} + (2x + 1)^2 e^{x^2 + x}$$

$$y' = y(2x + 1) + 2y$$

$$y' = (2x + 1) e^{x^2 + x} + 2e^{x^2 + x}$$

$$y'(2x + 1) = (2x + 1) e^{x^2 + x} + 2e^{x^2 + x}$$

$$= (2x + 1)^2 e^{x^2 + x}$$

$$2y = 2 \cdot e^{x^2 + x}$$

$$y'(2x + 1) + 2y = (2x + 1)^2 e^{x^2 + x} + 2e^{x^2 + x}$$

$$y'' = y'(2x + 1) + 2y$$

$$2e^{x^2 + x} + (2x + 1)^2 e^{x^2 + x} = (2x + 1)^2 e^{x^2 + x} + 2e^{x^2 + x}$$

$$L = y''$$

$$W^2 = y'' + 2$$

$$P = y'(2x + 1)$$

$$V' = 2$$

$$U = y'$$

$$V'' = 0$$

$$U'' = y'' + 1$$

$$P^n = y^{n+1} \cdot (2x + 1) + n \cdot y^n \cdot 2$$

$$S = 2y$$

$$S^n = 2y^n$$

$$U^n = P^n + 5$$

$$y^{n+2} = (2x+1)y^{n+1} + 2ny^n + 2y^n$$

$$y^{n-2} = (2x+1)y^{n+1} + 2(n+1)y^n$$

Question 2

Using the

theorem, given that

$$y = x^3 e^{4x}$$

determine  $y^5$

$$v = x^3$$

$$u = e^{4x}$$

$$v' = 3x^2$$

$$u' = 4e^{4x}$$

$$v'' = 6x$$

$$u'' = 4 \cdot 4e^{4x}$$

$$v''' = 6$$

$$u''' = 4 \cdot 4 \cdot 4e^{4x}$$

$$v^{iv} = 0$$

$$u^{iv} = 4^n e^{4x}$$

$$y^n = 4^n e^{4x} \cdot x^3 + n \cdot 4^{n-1} e^{4x} \cdot 3x^2 + \frac{n(n-1)}{2} 4^{n-2} e^{4x} \cdot 6x + \frac{n(n-1)(n-2)}{6} 4^{n-3} e^{4x} \cdot 6$$

$$y^n = 4^n e^{4x} x^3 + n 4^{n-1} e^{4x} 3x^2 + n(n-1) 4^{n-2} e^{4x} 3x + n(n-1)(n-2) 4^{n-3} e^{4x}$$

$$y^5 = 4^5 e^{4x} x^3 + 4e^{4x} 3x^2 + 5 \cdot 4 \cdot 4^3 e^{4x} 3x + 5 \cdot 4 \cdot 3 \cdot 4^2 e^{4x}$$

Question 2

$$x^2 y'' + xy' + y = 0 \text{ show that } x^2 y^{(n+2)} + (2n+1)xy^{(n+1)} + (n^2+1)y^{(n)} = 0$$

$$\text{let } W = x^2 y''$$

$$V = x^2$$

$$V' = 2x$$

$$V'' = 2$$

$$V''' = 0$$

$$U = y''$$

$$U' = y'''$$

$$U'' = y^{(IV)}$$

$$U^n = y^{n+2}$$

$$W^n = y^{n+2} x^2 + n \cdot y^{n+1} 2x + n(n-1) y^n$$

$$W^n = x^2 y^{n+2} + n 2x y^{n+1} + n(n-1) y^n$$

$$\text{let } p = xy'$$

$$v = x$$

$$v' = 1$$

$$v'' = 0$$

$$u = y'$$

$$u' = y''$$

$$u^n = y^{n+1}$$

$$p^n = y^{n+1} x + n \cdot y^n \cdot 1$$

$$p^n = x y^{n+1} + n y^n$$

$$s = y$$

$$s^n = y^n$$

$$y^{n+2} x^2 + n \cdot 2xy^{n+1} + n(n+1)y^n + y^{n+1} x + n y^n + y^n = 0$$

$$y^{n+2} x^2 + (n \cdot 2x y^{n+1} + x y^{n+1}) + [n(n+1)y^n + n y^n + y^n] = 0$$

$$x^2 y^{n+2} + (2n+1)xy^{n+1} + [n(n-1) + 1]y^n = 0$$

$$x^2 y^{n+2} + (2n+1)xy^{n+1} + (n^2 + 1)y^n = 0$$