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MATHS ASSIGNMENT

1. $y = e^{x^2} + x$

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

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

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

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

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

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

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

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

from the equation

Part A

$A = y''$, $A' = y'''$, $A'' = y^{2+n}$

PART B

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

$u = y'$, $u^n = y^n + 1$

$v = 2x+1$, $v^{(1)} = 2$, $v^{(2)} = 0$

$B = y(n+1)(2x+1) + n(y^n)(2) + 0$

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

PART C

$C = 2y$

$C^n = 2y^n$

$A^n + B^n + C^n$

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

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

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

2 (i) $y = x^3 e^{4x}$, y^5

let $= u = e^{4x}$, $u' = 4e^{4x} + u'' = 16e^{4x}$, $u^n = 4^n e^{4x}$

Let $v = x^3$, $v' = 3x^2$, $v'' = 6x$, $v''' = 6$, $v^{iv} = 0$

Using Leibnitz theorem

$y^n = 4^n e^{4x} \cdot x^3 + n \, 4^{n-1} e^{4x} \cdot 3x^2 + \frac{n(n-1)}{2!} 4^{(n-2)} e^{4x} \cdot 6x + \frac{n(n-1)(n-2)}{3} \cdot 4^{(n-3)} e^{4x} \cdot 6 + 0$

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

$y^5 = 1024 e^{4x} \cdot x^3 + 3840 e^{4x} \cdot x^2 + 3840 e^{4x} + 960 e^{4x}$

$y^5 = 64 e^{4x} (16x^3 + 60x^2 + 60x + 15)$

ii $x^2 \frac{d^2y}{dx} + x \frac{dy}{dx} + y = 0$ Shows that $x^2 y(n+2) + (2n+1)x \; y(n+2) + (n^2+1) y^n = 0$

for PART A.

$A = x^2 y''$

$u = y''$, $u^n = y^{n+2}$

$v = x^2$, $v' = 2x$, $v'' = 2$, $v''' = 0$

$A'' = (y^{n+2}) x^2 + n(y^{n+2}) 2x + \frac{n(n-1)}{2} \cdot (y^2) 2 + 0$

$A'' = x^2 y^{(n+2)} 2x + \frac{n(n-1)}{2} \cdot (y^2) 2 + 0$

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

for PART B,

$B = xy'$

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

$v = x$, $v = 1$, $v'' = 0$

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

$= xy^{n+1} + ny^n$

For PART C

$C = y$

$C^n = y^n$

$\therefore A^n + B^n + C^n = 0$

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$= 6x + \frac{n(n-1)(n-2)}{3}$

$)(4)(3) \cdot 4^2 e^{4x}$

$+1)x \; y(n+2) +$

$x^2 y(n+12) + 2x n y^{(n+1)} + (n^2 - n) y^n$

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

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