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No 1.

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

$\frac{dy}{dx} = (2x+1)$

$\frac{d^2y}{dx^2} = 2e^{x^2+x} + (2x+1)(2x+1)e^{x^2+x}$

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

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

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

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

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

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

$y' = w_2$

$d = y'$ $\quad v = 2x+1$

$d^n = y^{n+1}$ $\quad v' = 2$

$d^{n-1} = y^n$ $\quad v'' = 0$

$w_n = u = y^2$

$u^n = y^{(n+2)}$

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$w_3 = u=y \quad v=2$

$u^n = y^n \quad v=0$

$w_1 = w_2 + w_3$

or $w_1 + w_2 + w_3 = 0$.

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

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

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

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

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

$u = e^{4x}$	$v = x^3$
$u^n = 4^n e^{4x}$	$v' = 3x^2$
$u^{n-1} = 4^{(n-1)} e^{4x}$	$v^2 = 6x$
$u^{n-2} = 4^{(n-2)} e^{4x}$	$v^3 = 6$
$u^{n-3} = 4^{(n-3)} e^{4x}$	$v^4 = 0$

$= 4^n e^{4x} x^3 + n4^{(n-1)} e^{4x} \cdot 3x^2 + \frac{n(n-1)4^{(n-1)} e^{4x} \cdot 6x}{2!} + \frac{n(n-1)(n-2)4^n e^{4x} \cdot 6}{3!}$

$n = 5$

$4^{(5)} e^{4x} x^3 + 5\,4^{(4)} e^{4x} \cdot 3x^2 + 10\,4^{(3)} e^{4x} \cdot 6x + 10\,4^{(2)} e^{4x} \cdot 6$

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$x^2 \frac{d^2y}{dx^2} + x\frac{dy}{dx} + y = 0$

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

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

$w_1 \quad w_2 \quad w_3$

w_1	
$u = y^{(2)}$	$v = x^n$
$u^n = y^{n+2}$	$v' = 2x$
$u^{n-1} = y^{(n+1)}$	$v'' = 2$
$u^{n-2} = y^{(n)}$	

w_2	
$u = y^1$	$v = x$
$u^n = y^{n+1}$	$v' = 1$
$u^{n-1} = y^n$	$v'' = 0$

w^3

$u = y$

$u^n = y^n$

$w_1 + w_2 + w_3$

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

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$= x^2 y^{(n+2)} + 2xny^{(n+1)} + n(n-1)y^n + xy^{n+1} + ny^n + y^n = 0.$

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

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

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

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

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