Question	Scheme	Marks
3	$\frac{dy}{dx} = 3e^{3x}\sin 2x + 2e^{3x}\cos 2x$	M1A1A1
	Method A	
	$\frac{d^2y}{dx^2} = 3\left(3e^{3x}\sin 2x + 2e^{3x}\cos 2x\right) + 6e^{3x}\cos 2x - 4e^{3x}\sin 2x$	M1
	$\frac{d^2y}{dx^2} = 3\frac{dy}{dx} + 6e^{3x}\cos 2x - 4y$	M1
	$2e^{3x}\cos 2x = \frac{dy}{dx} - 3y \Rightarrow 6e^{3x}\cos 2x = 3\frac{dy}{dx} - 9y$	M1
	$\frac{d^2y}{dx^2} = 3\frac{dy}{dx} + 3\frac{dy}{dx} - 9y - 4y \Rightarrow 13y + \frac{d^2y}{dx^2} = 6\frac{dy}{dx}$	M1A1 [8]
	Method B	
	$\frac{dy}{dx} = 3y + 2e^{3x}\cos 2x$	
	$\frac{d^2y}{dx^2} = 3\frac{dy}{dx} + 6e^{3x}\cos 2x - 4e^{3x}\sin 2x,\ \frac{d^2y}{dx^2} = 3\frac{dy}{dx} + 6e^{3x}\cos 2x - 4y$	[M1,M1
	$2e^{3x}\cos 2x = \frac{dy}{dx} - 3y \Rightarrow 6e^{3x}\cos 2x = 3\frac{dy}{dx} - 9y$	M1
	$\frac{d^2y}{dx^2} = 3\frac{dy}{dx} + 3\frac{dy}{dx} - 9y - 4y \Rightarrow 13y + \frac{d^2y}{dx^2} = 6\frac{dy}{dx}$	M1A1]
	Method C	
	$\frac{d^2y}{dx^2} = 3\left(3e^{3x}\sin 2x + 2e^{3x}\cos 2x\right) + 6e^{3x}\cos 2x - 4e^{3x}\sin 2x$	[M1
	$13y + \frac{d^2y}{dx^2} = 13e^{3x}\sin 2x + (5e^{3x}\sin 2x + 12e^{3x}\cos 2x)$	M1
	$6\frac{dy}{dx} = 6(3e^{3x}\sin 2x + 2e^{3x}\cos 2x)$ $(= 18e^{3x}\sin 2x + 12e^{3x}\cos 2x)$	M1
	$LHS = 13e^{3x}\sin 2x + (5e^{3x}\sin 2x + 12e^{3x}\cos 2x)$ $= 18e^{3x}\sin 2x + 12e^{3x}\cos 2x$ $RHS = 6(3e^{3x}\sin 2x + 2e^{3x}\cos 2x)$ $= 18e^{3x}\sin 2x + 12e^{3x}\cos 2x$ $LHS = RHS$	M1A1]
		Total 8 marks

Question	Notes	Marks
3	$y = e^{3x}\sin 2x$	
	For an attempt to differentiate the given expression.	

	• There needs to be an acceptable attempt to differentiate both terms. $e^{3x}\sin 2x \to ke^{3x}\sin 2x + le^{3x}\cos 2x$ with $k,l \neq 0$ • There need to be two terms added. $\frac{dy}{dx}=3e^{3x}\sin 2x+2e^{3x}\cos 2x$	M1
	One term completely correct. $\frac{dy}{dx}=3e^{3x}\sin 2x+'2e^{3x}\cos 2x'$ or $\frac{dy}{dx}='3e^{3x}\sin 2x'+2e^{3x}\cos 2x$	A1
	Fully correct differentiated expression. $\frac{dy}{dx}=3e^{3x}\sin 2x+2e^{3x}\cos 2x$	A1
	Method A	
	For an attempt to find $\frac{d^2y}{dx^2}$ Minimally acceptable attempt is $ke^{3x}\sin 2x + le^{3x}\cos 2x \to k(me^{3x}\sin 2x + ne^{3x}\cos 2x) + l(pe^{3x}\cos 2x + qe^{3x}\sin 2x)$ k, l as in their first derivative, $m,n,p,q \neq 0$ $\frac{d^2y}{dx^2}=3\left(3e^{3x}\sin 2x+2e^{3x}\cos 2x\right)+6e^{3x}\cos 2x-4e^{3x}\sin 2x$	M1
	For substituting y and $\frac{dy}{dx}$ into their $\frac{d^2y}{dx^2}$ $\frac{d^2y}{dx^2}=3\frac{dy}{dx}+6e^{3x}\cos 2x-4y$	M1
	For preparing to eliminate cos2x by rearranging their $\frac{dy}{dx}$ $2e^{3x}\cos 2x=\frac{dy}{dx}-3y \Rightarrow 6e^{3x}\cos 2x=3\frac{dy}{dx}-9y$ Allow errors in arithmetic but not mathematically incorrect process.	M1
	For an unsimplified expression only in terms of y, $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ $\frac{d^2y}{dx^2}=3\frac{dy}{dx}+3\frac{dy}{dx}-9y-4y$	M1
	For the required simplified expression with fully correct working. $13y+\frac{d^2y}{dx^2}=6\frac{dy}{dx}$	A1 [8]
	Method B	
	For an attempt to find $\frac{d^2y}{dx^2}$ using $\frac{dy}{dx}=3y+2e^{3x}\cos 2x$	

<table>
<tr><td rowspan="10"></td><td colspan="2">Minimally acceptable attempt is $\frac{\mathrm{d}y}{\mathrm{d}x} = ky + le^{3x}\cos 2x \rightarrow$
$$\frac{\mathrm{d}^2y}{\mathrm{d}x^2} = k\frac{\mathrm{d}y}{\mathrm{d}x} + l(pe^{3x}\cos 2x + qe^{3x}\sin 2x)$$
k, l as in their first derivative, $p, q \neq 0$
$\frac{\mathrm{d}^2y}{\mathrm{d}x^2} = 3\frac{\mathrm{d}y}{\mathrm{d}x} + 6\mathrm{e}^{3x}\cos 2x - 4\mathrm{e}^{3x}\sin 2x$, $\frac{\mathrm{d}^2y}{\mathrm{d}x^2} = 3\frac{\mathrm{d}y}{\mathrm{d}x} + 6\mathrm{e}^{3x}\cos 2x - 4y$</td><td>M1,M1</td></tr>
<tr><td colspan="2">For preparing to eliminate cos2x by rearranging their $\frac{\mathrm{d}y}{\mathrm{d}x}$
$2\mathrm{e}^{3x}\cos 2x = \frac{\mathrm{d}y}{\mathrm{d}x} - 3y \Rightarrow 6\mathrm{e}^{3x}\cos 2x = 3\frac{\mathrm{d}y}{\mathrm{d}x} - 9y$
Allow errors in arithmetic but not mathematically incorrect process.</td><td>M1</td></tr>
<tr><td colspan="2">For an unsimplified expression only in terms of y, $\frac{\mathrm{d}y}{\mathrm{d}x}$ and $\frac{\mathrm{d}^2y}{\mathrm{d}x^2}$
$\frac{\mathrm{d}^2y}{\mathrm{d}x^2} = 3\frac{\mathrm{d}y}{\mathrm{d}x} + 3\frac{\mathrm{d}y}{\mathrm{d}x} - 9y - 4y$</td><td>M1</td></tr>
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$13y + \frac{\mathrm{d}^2y}{\mathrm{d}x^2} = 6\frac{\mathrm{d}y}{\mathrm{d}x}$</td><td>A1</td></tr>
<tr><td colspan="3">Method C</td></tr>
<tr><td colspan="2">For an attempt to find $\frac{\mathrm{d}^2y}{\mathrm{d}x^2}$
Minimally acceptable attempt is $ke^{3x}\sin 2x + le^{3x}\cos 2x \rightarrow$
$k(me^{3x}\sin 2x + ne^{3x}\cos 2x) + l(pe^{3x}\cos 2x + qe^{3x}\sin 2x)$
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$\frac{\mathrm{d}^2y}{\mathrm{d}x^2} = 3\left(3\mathrm{e}^{3x}\sin 2x + 2\mathrm{e}^{3x}\cos 2x\right) + 6\mathrm{e}^{3x}\cos 2x - 4\mathrm{e}^{3x}\sin 2x$</td><td>M1</td></tr>
<tr><td colspan="2">For substituting y and $\frac{\mathrm{d}^2y}{\mathrm{d}x^2}$ into the LHS of the result.</td><td>M1</td></tr>
<tr><td>For substituting $\frac{\mathrm{d}y}{\mathrm{d}x}$ into the RHS of the result.</td><td rowspan="2">For simplifying the LHS of the result and writing as $k(3e^{3x}\sin 2x + 2e^{3x}\cos 2x)$</td><td>M1</td></tr>
<tr><td>For unsimplified expressions for the LHS and RHS of the result in terms of $e^{3x}\sin 2x$ and $e^{3x}\cos 2x$ only and method to simplify both sides</td><td>M1</td></tr>
<tr><td colspan="2">For correctly simplifying the LHS and RHS and showing equal.</td><td>A1</td></tr>
<tr><td colspan="4">Total 8 marks</td></tr>
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