Question Number	Scheme	Marks
7(a)	$\frac{\mathrm{d}y}{\mathrm{d}x} = v + x\frac{\mathrm{d}v}{\mathrm{d}x}$ or $\frac{\mathrm{d}v}{\mathrm{d}x} = x^{-1}\frac{\mathrm{d}y}{\mathrm{d}x} - x^{-2}y$ (oe)	M1A1
	$\frac{\mathrm{d}^2y}{\mathrm{d}x^2} = \frac{\mathrm{d}v}{\mathrm{d}x} + \frac{\mathrm{d}v}{\mathrm{d}x} + x\frac{\mathrm{d}^2v}{\mathrm{d}x^2}$ or $\frac{\mathrm{d}^2v}{\mathrm{d}x^2} = -x^{-2}\frac{\mathrm{d}y}{\mathrm{d}x} + x^{-1}\frac{\mathrm{d}^2y}{\mathrm{d}x^2} + 2x^{-3}y - x^{-2}\frac{\mathrm{d}y}{\mathrm{d}x}$ (oe)	dM1A1
	$3\left(2\frac{\mathrm{d}v}{\mathrm{d}x} + x\frac{\mathrm{d}^2v}{\mathrm{d}x^2}\right) - \frac{6}{x}\left(v + x\frac{\mathrm{d}v}{\mathrm{d}x}\right) + \frac{6xv}{x^2} + 3xv = x^2$ (oe in reverse)	ddM1
	$3x\frac{\mathrm{d}^2v}{\mathrm{d}x^2} + 6\frac{\mathrm{d}v}{\mathrm{d}x} - 6\frac{\mathrm{d}v}{\mathrm{d}x} - \frac{6}{x}v + \frac{6v}{x} + 3xv = x^2$	
	$3\frac{\mathrm{d}^2v}{\mathrm{d}x^2} + 3v = x$ *	A1 * (6)
(b)	$3\lambda^2 + 3 = 0$ so $\lambda = \pm \mathrm{i}$	M1
	$(v =) A\mathrm{e}^{\mathrm{i}x} + B\mathrm{e}^{-\mathrm{i}x}$ or $(v =) C\cos x + D\sin x$	A1
	P.I: Try $(v =) kx\ (+l)$	B1
	$\frac{\mathrm{d}v}{\mathrm{d}x} = k$ $\frac{\mathrm{d}^2v}{\mathrm{d}x^2} = 0$	
	$3\times 0 + 3\left(kx\ (+l)\right) = x$	M1
	$k = \frac{1}{3}$ $(l = 0)$	
	$v = A\mathrm{e}^{\mathrm{i}x} + B\mathrm{e}^{-\mathrm{i}x} + \frac{1}{3}x$ or $v = C\cos x + D\sin x + \frac{1}{3}x$	A1
	$y = x\left(A\mathrm{e}^{\mathrm{i}x} + B\mathrm{e}^{-\mathrm{i}x} + \frac{1}{3}x\right)$ or $y = x\left(C\cos x + D\sin x + \frac{1}{3}x\right)$	B1ft (6)
		[12]

	Notes
(a)	
M1	Attempt to find a relevant first derivative from $y = xv$ e.g to get $\frac{\mathrm{d}y}{\mathrm{d}x}$ or $\frac{\mathrm{d}v}{\mathrm{d}x}$ - product or quotient rule must be used. Methods via $\frac{\mathrm{d}..}{\mathrm{d}v}$ would require a chain rule to reach a relevant derivative.
A1	Correct derivative
dM1	Attempt to differentiate **their** $\frac{\mathrm{d}y}{\mathrm{d}x}$ or $\frac{\mathrm{d}v}{\mathrm{d}x}$ to obtain an expression for $\frac{\mathrm{d}^2y}{\mathrm{d}x^2}$ or $\frac{\mathrm{d}^2v}{\mathrm{d}x^2}$ - product rule must be used. Depends on the previous M mark
A1	Correct expression for $\frac{\mathrm{d}^2y}{\mathrm{d}x^2}$ or $\frac{\mathrm{d}^2v}{\mathrm{d}x^2}$

	Notes
ddM1	Depends on both previous M marks. Substitute **their** $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ and $y = xv$ in the original equation to obtain a differential equation in v and x. Alternatively substitute **their** $\frac{dv}{dx}$ and $\frac{d^2v}{dx^2}$ and $v = \frac{y}{x}$ into equation (II) to obtain a differential equation in y and x
A1*	Obtain the **given** equation/original equation with no errors in the working. There must be at least one step shown between the initial substitution and the result
(b)	
M1	Forms correct AE and attempts to solve (accept $3m^2 + 3$ (=0) leading to any value(s)).
A1	Correct CF.
B1	Suitable form for PI (ie one that include kx)
M1	Differentiate their PI twice and substitute their derivatives in the equation $3\frac{d^2v}{dx^2} + 3v = x$
A1	Obtain the correct result (either form). Must be $v =$…
B1ft	Reverse the substitution. Follow through their previous line. Must be $y =$..