Question Number	Scheme	Notes	Marks
2(a)	$y=(1-3x)^A+e^{Bx} \Rightarrow \frac{dy}{dx}=-3A(1-3x)^{A-1}+Be^{Bx}$	Correct first derivative. Accept unsimplified	**B1**
	$\frac{d^2y}{dx^2}=9A(A-1)(1-3x)^{A-2}+B^2e^{Bx}$ $\frac{d^3y}{dx^3}=-27A(A-1)(A-2)(1-3x)^{A-3}+B^3e^{Bx}$ or e.g., $-27(A^3-3A^2+2A)(1-3x)^{A-3}+B^3e^{Bx}$ M1: Obtains $\frac{d^3y}{dx^3}=g(A)(1-3x)^{A-3}+h(B)e^{Bx}$ A1: Fully correct third derivative. Could be unsimplified. Condone poor bracketing unless further work confirms error. If g(A) is only seen expanded then it must be correct		**M1** **A1**
			(3)
(b)	$f'(0)=-3A+B=0$	Substitutes $x=0$ into their first derivative and sets = 0 and achieves a linear equation in A and B	**M1**
	$f''(0)=9A(A-1)+B^2=0$ $\Rightarrow 9A^2-9A+(3A)^2=0$ or $\Rightarrow 9\left(\frac{B}{3}\right)\left(\frac{B}{3}-1\right)+B^2=0$	Substitutes $x=0$ into their second derivative, sets = 0 and obtains a quadratic equation in A (or B) only	**dM1**
	$18A^2-9A=0 \Rightarrow 9A(2A-1)=0 \Rightarrow A=...$ or $2B^2-3B=0 \Rightarrow B(2B-3)=0 \Rightarrow B=...$	Solves for A and B. No working is required but must get real values and neither can be 0 unless the zero solution is additional	**ddM1**
	$A=\frac{1}{2},\ B=\frac{3}{2}$	Both correct values. Accept equivalent fractions/decimals. Ignore extra zero solution	**A1**
	Allow all marks in (b) even if full marks were not obtained in (a)		**(4)**
(c)	$\frac{d^3y}{dx^3}=-27A(A-1)(A-2)(1-3x)^{A-3}+B^3e^{Bx}$ $\left(\frac{d^3y}{dx^3}\right)_{x=0}=-27\left(\frac{1}{2}\right)\left(\frac{1}{2}-1\right)\left(\frac{1}{2}-2\right)+\left(\frac{3}{2}\right)^3=...\ \left(-\frac{27}{4}\right)$ Substitutes their A and their B and $x=0$ into their 3rd derivative and obtains a value. A and B must be non-zero and must have come from simultaneous equations (one linear, one quadratic). If $k=...$ they must have divided by 6		**M1**
	$k=-\frac{27}{4}\div 6=...$ Divides their value by 6 or 3! to find a value for k. These two M marks are likely to scored at the same time. If just a value is given without a substitution attempt it must be consistent.		**dM1**
	$k=-\frac{9}{8}$	Correct value for k. This fraction or $-1\frac{1}{8}$ This mark requires a fully correct solution.	**A1**
			(3)
			Total 10
	Alternative for (b) & (c) by series expansions: $y=(1-3x)^A+e^{Bx}=1-3Ax+\frac{A(A-1)}{2}(-3x)^2+\frac{A(A-1)(A-2)}{3!}(-3x)^3+...+1+Bx+\frac{(Bx)^2}{2}+\frac{(Bx)^3}{3!}+...$ $=2+kx^3+... \Rightarrow -3A+B=0\ \ (M1)$ $\frac{9A(A-1)}{2}+\frac{B^2}{2}=0 \Rightarrow 9A^2-9A+9A^2=0\ \ (dM1)$ $2A^2-A=A(2A-1)=0 \Rightarrow A=\frac{1}{2},\ \ B=\frac{3}{2}\ \ (ddM1A1)$ $k=-\frac{9}{2}A(A-1)(A-2)+\frac{B^3}{6}\ \ (M1)\ \ \Rightarrow k=-\frac{9}{2}\left(\frac{1}{2}\right)\left(-\frac{1}{2}\right)\left(-\frac{3}{2}\right)+\frac{1}{6}\left(\frac{3}{2}\right)^3=...,\ \ -\frac{9}{8}\ \ (dM1,A1)$		