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|---|---|---|---|---|---|---|---|
| **4** | **(a)** | | $\frac{dy}{dx}=\frac{6}{3x-k}+2x-3$<br>$\frac{d^2y}{dx^2}=-\frac{18}{(3x-k)^2}+2$<br>$\frac{d^2y}{dx^2}=0\Rightarrow\left(3(1)-k\right)^2=9$<br>$3-k=\pm3\Rightarrow k=6\left(\because k>0\right)$ | **M1***<br>**A1**<br>**A1ft**<br>**M1dep***<br>**A1**<br>**[5]** | **2.1**<br>**1.1**<br>**1.1**<br>**1.1**<br>**2.2a** | Differentiates wrt $x$ – answer of the form $c\left(k-3x\right)^{-1}+2x-3$ where $c\neq0$<br>oe<br>Follow through their first derivative<br>Sets second derivative equal to zero and substitutes $x$ = 1<br>**AG** – sufficient working must be shown $\left(\text{e.g. } k^2-6k=0\Rightarrow k=6\right)$ | |
| **4** | **(b)** | | Considers both f(0.5) and f(1.5) where $f(x)=\pm[2\ln(6-3x)+x^2-3x]$<br>$f(0.5)=1.758...>0$ and $f(1.5)=-1.439...<0$<br>change of sign indicates that the $x$-intersect lies between 0.5 and 1.5 | **M1**<br>**A1**<br>**[2]** | **1.1**<br>**2.4** | Working or correct answer for one value is sufficient evidence of correct method but both 0.5 and 1.5 must be seen<br>Correct values (to at least 2 sf rot) together with explanation (change of sign) and conclusion (as a minimum 'root') | |
| **4** | **(c)** | | $x_{n+1}=x_n-\left\{\frac{2\ln(6-3x_n)+x_n^{\ 2}-3x_n}{6(3x_n-6)^{-1}+2x_n-3}\right\}$<br>$x_0=1$, $x_1=1.0657415...$, $x_2=1.0656753...$<br>$x$ coordinate is 1.06568 | **M1**<br>**A1**<br>**A1**<br>**[3]** | **2.1**<br>**1.1**<br>**2.2a** | Correct NR formula with their first derivative and $k$ = 6<br>Uses given starting value and states next two iterations to at least 6 d.p. rot<br>cao – stated to 5 decimal places only | Allow $x$ not $x_n$<br>Correct answer with no working scores 0/3 |

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| **4** | **(d)** | | $f(1.065675) = 0.00000091... > 0$<br>$f(1.065685) = -0.000029... < 0$ – change of sign indicates that 1.06568 is correct to 5 decimal places. | **B1**<br><br>**[1]** | **2.2a** | Must be evaluated to at least 1 sf (rot) – together with explanation and conclusion | |