A level Mathematics Practice Paper – Newton-Raphson method – Mark scheme

Question	Scheme		Marks
1(a)	$f'(x) = x^{-\frac{1}{2}} - \frac{1}{2}x^{-\frac{3}{2}}$		M1 A1
			(2)
1(b)	$f(5) = -0.0807$ $f'(5) = 0.4025$		B1 M1
	$x_1 = x_0 - \frac{f(x_0)}{f'(x_0)} = 5 - \frac{-0.0807}{0.4025}$		M1
	$= 5.2(0)$		A1
			(4)
			(6 marks)
2(a)	$f(x) = x^2 + \frac{5}{2x} - 3x - 1, \quad x \neq 0$		
	$f(x) = x^2 + \frac{5}{2}x^{-1} - 3x - 1$		
	$f'(x) = 2x - \frac{5}{2}x^{-2} - 3\{+0\}$	At least two of the four terms differentiated correctly.	M1
		Correct differentiation. (Allow any correct unsimplified form)	A1
	$\left\{f'(x) = 2x - \frac{5}{2x^2} - 3\right\}$		
			(2)
2(b)	$f(0.8) = 0.8^2 + \frac{5}{2(0.8)} - 3(0.8) - 1 (= 0.365) \left(= \frac{73}{200}\right)$	A correct numerical expression for f(0.8)	B1
	$f'(0.8) = -5.30625 \left(= \frac{-849}{160}\right)$	Attempt to insert $x = 0.8$ into their f'(x). Does not require an evaluation. (If $f'(0.8)$ is incorrect for their derivative and there is no working score M0)	M1
	$\alpha_2 = 0.8 - \left(\frac{"0.365"}{"-5.30625"}\right)$	Correct application of Newton-Raphson using their values. Does not require an evaluation.	M1
	$= 0868786808...$		
	$= 0.869$ (3dp)	0.869	A1 cao
			(4)
			(6 marks)

A level Mathematics Practice Paper – Newton-Raphson method – Mark scheme

Question	Scheme	Marks
3	$\mathrm{f}(x) = x^2 + \frac{3}{4}x^{-\frac{1}{2}} - 3x - 7$	
	$\mathrm{f}'(x) = 2x - \frac{3}{8}x^{-\frac{3}{2}} - 3 \{+0\}$	M1A1
	$\mathrm{f}(4) = -2.625 = -\frac{21}{8} = -2\frac{5}{8}$ *or* $4^2 + \frac{3}{4\sqrt{4}} - 3\times 4 - 7$	B1
	$\mathrm{f}'(4) = 4.953125 = \frac{317}{64} = 4\frac{61}{64}$	M1
	$\alpha_2 = 4 - \left(\frac{"-2.625"}{"4.953125"}\right)$	M1
	$= 4.529968454...$ $\left(= \frac{1436}{317} = 4\frac{168}{317}\right)$	
	$= 4.53$ (2 dp)	A1 **cao**
		(6 marks)
4(a)	$\mathrm{f}(x) = x^3 - \frac{5}{2x^{\frac{3}{2}}} + 2x - 3$	
	$\mathrm{f}(1.1) = -1.6359604$, $\mathrm{f}(1.5) = 2.0141723$	M1
	Sign change (and $\mathrm{f}(x)$ is continuous) therefore **a root / α** is between $x = 1.1$ and $x = 1.5$	A1
		(2)
4(b)	$\mathrm{f}(x) = x^3 - \frac{5}{2}x^{-\frac{3}{2}} + 2x - 3$ $\Rightarrow \mathrm{f}'(x) = 3x^2 + \frac{15}{4}x^{-\frac{5}{2}} + 2$	M1A1
		(2)
4(c)	$\mathrm{f}'(1.1) = 3(1.1)^2 + \frac{15}{4}(1.1)^{-\frac{5}{2}} + 2 (= 8.585)$	M1
	$\alpha_2 = 1.1 - \left(\frac{"-1.6359604"}{"8.585"}\right)$	M1
	$\alpha_2 = 1.291$	A1
		(3)
		(7 marks)

A level Mathematics Practice Paper – Newton-Raphson method – Mark scheme

	Source paper	Question number	New spec references	Question description	New AOs
1	FP1 Jan 2013	3	9.2	Newton-Raphson method	11.1.2, 12.1
2	FP1 June 2011	4	9.2	Newton-Raphson method	11.1.2, 12.1
3	FP1 June 2012	3	9.2	Newton-Raphson method	11.1.2, 12.1
4	FP1 June 2014	2	9.2	Newton-Raphson method	11.1.2, 12.1