Question	Answer	Marks	Guidance
1	<u>Either</u>		
	State or imply non-modular inequality $(3x-5)^2 < 4x^2$ or corresponding equation or pair of linear equations	**B1**	SC: Common error $(3x-5)^2 < 2x^2$
	Attempt solution of 3-term quadratic equation or solution of 2 linear equations	**M1**	
	Obtain critical values 1 and 5	**A1**	Critical values $\frac{15 \pm 5\sqrt{2}}{7}$ or 3.15, 1.13 allow B1
	State correct answer $1 < x < 5$	**A1**	$\frac{15-5\sqrt{2}}{7} < x < \frac{15+5\sqrt{2}}{7}$ or $1.13 < x < 3.15$ B1 Max 2/4 Allow M1 for $(7x \pm 5)(x \pm 5)$
	<u>Or</u>		
	Obtain $x = 5$ by solving linear equation or inequality or from graphical method or inspection	**B1**	Allow B1 for 5 seen, maybe in an inequality
	Obtain $x = 1$ similarly	**B2**	Allow B2 for 1 seen, maybe in an inequality
	State correct answer $1 < x < 5$	**B1**	
		4	

Question	Answer	Marks	Guidance
2	Recognise 9^x as $(3^x)^2$ or 3^{2x}	B1	May be implied by $3^x\left(3^x+1\right)(=240)$
	Attempt solution of quadratic equation in 3^x	*M1	Perhaps using substitution $u=3^x$
	Obtain, finally, $3^x=15$ only	A1	
	Apply logarithms and use power law for $3^x=k$ where $k>0$	M1	Dependent *M, need to see $x\ln 3=\ln k$, $x=\log_3 k$ oe
	Obtain 2.465	A1	May be done using $9^{\frac{x}{2}}$, same processes
		5	

Question	Answer	Marks	Guidance
3	Differentiate to obtain $10\cos 2x$	B1	
	Differentiate to obtain $-6\sec^2 2x$	B1	
	Equate first derivative to zero and find value for $\cos^3 2x$	M1	
	Use correct process for finding *x* from $\cos^3 2x=k$	M1	
	Obtain 0.284 nfww	A1	Or greater accuracy
		5	

Question	Answer	Marks	Guidance
4	Obtain $6ye^{2x}+3e^{2x}\frac{dy}{dx}$ as derivative of $3ye^{2x}$	**B1**	Allow unsimplified
	Obtain $2y\frac{dy}{dx}$ as derivative of y^2	**B1**	
	Obtain 4 as a derivative of $4x$ and zero as a derivative of 10	**B1**	Dependent B mark, must have at least one of the two previous B marks
	Substitute 0 and 2 to find gradient of curve	**M1**	Dependent on at least one B1
	Obtain $-\frac{16}{7}$ or -2.29	**A1**	Allow greater accuracy
		5	

Question	Answer	Marks	Guidance
5(i)	Rearrange at least as far as $2x=\ln(...)$	**M1**	Allow if in terms of p, need to see y equated to 0
	Obtain $x=\frac{1}{2}\ln(1.6x^2+4)$	**A1**	AG; necessary detail needed
		2	

Question	Answer	Marks	Guidance
5(ii)	Either		
	Consider sign of $x - \frac{1}{2}\ln(1.6x^2 + 4)$ for 0.75 and 0.85 or equivalent	**M1**	Need to see substitution of numbers
	Obtain –0.04 and 0.03 or equivalents and justify conclusion	**A1**	AG; necessary detail needed, change of sign or equivalent must be mentioned
	Or		
	Consider sign of $5e^{2x} - 8x^2 - 20$ for 0.75 and 0.85	**M1**	Need to see substitution of numbers
	Obtain –2.09... and 1.58… or equivalents and justify conclusion	**A1**	AG; necessary detail needed, change of sign or equivalent must be mentioned
		2	
5(iii)	Use iteration process correctly at least once	**M1**	Starting with value such that iterations converge to correct values
	Obtain final value 0.80956	**A1**	Must be 5sf for the final answer
	Show sufficient iterations to justify value or show sign change in interval (0.809555, 0.809565)	**A1**	
		3	

Question	Answer	Marks	Guidance
5(iv)	Obtain first derivative $10e^{2x} - 16x$	B1	
	Substitute value from iteration to find gradient, must be in the form $pe^{2x} + qx$	M1	
	Obtain 37.5	A1	Or greater accuracy, allow awrt 37.5 from use of $x = 0.8096,\ \ 0.80955$ oe
		3	

Question	Answer	Marks	Guidance
6(a)	Integrate to obtain form $k\ln(3x+2)$	*M1	Condone poor use of brackets if recovered later
	Obtain correct $4\ln(3x+2)$	A1	
	Substitute limits correctly	M1	Dependent *M, must see $k\ln 20 - k\ln 5$ oe
	Apply relevant logarithm properties correctly	M1	Dependent *M, do not allow $\frac{4\ln 20}{4\ln 5}$ oe, must be using both the subtraction and power laws correctly
	Obtain $\ln 256$ nfww	A1	AG; necessary detail needed
		5	

Question	Answer	Marks	Guidance
6(b)	Use identity to obtain $4(1-\cos 2x)$ oe	B1	
	Use identity to obtain $\sec^2 2x-1$	B1	
	Integrate to obtain form $k_1x+k_2\sin 2x+k_3\tan 2x$	*M1	Allow M1 if integrand contains $p\cos 2x+q\sec^2 2x$ and no other trig terms
	Obtain correct $3x-2\sin 2x+\frac{1}{2}\tan 2x$	A1	
	Apply limits correctly retaining exactness	M1	Dependent *M, allow $\sin\frac{\pi}{3}$, $\tan\frac{\pi}{3}$
	Obtain $\frac{1}{2}\pi-\frac{1}{2}\sqrt{3}$ or exact equivalent	A1	
		6	

Question	Answer	Marks	Guidance
7(i)	Substitute $-\frac{3}{2}$ and simplify	M1	Allow use of identity assuming a factor of $2x+3$ to obtain a quadratic factor. Need to see use of 4 equations to verify quadratic for M1, A1 for conclusion. Allow verification by expansion. Allow use of identity including a remainder to obtain a quadratic factor and a remainder of zero. Need to see use of 4 equations for M1, A1 for conclusion. Allow verification by expansion. Allow use of long division , must reach a remainder of zero for M1
	Obtain $-27+9+15+3$ or equivalent, hence zero and conclude , may have explanation at start of working	A1	Need powers of $-\frac{3}{2}$ evaluating for A1 AG; necessary detail needed
		2	
7(ii)	Use $\cos 2\theta = 2\cos^2\theta - 1$	B1	
	Simplify $a\cos^2\theta + b = \dfrac{6\cos\theta - 5}{2\cos\theta + 1}$ to polynomial form	M1	
	Obtain $8\cos^3\theta + 4\cos^2\theta - 10\cos\theta + 3 = 0$	A1	AG; necessary detail needed, must be completely correct with no poor use of brackets for A1
		3	

Question	Answer	Marks	Guidance
7(iii)	Attempt either division by $2x+3$ and reach partial quotient x^2+kx or use of identity or inspection	*M1	Or equivalent using $\cos\theta$ or c
	Obtain quotient $4x^2-4x+1$	A1	Or equivalent
	Obtain factorised form $(2x+3)(2x-1)^2$	A1	Or equivalent, may be implied by later work
	Solve for $\cos\theta=k$ to find at least one value between 0 and 360	M1	Dependent *M
	Obtain 60 and 300 and no others	A1	SC1: Equation solver used to obtain 60 and 300 and no others, then 5/5 SC2:Equation solver used to obtain 60 then 4/5 SC 3: $\cos\theta=0.5$, $(\cos\theta=-1.5)$ seen implies first 3 marks.
		5	