Question Number	Scheme	Marks
10 (a)	$y = 2x + \frac{64}{x^2} - 3$	
	$\frac{dy}{dx} = 2 - \frac{128}{x^3}$	M1, A1
	Attempts to solve $\frac{dy}{dx} \Rightarrow x^3 = 64 \Rightarrow x = 4$ *	dM1, A1*
		(4)
(b)	$\int 2x + \frac{64}{x^2} - 3\,dx = x^2 - \frac{64}{x} - 3x \quad (+c)$	M1, A1
	Finds the y values at both $x = 2$ and $x = 4$. $M = (0, 17)$ and $N = (0, 9)$	B1
	Full attempt at area = $\left[x^2 - \frac{64}{x} - 3x\right]_2^4 - 9 \times 2 + 2 \times (17 - 9) = 22 - 18 + 16 = 20$	dM1, A1
		(5)
		(9 marks)

Question Number	Scheme	Marks
7 (i)	$(2\theta =)\arctan\left(\frac{5}{7}\right)$	M1A1
	$(\theta =)$ awrt $17.8°, 107.8°$	dM1A1
		(4)
(ii)	$24\tan x = 5\cos x \Rightarrow 24\sin x = 5\cos^2 x$ oe	M1
	$\Rightarrow 24\sin x = 5(1 - \sin^2 x)$	dM1
	$\Rightarrow 5\sin^2 x + 24\sin x - 5 = 0$	A1
	$\Rightarrow \sin x = \frac{1}{5}$	ddM1
	$\Rightarrow (x =)$ awrt $0.201, 2.940$	A1
		(5)
		(9 marks)

Question	Answer	Marks	Guidance
5(a)	Carry out division at least as far as x^2+kx or equivalent …	**M1**	OE, e.g. comparing coefficients with coefficient of x^2 equal to 1 and attempt at a second coefficient.
	Obtain quotient $x^2+4x+12$	**A1**	
	Confirm remainder is 7	**A1**	AG
		3	
5(b)	Include $(x-2)^2$ as a factor	**M1**	Must be a product of factors only **SC B1** for $\left(x^2-4x+4\right)\left(x^2+4x+12\right)$
	Conclude $(x-2)^2(x^2+4x+12)$	**A1**	isw any attempt to factorise the quotient.
		2	
5(c)	Apply logarithms and use power law for $e^{-3y}=k$ where $k>0$	**M1**	
	Obtain $y=-\frac{1}{3}\ln 2,\ \frac{1}{3}\ln\frac{1}{2}$	**A1**	Or exact equivalent Must be simplified e.g. not lne or $\frac{6}{3}$ ISW extra solutions but A0 if undefined solutions are included.
		2	

Question	Answer	Marks	Guidance
1(a)	State or imply $2y\ln a=3x+k$ and conclude that gradient is $\frac{3}{2\ln a}$	**B1**	AG – necessary detail needed.
		1	
1(b)	Equate $\frac{3}{2\ln a}$ to gradient of line	**M1**	
	Obtain $\frac{3}{2\ln a}=\frac{2.85}{2.9}$ or equivalent and hence obtain $a=4.6$ or $a=e^{\frac{29}{19}}$	**A1**	Allow greater accuracy.
	Substitute appropriate values to find value of k	**M1**	
	Obtain $k=1.7$	**A1**	
	Alternative Method for Question 1(b)		
	Obtain $0.95(2\ln a)=3(0.4)+k$ or $a^{1.9}=e^{1.2+k}$	**M1**	OE
	Obtain $3.80(2\ln a)=3(3.3)+k$ or $a^{7.6}=e^{9.9+k}$	**M1**	OE
	Obtain $a=4.6$ or $a=e^{\frac{29}{19}}$	**A1**	Allow greater accuracy.
	Obtain $k=1.7$	**A1**	
		4	

Question Number	Scheme	Marks
2 (a)	Strip width = 1.5	B1
	$\frac{3}{4}\{4.16+2.28+2\times(2.91+a+1.73+1.37+1.43)\}=19.3\Rightarrow a=...$	M1
	a = awrt 2.21	A1
		(3)
(b)	$\int_{-4}^{5}(2\,f(x)-3)\,dx=2\times19.3-[3x]_{-4}^{5}$	M1
	$=11.6$	A1
		(2)
		Total 5

Question	Scheme	Marks
8(i)	$3\sin(\theta+30°)=7\cos(\theta+30°)\Rightarrow\tan(\theta+30°)=\frac{7}{3}$	**B1**
	$\theta+30°=\arctan\left(\frac{7}{3}\right)\ (=66.8°)$	**M1**
	$\theta=36.8°$ or $216.8°$ (awrt)	**A1A1**
		(4)
(ii)	(a) $3\sin^3 x=5\sin x-7\sin x\cos x\Rightarrow3\sin x(1-\cos^2 x)=5\sin x-7\sin x\cos x$	**M1**
	$\Rightarrow\sin x(5-7\cos x+3\cos^2 x-3)=0$	
	$\Rightarrow\sin x(3\cos^2 x-7\cos x+2)=0$	**A1**
	(b) $\sin x=0\Rightarrow x=0$	**B1**
	$\Rightarrow\sin x(3\cos x-1)(\cos x-2)=0\Rightarrow\cos x=...$	**M1**
	$3\cos x=1\Rightarrow x=\arccos\left(\frac{1}{3}\right)=(\pm)1.23$	**M1**
	Both of x = awrt $-1.23,\ 1.23$	**A1**
		(6)
		(10 marks)

Question Number	Scheme	Marks
9 (a)	Uses $\tan\theta = \frac{\sin\theta}{\cos\theta} \rightarrow$ $\cos\theta - 1 = 4\sin\theta\frac{\sin\theta}{\cos\theta}$	M1
	$\cos^2\theta - \cos\theta = 4\sin^2\theta$ oe	A1
	Uses $\sin^2\theta = 1 - \cos^2\theta \rightarrow$ $\cos^2\theta - \cos\theta = 4(1 - \cos^2\theta)$	M1
	$5\cos^2\theta - \cos\theta - 4 = 0$ *	A1 *
		(4)
(b)	$(5\cos 2x + 4)(\cos 2x - 1) = 0$	M1
	Critical values of $-\frac{4}{5}, 1$	A1
	Correct method to find x from their $\cos 2x = -\frac{4}{5}$	dM1
	$x = 0, 1.25$	A1
		(4) **(8 marks)**

Question	Answer	Marks	Guidance
2	Attempt solution of equation or inequality, where signs of x and $4x$ are different	**M1**	
	Obtain $\frac{4}{5}$ …	**A1**	OE
	… and finally no other value	**A1**	
	Conclude $x < \frac{4}{5}$	**A1**	Allow $\left(-\infty, \frac{4}{5}\right)$.
	Alternative Method for Question 2		
	State or imply non-modulus equation $(x-7)^2 = (4x+3)^2$ or inequality	**B1**	
	Attempt solution of three-term quadratic equation or inequality	**M1**	
	Obtain finally $\frac{4}{5}$ only	**A1**	
	Conclude $x < \frac{4}{5}$	**A1**	Allow $\left(-\infty, \frac{4}{5}\right)$
		4	

Question	Scheme	Marks
10(a)	Equation of circle is $(x-3)^2+(y-5)^2=r^2$ and line is $y=2x+k$ So intersect when $(x-3)^2+(2x+k-5)^2=r^2$	M1
	$\Rightarrow x^2-6x+9+4x^2+4(k-5)x+(k-5)^2=r^2$ $\Rightarrow 5x^2+(-6+4k-20)x+9+k^2-10k+25-r^2=0$	dM1
	$\Rightarrow 5x^2+(4k-26)x+k^2-10k+34-r^2=0$ *	A1*
		(3)
(b)	Tangent to $C \Rightarrow b^2-4ac=0 \Rightarrow (4k-26)^2-4\times5\times(k^2-10k+34-r^2)=0$	M1
	$\Rightarrow 16k^2-208k+676-20k^2+200k-680+20r^2=0$ $\Rightarrow 5r^2=...$	M1
	$\Rightarrow 5r^2=k^2+2k+1=(k+1)^2$	A1
		(3)
(b) Way 2	Gradient of BX is $-\frac{1}{2}$ so equation of BX is $y-5=-\frac{1}{2}(x-3)$ $y-5=-\frac{1}{2}(x-3), y=2x+k \Rightarrow x=..., y=...\left(\frac{13-2k}{5},\frac{26+k}{5}\right)$	M1
	$\left(\frac{13-2k}{5}-3\right)^2+\left(\frac{26+k}{5}-5\right)^2=r^2$	dM1
	$\Rightarrow 5r^2=k^2+2k+1=(k+1)^2$	A1
		(3)
(c)	Triangle AXB is right angled so $AB^2+r^2=XA^2=(3-0)^2+(5-k)^2$	M1
	$AB^2=4r^2$ so $AB^2+r^2=5r^2$	M1
	$\Rightarrow 5r^2=9+(5-k)^2$	A1
	$\Rightarrow k^2+2k+1=9+25-10k+k^2$	M1
	$\Rightarrow 12k=33 \Rightarrow k=...$	dM1
	$k=\frac{11}{4}$	A1
		(6)
		(12 marks)