Mark scheme

Area under a curve

Additional Mathematics 0606 · Questions from Paper 1 and Paper 2

Total marks

57

MARKS FOR EACH QUESTION

1	2	3	4	5	6	7	8	9	10	Total
4	5	5	5	5	6	6	6	6	9	**57**

Question 1 [4]

1	$[y=]\dfrac{1}{\operatorname{cosec}5x} = \sin 5x$ nfww	**B1**	
	$\int_0^{\frac{\pi}{5}} y\,\mathrm{d}x = \left[-\dfrac{\cos 5x}{5}\right]_0^{\frac{\pi}{5}}$	**B1**	**FT** *their a*sin5*x*
	$-\dfrac{1}{5}\cos\left(5\times\dfrac{\pi}{5}\right)-\left(-\dfrac{1}{5}\cos\left(5\times 0\right)\right)$	**M1**	**FT** *their a*(*k*cos*bx*) where $k<0$ or $k=\dfrac{1}{5}$
	$\dfrac{2}{5}$	**A1**	

Question 2 [5]

2	$\dfrac{1}{3}\sin 3x-2\cos 2x+x$	**2**	**M1** for $a\sin 3x+b\cos 2x+x$, $a\neq\pm 3$ and $b\neq\pm 8$ **A1** all correct
	$\left(\dfrac{1}{3}\sin\dfrac{3\pi}{2}-2\cos\pi+\dfrac{\pi}{2}\right)-(-2)$	**M1**	**Dep** on previous **M** mark for correct substitution (seen or implied) of **both** limits in *x*
	$\dfrac{11}{3}$	**A1**	
	$\dfrac{\pi}{2}$	**B1**	From correct substitution (seen or implied) of **both** limits in *x*

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Question 3 **[5]**

3	$1+2\mathrm{e}^{2x}+\mathrm{e}^{4x}$	**B1**	For correct integrand
	$x+\mathrm{e}^{2x}+\dfrac{\mathrm{e}^{4x}}{4}$	**B2**	**B1** for 2 correct terms in integral
	$\left(2+\mathrm{e}^{4}+\dfrac{\mathrm{e}^{8}}{4}\right)-\left(1+\dfrac{1}{4}\right)$	**M1**	For correct application of limits. Must be in the form $m\mathrm{e}^{4x}+n\mathrm{e}^{2x}+x$
	$\dfrac{3}{4}+\mathrm{e}^{4}+\dfrac{\mathrm{e}^{8}}{4}$	**A1**	

Question 4 **[5]**

4	$(\sin\theta+\cos\theta)^2+(\sin\theta-\cos\theta)^2=2$	**2**	**M1** for expansion of both terms with an attempt to simplify either using the correct identity or eliminating terms in $2\sin\theta\cos\theta$
	$\int 2\ \mathrm{d}\theta=2\theta$	**M1**	**Dep M1**
	$\int_{\frac{\pi}{2}}^{\frac{3\pi}{2}} 2\ \mathrm{d}\theta=3\pi-\pi$ $=2\pi$	**2**	**Dep M1** for correct use of limits

Question 5 **[5]**

5	$\ln(4x+3)$	**B1**	
	$2\ln(8a+7)-2\ln(3)\ \ (=\ln 16)$	**M1**	**Dep** for correct application of limits in *their* $k\ln(4x+3)$
	$(2)\ln\dfrac{8a+7}{3}$ oe	**M1**	**Dep** for use of division rule
	$\ln 16=2\ln 4$ oe	**B1**	
	$a=\dfrac{5}{8}$ only	**A1**	

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Question 6 [6]

6(i)	$\frac{\mathrm{d}}{\mathrm{d}x}\left(\frac{5}{3x+2}\right)=-5(3x+2)^{-2}\times 3$	**M1**	$-5(3x+2)^{-2}$
		A1	$\times 3$
6(ii)	$\int \frac{30}{(3x+2)^2}\,\mathrm{d}x=\left[\frac{-10}{(3x+2)}\right]$	**M1**	$\frac{1}{(3x+2)}$
		A1	$\times -10$
6(iii)	$\left[\frac{-10}{(3x+2)}\right]_1^2=-\frac{10}{8}+\frac{10}{5}$	**M1**	Insert limits and subtract
	$=\frac{3}{4}$	**A1**	

Question 7 [6]

7	$\frac{(x+1)^2}{x^2}=\frac{x^2+2x+1}{x^2}=1+\frac{2}{x}+\frac{1}{x^2}$	**2**	**B1** for expanding numerator seen anywhere. **M1** for attempt to divide *their* three term numerator by x^2.
	$\int 1+\frac{2}{x}+\frac{1}{x^2}\mathrm{d}x=x+2\ln x-\frac{1}{x}+(c)$	**2**	**A2/1/0** minus 1 each error or omission.
	$\left[4-2\ln 4-\frac{1}{4}\right]-\left[2+2\ln 2-\frac{1}{2}\right]$	**M1**	**Dep** insert 4 and 2 into *their* three or two term integrand and subtract correctly.
	$=\frac{9}{4}+2\ln 2$	**A1**	oe must be exact two terms. isw

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Question 8 [6]

8(a)	$2x^2+5x-\frac{1}{2}\ln(2x+3)+c$ oe	**B3**	**B2** for $2x^2+5x-\frac{1}{2}\ln(2x+3)$ or $2x^2+5x-\frac{1}{2}\ln 2x+3+c$ or $2x^2+5x+k\ln(2x+3)+c$ with $k\neq 0$ or **B1** for $2x^2+5x+\ldots+c$ or $\ldots-\frac{1}{2}\ln 2x+3$ or $\ldots+k\ln(2x+3)$ with $k\neq 0$
8(b)	Substitutes limits and subtracts in correct order	**M1**	**FT** *their* part (a) providing it includes a term $k\ln(2x+3)$ with $k\neq 0$
	$\left[18+15-\frac{1}{2}\ln 9\right]-\left[2+5-\frac{1}{2}\ln 5\right]$	**A1**	
	$26-\frac{1}{2}\ln\frac{9}{5}$ or $26+\frac{1}{2}\ln\frac{5}{9}$ oe	**A1**	

Question 9 [6]

9	$\int e^{\frac{t}{4}}\,dt=4e^{\frac{t}{4}}(+c)$ and $\int\frac{16e}{t^2}dt=\frac{-16e}{t}(+c)$	**B3**	**B2** for either correct or **B1** for $\int e^{\frac{t}{4}}\,dt=ae^{\frac{t}{4}}(+c)$ where a is a constant, $a>0$ or $\int\frac{16e}{t^2}dt=\frac{-b}{t}(+c)$ where b is a constant $b>0$
	Correct plan: $\int_0^4 e^{\frac{t}{4}}\,dt+\int_4^k\frac{16e}{t^2}dt=13.4$ soi	**M1**	
	Correct equation: $4e^1-4e^0+\left(-\frac{16e}{k}+\frac{16e}{4}\right)=13.4$ OR [When $t=4$ $s=4e-4$ When $t=k$ $s=\frac{-16e}{k}+8e-4$ and] $13.4=\frac{-16e}{k}+8e-4$	**A1**	**dep** on **B3**; implies **M1**
	$k=10$ or awrt 10.0	**A1**	dep on all previous marks awarded

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Question 10 **[9]**

10(a)	$a(5x-2)^{\frac{1}{3}}$	**M1**	
	$\frac{3}{5}(5x-2)^{\frac{1}{3}}$ oe	**A1**	
	$\frac{3}{5}\left(18^{\frac{1}{3}}-2\right)$ or exact equivalent	**2**	**Dependent M1** for correct use of limits

10(b)	$2\ln(2x+1)$ oe	**B1**	
	$-\frac{4}{2x+1}$ oe	**B1**	
	$\left(2\ln 2-\frac{4}{2}\right)-(-4)$	**M1**	For correct substitution of limits, must be using the form $a\ln(2x+1)+\frac{b}{2x+1}$
	$\ln 4+2$	**2**	**A1** for each term

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