Question	Answer	Marks	Guidance
1(a)	$-3 < x < 1 \quad x > 5$	**B1**	
1(b)	$-\frac{1}{3}(x+3)(x-1)(x-5)$	**3**	**B1** for a negative cubic function **B1** for a cubic function multiplied by $\frac{1}{3}$ **B1** for $(x+3)(x-1)(x-5)$
2(a)	$a = \frac{10}{3}$ or $3\frac{1}{3}$	**B1**	
	$b = \frac{7}{3}$ or $2\frac{1}{3}$	**B1**	
	$c = \frac{9}{2}$ or $4\frac{1}{2}$ or 4.5	**B1**	
2(b)	$10(2^p)^2 - 17(2^p) + 3 = 0$ $(5(2^p)-1)(2(2^p)-3) = 0$ $2^p = \frac{1}{5}, \ 2^p = \frac{3}{2}$	**M1**	For recognition of a quadratic in 2^p, attempt to factorise and solve for 2^p
	$p = \frac{\ln\frac{1}{5}}{\ln 2}$ or $p = \frac{\ln 1.5}{\ln 2}$ oe	**M1**	For correct attempt to deal with $2^p = k$
	–2.32	**A1**	
	0.585	**A1**	
3(a)	$\lg\frac{1000a^2}{b^4}$	**4**	**B1** for $3 = \lg 1000$
			B1 for use of power rule once
			B1 for use of addition or subtraction rule once
			B1 All correct

Question	Answer	Marks	Guidance
3(b)	**Either** $3\log_a 4 = \dfrac{3}{\log_4 a}$	**B1**	
	$2(\log_4 a)^2 - 7\log_4 a + 3 = 0$ $(2\log_4 a - 1)(\log_4 a - 3) = 0$ $\log_4 a = \dfrac{1}{2}$ or $\log_4 a = 3$	**M1**	For obtaining a quadratic equation and solution
	$a = 4^{\frac{1}{2}}$ or $a = 4^3$	**M1**	**Dep** For dealing with the logarithm correctly once, may be implied by a correct solution
	64	**A1**	
	2	**A1**	
	Or $2\log_4 a = \dfrac{2}{\log_a 4}$	**(B1)**	
	$3(\log_a 4)^2 - 7\log_a 4 + 2 = 0$ $(3\log_a 4 - 1)(\log_a 4 - 2) = 0$ $\log_a 4 = \dfrac{1}{3}$ or $\log_a 4 = 2$	**(M1)**	For obtaining a quadratic equation and solution
	$a^{\frac{1}{3}} = 4$ or $a^2 = 4$	**(M1)**	**Dep** For dealing with the logarithm correctly once, may be implied by a correct solution
	64	**(A1)**	
	2	**(A1)**	
4	$\tan\left(2x + \dfrac{\pi}{3}\right) = \dfrac{1}{\sqrt{3}}$	**B1**	
	$x = -\dfrac{7\pi}{12},\ -\dfrac{\pi}{12},\ \dfrac{5\pi}{12},\ \dfrac{11\pi}{12}$	**3**	**M1** for using correct order of operations **A1** for two correct solutions **A1** for two further correct solutions and no other solutions in range

Question	Answer	Marks	Guidance
5	**Either** Maximum when $\sin\frac{x}{3}=1$ or minimum when $\sin\frac{x}{3}=-1$	**M1**	For recognition that value of maximum or minimum is necessary
	$c=9$	**A1**	
	$c=-1$	**A1**	
	or $\frac{dy}{dx}=\frac{5}{3}\cos\frac{x}{3}$ When $\frac{dy}{dx}=0$, $\sin\frac{x}{3}=+1$ or -1	**(M1)**	For differentiation, equating to zero to obtain values for $\sin\frac{x}{3}$
	$c=9$	**(A1)**	
	$c=-1$	**(A1)**	
6(a)	$0=-\frac{5}{4}+\frac{a}{4}+5+b$	**M1**	For use of the factor theorem
	$-24=-10+a+10+b$	**M1**	For use of the remainder theorem
	$a+4b=-15$ $a+b=-24$ leading to	**M1**	**Dep** on both previous **M** marks for solution of *their* equations without using a calculator
	$a=-27$, $b=3$	**A1**	
6(b)	$(2x+1)(5x^2..........+\textit{their}\ \ b)$	**M1**	Allow for observation or algebraic long division. *Their a* and *b* must be integers.
	$(2x+1)(5x^2-16x+3)$	**A1**	
	$(2x+1)(5x-1)(x-3)$	**2**	**M1** for attempt to factorise *their* 3-term quadratic **A1** all correct from fully correct working
6(c)	3	**B1**	**FT** on *their* (integer) *b*
7(a)(i)	**b** – **a**	**B1**	
7(a)(ii)	**c** – **b**	**B1**	

Question	Answer	Marks	Guidance
7(a)(iii)	$n\overrightarrow{AB} = m\overrightarrow{BC}$	**M1**	For substitution of *their* **(i)** and **(ii)** into $n\overrightarrow{AB} = m\overrightarrow{BC}$
	$n\mathbf{a} + m\mathbf{c} = (m+n)\mathbf{b}$	**A1**	For correct manipulation to obtain the **given answer**
7(b)	$2\lambda - 4\mu + 4 = 4\lambda + 4$ or $\lambda + 7\mu - 7 = -2\lambda - 2$	**M1**	For equating like components at least once, allow unsimplified
		M1	**Dep** for solving *their* equations to obtain both λ and μ
	$\mu = 5$	**A1**	
	$\lambda = -10$	**A1**	
8(a)	**Either** Starting with a 6: 120 ways	**B1**	May be implied by final answer
	Starting with 5, 7 or 9: 540 ways	**B1**	May be implied by final answer
	Total 660	**B1**	
	Or Alternative 1 Ending with a 6: 180 ways	**(B1)**	May be implied by final answer
	Ending with 0 or 4: 480ways	**(B1)**	May be implied by final answer
	Total 660	**(B1)**	
	Or Alternative 2 11 ways of obtaining even 5-digit numbers which start with 5, 6, 7, 9	**(B1)**	For $11 \times k$ May be implied by final answer
	${}^5P_3$ ways of arranging remaining 3 digits: 60	**(B1)**	For $m \times 60$ where m is from an attempt to list all cases for first and last digits May be implied by final answer
	$11 \times 60 = 660$	**(B1)**	
	Or Alternative 3 Total arrangements ${}^7P_5$ minus (all odds + evens starting with 1 + evens starting with 0 or 4) = 2520 – (1440 + 180 + 240)	**(B2)**	For 2520 – (1440 + 180 + 240)
	660	**(B1)**	

Question	Answer	Marks	Guidance
8(b)	$\frac{n!}{(n-4)!4!} = \frac{6n!}{(n-2)!2!}$	**B1**	
	$(n-2)(n-3) = 72$	**2**	**B1** for $(n-2)(n-3)$
			B1 for 72
	$n = 11$ only	**2**	**M1** for correct attempt to form and solve a quadratic equation **A1** for $n = 11$ only
9(a)	$AOD = 2 \times \tan^{-1}\left(\frac{2}{3}\right)$	**M1**	For correct method to find *AOD*
	$AOD = 1.1760...$ $AOD = 1.176$ [to 3dp]	**A1**	Need to see 4 dp or more to justify 3 dp answer
9(b)	Major arc $MN = (2\pi - 1.176)12$	**B1**	
	ND or *MA* $= 12 - \sqrt{13}$	**B1**	
	Perimeter = major arc *MN* + *MA* + *ND* + 16 oe	**B1**	For *their* values in a correct plan, may be implied by a correct answer
	Perimeter = 94.1	**B1**	
9(c)	Minor sector area = $\frac{1}{2} \times 1.176 \times 12^2$ **or** Major sector area = $\frac{1}{2} \times (2\pi - 1.176) \times 12^2$	**B1**	
	Area = major sector area – remainder of rectangle or Area = area of circle – minor sector area – remainder of rectangle or Area = circle – rectangle – minor sector + triangle *AOD*	**B1**	For *their* values in a correct plan, may be implied by a correct answer
	Area = 350	**B1**	Allow greater accuracy
10(a)	At *A* $y = 4$	**B1**	
	At *B* $y = \frac{13}{16}$ or 0.8125	**B1**	

Question	Answer	Marks	Guidance
10(b)	**Either** Area of trapezium = $\frac{231}{32}$	**B1**	Allow unsimplified
	$\int_{-1}^{2}\frac{1}{(x+2)^2}+\frac{3}{x+2}\,dx$ $=\left[-\frac{1}{x+2}+3\ln(x+2)\right]_{-1}^{2}$	**2**	**B1** for $-\frac{1}{x+2}$ **B1** for $3\ln(x+2)$
	$\left[\left(-\frac{1}{4}+3\ln 4\right)-(-1)\right]$	**M1**	For correct use of limits in *their* integral, but must have at least one of the two preceding **B** marks
	Area = $\frac{207}{32}-\ln 64$	**2**	**A1** for $\frac{207}{32}$ **A1** for $-\ln 64$
	Or $\int_{-1}^{2}-\frac{17}{16}x+\frac{47}{16}-\frac{1}{(x+2)^2}-\frac{3}{x+2}\,dx$ $\left[\left(-\frac{17}{32}x^2+\frac{47}{16}x+\frac{1}{x+2}-3\ln(x+2)\right)\right]_{-1}^{2}$	**(3)**	**B1** for $-\frac{17}{32}x^2+\frac{47}{16}x$ **B1** for $\int\frac{1}{(x+2)^2}dx=-\frac{1}{(x+2)}$ **B1** for $\int\frac{3}{x+2}dx=3\ln(x+2)$
	$\left(-\frac{17}{8}+\frac{47}{8}+\frac{1}{4}-3\ln 4\right)-\left(-\frac{17}{32}-\frac{47}{16}+1\right)$	**(M1)**	For correct use of limits in *their* integral, but must have at least one of the two preceding **B** marks
	Area = $\frac{207}{32}-\ln 64$	**(2)**	**A1** for $\frac{207}{32}$ **A1** for $-\ln 64$
11(a)(i)	0	**B1**	
11(a)(ii)	–3	**B1**	
11(a)(iii)	$\left(\frac{1}{2}(25+15)\times 30\right)+\left(\frac{1}{2}(30+60)\times 10\right)+\left(\frac{1}{2}\times 20\times 60\right)$	**M1**	For an unsimplified expression for the required area allowing at most one incorrect length
	Total distance = 1650	**A1**	
11(b)(i)	$v=4\cos\frac{5\pi}{3}-4$ $=-2$	**M1**	
	Speed = 2	**A1**	

Question	Answer	Marks	Guidance
11(b)(ii)	$a = -12\sin 3t$	**B1**	
	$\sin 3t = 0$ $3t = \pi$ Leading to	**M1**	For equating to zero and attempt to solve to obtain *t*, allow if in degrees
	$t = \frac{\pi}{3}$	**A1**	
11(b)(iii)	$s = k\sin 3t - 4t\left(+c\right)$	**M1**	
	$s = \frac{4}{3}\sin 3t - 4t$	**A1**	