4752 **January 2013**

Question			Answer	Marks	Guidance	
1			$kx^{\frac{5}{2}}$	M1		
			$k = 12$	A1		
			$+ c$	A1 **[3]**		
2	**(i)**		converging + valid reason	1 **[1]**		eg converges to 0, $r = \frac{1}{2}$, difference between terms decreasing, sum of terms converges to 6, G.P. with $|r| < 1$
2	**(ii)**		neither + valid reason	1 **[1]**		eg divergent oe, A.P., $d = 4$ oe, convergent and periodic ruled out with correct reasons
2	**(iii)**		periodic + valid reason	1 **[1]**		eg repeating cycle of terms
3	**(i)**		$(0.8, -2)$ oe	2 **[2]**	**B1** each coordinate	**SC0** for $(4, -2)$
3	**(ii)**		Translation $\begin{pmatrix} 90 \\ 0 \end{pmatrix}$ oe	B1 B1 **[2]**	or eg 270 to left	allow **B2** for rotation through 180° about $(45, 0)$ oe

Question			Answer	Marks	Guidance	
4	**(i)**		$1.2r = 4.2$	M1	or $\dfrac{68.7549...}{360} \times 2\pi r = 4.2$ with θ to 3 sf or better	**B2** if correct answer unsupported
			3.5 cao	A1		
				[2]		
4	**(ii)**		$\cos 0.6 = \dfrac{d}{\text{their}3.5}$	M1	or $\cos 34.377.. = \dfrac{d}{\text{their}3.5}$ with θ to 3 sf or better	or correct use of Sine Rule with 0.9708 (55.623°) or area $= 5.709 = 0.5 \times h \times 3.952$, or $3.5^2 - 1.976^2 = d^2$
			$2.888..$ to 2.9	A1		
				[2]		
5			gradient $= \dfrac{4\sqrt{9.5} - 12}{9.5 - 9}$	M1		$4\sqrt{38} - 24\ 4\sqrt{38} - 24$
			0.6577 to 0.66	A1	or $0.657656...$isw	
			$9 < x_C < 9.5$	B1		allow $8.53 \le x_C < 9$
				[3]		
6			$6x^2 + 18x - 24$	B1		
			their $6x^2 + 18x - 24 = 0$ or > 0 or ≥ 0	M1		or sketch of $y = 6x^2 + 18x - 24$ with attempt to find x-intercepts
			-4 and $+1$ identified oe	A1		
			$x < -4$ and $x > 1$ cao	A1	or $x \le -4$ and $x \ge 1$	if **B0M0** then **SC2** for fully correct answer
				[4]		

Question			Answer	Marks	Guidance
7			$\cos A = \dfrac{105^2 + 92^2 - 75^2}{2 \times 105 \times 92}$ oe	M1	or $\cos B = \dfrac{75^2 + 92^2 - 105^2}{2 \times 75 \times 92}$ oe or $\cos C = \dfrac{105^2 + 75^2 - 92^2}{2 \times 105 \times 75}$ oe
			0.717598…soi	A1	0.2220289…soi 0.519746…soi
			A = 44.14345…° soi [0.770448553…]	A1	B = 77.1717719……° soi [1.346901422] C = 58.6847827…° soi [1.024242678…]
					ignore minor errors due to premature rounding for second **A1** condone *A*, *B* or *C* wrongly attributed
			½ × 92 × 105 × sin (*their* A)	M1	or ½ × 75 × 92 × sin (*their* B) or ½ × 75 × 105 × sin (*their* C)
			3360 or 3361 to 3365	A1	**or** **M3** for $\sqrt{136(136-75)(136-105)(136-92)}$ **A2** for correct answer 3360 or 3363 - 3364
				[5]	
8	**(i)**			M1	for curve of correct shape in both quadrants **SC1** for curve correct in 1st quadrant and touching (0,1) or identified in commentary
				A1	through (0, 1) shown on graph or in commentary
				[2]	

Question			Answer	Marks	Guidance	
8	**(ii)**		$5x - 1 = \dfrac{\log_{10} 500\,000}{\log_{10} 3}$	M1	or $5x - 1 = \log_3 500\,000$	condone omission of base 10 use of logs in other bases may earn full marks
			$x = (\dfrac{\log_{10} 500\,000}{\log_{10} 3} + 1) \div 5$	M1	$x = (\log_3 500000 + 1) \div 5$	
			$[x =]\ 2.588$ to 2.59	A1	oe; or **B3** www	if unsupported, **B3** for correct answer to 3 sf or more www
				[3]		
9	**(i)**		$(\dfrac{\frac{\sin\theta}{\cos\theta}}{\cos\theta}) = 1$ oe	M1		
			$\sin\theta = \cos^2\theta$ and completion to given result	A1	www	
				[2]		
9	**(ii)**		$\sin^2\theta + \sin\theta - 1[\,= 0]$	M1	allow 1 on RHS if attempt to complete square	condone $y^2 + y - 1 = 0$
			$[\sin\theta =]\dfrac{-1 \pm \sqrt{5}}{2}$ oe may be implied by correct answers	A1	may be implied by correct answers	mark to benefit of candidate ignore any work with negative root & condone omission of negative root with no comment eg **M1** for 0.618…
			$[\theta =]\ 38.17...$,or 38.2 and 141.83..., 141.8 or 142	A1	ignore extra values outside range, **A0** if extra values in range or in radians **NB** 0.6662 and 2.4754 if working in radian mode earns **M1A1A0**	if unsupported, **B1** for one of these, **B2** for both. If both values correct with extra values in range, then **B1**. **NB** 0.6662 and 2.4754 to 3sf or more
				[3]		

Question			Answer	Marks	Guidance	
10	**(i)**		at A $y = 3$	B1		
			$\dfrac{dy}{dx} = 2x - 4$	B1		
			their $\dfrac{dy}{dx} = 2 \times 4 - 4$	M1*	must follow from attempt at differentiation	
			grad of normal $= {}^{-1}/_{\text{their 4}}$	M1dep*		
			$y - 3 = ({}^{-1}/_4) \times (x - 4)$ oe isw	A1		
			substitution of $y = 0$ and completion to given result with at least 1 correct interim step www	A1	or substitution of $x = 16$ to obtain $y = 0$	correct interim step may occur before substitution
				[6]		
10	**(ii)**		at B, $x = 3$	B1	may be embedded	
			$F[x] = \dfrac{x^3}{3} - \dfrac{4x^2}{2} + 3x$	M1*	condone one error, must be three terms, ignore $+ c$	
			$F[4] - F[\text{their } 3]$	M1* dep	dependent on integration attempted	
			area of triangle $= 18$ soi	B1		may be embedded in final answer
			area of region $= 19\dfrac{1}{3}$ oe isw	A1	19.3 or better	
				[5]		

Question			Answer	Marks	Guidance	
11	(i)	(A)	$2A + D = 25$ oe $4A + 6D = 250$ oe $D = 50$, $A = -12.5$ oe **[4]**	B1 B1 B1 B1		condone lower-case a and d
11	(i)	(B)	$\dfrac{50}{2}\left(2 \times theirA + 49 \times their D\right)$ [= 60 625] or $\dfrac{20}{2}\left(2 \times their\,A + 19 \times their\,D\right)$ [= 9250] their "$S_{50} - S_{20}$" 51 375 cao **[3]**	M1 M1 A1	or $a =$ their $A + 20D$ $S_{30} = \dfrac{30}{2}(a + l)$ oe with $l =$ their $A + 49D$	$S_{30} = \dfrac{30}{2}(2 \times their987.5 + 29 \times their50)$

Question			Answer	Marks	Guidance
11	(ii)		$\dfrac{a(r^2-1)}{r-1}=25$ or $\dfrac{a(r^4-1)}{r-1}=250$	B1	
			$\dfrac{a\dfrac{(r^4-1)}{r-1}}{a\dfrac{(r^2-1)}{(r-1)}}=\dfrac{250}{25}$ oe and completion to given result www	M1	at least one correct interim step required allow $a(1+r)$ as the denominator in the quadruple- decker fraction
			use of $r^4-1=(r^2-1)(r^2+1)$ to obtain $r^2+1=10$ www	M1	or multiplication and rearrangement of quadratic to obtain $r^4-10r^2+9=0$ oe with all three terms on one side $r^2=x$ oe may be used or **M1** for valid alternative algebraic approaches eg using $a(1+r)=25$ <u>and</u> $ar^2+ar^3=ar^2(1+r)=225$
			$r=\pm 3$	A1	or **B2** for all four values correct, **B1** for both r values or both a values or one pair of correct values if second **M** mark not earned
			$a=6.25$ or -12.5 oe	A1	or **A1** for one correct pair of values of r and a
				[5]	
12	(i)		$\log_{10}p=\log_{10}a+\log_{10}10^{kt}$	M1	condone omission of base; if unsupported, **B2** for correct equation
			$\log_{10}p=\log_{10}a+kt$ www	A1	
				[2]	
12	(ii)		2.02, 2.13, 2.23	B1	allow given to more sig figs 2.022304623…, 2.129657673, 2.229707433
			plots correct ruled line of best fit	B1f.t. B1	to nearest half square y-intercept between 1.65 and 1.7 and at least one point on or above the line and at least one point on or below the line ft their plots must cover range from $x=9$ to 49
				[3]	

4752   **Mark Scheme**   **January 2013**

Question			Answer	Marks	Guidance	
12	**(iii)**		0.0105 to 0.0125 for k	B1		must be connected to k
			1.66 to 1.69 for $\log_{10}a$ or 45.7 to 49.0 for a	B1		must be connected to a
			$\log_{10}p = $ their kt + their $\log_{10}a$	B1	must be a correct form for equation of line and with their y-intercept and their gradient (may be found from graph or from table, must be correct method)	
			$p = $ their "$47.9 \times 10^{0.0115t}$"or $10^{1.6785+0.0115t}$ "	B1	as above, "47.9" and "0.0115" must follow from correct method	
				[4]		
12	**(iv)**		45.7 to 49.0 million	1	'million' needed, not just the value of p	
				[1]		
12	**(v)**		reading from graph at 2.301..	M1*	or $\log_{10}200 = $ "$\log_{10}a + kt$"	or $200 = $ "$10^{\log a + kt}$" oe
			their 54	M1dep*	eg for their $t = \dfrac{\log 200 - 1.68}{0.0115}$	or **M1** for their $t = \dfrac{\log \dfrac{200}{47.9}}{0.0115}$
			2014 cao	A1	if unsupported, allow **B3** only if consistent with graph	
				[3]		