Pure Core 2 Past Paper Questions: Mark Scheme

Taken from MAME, MAP1, MAP2, MAP3

Methods November 2003

5 (a)	$p=\left(2^3\right)^{\frac{1}{2}}=2^{\frac{3}{2}}$	B1	1	Convincingly shown (AG)
(b)	$q=\left(2^2\right)^{\frac{3}{4}}=2^{\frac{3}{2}}$	B1	1	
(c)	Addition of indices	M1		OE
	$pq=2^3$	A1F	2	Allow $2^{\frac{6}{2}}$; ft wrong answer to (b)
	Total		**4**	

Pure 1 January 2001

Q	Solution	Marks	Total	Comments
1 (a)	Differentiation	M1		at least one term correct
	$y' = 2x + 2x^{-3}$	A1		accept unsimplified
	$\cdots = 4\frac{1}{4}$ when $x=2$	A1F	3	f.t numerical or sign error
(b)	Integration	M1		at least one term correct
	$\int y\,dx = \frac{1}{3}x^3 + x^{-1}\ (+c)$	A1	2	accept unsimplified
	Total		**5**	
3 (a)	Arc length = 4.5 cm	B1	1	condone misuse/omission of units
(b)	Use of sector area formula	M1		OE; award M1 even if degrees used
	Sector area = 6.75 cm^2	A1	2	allow all marks for sector and triangle whether done in (b) or (c)
(c)	Triangle area = $\frac{1}{2}\left(3^2\right)\sin 1.5$	M1		
	$\cdots \approx 4.49\text{ cm}^2$	A1		PI
	Subtraction	m1		
	Segment area $\approx 2.26\ (\approx 2.3)\text{ cm}^2$	A1	4	convincingly found (AG)
	Total		**7**	

5 (a)	Length of 4th piece is ar^3 $\cdots = 8$ metres	M1 A1	2	condone omission of units
(b)	Use of formula for sum to infinity Sum to infinity $= \frac{27}{1-\frac{2}{3}} = 81$	M1 A1	2	with numbers substituted; OE e.g. sum to n terms convincingly found (AG)
(c)	Use of formula for sum to n terms Sum to 11 terms $= \frac{27\left(1-\left(\frac{2}{3}\right)^{11}\right)}{1-\frac{2}{3}}$ $\cdots \approx 80.06 \quad (>80)$	M1 A1 A1	3	with numbers substituted; OE e.g. add 11 terms $\frac{27-\left(\frac{2}{3}\right)^{11}}{1-\frac{2}{3}}$ earns M1A0A0 accurate value needed (> 80 given)
(d)	$u = 27\left(\frac{2}{3}\right)^{10}$ Use of log law(s) $\ln u = \ln 27 + 10(\ln 2 - \ln 3)$ $\cdots = 10\ln 2 - 7\ln 3$	B1 M1 A1F A1F	4	OE at least one law appropriately used f.t 11 instead of 10 f.t one small error
	Total		**11**	

Pure 1 June 2001

1	a	Use of correct formula for AP (OE)	M1		with values inserted, mostly correct
		All values correct	A1		
		Sum is 75 150	A1	3	NMS 2/3
	b	Use of correct formula for finite GP	M1		with values inserted, mostly correct
		All values correct	A1		
		Sum is $3^n - 1$	A1	3	ie $p = 3$, $q = 1$: condone $q = -1$ if no other error seen; NMS 2/3
				6	
4	a	Use of $\sin^2\theta + \cos^2\theta \equiv 1$	M1		
		$2s^2 + s - 1 = 0$	A1	2	convincingly shown (AG)
	b	Solving appropriate quadratic	M1		
		$\sin\theta = \frac{1}{2}$ or -1	A1		Allow NMS
		Any one correct root	B1		Condone degrees or dec approx here
		Roots are $\pi/6$, $5\pi/6$, $3\pi/2$	B1	4	B0 if other values given between 0 and 2π
	c	At least one of c's values halved	M1		
		All of c's values halved	A1F	2	Must be more than one root found
				8	
5	a	$y = x^{5/2}$	B1	1	
	b	$\frac{dy}{dx} = \frac{5}{2}x^{3/2}$	M1A1		M1 for kx^{p-1} with c's non-integer value of p
		$\ldots = 67\frac{1}{2}$	A1F	3	ft wrong coefficient of $x^{3/2}$
				4	

Pure 1 January 2002

Q	Solution	Marks	Total	Comments
1 (a)	Use of $y' = nx^{n-1}$	M1		coeff or index right or both approx right
	$y' = \frac{1}{3}x^{\frac{-2}{3}}$	A1	2	
(b)(i)	$\int y\,dx = \frac{x^{n+1}}{n+1}(+c)$	M1		Coeff or index right or consistent with each other
	$= \frac{x^{\frac{4}{3}}}{4/3}(+c)$	A1	2	Accept unsimplified
(ii)	Substituting $x = 8$ in integral	M1		not in y or in y'
	$\int_0^8 \ldots = 12$	A1F	2	ft wrong coeff of $x^{4/3}$; allow decimals
	Total		**6**	
2 (a)	$\log_2 8 = 3$ because $2^3 = 8$	E1	1	OE; AG
(b)(i)	$\log_2(8^4) = 12$	B1	1	
(ii)	Use of at least one log law	M1		OE, eg $\frac{1}{\sqrt{8}} = 8^{-1/2}$
	$\log_2\left(\frac{1}{\sqrt{8}}\right) = -\frac{3}{2}$	A1	2	NMS B1 for AWRT −1.5
	Total		**4**	
3 (a)	Use of formula for nth term of AP	M1		allow M1 for, eg, $15+3n$
	nth term $= 15 + 3(n-1)$	A1	2	
(b)	Formula for sum of AP	M1		allow even if formula not used
	Total time $= \frac{1}{2}n(30 + 3(n-1))$ days	A1F		ft wrong answer to (a)
	$= \frac{3}{2}n(n+9)$ days	A1	3	convincingly found (AG)
(c)	$\frac{3}{2}n(n+9) = 600$	M1		With attempt to solve quadratic
	$(n+25)(n-16) = 0$	m1		Accept full list of 16 terms (3/3)
	Length = 16 miles	A1	3	NMS B2 for $n = 16$
	Total		**8**	

Question 5b

(b)(i)	Formula for sector area	M1		allow even if not used; condone degrees here (M1 A0)
	Area $A = 25\theta$ cm^2	A1	2	condone omission of units; accept unsimplified but not in terms of r
(ii)	Appropriate use of tan θ (OE)	M1		in finding area of Δ
	Area $\Delta = \frac{1}{2}OP \times PT = \frac{25}{2}\tan\theta$ cm^2	A1	2	accept unsimplified
(iii)	Area B is twice Δ minus A	M1		
	ie $25(\tan\theta - \theta)$ cm^2	A1	2	convincingly obtained (AG)
(iv)	Equating answers to part (i) and part (iii)	M1		dependent on M1 in part (i)
	$25(\tan\theta - \theta) = 25\theta$, hence result	A1	2	ditto
(v)	$\theta \approx 1.2$(AWRT)	B1F	1	condone use of other methods or NMS; ft wrong interval of correct width in part (a)(ii)

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2 (a)	Correct formula for sum of AP stated.	M1		
	All values substituted	m1		
	Sum 392	A1	3	NMS 3/3
(b)(i)	Terms 47, 44, 41, 38	B2, 1	2	B1 for 47 or consistent errors
(ii)	16 positive terms justified	E2, 1	2	E1 for partial reasoning, e.g. $u_{16} = 2$
	Total		**7**	

5 (a)(i)	$\sin\frac{\pi}{4}=\frac{1}{\sqrt{2}}$	B1		OE exact value
(ii)	$\cos\frac{\pi}{6}=\frac{\sqrt{3}}{2}$	B1		ditto
(iii)	$\tan\frac{\pi}{3}=\sqrt{3}$	B1	3	ditto
(b)	$\sin^2 x=\frac{1}{2}\Rightarrow \sin x=(\pm)\frac{1}{\sqrt{2}}$	M1		Accept degrees or decimal approximation throughout (b) and (c) (at least 2 DP)
	One x - coordinate is $\frac{\pi}{4}$	A1		NMS 2/2
	Other is $\pi-\frac{\pi}{4}=\frac{3\pi}{4}$	A1F	3	ft first value wrong; allow NMS
(c)	$\sin^2 x>\frac{1}{2}\Leftrightarrow \frac{\pi}{4}<x<\frac{3\pi}{4}$	B2F	2	ft wrong values in (b); condone $\leq$ for $<$
(d)	$\sin^2 x+\cos^2 x=1$ stated	M1		or complete method based on earlier results
	Conclusion (AG)	A1	2	
	Total		**10**	

Q	Solution	Marks	Total	Comments
6 (a)(i)	$\alpha=\frac{\pi}{3}$	B1	1	Condone decimal approximation here
(ii)	Arc length $=r\alpha$	M1		OE; Allow even if not used
	$\ldots=2\pi$ cm	A1	2	Condone dec and/or no units
(iii)	Area $\Delta=\frac{1}{2}bc\sin\alpha$	M1		OE; must be used
	Correct use of $\sin 60^\circ=\frac{\sqrt{3}}{2}$	m1		OE, eg Pythagoras and $\sqrt{27}=3\sqrt{3}$
	Area $9\sqrt{3}\text{ cm}^2$	A1	3	convincingly found (AG)
(iv)	Sector area $=\frac{1}{2}r^2\alpha$	M1		OE; Allow even if not used
	Both values substituted	m1		
	$\ldots=6\pi\text{ cm}^2$	A1	3	convincingly found (AG)
(b)(i)	Total length $=3\times$ length of arc BC	M1		PI
	$\ldots\approx 19$ cm	A1F	2	Accept AWRT 19; condone omission of units; NMS 2/2 ft wrong answer to (a)(ii) provided M1 earned there
(ii)	Segment area considered	M1		PI
	Total area = 3(segment)+ triangle	m1		OE; condone halving of this area
	$\ldots\approx 25\text{ cm}^2$	A1	3	Accept AWRT 25; condone omission of units
	Total		**14**	

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2 (a)	$u_1 = 10.5$, $u_2 = 11$	B1B1	2	Allow 1/2 for answers 10, 10.5
(b)	Common difference is 0.5	B1	1	
(c)	$10 + 0.5n = 25 \Rightarrow 0.5n = 15$	M1		
	$\ldots \Rightarrow n = 30$	A1	2	NMS 2/2
(d)	Formula for sum of AP stated	M1		
	$\text{Sum} = \frac{30}{2}(10.5 + 25)$	m1		OE; Allow with one error
	$\ldots = 532.5$	A1	3	NMS 3/3
	Total		**8**	
3 (a)	$\int x^{\frac{3}{2}}\,\mathrm{d}x = \dfrac{x^{\frac{5}{2}}}{\frac{5}{2}}(+c)$	M1A1		M1 for attempt at $\dfrac{x^{n+1}}{n+1}$
	Substitution and subtraction	m1		Subtraction must be the right way round
	$\int_1^4 x^{\frac{3}{2}}\mathrm{d}x = \dfrac{4^{\frac{5}{2}}}{\frac{5}{2}} - \dfrac{1^{\frac{5}{2}}}{\frac{5}{2}} = \frac{62}{5}$	A1	4	AG but allow evaluation on calculator
	Total		**8**	
4 (a)	$\log_2 8 = 3$	B1	1	
(b)	$\log_2 9 = 2\log_2 3$	B1	1	
(c)	$\log_2 72 = \log_2 8 + \log_2 9 = 3 + 2\log_2 3$	B1F	1	ft wrong answers to (a) and/or (b), even where answer not of required form
	Total		**3**	

Q	Solution	Marks	Total	Comments
5				NB Allow overspill between the parts of this question eg work for (c)(i) done in (b)
(a)	$3\dfrac{\sin\theta}{\cos\theta}=2\cos\theta \quad\Rightarrow\quad 3\sin\theta=2\cos^2\theta$	B1	1	AG: either $\dfrac{\sin\theta}{\cos\theta}$ or "$\times\cos\theta$" must be seen
(b)	$\sin^2\theta+\cos^2\theta\equiv1$ quoted	M1		
	$3\sin\theta=2(1-\sin^2\theta)$	A1		Replacing $\cos^2$ with $1-\sin^2$ in equation in (a), or replacing $\sin^2$ with $1-\cos^2$ in equation in (b)
	So $2\sin^2\theta+3\sin\theta-2=0$	A1	3	AG but condone reverse logic Must see intermediate step(s) from previous A1
(c)(i)	Attempt to solve for $\sin\theta$ $(2\sin\theta-1)(\sin\theta+2)=0$	M1		M0 for verification
	Values correct and conclusion drawn	A1		OE; NMS 2/2 for roots ½ and -2; NMS 1/2 for roots ½, 2
		A1	3	AG: impossibility of $\sin\theta\pm2=0$ must be explained correctly
(ii)	$\theta=\dfrac{\pi}{6}$	B1		Condone degrees or decimals in (ii)
	$\theta=\dfrac{5\pi}{6}$ (and no others in domain)	B1F	2	Ignore values outside domain; ft first value wrong
(iii)	$\tan\dfrac{\pi}{6}=\dfrac{1}{\sqrt3}$	B1		OE exact form
	$\cos\dfrac{\pi}{6}=\dfrac{\sqrt3}{2}$	B1	2	OE exact form
(iv)	$3\left(\dfrac{1}{\sqrt3}\right)=\sqrt3,\quad 2\left(\dfrac{\sqrt3}{2}\right)=\sqrt3$	B1	1	AG: $\sqrt3$ in denominator must be handled properly
	Total		**12**	

Pure 1 January 2003

Q	Solution	Marks	Total	Comments
1 (a)	$10r=9\Rightarrow r=0.9$	B1	1	Convincingly shown (AG)
(b)	Formula for nth term of GP stated	M1		Or used
	$u_n=10(0.9)^{n-1}$	A1	2	OE
(c)	Formula for sum to n terms stated	M1		Or used; M0 for list of terms
	$S_{25}=\dfrac{10(1-0.9^{25})}{1-0.9}\approx92.8(21)$	A1	2	AG (92.8): allow just 3SF if no error
(d)	Formula for sum to infinity stated	M1		Or used
	$S_\infty=100$	A1	2	
	Total		**7**	

4 (a)(i)	Use of $\sin^2\theta + \cos^2\theta \equiv 1$	M1		OE, e.g. Pythagoras
	$\cos\theta = \frac{12}{13}$ convincingly shown	A1	2	AG but condone no mention of ±
(ii)	Use of $\tan\theta = \frac{\sin\theta}{\cos\theta}$	M1		OE, eg right-angled triangle
	$\tan\theta = \frac{5}{12}$	A1	2	
(b)	$\theta \approx 0.395$	B1	1	Condone AWRT 0.395 or 22.6°
(c) (i)	Formula for arc length stated	M1		or used
	$r \approx \frac{5}{0.395} \approx 12.7$	A1	2	AG (12.7)
(ii)	Formula for sector area stated	M1		or used
	Substitution of appropriate values	m1		not $\frac{1}{2}(12.7^2)(22.6)$
	Area is $\frac{1}{2}(12.7)^2\ (0.395) \approx 32\text{ cm}^2$	A1	3	Condone absence of units; accept AWRT 32
	Total		**10**	

6 (a)(i)	$f'(x) = \frac{1}{2}x^{-\frac{1}{2}}$	M1A1	2	M1 if coefficient or index correct
(ii)	Gradient at $x = 4$ is $\frac{1}{4}$	A1F	1	ft wrong coeff
(b)(i)	$\int f(x)dx = \frac{x^{\frac{3}{2}}}{\frac{3}{2}}$...	M1A1		M1 for $kx^{\frac{3}{2}}$
	...+ $2x$ (+c)	B1	3	
(ii)	Substituting $x = 4$	M1		In c's integral (not f(x) or $f'(x)$)
	$\int_0^4 f(x)dx = \frac{40}{3}$	A1	2	Convincingly found (AG)
(c)	$y = x^{\frac{1}{2}} + 2 \Rightarrow x^{\frac{1}{2}} = y - 2$	M1		OE
	$\ldots \Rightarrow x = (y-2)^2$, hence result	A1	2	Convincingly shown (AG)
(d)(i)	Line of symmetry is $y = x$	B1	1	
(ii)	Complete method for area of A	M2, 1		M1 for area of some relevant region (not just a rectangle or triangle) or $\int_2^4 (x-2)^2\ dx$
	Shaded area is $\frac{32}{3}$	A2,1	4	A1 for area of relevant region or $\ldots = \frac{8}{3}$ or if c makes one error after M2 SC M1A1 for $\int_0^4 f(x)dx - \int_0^4 f^{-1}(x)dx = 8$
	Total		**15**	

Pure 1 June 2003

1 (a)(i)	$\int x^{\frac{3}{2}}\,dx = \frac{x^{\frac{5}{2}}}{\frac{5}{2}}(+c)$	M1A1	2	M1 if index correct or for example $\frac{x^{\frac{4}{2}}}{\frac{4}{2}}$; condone $1\frac{3}{2}$ for $\frac{5}{2}$
(ii)	Substitution of $x = 4$	m1		
	$\int_0^4 x^{\frac{3}{2}}\,dx = \frac{64}{5} = 12.8$	A1F	2	ft wrong coefficient of $x^{\frac{5}{2}}$
(b)	Required Area = area of $\Delta - 12.8$	M1		Condone eg area of $\Delta = 4\times 8$
	$= \frac{1}{2}(4\times 8) - 12.8 = 3.2$	A1F	2	ft wrong answer to (a)(ii) provided answer > 0
	Total		**6**	
2(a)	$y' = 1 - 8x^{-3}$	M1A1	2	M1 if at least one term correct
(b)	At SP, $8x^{-3} = 1$	m1		
	SP is (2, 3)	A1A1	3	NMS $x = 2$, B1 $y = 3$, B1
(c)	$y'' = 24x^{-4}$	m1A1F		m1 if index correct; ft numerical error or $y' = -8x^{-3}$
	$\ldots = \frac{3}{2}$ at SP	A1F		ft wrong coefficient of x^{-4}
	so SP is a min	E1F	4	ft wrong (non-zero) value of y'' at SP; allow '$y'' = 24x^{-4} > 0$' without a value
	Total		**9**	
3(a)(i)	Sector area formula	M1		Allow even if formula not used
	Sector area $= 32\theta\,\text{cm}^2$	A1	2	Condone omission of units throughout
(ii)	Appropriate use of $\sin\theta$	M1		
	Triangle area $= 32\sin\theta\,\text{cm}^2$	A1	2	
(iii)	Segment area $= (32\theta - 32\sin\theta)\text{cm}^2$	A1F	1	ft c's answers, dependent on both M marks
4 (a)	$\sin^2 x + \cos^2 x \equiv 1$ stated	M1		or used
	$2\sin^2 x + \sin x = 0$	A1	2	convincingly shown (AG)
(b)	$\sin x = 0$ or $-\frac{1}{2}$	B1B1		
	$\sin x = 0 \Rightarrow x = 0$ or π	B1		In (b) condone degrees or decimals, and ignore values outside domain B0 if other values in domain included
	Use of $\sin\frac{\pi}{6} = \frac{1}{2}$ OE	M1		PI
	$\sin x = -\frac{1}{2} \Rightarrow x = \frac{7\pi}{6}$ or $\frac{11\pi}{6}$	A1A1	6	Deduct 1 for each incorrect value given (in domain) NMS 4/4
	Total		**8**	

6 (a)(i)	Increase is $a\left(\frac{p}{100}\right)$	B1		OE
	So common ratio is $1+\frac{p}{100}$	B1	2	convincingly shown (AG)
(ii)	$b=2000\left(1+\frac{p}{100}\right)$	B1		Condone a for 2000 here
	$c=2000\left(1+\frac{p}{100}\right)^2$	B1	2	ditto
(b)(i)	Equating last answer to 2332.8	M1		2000 must be present now
	$\left(1+\frac{p}{100}\right)^2=1.1664$	A1		OE; verification earns M1A1 max
	So $p=8$	A1	3	convincingly shown (AG)
(ii)	Use of ar^n	M1		Allow ar^{n-1} or ar^{n+1}
	$u_n=2000(1.08)^n$	A1	2	Condone $2000(1.08)^{n-1}$ here
(iii)	Balance $=£2000(1.08)^{10}$	M1		Condone index 9 or 11 here
	$\ldots\approx £4317.85$	A1	2	NMS 2/2; allow AWRT 4320 or 4310 to 3sf
	Total		**11**	
	Total		**60**	

Pure 1 November 2003

Q	Solution	Marks	Total	Comments
1 (a)	Common ratio $=\frac{1}{3}$	B1	1	Allow AWRT 0.333
(b)	Formula for 10th term	M1		Stated or used; condone ar^{10}
	10th term $=\frac{2}{3^8}\approx 0.000305$	A1	2	NMS 2/2; condone 0.000304 or AWRT 0.0003048
(c)	Formula for sum to infinity	M1		Stated or used
	Sum to infinity $=\frac{6}{\cancel{2}/3}=9$	A1	2	Must be exact
	Total		**5**	
2(a)(i)	$y'=5\left(\frac{3}{2}x^{\frac{1}{2}}\right)-3$	M1A1	2	M1 if coeff and/or index correct in 1st term
(ii)	$\ldots=0$ when $15x^{\frac{1}{2}}=6$	m1		
	ie $x^{\frac{1}{2}}=0.4$	A1		Allow B1 for verification after m1 or m0
	ie $x=0.16$	A1	3	Conclusion must be drawn (AG)
3 (a)	Right shape from O to asymp	M1		Ignore anything shown outside domain
	Complete graph	A1		
	Correct x scale indicated	A1		Condone decimals and/or degrees in (a) and (b)
	Asymptotes $x=\frac{\pi}{2}$, $x=\frac{3\pi}{2}$	A1	4	Equations needed, not just x values; Condone $x\neq\ldots$ but not $y=\ldots$
(b)	One root is $\frac{\pi}{3}$	B1		Allow AWRT 1.05
	Second root is $\frac{\pi}{3}+\pi=\frac{4\pi}{3}$	M1A1F	3	AWRT 4.19; ft wrong value for first root; ignore roots outside domain; A0 if c gives other 'root(s)' in domain

5 (a)	$5^3 = 125$ so $\log_5 125 = 3$	E1	1	
(b)(i)	$\log_5(125^2) = 2 \times 3 = 6$	B1	1	
(ii)	$\log_5 \sqrt{125} = 3 \div 2 = \frac{3}{2}$	B1	1	
(iii)	$\log_5\left(\frac{1}{\sqrt{125}}\right) = -\frac{3}{2}$	B1F	1	ft wrong answer to (ii)
(c)	Use of $\log kx = \log k + \log x$	M1		or $125x = 5^4$
	$x = 5$	A1	2	
	Total		**6**	
6 (a)(i)	$10° = \frac{\pi}{18}$ rad $(\approx 0.056\pi)$	M1A1	2	M1 for attempt, condone AWRT 0.055π or 0.056π
(ii)	Sector area formula	M1		Stated or used
	Area $= \frac{1}{2}(60)^2\left(\frac{\pi}{18}\right)(\text{mm}^2)$	m1		Allow use of c's answer to (i)
	$\ldots = 100\pi$ mm^2	A1	3	Must be exact here (AG)
(b)(i)	Area of S_2 is $120\pi(\text{mm}^2)$	A1		Condone decimals in (b)(i) (377, 440,503)
	Areas 140π, $160\pi(\text{mm}^2)$	A1A1	3	NMS 2/3 even after M0 or m0
				SC 2/3 for consistent attempts to use $\frac{1}{2}r^2\theta$
(ii)	Formula for sum of AP	M1		Stated or used
	Sum $= \frac{n}{2}(200\pi + (n-1)(20\pi))$	m1		OE; condone one small error
	$\ldots = 100\pi n + 10\pi n(n-1)$	A1		OE
	$\ldots = 10\pi n(n+9)(\text{mm}^2)$	A1	4	Convincingly shown (AG)
(iii)	Attempt at verification	M1		or solution of appropriate equation
	$n = 15 \Rightarrow$ sum $= 3600\pi(\text{mm}^2)$	A1		OE, eg with angles rather than areas
	... = area of disc, hence result	A1	3	Convincingly shown (AG)
	Total		**15**	

Pure 1 January 2004

Q	Solution	Marks	Total	Comments
1 (a)	$\int x^{\frac{1}{2}}\,dx = \dfrac{x^{\frac{3}{2}}}{\frac{3}{2}}\ (+c)$	M1A1	2	M1 for the correct power of x
(b)	Substitution of $x = 2$	ml		
	$\int_0^2 x^{\frac{1}{2}}\,dx = \frac{2}{3}(2^{\frac{3}{2}})$	A1F		ft wrong coeff of $x^{\frac{3}{2}}$; decimals not allowed
	$\ldots = \frac{4}{3}\sqrt{2}$	A1F	3	ditto
	Total		**5**	
2 (a)	$u_1 = 6,\ u_2 = 18$	B1B1	2	Allow 1/2 for answers 2, 6
(b)	Common ratio is 3	B1	1	Condone 1:3
(c)	Formula for sum of GP stated	M1		or used
	$S_{10} = \dfrac{6(3^{10} - 1)}{3 - 1}$	m1		Allow with one numerical error
	$\ldots = 3(3^{10} - 1)$	A1	3	Convincingly shown (AG)
	Total		**6**	
3 (a)	Sector area formula stated Sector area = $12.5\ \theta$ (cm²)	M1 A1	 2	or used Condone omission of units throughout
(b)(i)	Equating sector area to 6.25 $\theta = 0.5$	M1 A1	 2	
(ii)	Arc length formula stated	M1		or used
	Perimeter = 22.5 (cm)	A1F	2	ft wrong value of θ
	Total		**6**	
4(a)(i)	Terms 102, 104	B1B1	2	
(ii)	Formula for nth term stated $100 + 2\,(n - 1) = 200$	M1 m1		or used OE; allow with one numerical error
	No of terms = 51	A1	3	Allow NMS; allow 2/3 for answer 50
(b)	Formula for sum of AP stated Total length = $\frac{51}{2}(100+200)$	M1 Ml		or used OE; allow with one numerical error
	$\ldots = 7650$ (mm)	A1	3	**SC** allow 3/3 for correct answer obtained by adding all 51 numbers but NMS 1/3
	Total		**8**	

Q		Solution	Marks	Total	Comments
7	(a)	$\sin\frac{\pi}{6}=\frac{1}{2}$	B1		Allow 0.5
		$\cos\frac{\pi}{6}=\frac{\sqrt{3}}{2}$	B1		OE surd, eg $\sqrt{0.75}$
		$\tan\frac{\pi}{6}=\frac{1}{\sqrt{3}}$	B1	3	OE surd, eg $\sqrt{\frac{1}{3}}$ or $\frac{\sqrt{3}}{3}$
	(b)	**Either** $\sin^2 x+\cos^2 x\equiv 1$ stated	M1		or used
		Elimination of $\sin x$ or of $\cos x$	ml		
		$4\cos^2 x=3$ or $4\sin^2 x=1$	A1		OE
		Or $\tan x\equiv\sin x/\cos x$ stated	M1		or used
		Equation in terms of $\tan x$ only	m1		
		$3\tan^2 x=1$	A1		OE
		Then one value is $\frac{\pi}{6}$	B1		Condone 0.52; condone degrees or decimals throughout
		At least one other value found	M1		NMS 2/2 if completely correct list given
		Values are $\frac{\pi}{6},\frac{5\pi}{6},\frac{7\pi}{6},\frac{11\pi}{6}$ only	A1	6	Ignore values outside domain
		Total		**9**	

Pure 1 June 2004

Q	Solution	Marks	Total	Comments
1(a)	Formula for sum of AP	M1		Stated or used
	All numbers substituted	m1		Condone one error here
	Sum is 20 100	A1	3	NMS 3/3
(b)(i)	Values are 6, 14, 22, 30	B2, 1	2	B1 for one error, eg – 2 , 6, 14, 22
(ii)	Any clear correct method	M1		
	Sum is $2\times 20100=40\,200$	A1F	2	ft wrong answer to (a); NMS 2/2
	Total		**7**	
2(a)	Arc length formula	M1		stated or used $(\theta$ in radians$)$
	$P=8(\theta+2)$	A1	2	Convincingly shown (AG)
(b)	Sector area formula	M1		Stated or used $(\theta$ in radians$)$
	$A=32\theta$	A1	2	
(c)	$32\theta=8(\theta+2)$	M1		Condone mixture of deg and rad here
	Solving to give $\theta=\frac{2}{3}$	m1A1F	3	Allow $\frac{16}{24}$; ft numerical error in (b); NMS 2/3
	Total		**7**	
3(a)	$y(0)=6,\ y(1)=-1$	B1B1		
	Sign change, so root between	E1	3	
(b)(i)	$y'=2\left(\frac{3}{2}x^{\frac{1}{2}}\right)\ldots$	M1A1		M1 for $kx^{\frac{1}{2}}$
	$\ldots=9$	B1		
	$y''=3\left(\frac{1}{2}x^{-\frac{1}{2}}\right)$	M1A1	5	M1 for $kx^{-\frac{1}{2}}$ as deriv of 1st term
(ii)	At SP $3x^{\frac{1}{2}}=9$	M1		Or B1 for $x=9$ verified, then B1 for $y=-27$
	So $x=9$	A1F		ft numerical error in y'
	and $y=-27$	A1	3	
(iii)	At SP $y''=\frac{1}{2}$	B1		
	This is positive, so minimum	E1F	2	ft wrong value for y'' at SP
	Total		**13**	

Q	Solution	Marks	Total	Comments
4(a)	$\ln(pq) = \ln p + \ln q$	B1	1	
(b)	$\ln(p^2q^3) = 2\ln p + 3\ln q$	B1	1	
(c)	$\ln\left(\dfrac{p}{q}\right) = \ln p - \ln q$	B1	1	
(d)	$\ln\sqrt{\dfrac{p}{q}} = \dfrac{1}{2}\ln p - \dfrac{1}{2}\ln q$	B1F	1	ft wrong answer to (c)
	Total		**4**	
5(a)(i)	$r = \dfrac{345}{230} = 1.5$	B1	1	Convincingly shown but condone verification (AG)
(ii)	3rd term = 517.5 4th term = 776.25	B1 B1	2	Allow 517 or 518 Allow AWRT 776 or 777 SC B1 for answers 776(.25) and 1164(.375)
(b)	1801 value from 4th term i.e. (AWRT) 7 760 000 to 3 SF or 7 770 000	M1 A1F	2	ft c's value for 4th term in (a) (ii) NMS 2/2 for c's answer $\times 10\,000$
	Total		**5**	
6(a)	$\sin^2 x + \cos^2 x \equiv 1$ So at P/Q $\sin^2 x + \sin x - 1 = 0$	M1 A1	2	Stated or used convincingly shown (AG)
(b)(i)	$\sin x = \dfrac{-1 \pm \sqrt{5}}{2}$	M1A1	2	NMS 2/2 for AWRT 0.618 **and** AWRT −1.62
(ii)	Pos value is 0.618(03) $-1.62 < -1$ so impossible	A1 E1	2	Convincingly shown (AG) Allow 'sin x can't be neg in given domain'
(c)	Attempt at $\sin^{-1} 0.618$ x – coord of P is 0.67 x –coord of Q is 2.48	M1 A1 A1F	3	PI by answer in radians or degrees Allow AWRT 0.67 or 0.66 AWRT 2.48 or 2.47 or 142; ft wrong co-ordinate for P
	Total		**9**	

Pure 2 June 2002

	Total		**(3)**	
2(a)(i)	Setting up simultaneous equations $b = 0.2$ $a = 12$	M1 A1 A1	(3)	
(ii)	$p_3 = 14.92$	B1√	(1)	Accept 14.9 ft their a and b
(b)	$w = 12 + 0.2w$ (or $\equiv$) $w = 15$	M1 A1 √	(2)	Must be equation: 15 only gets M0A0
	Total		**(6)**	

Pure 2 June 2004

Q	Solution	Marks	Total	Comments
6(a)(i)	$C(4, 3)$	B1		
(ii)	$r = 2$	B1	2	
(b)(i)	$(x-4)^2 + (y-3)^2 = 4$ and $y = x+1$			
	meet when $(x-4)^2 + (x+1-3)^2 = 4$	M1		Substitution attempted or eliminating x
	$\Rightarrow (x-4)^2 + (x-2)^2 = 4$			
	$(x^2 - 8x + 16) + (x^2 - 4x + 4) = 4$	M1		Multiply out correctly and simplification attempted
	$2x^2 - 12x + 20 = 4$			
	$x^2 - 6x + 8 = 0$	A1		quadratic
	$(x-4)(x-2) = 0$	M1		factorise/other valid method attempted
	$x = 4$ or $x = 2$			
	$x = 4 \Rightarrow y = 5$, $x = 2 \Rightarrow y = 3$ $A(4, 5)$ & $B(2, 3)$	A1ft	5	Both points (cao)
(ii)	Area of segment $= \frac{1}{4}\pi(2)^2 - \frac{1}{2}(2 \times 2)$	M1		$\frac{1}{4} \times$circle - triangle
		A1ft		(on their value of r)
	$= \pi - 2$	A1	3	AG (AWRT 1.14)
	Total		**10**	

Pure 3 January 2002

Q	Solution	Marks	Total	Comments
1	$\binom{7}{4} 3^3\, 2^4$	M1		${}^7C_4$ in any form and either 3^3 or 2^4 present or implied
		A1		All present.
	15 120	A1	3	Accept as part of an expansion
	Total		**3**	

Pure 3 June 2003

Q	Solution	Marks	Total	Comments
1	$\binom{9}{3} 2^6\, 3^3$	M1		${}^9C_3$ in any form
		M1		2^6 and 3^3 present or implied
	145 152	A1	3	Accept as part of an expansion
	Total		**3**	