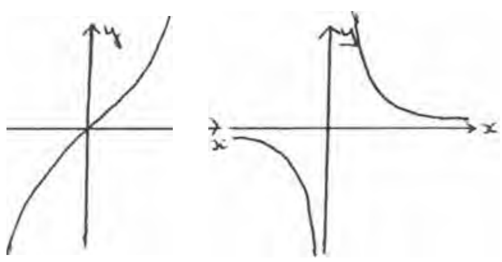
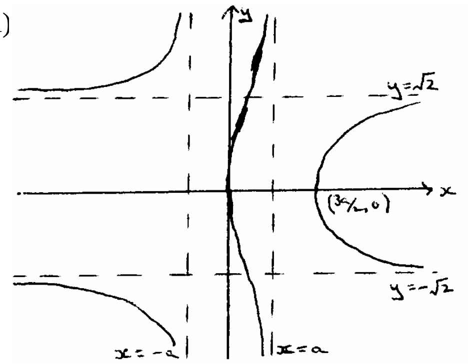
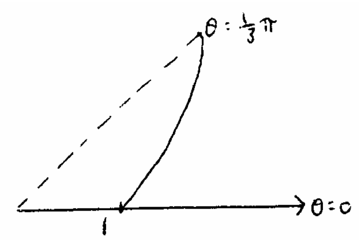
Mark Scheme 4726
January 2007

1 (i) f(O) = In 3 f	Bl
f‘(0) = $^1/_3$	Bl
f”(O) = -‘/$_9$ *A.G.*	B1 Clearly derived
(ii) Reasonable attempt at Maclaurin	Ml Form In3 + *ax* + *bx*^{2}, with *a,b* related to f “ f’
f(*x*) = ln 3 + $^1/_3x$-$^1/_{18}x^2$	*Al* √*J* On their values off’and f”
	SR Use *ln(3+x)* = In3 + In(1 +$^1/_3$ *x)* Ml Use Formulae Book to get
	In3 + *Y3X - Y2(VJX)2* =
	In3 + *Y3X - 1/lgX2* Al
2 (i) f(0.8) = - 0.03, f(0.9) = +0.077 (accurately e.g. accept -0.02 t0 -0.04)	B1
Explain (change of sign, graph etc.)	B1
	SR Use *x* = √*J(tan^{-l}x)* and compare *x* to √J(tan^{-l} x) for *x=0.8*, 0.9 B 1
	Explain “change in sign” B 1
(ii) Differentiate two terms	B1 Get *2x* - I *I(* 1 +*x*^{2}*)*
Use correct form of Newton-Ra ph son with 0.8, using their f *‘(x)*	Ml 0.8 - *f(0.8)/f ‘(0.8)*
Use their N-R to give one more approximation to 3 d.p. minimum	Ml√
Get *x* = 0.835	Al 3d.p. - accept answer which rounds
3 (i) Show area of rect. = $^1/_4$ (e$^{l/16}$ + e$^{1/4}$ + e$^{9/16}$ + e^l)	Ml Or numeric equivalent
Show area = 1.7054	Al At least 3 d.p. correct
Explain the < 1.71 in terms of areas	Bl AG. Inequality required
(ii) Identify areas for > sign	B1 Inequality or diagram required
Show area of rect. = $^1/_4$ *(e^o* + *e^{ll16}* + e$^{1/4}$ + e$^{9/16}$)	Ml Or numeric evidence
Get *A* > 1.27	Al cao; or answer which rounds down
4 (i) 	BI Correct shape for sinh *x*
	B1 Correct shape for cosech *x*
	B1 Obvious point *(dy/dx* ≠O)/asymptotes clear
(ii) Correct definition of sinh *x*	B1 May be implied
Invert and mult. by *eX* to AG.	B1 Must be clear; allow *2/(eX* - e *-X)* as mimimum simplification
Sub. *u* = *e^X* and *du* = *e^X dx*	M1 Or equivalent, all *x* eliminated and not *dx* = *du*
Replace to *2/(u^2* - 1) *du*	Al
Integrate to *aln((u - l)/(u* + 1)	A1√ Use formulae book, PT, or atanh^{-l}u
Replace *u*	Al No need for *c*

5 (i) Reasonable attempt at parts Get $x^n \sin x - \int \sin x . nx^{n-1}\,dx$	M1 Involving second integral Al
Attempt parts again Accurately	M1 Al
Clearly derive AG.	A1 Indicate $(\frac{1}{2}\pi)^n$ and 0 from limits
(ii) Get $I_4 = (\frac{1}{2}\pi)^4 - 12I_2$ or $I_2 = (\frac{1}{2}\pi)^2 - 2I_0$	B1
Show clearly $I_0 = 1$	B1 May use I_2
Replace their values in relation Get	M1
$I_4 = \frac{1}{16}\pi^4 - 3\pi^2 + 24$	A1 cao
6 (i) $x = \pm a$, $y = 2$	B1, B1, B1 Must be =; no working needed
(ii) 	B1 Two correct labelled asymptotes ll Ox and approaches B1 Two correct labelled asymptotes ll Oy and approaches B1 Crosses at $(\frac{3}{2}a,0)$ (and (0,0) - may be implied B1 90° where it crosses Ox; smoothly B1 Symmetry in Ox
7 (i) Write as $A/t + B/t^2 + (Ct + D)/(t^2 + 1)$	M1 Allow $(At+B)/t^2$; justify $B/t^2 + D/(l + t^2)$ if only used
Equate $At(t^2 + 1) + B(t^2 + 1) + (Ct+D)t^2$ to $1 - t^2$	M1√
Insert t values / equate coeff.	M1 Lead to at least two constant values
Get A = C = 0, B = L D =-2	Al SR Other methods leading to correct PF can earn 4 marks; 2 M marks for reasonable method going wrong
(ii) Derive or quote cos x in terms of t	Bl
Derive or quote dx = 2 $dt/(1 + t^2)$	B1
Sub. in to correct P.F.	M1 Allow $k\,(l-t^2)/((t^2(l+t^2))$ or equivalent
Integrate to $-1/t - 2\tan^{-1}t$	Al√ From their k
Use limits to clearly get AG.	Al
8 (i) Get $(e^y - e^{-y})/(e^y + e^{-y})$	B1 Allow $(e^{2Y}-1)/(e^{2y}+ 1)$ or if x used
(ii) Attempt quad. in e^Y	M1 Multiply by e^Y and tidy
Solve for e^Y	M1
Clearly get AG.	Al
(iii) Rewrite as tanh $x = k$	M1 SR Use hyp def^n to get quad. in e^X M I
Use (ii) for x = ½ 1n 7 or equivalent	Al Solve e^{2x} = 7 for x to $\frac{1}{2}$ 1n 7 Al
(iv) Use of log laws	Bl One used correctly
Correctly equate 1n A = 1n B to $A = B$	M1 Or $1n(^A/_B) = 0$
Get $x = \pm \frac{3}{5}$	Al

9 (i)		B1 Shape for correct θ; ignore other θ Used; start at $(r,0)$ B1 θ=0, r=1 and increasing r
(ii)	Use correct formula with correct r	B1
	$\int \sec^2 x\, dx = \tan x$ used	B1
	Quote $\int 2 \sec x \tan x\, dx = 2\sec x$	B1 Or sub. correctly
	Replace $\tan^2 x$ by $\sec^2 x - 1$ to integrate	M1
	Reasonable attempt to integrate 3 terms And to use limits correctly	M1
	Get $\sqrt{3} + 1 - \frac{1}{6}\pi$	Al Exact only
(iii)	Use $x = r\cos\theta$, $y = r\sin\theta$, $r = (x^2+y^2)^{1/2}$	M1
	Reasonable attempt to eliminate r,θ	M1
	Get $y = (x-1)\sqrt{(x^2+y^2)}$	A1 Or equivalent