1 Derive/quote $g'(x)= p/(1+x^2)$ B1
Attempt $f'(x)$ as $a/(1+bx^2)$ M1 Allow any a, b=2 or 4
Use x =½ to set up a solvable equation in p, leading to at least one solution M1
Get $p = {}^5/_4$ only A1 AEEF

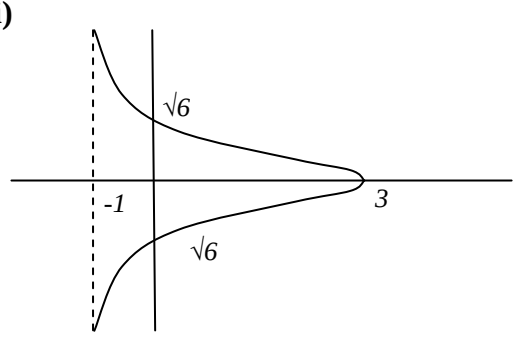
2 Reasonable attempt at $e^{2x}(1+2x+2x^2)$ M1 3 terms of the form $1+2x+ax^2$, $a\neq 0$
Multiply out their expressions to get all terms up to x^2 M1 (3 terms) x (minimum of 2 terms)
Get $1+3x+4x^2$ A1 cao
Use binomial, equate coefficients to get 2 solvable equations in a and n M1 Reasonable attempt at binomial, each term involving a and n (an=3, $a^2n(n-1)/2$=4)
Reasonable attempt to eliminate a or n M1
Get n=9, a=⅓ cwo A1 cao

SC Reasonable $f'(x)$ and $f''(x)$ using product rule (2 terms) M1
Use their expressions to find $f'(0)$ and $f''(0)$ M1
Get $1+3x+4x^2$ cao A1

3 Quote/derive correct $dx=2dt/(1+t^2)$ B1
Replace all x (not $dx=dt$) M1 From their expressions
Get $2/(t-1)^2$ or equivalent A1
Reasonable attempt to integrate their expression M1
Use correct limits in their correct integral A1√ Must involve √3
Clearly tidy to √3+1 from cwo A1 A.G.

4 (i) Get a = -2 B1 May be quoted
Get b = 6 B1 May be quoted (from correct working)
Get c = 1 B1 May be quoted

(ii)



B1 Correct shape in $-1<x\leq 3$ only
(allow just top or bottom half)

B1 90^0 (at x=3) (must cross x-axis i.e. symmetry)

B1 Asymptote at x= -1 only (allow −1 seen)

B1√ Correct crossing points; $\pm\sqrt{(b/c)}$ from their b,c

5 (i) Reasonable attempt at parts — M1 Leading to second integral
Get $e^x(1-2x)^n - \int e^x.n(1-2x)^{n-1}.-2\ dx$ — A1 Or $(1-2x)^{n+1}/(-2(n+1))e^x - \int (1-2x)^{n+1}/(-2(n+1))e^x dx$

Evidence of limits used in integrated part — M1 Should show ±1
Tidy to A.G. — A1 Allow $I_{n+1} = 2(n+1)I_n - 1$

(ii) Show any one of $I_3=6I_2-1$, $I_2=4I_1-1$, $I_1=2I_0-1$ — B1 May be implied
Get $I_0(=e^{½}-1)$ or $I_1(=2e^{½}-3)$ — B1
Substitute their values back for their I_3 — M1 Not involving n
Get $48e^{½} - 79$ — A1

6 (i) Reasonable attempt to differentiate sinh $y = x$ to get dy/dx in terms of y — M1 Allow $\pm\cosh y\ dy/dx = 1$
Replace sinh y to A.G. — A1 Clearly use $\cosh^2 - \sinh^2 = 1$
SC Attempt to diff. $y = \ln(x+\sqrt{(x^2+1)})$ using chain rule — M1
Clearly tidy to A.G. — A1

(ii) Reasonable attempt at chain rule — M1 To give a product
Get $dy/dx = a\ \sinh(a\sinh^{-1}x)/\sqrt{(x^2+1)}$ — A1
Reasonable attempt at product/quotient — M1 Must involve sinh and cosh
Get d^2y/dx^2 correctly in some form — A1√ From $dy/dx = k\ \sinh(a\sinh^{-1}x)/\sqrt{(x^2+1)}$
Substitute in and clearly get A.G. — A1
SC Write $\sqrt{(x^2+1)}dy/dx = k\ \sinh(a\sinh^{-1}x)$ or similar Derive the A.G.

7 (i) Get 5.242, 5.239, 5.237 — B1√ Any 3(minimum) correct from previous value
Get 5.24 — B1 Allow one B1 for 5.24 seen if 2 d.p.used

(ii) Show reasonable staircase for any region — B1 Drawn curve to line
Describe any one of the three cases — B1
Describe all three cases — B1

(iii) Reasonable attempt to use log/expo. rules — M1 Allow derivation either way
Clearly get A.G. — A1
Attempt $f'(x)$ and use at least once in correct N-R formula — M1
Get answers that lead to 1.31 — A1 Minimum of 2 answers; allow truncation/rounding to at least 3 d.p.

(iv) Show $f'(\ln 36) = 0$ — B1
Explain why N-R would not work — B1 Tangent parallel to Ox would not meet Ox again or divide by 0 gives an error

8 (i) Use correct definition of cosh x B1

Attempt to cube their definition involving e^{x} and e^{-x} (or $e^{2x}$and e^{x}) M1 Must be 4 terms

Put their 4 terms into LHS and attempt to simplify M1

Clearly get A.G. A1

SC Allow one B1 for correct derivation from $\cosh 3x = \cosh(2x+x)$

(ii) Rewrite as $k\cosh 3x = 13$ M1

Use ln equivalent on $13/k$ M1 Allow $\pm\ln$ or $\ln(13/k \pm\sqrt{(13/k)^2 - 1})$ for their k or attempt to set up and solve quadratic via exponentials

Get $x = (\pm)\ \frac{1}{3}\ln 5$ A1

Replace in cosh x for u M1

Use $e^{a\ln b} = b^{a}$ at least once M1

Get $\frac{1}{2}(5^{\frac{1}{3}} + 5^{-\frac{1}{3}})$ A1

9 (i) Attempt integral as $k(2x+1)^{1.5}$ M1

Get 9 A1 cao

Attempt subtraction of areas M1 Their answer – triangle

Get 3 A1√ Their answer − 6 (>0)

(ii) Use $r^2=x^2+y^2$ and $x=r\cos\theta$, $y=r\sin\theta$ B1

Eliminate x and y to produce quadratic equation (=0) in r (or $\cos\theta$) M1

Solve their quadratic to get r in terms of θ (or vice versa) A1√

Clearly get A.G. A1 $r>0$ may be assumed

Clearly show θ_1(at B)=$\tan^{-1}\frac{3}{4}$ and θ_2 (at A) =π B1

SC Eliminate y to get r in terms of x only M1

Get $r = x + 1$ A1

SC Start with $r=1/(1-\cos\theta)$ and derive cartesian

(iii) Use area = $\frac{1}{2}\int r^2\ d\theta$ with correct r B1 cwo; ignore limits

Rewrite as $k\text{cosec}^4(\frac{1}{2}\theta)$ M1 Not just quoted

Equate to their part **(i)** and tidy M1 To get $\int$ = some constant

Get 24 A1 A.G.