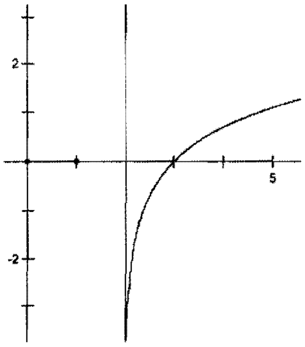
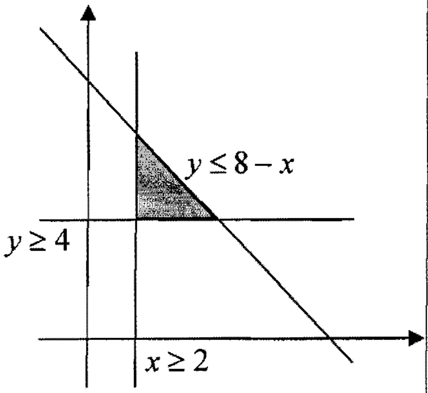
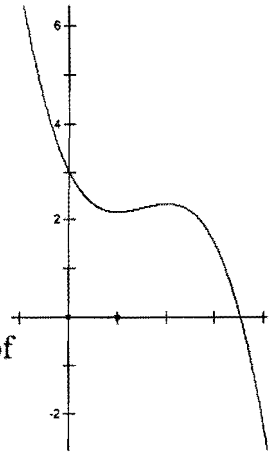
These are suggested answers only. Any reasonable solution should be accepted.

Solutions	Marks/Comments
1 a) i) $(4x+3)(4x-3)$	1
ii) $5a(a+2)$	1
b) $3\sqrt{5}+\sqrt{4}\sqrt{5}=3\sqrt{5}+2\sqrt{5}$	1
$5\sqrt{5}=\sqrt{25}\sqrt{5}=\sqrt{125}$	1
c) x^2y+3xy^2	1
d) $\lim_{x\to\infty}\left(3-\frac{4x}{x^2}+\frac{5}{x^2}\right)$	1
$=3$	1
e) $x^2-x-1=0$	1
$\frac{-b\pm\sqrt{b^2-4ac}}{2a}=\frac{1\pm\sqrt{1+4}}{2}=\frac{1\pm\sqrt{5}}{2}$	1
f) $x=0\cdot\dot{4}\dot{2}$ $100x=42\cdot\dot{4}\dot{2}$	1
$99x=42 \qquad x=\frac{42}{99}=\frac{14}{33}$	1
g) 1·61	1 /12
2 a) $d=\sqrt{(x_1-x_2)^2+(y_1-y_2)^2}=\sqrt{6^2+3^2}$	1
$=\sqrt{45}$ $=3\sqrt{5}$	1 simplification not reqd
b) $m=\frac{-3}{6}=\frac{-1}{2}$	1
$\theta=\tan^{-1}\left(\frac{1}{2}\right)=26^\circ34'=27^\circ$	1 ignore rounding error
c) subbing x = -5, y = 5 or $y-2=-\frac{1}{2}(x-1)$	1
-5 + 2×5 – 5 = 0 true $\quad x+2y-5=0$ subbing x = 1, y = 2 1 + 2 × 2 – 5 = 0 true	1

d) $d = \dfrac{\lvert Ax_1 + By_1 + C \rvert}{\sqrt{A^2 + B^2}}$ $\quad x_1 = 1, y_1 = 6$	1
$d = \dfrac{\lvert 1 + 12 - 5 \rvert}{\sqrt{5}} = \dfrac{8}{\sqrt{5}}$	1
e) $A = \dfrac{bh}{2} = 3\sqrt{5} \times \dfrac{8}{\sqrt{5}} \div 2 = 12$	1
f) call BC =4 the base and the perpendicular distance to A = 6, the height. $4 \times 6 \div 2 = 12$	1
g) (-5, 1), (-5, 9), (7, 3)	1 for first, 1 more for all 3 /12
3. a) i) note $\sqrt[4]{x^3} = x^{\frac{3}{4}}$	1
$\dfrac{d}{dx}\left(x^{\frac{3}{4}}\right) = \dfrac{3}{4}x^{\frac{-1}{4}}$	1
ii) $vu' + uv'$	1
$\cos x \ln x + \dfrac{\sin x}{x}$	1
iii) $\dfrac{vu' - uv'}{v^2}$	1
$\dfrac{e^x \cos x - e^x \sin x}{(e^x)^2} = \dfrac{\cos x - \sin x}{e^x}$	1
b) $V = \pi \int_a^b x^2 dy$ noting $x = 4 - y$ i.e. $x^2 = 16 - 8y + y^2$	1
$V = \pi \int_0^3 16 - 8y + y^2 .dy = \pi \left[16y - 4y^2 + \dfrac{y^3}{3} \right]_0^3$	1
$= \pi(48 - 36 + 9)$ $= 21\pi$	1
c) $g(x) = \int g'(x).dx = x^3 - 4x - x^{-1} + c$	1
but $g(x) = 4$ when $x = 1$ i.e. $4 = 1 - 4 - 1 + c$ so $c = 8$	1
and $g(x) = x^3 - 4x - \dfrac{1}{x} + 8$	1 /12
4 a) i) $4 \times 250 \times 30 = \$30\ 000$	1
ii) $250 \times 1{\cdot}02^{120} = \$2\ 691{\cdot}29$	1
iii) $250 \times (1{\cdot}02^{120} + 1{\cdot}02^{119} + 1{\cdot}02^{118} + \ldots\ldots + 1{\cdot}02)$	1

$250 \times \dfrac{a(r^n-1)}{r-1} = 250 \times \dfrac{1\cdot 02(1\cdot 02^{120}-1)}{1\cdot 02-1}$	1
$250 \times 498\cdot 02328 = \$124\ 505\cdot 83$	1
iv) \$124 505·82 - \$30 000 = \$94 505.83	1 for the subtraction
b) $\theta = 1$ and $A = \dfrac{1}{2}r^2\theta$	1
$A = 0\cdot 5 \times 5^2 \times 1 = 12.5cm^2$	1
c) $f'(x) = 2e^x$ $f'(0) = 2$ slope of tangent	1
$y - 2 = 2x$ $y = 2x + 2$	1
d)  asymptote $x = 2$	1
x intercept 3	1
	/12
5 a) i) $B\hat{A}M = C\hat{D}M$ alternate angles parallel lines	1
$C\hat{M}D = B\hat{M}A$ vertically opposite angles	1
ΔAMB|||ΔDMC equiangular	1
ii) Ratio of areas = 6·25 (=$2\cdot 5^2$)	
total area = 10 + 62·5 = 72·5	1
b) i) $I = \dfrac{1}{4}\sin(4x) + c$	1 ignore c
ii) $\int^{e^4} \dfrac{x}{x^2+4}.dx = \dfrac{1}{2}\int^{e^4} \dfrac{2x}{x^2+4}.dx$	1
$\dfrac{1}{2}\left[\ln(x^2+4)\right]^{e^4} = \dfrac{1}{2}(\ln(e^8+4) - \ln 5)$	1
$\ln\sqrt{\dfrac{e^8+4}{5}}$	
c) Notes as to what graph is what should appear on the graph 	1 for at least 1 area shown 1 for all 3 graphs shown 1 for correct area and annotation

5 d) $3+4+9+4=20$ $P=\frac{9}{20}\times\frac{8}{19}=\frac{18}{95}$	1 1 simplification not reqd /12
6 a) i) $x=1, x=2$ ii) point of inflexion iii)  iv) The graph of derivative indicates slope ≥ -2 between $x=0$ and $x=1$. The slope would have to be less than -3 To reach from $y=3$ to $y=0$ in the space of 1 unit	1 1 1 shape 1 intercept 1 Ignore inaccuracy such as crossing the axis before first min.
b) i) $3-\frac{x}{2}=\frac{x^2}{2}-2x+1$ $6-x=x^2-4x+2$ $0=x^2-3x-4$ $0=(x-4)(x+1)$ $x=$ -1 or 4 ii) $I=\int_{-1}^{4}3-\frac{x}{2}-\left(\frac{x^2}{2}-2x+1\right).dx$ $\int_{-1}^{4}2+\frac{3x}{2}-\frac{x^2}{2}.dx=\left[2x+\frac{3x^2}{4}-\frac{x^3}{6}\right]_{-1}^{4}=8+12-\frac{32}{3}-\left(\frac{3}{4}+\frac{1}{6}-2\right)=10\tfrac{5}{12}$	 1 1 1 1
c) (i) P(WWW) = $0.4^3=0.064$ (ii) P(LLL) = $0.6^3=0.216$ (iii) P(win at least 1 but not 3) = 1-(0.064 + 0.216) = 1 – 0.28 = 0.72	1 for 1/120 1 /12
7 a) i) $\frac{dP}{dt}=kP_0e^{kt}$ $=kP$ as required ii) when $t=6, P=1400000, P_0=900000,$ $1400000=900000e^{6k}$ $\frac{14}{9}=e^{6k}$ $6k=\ln(14/9)$ $k=0\cdot073638792$ iii) at $t=10$ $P=900000\times e^{10\times0.073638792}$ = 1 879 541	1 1 1 1

iv) $\frac{3000000}{900000} = e^{t\times 0.073638792}$ $\ln 3.\dot{3} = t \times 0.073638792 \quad t = 16hrs21'$	1
b) i) $y=(x+2)(x-1)$ ii) $y = 3\cos x + 1$ iii) $y = 3^x$	1 1 for 1 element 1 for the others 1
c) i) $360° = 2\pi$ therefore 2π by the number of sides n ii) $n\times\frac{1}{2}ab\sin C = n\times\frac{1}{2}\times 1\times 1\times\sin\left(\frac{2\pi}{n}\right) = \frac{n}{2}\sin(\frac{2\pi}{n})$ iii) As n increases the area of polygon approaches area of the circle i.e. $\pi\times 1\times 1 = \pi$	1 1 1 /12
8 a) i) Solving simultaneously $8mx - 16m^2 = x^2$ $x^2 - 8mx + 16m^2 = 0$ $(x-4m)^2 = 0$ As this has only 1 answer the line is a tangent ii) $x = 2, y = -4$ and $-4 = 2m - 2m^2$ $2m^2 - 2m - 4 = 0 \quad 2(m-2)(m+1) = 0 \quad m = -1$ or 2	1 1 1 1
b) i) $A \cong \frac{h}{3}\left(f(0) + f(4) + 2\times f(2) + 4\times(f(1)+f(3))\right)$ $\cong \frac{1}{3}\left(3 + 0 + 2\times\frac{\sqrt{108}}{4} + 4\times\left(\frac{\sqrt{135}}{4} + \frac{\sqrt{63}}{4}\right)\right)$ $= 9{\cdot}2507855$ ii) $3\times 4\times\pi\div 4 = 9{\cdot}424778$ the estimate slightly less than the true value	1 1 1 1 some effort to compare
c) i) $2y = x^2 - 4x \quad 2y + 4 = x^2 - 4x + 4$ $4\times\frac{1}{2}(y+2) = (x-2)^2$ ii) Focus is (2, -1·5) iii) Directrix $y = -2\cdot 5$	1 1 1 1 /12
9 a) $n = 100, \quad a = d = 5$ $\frac{n}{2}\left(2a + (n-1)d\right) = 50\times(10+495) = 25250$	1 1
b) $\frac{p}{\sin 72} = \frac{q}{\sin 39}$ so … $\frac{p}{q} = \frac{\sin 72}{\sin 39} = 1\cdot 511$	1 + 1

c) i) $c^2 = a^2 + b^2 - 2ab\cos C$ = $= 200^2 + 105^2 - 2\times 200\times 105\times\cos 150$ =87398 $c = 295.63$ ii) By Cos Rule $FH^2 = 200^2 + 205^2 - 2\times200\times205\times\cos 13^\circ$ FH = 45.06847 200^2+(45.06847)=42031 $205^2 = 42025$ Square of hypotenuse $\approx$ sum of squares on shorter sides. By Pythagoras Thm, angle is approx 90° Or use cos rule again to find angle, $\cos\theta = \dfrac{200^2 + FH^2 - 205^2}{2\times 200\times FH}$ $\theta = 89^\circ 58'$ approximately a right angle. d) (i) AC=BC radii of equal circles AE=BE radii of equal circles CE common $\therefore \Delta AEC \equiv \Delta BEC$ (SSS) rule (ii) There are several possibilities a.CE bisects apex of isosceles ΔACB (corresponding angles in congruent triangles) and hence bisects base AB b. ACBE is rhombus, $\therefore$ diagonals bisect at right angles. c. Prove $\Delta ACD \equiv \Delta BCD$ (SAS), hence AD = DB Others possible.	1 1 ignore rounding errors 1 1 1 both equal radii 1 common side + conclusion 2 marks for any reasonable explanation /12
10 a) i) in this case the other side equals $200 - 2x$ Then $A = x(200 - 2x) = 200x - 2x^2$ ii) $\dfrac{dA}{dx} = 200 - 4x$ which = 0 when $x = 50$ then $A = 100\times 50 = 5\ 000\text{m}^2$ this is a maximum since if we take $w = 49$ then $l = 102$ and A = 4998 b) i) $t = 0$ $v = 3 + 6 = 9$ ii) $\int v.dt = x = 3e^t - 6e^{-t} + c$ but $x = 0$ when $t = 0$ so $0 = 3 - 6 + c$ whence c = 3 then $x = 3e^t - 6e^{-t} + 3$ iii) If $e^t = 3$, $e^{-t} = \dfrac{1}{3}$ and so $x = 3\times 3 - 2 + 3 = 10$ Under these conditions $3e^{2t} - 7e^t - 6 = 0$ $3\times 9 - 7\times 3 - 6 = 0$ iv) $(3e^t + 2)(e^t - 3) = 0$ $t = \ln 3$ = 1 minute 6 seconds c) $a = 6$ $b = 3$	1 1 1 1 1 1 1 1 1 1 1 1 /12