1. $\left(s^2+1\right)\frac{dr}{ds}=rs$

$\int \frac{1}{r}\,dr=\int \frac{s}{s^2+1}\,ds$

$\ln|r|=\frac{1}{2}\ln\left|s^2+1\right|+c$

$r=1, s=2$

$0=\frac{1}{2}\ln 5+c$

$\ln|r|=\frac{1}{2}\ln\left|s^2+1\right|-\frac{1}{2}\ln 5$

$2\ln|r|=\ln\left|\frac{s^2+1}{5}\right|$

$r^2=\frac{s^2+1}{5}$

$5r^2=s^2+1$

2. Let $x=\sqrt{6}$

$x^2=6$

$x^2-6=0$

$f(x)=x^2-6$

$f'(x)=2x$

$x_n=x-\frac{x^2-6}{2x}$

$x_0=2.5$

$$x_1 = 2.5 - \frac{2.5^2 - 6}{2(2.5)} = 2.45$$

$$x_2 = 2.45 - \frac{2.45^2 - 6}{2(2.45)} = 2.44949$$

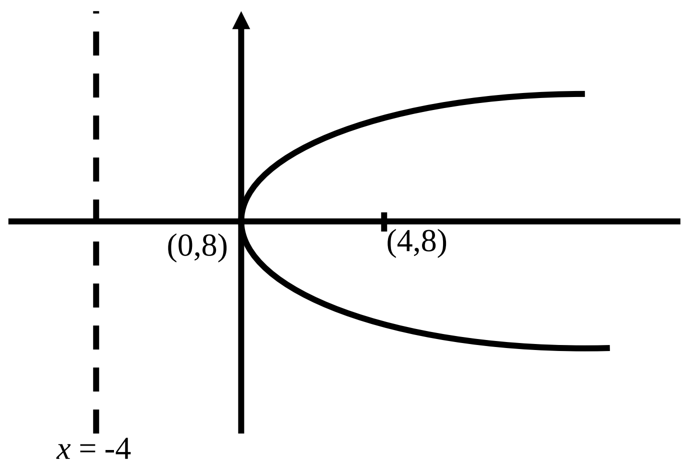
$$x_3 = 2.44949 - \frac{2.44949^2 - 6}{2(2.44949)} = 2.44949$$

$$x_4 = 2.44949 - \frac{2.44949^2 - 6}{2(2.44949)} = 2.44949$$

$\therefore x = 2.449499$

3. $(y-8)^2 = 4(4)x$

$(y-8)^2 = 16x$



4. a) $\int \frac{1}{x^2}\left(4 - 3x^4\right)dx$

$= \int 4x^{-2} - 3x^2\, dx$

$= \frac{4x^{-1}}{-1} - \frac{3x^3}{3} + c$

$= -\frac{4}{x} - x^3 + c$

b) let $u = x - 1 \Rightarrow x = u + 1$

$du = dx$

$$\int_2^3 \frac{x}{(x-1)^2}dx = \int_1^2 \frac{u+1}{u^2}du$$

$$= \int_1^2 \frac{1}{u} + \frac{1}{u^2}\, du$$

$$= \left[\ln u - \frac{1}{u} \right]_1^2 \quad \text{or} \quad \left[\ln(x-1) - \frac{1}{x-1} \right]_2^3$$

$$= (\ln 2 - \ln 1) - \left(\frac{1}{2} - 1 \right)$$

$$= \ln 2 + \frac{1}{2}$$

5. $$x^2 + y^2 - x - \frac{5}{2}y + \frac{3}{2} = 0$$

$$\left(x - \frac{1}{2} \right)^2 - \frac{1}{4} + \left(y - \frac{5}{4} \right)^2 - \frac{25}{16} = -\frac{3}{2}$$

$$\left(x - \frac{1}{2} \right)^2 + \left(y - \frac{5}{4} \right)^2 = \frac{5}{16}$$

$$centre = \left(\frac{1}{2}, \frac{5}{4} \right) \quad r = \sqrt{\frac{5}{16}}$$

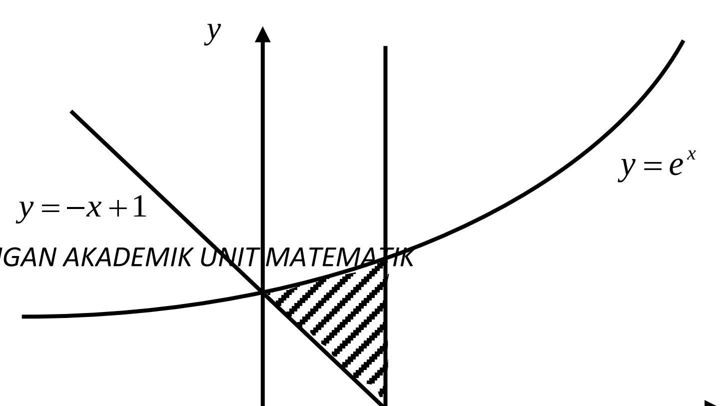
$$M_N = \frac{\frac{5}{4} - 1}{\frac{1}{2} - 1} = -\frac{1}{2} \qquad M_T = 2$$

Equation normal: $y - 1 = -\frac{1}{2}(x - 1)$

$2y + x - 3 = 0$

Equation tangent is: $y - 1 = 2(x - 1)$

6.



Area $= \int_0^1 e^x - (-x+1)dx$

$= \left| e^x + \frac{x^2}{2} - x \right|_0^1$

$= \left(e + \frac{1}{2} - 1 \right) - (1)$

$= e - \frac{3}{2} unit^2$

Volume = $\pi \int_0^1 (e^x)^2 - (-x+1)^2 dx$

$= \pi \left| \frac{e^{2x}}{2} - \frac{x3}{3} + x^2 - x \right|_0^1$

$= \pi \left[\left(\frac{e^2}{2} - \frac{1}{3} + 1 - 1 \right) - \left(\frac{1}{2} \right) \right]$

$= \left(\frac{e^2}{2} - \frac{5}{6} \right) \pi \quad unit^3$