1) $\operatorname{arctg}\left(\frac{y}{x}\right) = \ln\sqrt{x^2+y^2}$

$$\frac{1}{1+\left(\frac{y}{x}\right)^2}\left[\frac{y'}{x}-\frac{y}{x^2}\right] = \frac{1}{\sqrt{x^2+y^2}}\cdot\frac{1}{2}(2x+2yy')(x^2+y^2)^{-\frac{1}{2}}$$

$$\frac{x^2}{y^2+x^2}\cdot\frac{xy'-y}{x^2} = \frac{2x+2yy'}{(x^2+y^2)^{\frac{1}{2}}(y^2+x^2)^{\frac{1}{2}}}$$

$$xy'-y = \frac{2x+2yy'}{x^2+y^2}$$

$\cancel{xy'-y = 2x}$

$$y'x(x^2+y^2)-y(x^2+y^2) = 2x+2yy'$$

$$y' = \frac{2x+y(x^2+y^2)}{x(x^2+y^2)-2y}$$

2) $\begin{cases} y = \frac{t^2}{t-1} \\ x = \frac{t}{t^2-1} \end{cases} \Rightarrow \quad y'_x = \frac{y'_t}{x'_t} \quad x'_t = -\frac{1}{t^2} \quad \Rightarrow \quad y'_t = \frac{1}{-\frac{1}{t^2}} = -t^2$

3) $y = (x^2+2)^5(3x-x^3)^3$

$$\ln y = \ln(x^2+2)^5\cdot\ln(3x-x^3)^3 = 15\ln(x^2+2)\ln(3x-x^3)$$

$$(\ln y)' = \frac{1}{y'} = 15\left[\frac{1}{x^2+2}\cdot 2x\right]\cdot\ln(3x-x^3) + \frac{3x-3x^2}{3x-x^3}\ln(x^2+2)$$

$$= \frac{30x\cdot\ln(3x-x^3)}{x^2+2} + \frac{3(1-x^2)\ln(x^2+2)}{3x-x^3}$$

$$y' = \frac{(x^2+2)\cdot(3x-x^3)}{(3x-x^3)\cdot 30x\cdot\ln(3x-x^3)+(x^2+2)\cdot 3(1-x^2\ln(x^2+2}$$

4) $y = x^x$

$x^x(\ln(x)+1)$

$y'(x) = x^x(1+\ln(x))$

5) $$y = \frac{(2-x^2)^3 \cdot (x-1)^2}{(2x^3-3x)\cdot e^x}$$

$\ln y = 3\ln(2-x^2) + \ln(x-1)\cdot 2 - x - \ln(2x^3-3x)$

$$\frac{1}{y'} = \frac{-6x}{2-x^2} + \frac{2}{x-1} - 1 - \frac{6x^2-3}{2x^3-3x} =$$

$$= \frac{-6x(x-1)+2}{(x-1)(2-x^2)} - \left[\frac{6x^2-3+2x^3-3x}{2x^3-3x}\right]$$

$$y' = -\left[\frac{(x-1)(2-x^2)(2x^3-3x)}{[6x(x-1)+2](2x^3-3x)+(2x^3+6x^2-3x-3)}\right]$$

6) $(\operatorname{arctg} x)' = \frac{1}{1+x^2}$

7) $P = 144$ $\Rightarrow$ $P = 2(a+b)$ $\Rightarrow$ $S = a\cdot b = (72 - b)\cdot b$

$S - ?$ $\quad 2(a+b) = 144$ $\quad S(x) = 72x - x^2$

$a - ?$ $\quad a+b = 72$ $\quad S'(x) = 72 - 2x$

$b - ?$

$S'(x) = 0 \Rightarrow 72 - 2x = 0$

$x = 36$

$S = 36 \cdot 36 = 1296$