

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

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

$$\frac{x^2}{x^2 + y^2} \cdot \frac{y'x - y}{x^2} - \frac{2x + 2yy'}{\sqrt{x^2 + y^2}} = 0$$

$$\frac{y'x - y}{x^2 + y^2} - \frac{2x + 2yy'}{\sqrt{x^2 + y^2}} = 0$$

$$y'x - y - 2\sqrt{x^2 + y^2}(x + yy') = 0$$

$$\boxed{\begin{matrix} x \neq 0 \\ y \neq 0 \end{matrix}}$$

$$y'x - y - 2x\sqrt{x^2 + y^2} + 2yy'\sqrt{x^2 + y^2} = 0$$

$$y'x + 2yy'\sqrt{x^2 + y^2} = y + 2x\sqrt{x^2 + y^2}$$

$$\cancel{y'} y' = \frac{y + 2x\sqrt{x^2 + y^2}}{x + 2y\sqrt{x^2 + y^2}}$$

$$2) \begin{cases} y = \frac{t^2}{t-1} \\ x = \frac{t}{t^2-1} \end{cases}$$

$$y'_x = \frac{y'_t}{x'_t}$$

$$y'_t = \frac{2t(t-1) - t^2}{(t-1)^2}$$

$$x'_t = \frac{t^2 - 1 - t \cdot 2t}{(t^2 - 1)^2} = \frac{t^2 - 2t - 1}{(t^2 - 1)^2}$$

$$y'_x = \frac{(2t^2 - 2t - t^2)(t^2 - 1)^2}{(t-1)^2(t^2 - 2t - 1)}$$

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

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

$$\frac{y'}{y} = \frac{10x}{x^2 + 2} + 3 \ln(3x - x^3) + 15 \ln(x^2 + 2) \cdot \frac{3 - 3x^2}{3x - x^3}$$

$$\begin{aligned} y' &= \underline{30x \ln(3x - x^3) \cdot (x^2 + 2)^4 \cdot (3x - x^3)^3} + \\ &+ 45 \ln(x^2 + 2) \cdot (1 - x^2) (3x - x^3)^2 \cdot (x^2 + 2)^5 = \\ &= 15(x^2 + 2)^4 \cdot (3x - x^3)^2 (2x \ln(3x - x^3) + (3x - x^3) + \\ &+ 3 \ln(x^2 + 2) (1 - x^2) (x^2 + 2)) \end{aligned}$$

$$4) y = x^x$$

$$\ln y = x \ln x$$

$$\frac{y'}{y} = \ln x + 1$$

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

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

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

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

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

$$* 7) 2x + 2y = 144$$

$$(xy)' = 0$$

$$y = 72 - x$$

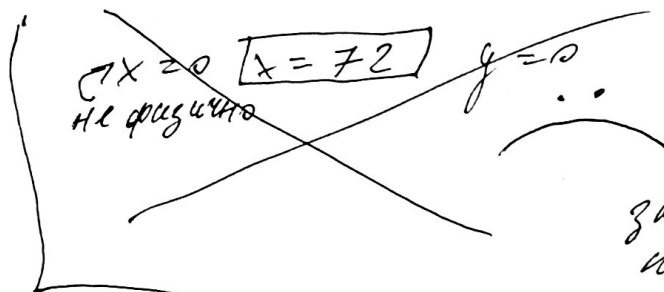
$$(72x - x^2)' = 0$$

$$(x - 72)' = 0$$

$$2x - 72 = 0$$

$$x = 36$$

$$y = 72 - 36 = 36$$



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