1. $y = \frac{1}{x} + \frac{2}{x^2} - \frac{5}{x^3} + \sqrt{x} - \sqrt[3]{x} + \frac{3}{\sqrt{x}}$

$y' = -\frac{1}{x^2} - \frac{4}{x^3} + \frac{15}{x^4} + \frac{1}{2\sqrt{x}} - \frac{1}{3\sqrt[3]{x^2}} - \frac{3}{2\sqrt{x^3}}$

---

2. $y = x \cdot \sqrt{1+x^2}$

$y' = x \cdot \left(\sqrt{1+x^2}\right)' + (x)' \cdot \sqrt{1+x^2} =$

$= \sqrt{1+x^2} + \frac{(1+x^2)'}{2\sqrt{1+x^2}} \cdot x = \sqrt{1+x^2} + \frac{2x \cdot x}{2\sqrt{1+x^2}} =$

$= \frac{1+2x^2}{\sqrt{1+x^2}}$

---

3. $y = \frac{2x}{1-x^2}$, $y' = 2 \cdot \left(\frac{(1-x^2)\cdot(x)' - x\cdot(1-x^2)'}{(1-x^2)^2}\right) =$

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

---

4. $y = \sqrt{x+\sqrt{x+\sqrt{x}}}$, $y' = \frac{\left(x+\sqrt{x+\sqrt{x}}\right)'}{2\sqrt{x+\sqrt{x+\sqrt{x}}}} =$

$= \frac{1}{2\sqrt{x+\sqrt{x+\sqrt{x}}}} \cdot \left(1 + \frac{1+\frac{1}{2\sqrt{x}}}{2\sqrt{x+\sqrt{x}}}\right)$

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

$y'=(x^2+2)^5\cdot(3x-x^3)^3\cdot\left(\ln\left((x^2+2)^5\cdot(3x-x^3)^3\right)\right)'=$

$=\left(\ln\left((x^2+2)^5\right)+\ln\left((3x-x^3)^3\right)\right)'=$

$y'=\left(5\frac{2x}{x^2+2}+3\cdot\frac{3-3x^2}{3x-x^3}\right)\cdot(x^2+2)^5\cdot(3x-x^3)^3$

---

6. $y=\sqrt[x]{x}$, $y'=\sqrt[x]{x}\cdot\left(\ln\left(\sqrt[x]{x}\right)\right)'=$

$=\sqrt[x]{x}\cdot\left(\frac{1}{x}\cdot\ln(x)\right)'=$

$=\sqrt[x]{x}\cdot\left(\frac{x\cdot(\ln(x))'-(x)'\cdot\ln(x)}{x^2}\right)=$

$=\sqrt[x]{x}\cdot\left(\frac{1-\ln(x)}{x^2}\right)$

---

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

$a=(\ln(y))'=\left(3\ln(2-x^2)+2\ln(x-1)-\ln(2x^3-3x)-x\right)'=$

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

$y'=y\cdot a$

8. $\begin{cases} x = \dfrac{t^2}{t-1} \\ y = \dfrac{t}{t^2-1} \end{cases}$ $\quad x_t' = \dfrac{t(t-2)}{(t-1)^2}$ $\quad y_t' = \dfrac{t^2+1}{(t^2-1)^2}$

$$y_x' = \frac{y_t'}{x_t'} = \frac{t^2+1}{(t^2-1)^2} \cdot \frac{(t-1)^2}{t^2-2t}$$

---

9. $\operatorname{arctg} \dfrac{y}{x} = \ln\sqrt{x^2+y^2}$

$$\ln\sqrt{x^2+y^2} - \operatorname{arctg} \frac{y}{x} = 0$$

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

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

$$y' = -\frac{x}{2y}$$

10. $y = \ln\left(x + \sqrt{x^2+1}\right)$

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

$$= \frac{1}{\sqrt{x^2+1}} \Rightarrow a$$

---

11. $y = x \cdot \ln\left(x + \sqrt{x^2+1}\right) - \sqrt{x^2+1}$

$$\ln\left(x + \sqrt{x^2+1}\right) = a$$

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

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

---

12. $y = \arcsin(\sin(x))$

$$y' = \frac{\cos(x)}{\sqrt{1 - \sin^2(x)}}$$

13.

$P = 144$

$P = 2(x+y) \Rightarrow y = \frac{P - 2x}{2}$

$S = x \cdot y = \frac{Px - 2x^2}{2}$ $\quad S' = P/2 - 2x$

$x = P/4 \Rightarrow x = 36$

$y = 36$