

**ИНДИВИДУАЛЬНЫЕ ТИПОВЫЕ ЗАДАНИЯ
ПО ДИСЦИПЛИНЕ
«МАТЕМАТИЧЕСКИЙ АНАЛИЗ»**

1. Найти область определения функции:

1.1 $y = \sqrt{9 - x^2}$

1.2 $y = \sqrt{x-5} + \sqrt{2-x}$

1.3 $y = \frac{1}{\sqrt{x^2 - 4x - 5}}$

1.4 $y = \ln\left(\frac{x}{x-3}\right)$

1.5 $y = \arcsin(2x-1)$

1.6 $y = \sqrt{x^2 - 4}$

1.7 $y = \sqrt{x-3} + \sqrt{5-x}$

1.8 $y = \sqrt{x^2 - 2x - 3}$

1.9 $y = \ln\left(\frac{x-5}{x}\right)$

1.10 $y = \arccos(2x+3)$

1.11 $y = \sqrt{16 - x^2}$

1.12 $y = \sqrt{\frac{x-2}{x+2}}$

1.13 $y = \frac{x}{\sqrt{x^2 - 3x + 2}}$

1.14 $y = 2\ln\left(\frac{x}{x+1}\right)$

1.15 $y = \arcsin\left(\frac{3-2x}{4}\right)$

1.16 $y = \sqrt{x^2 + 6x - 16}$

1.17 $y = \sqrt{x-3} + \sqrt{4-x}$

1.18 $y = \frac{1}{\sqrt{x^2 - 5x + 6}}$

1.19 $y = \ln\left(\frac{x+5}{x-3}\right)$

1.20 $y = \arccos\left(\frac{1-2x}{4}\right)$

1.21 $y = \sqrt{x^2 - 25}$

1.22 $y = \sqrt{x-4} + \sqrt{6-x}$

1.23 $y = \frac{1}{\sqrt{x^2 - 9x + 14}}$

1.24 $y = \ln\left(\frac{x+6}{x}\right)$

1.25 $y = \arcsin\left(\frac{x-3}{2}\right)$

1.26 $y = \sqrt{\frac{1-x}{1+x}}$

1.27 $y = \sqrt{x} + \lg(2x-3)$

1.28 $y = \frac{x}{\sqrt{x^2 - 7x + 10}}$

1.29 $y = \ln\left(\frac{x-2}{x+4}\right)$

1.30 $y = \arccos\left(\frac{x+3}{4}\right)$

2. Вычислить пределы рациональных выражений:

2.1 а) $\lim_{x \rightarrow \infty} \frac{3x^2 + 5x + 1}{x^2 + 4}$

б) $\lim_{x \rightarrow -1} \frac{2x^2 + 5x + 3}{x^2 - 4x - 5}$

2.2 а) $\lim_{x \rightarrow \infty} \frac{2x^3 + 4}{x^3 + 2x + 1}$

б) $\lim_{x \rightarrow 3} \frac{3x^2 - 10x + 3}{x^2 - 2x - 3}$

2.3 а) $\lim_{x \rightarrow \infty} \frac{x(x+1)(x+2)}{2x^3 + 5}$

б) $\lim_{x \rightarrow 2} \frac{x^2 + 6x - 16}{3x^2 - 5x - 2}$

2.4 а) $\lim_{x \rightarrow \infty} \frac{x^2 + 6x + 5}{3x^2 + 7}$

б) $\lim_{x \rightarrow 1} \frac{x^2 - 3x + 2}{3x^2 + 4x - 7}$

2.5 а) $\lim_{x \rightarrow \infty} \frac{x^4 + 3x + 1}{3x^4 + 5}$

б) $\lim_{x \rightarrow 3} \frac{2x^2 - 5x - 3}{x^2 - 5x + 6}$

2.6 а) $\lim_{x \rightarrow \infty} \frac{x^3 - 3x + 6}{x^2 + 7x - 1}$

б) $\lim_{x \rightarrow 1} \frac{3x^2 - 4x + 1}{2x^2 + 5x - 7}$

2.7 а) $\lim_{x \rightarrow \infty} \frac{3x^2 + 6x + 3}{2x^2 + 7}$

б) $\lim_{x \rightarrow 7} \frac{2x^2 - 13x - 7}{x^2 - 9x + 14}$

2.8 а) $\lim_{x \rightarrow \infty} \frac{x^2 + 4x + 5}{3x^2 + 7x + 2}$

б) $\lim_{x \rightarrow 5} \frac{2x^2 - 11x + 5}{x^2 - 7x + 10}$

2.9 а) $\lim_{x \rightarrow \infty} \frac{1 - 2x^2}{3x^2 + 5x + 1}$

б) $\lim_{x \rightarrow 6} \frac{2x^2 - 9x - 18}{x^2 - 7x + 6}$

2.10 а) $\lim_{x \rightarrow \infty} \frac{4x - 5x^3}{2x^2 + 3x + 3}$

б) $\lim_{x \rightarrow 6} \frac{x^2 - 9x + 18}{3x^2 - 17x - 6}$

$$\begin{array}{lll}
2.11 \text{ a) } \lim_{x \rightarrow \infty} \frac{3x^2 - 5x}{x - 5x^2 - 1} & \text{б) } \lim_{x \rightarrow -3} \frac{2x^2 + 5x - 3}{x + 3} & 2.12 \text{ a) } \lim_{x \rightarrow \infty} \frac{2 + 7x - 2x^2}{x^3 - 5x} \quad \text{б) } \lim_{x \rightarrow 4} \frac{x^2 - 16}{x^2 - 3x - 4} \\
2.13 \text{ a) } \lim_{x \rightarrow \infty} \frac{4x^2 + x}{3x^2 + 7x - 1} & \text{б) } \lim_{x \rightarrow 2} \frac{x^2 + x - 6}{2x^2 - 6x + 4} & 2.14 \text{ a) } \lim_{x \rightarrow \infty} \frac{2x^2 - 2x + 5}{3x + x^3} \quad \text{б) } \lim_{x \rightarrow 1} \frac{2x^2 + 3x - 5}{3x - 3} \\
2.15 \text{ a) } \lim_{x \rightarrow \infty} \frac{2x^2 + 3x + 2}{x + 3} & \text{б) } \lim_{x \rightarrow 3} \frac{2x^2 - 4x - 6}{5x - x^2 - 6} & 2.16 \text{ a) } \lim_{x \rightarrow \infty} \frac{5x - 3x^2}{x^2 + 4x + 3} \quad \text{б) } \lim_{x \rightarrow 2} \frac{2x^2 - 3x - 2}{-x^2 + 5x - 6} \\
2.17 \text{ a) } \lim_{x \rightarrow \infty} \frac{5x^2 + 6x - 1}{3x - 2x^2} & \text{б) } \lim_{x \rightarrow 1} \frac{2x^2 - x - 1}{x^2 - 3x + 2} & 2.18 \text{ a) } \lim_{x \rightarrow \infty} \frac{7x - x^3}{x^2 + 3x + 2} \quad \text{б) } \lim_{x \rightarrow 1} \frac{2x^2 + 3x - 5}{x^2 - 4x + 3} \\
2.19 \text{ a) } \lim_{x \rightarrow \infty} \frac{4x^3 + 5x^2}{2x^2 + x^3 + 30} & \text{б) } \lim_{x \rightarrow 3} \frac{2x^2 - 4x - 6}{7x - x^2 - 12} & 2.20 \text{ a) } \lim_{x \rightarrow \infty} \frac{4x + 5x^2}{x^3 - 3x + 1} \quad \text{б) } \lim_{x \rightarrow 2} \frac{x^2 - x - 2}{7x - 3x^2 - 2} \\
2.21 \text{ a) } \lim_{x \rightarrow \infty} \frac{x^2 + 2x + 6}{3x^2 + 7x - 1} & \text{б) } \lim_{x \rightarrow -2} \frac{x^3 + 3x^2 + 2x}{x^2 - x - 6} & 2.22 \text{ a) } \lim_{x \rightarrow \infty} \frac{3x^3 + x^2 - 2}{4x^3 + 5x + 1} \quad \text{б) } \lim_{x \rightarrow 1} \frac{2x^2 - x - 1}{3x^2 - x - 2} \\
2.23 \text{ a) } \lim_{x \rightarrow \infty} \frac{1 + x - 2x^2}{5x^2 - 8x - 4} & \text{б) } \lim_{x \rightarrow 4} \frac{x^2 + 3x - 28}{x^2 - 4x} & 2.24 \text{ a) } \lim_{x \rightarrow \infty} \frac{x^2 + x + 5}{x^3 - 3x^2 + 2} \quad \text{б) } \lim_{x \rightarrow 7} \frac{x^2 - 5x - 14}{2x^2 - 9x - 35} \\
2.25 \text{ a) } \lim_{x \rightarrow \infty} \frac{2 + 5x - 3x^2}{x^2 + 4x + 1} & \text{б) } \lim_{x \rightarrow -3} \frac{2x^2 + 5x - 3}{3x^2 + 10x + 3} & 2.26 \text{ a) } \lim_{x \rightarrow \infty} \frac{x^4 + 5}{x^3 + 4x^2 + 3} \quad \text{б) } \lim_{x \rightarrow 1} \frac{4x^2 + x - 5}{x^2 - 2x - 1} \\
2.27 \text{ a) } \lim_{x \rightarrow \infty} \frac{x^4 - 3x^2 + 2}{5x^4 + 3x + 2} & \text{б) } \lim_{x \rightarrow 5} \frac{2x^2 - 11x + 5}{x^2 - 7x + 10} & 2.28 \text{ a) } \lim_{x \rightarrow \infty} \frac{4x - 7x^2}{3x^2 - x + 2} \quad \text{б) } \lim_{x \rightarrow 6} \frac{2x^2 - 9x - 18}{x^2 - 7x + 6} \\
2.29 \text{ a) } \lim_{x \rightarrow \infty} \frac{x^2 - 3x + 2}{6x^2 + 4x + 9} & \text{б) } \lim_{x \rightarrow 2} \frac{2x^2 - 3x - 2}{x^2 + 6x - 16} & 2.30 \text{ a) } \lim_{x \rightarrow \infty} \frac{x^4 + 10x^2 - 3}{2x^5 - 5x^4 + 3x} \quad \text{б) } \lim_{x \rightarrow 1} \frac{x^2 - 7x + 6}{2x^2 + 5x - 7}
\end{array}$$

3. Вычислить пределы иррациональных алгебраических выражений:

$$\begin{array}{lll}
3.1 \lim_{x \rightarrow 7} \frac{x - 7}{\sqrt{2x + 11} - 5} & 3.2 \lim_{x \rightarrow 3} \frac{x - 3}{\sqrt{4x - 3} - 3} & 3.3 \lim_{x \rightarrow 4} \frac{\sqrt{4x} - x}{x^2 - 16} \\
3.4 \lim_{x \rightarrow 0} \frac{\sqrt{9 - x} - 3}{x^2 + x} & 3.5 \lim_{x \rightarrow 2} \frac{x^2 - 4}{\sqrt{6x + 4} - 4} & 3.6 \lim_{x \rightarrow 5} \frac{2x - 10}{\sqrt{5x} - 5} \\
3.7 \lim_{x \rightarrow 6} \frac{\sqrt{2x - 8} - 2}{x - 6} & 3.8 \lim_{x \rightarrow 5} \frac{3x - 15}{\sqrt{2x - 1} - 3} & 3.9 \lim_{x \rightarrow 6} \frac{\sqrt{2x - 8} - 2}{x - 6} \\
3.10 \lim_{x \rightarrow -1} \frac{x + 1}{\sqrt{x + 2} - 1} & 3.11 \lim_{x \rightarrow 0} \frac{x}{\sqrt{1 + 2x} - 1} & 3.12 \lim_{x \rightarrow 2} \frac{\sqrt{2x} - x}{x - 2} \\
3.13 \lim_{x \rightarrow 3} \frac{x - 3}{\sqrt{2x + 3} - 3} & 3.14 \lim_{x \rightarrow 0} \frac{2x^2}{\sqrt{x^2 + 2} - \sqrt{2}} & 3.15 \lim_{x \rightarrow 0} \frac{\sqrt{5 + x} - 3}{x^2 - 16} \\
3.16 \lim_{x \rightarrow 0} \frac{\sqrt{9 + x} - \sqrt{9 - x}}{3x} & 3.17 \lim_{x \rightarrow 2} \frac{\sqrt{x^2 - 3} - 1}{x^2 - 4} & 3.18 \lim_{x \rightarrow 0} \frac{\sqrt{1 - x} - \sqrt{1 + x}}{x} \\
3.19 \lim_{x \rightarrow 1} \frac{x^2 - 1}{\sqrt{x + 8} - 3} & 3.20 \lim_{x \rightarrow 0} \frac{\sqrt{9 - x} - 3}{x^2 + x} & 3.21 \lim_{x \rightarrow 0} \frac{2 - \sqrt{x^2 + 4}}{3x^2}
\end{array}$$

$$3.22 \lim_{x \rightarrow 9} \frac{\sqrt{2x+7} - 5}{3 - \sqrt{x}}$$

$$3.23 \lim_{x \rightarrow 0} \frac{2 - \sqrt{x}}{\sqrt{6x+1} - 5}$$

$$3.24 \lim_{x \rightarrow 0} \frac{3x}{\sqrt{10+x} - \sqrt{10-x}}$$

$$3.25 \lim_{x \rightarrow 0} \frac{x}{\sqrt{x+2} - 2}$$

$$3.26 \lim_{x \rightarrow 2} \frac{\sqrt{4x+1} - 3}{x^3 - 8}$$

$$3.27 \lim_{x \rightarrow 0} \frac{\sqrt{4+3x} - \sqrt{4-3x}}{7x}$$

$$3.28 \lim_{x \rightarrow 3} \frac{\sqrt{4x-3} - 3}{x^2 - 9}$$

$$3.29 \lim_{x \rightarrow 2} \frac{1 - \sqrt{x^2 - 3}}{x^2 - 4}$$

$$3.30 \lim_{x \rightarrow 0} \frac{3x^2}{\sqrt{1-x^2} - \sqrt{1+x^2}}$$

4. Вычислить пределы выражений, содержащих тригонометрические и обратные тригонометрические функции:

$$4.1 \lim_{x \rightarrow 0} \frac{\sin 2x + \sin 4x}{3x}$$

$$4.2 \lim_{x \rightarrow 0} \frac{\sin 5x - \sin 3x}{2x}$$

$$4.3 \lim_{x \rightarrow 0} \frac{\sin 6x + \sin 3x}{tg 2x}$$

$$4.4 \lim_{x \rightarrow 0} \frac{\arcsin 2x}{tg 5x}$$

$$4.5 \lim_{x \rightarrow 0} x \cdot ctg 8x$$

$$4.6 \lim_{x \rightarrow 0} \frac{1 - \cos 4x}{tg^2 6x}$$

$$4.7 \lim_{x \rightarrow 0} \sin 3x \cdot ctg 7x$$

$$4.8 \lim_{x \rightarrow 0} \frac{5x^2}{1 - \cos 4x}$$

$$4.9 \lim_{x \rightarrow 0} \frac{1 - \cos 6x}{x \cdot \sin 4x}$$

$$4.10 \lim_{x \rightarrow 0} \frac{x \cdot arctg 4x}{\cos 2x - \cos 4x}$$

$$4.11 \lim_{x \rightarrow 0} \frac{1 - \cos 2x}{x \sin x}$$

$$4.12 \lim_{x \rightarrow 0} \frac{x \cdot \sin x}{tg^2 5x}$$

$$4.13 \lim_{x \rightarrow 0} \frac{tg 2x \cdot \sin x}{1 - \cos 2x}$$

$$4.14 \lim_{x \rightarrow 0} \frac{1 - \cos 6x}{1 - \cos 8x}$$

$$4.15 \lim_{x \rightarrow 0} \frac{\sin^3 2x}{5x^3}$$

$$4.16 \lim_{x \rightarrow 0} \frac{\cos x - \cos^2 x}{3x \sin x}$$

$$4.17 \lim_{x \rightarrow 0} tg 2x \cdot ctg 5x$$

$$4.18 \lim_{x \rightarrow 0} \frac{\cos x - \cos^3 x}{\sin 2x}$$

$$4.19 \lim_{x \rightarrow 0} \frac{1 - \cos 4x}{1 - \cos 2x}$$

$$4.20 \lim_{x \rightarrow 0} \frac{\cos 4x - \cos 2x}{x \sin 2x}$$

$$4.21 \lim_{x \rightarrow 0} \frac{1 - \cos^2 3x}{x \cdot tg 2x}$$

$$4.22 \lim_{x \rightarrow 0} \frac{\cos 2x - \cos x}{1 - \cos x}$$

$$4.23 \lim_{x \rightarrow 0} \frac{1 - \cos^2 x}{x \cdot arctg 2x}$$

$$4.24 \lim_{x \rightarrow 0} \frac{xtg 3x}{1 - \cos 6x}$$

$$4.25 \lim_{x \rightarrow 0} \frac{x \sin x}{arctg^2 2x}$$

$$4.26 \lim_{x \rightarrow 0} \frac{1 - \cos 2x + tg^2 x}{x \sin x}$$

$$4.27 \lim_{x \rightarrow 0} \frac{tg x - \sin x}{x^2 \sin x}$$

$$4.28 \lim_{x \rightarrow 0} \frac{\cos 4x - \cos^2 4x}{2x \sin 6x}$$

$$4.29 \lim_{x \rightarrow 0} \sin 7x \cdot ctg 5x$$

$$4.30 \lim_{x \rightarrow -2} \frac{2x + 4}{\arcsin(x + 2)}$$

5. Вычислить пределы степенно-показательных выражений:

$$5.1 \lim_{x \rightarrow \infty} \left(\frac{x}{x-3} \right)^{x-5}$$

$$5.2 \lim_{x \rightarrow 0} \left(\frac{1}{x+1} \right)^{\frac{1}{2x}}$$

$$5.3 \lim_{x \rightarrow \infty} \left(\frac{3x+2}{3x-1} \right)^{2x+3}$$

$$5.4 \lim_{x \rightarrow \infty} \left(\frac{x+5}{x-3} \right)^{2x+7}$$

$$5.5 \lim_{x \rightarrow \infty} \left(\frac{x}{x-3} \right)^{x-5}$$

$$5.6 \lim_{x \rightarrow \infty} \left(\frac{x+2}{x-1} \right)^{\frac{x^2+1}{2x}}$$

$$5.7 \lim_{x \rightarrow \infty} \left(\frac{2x-1}{2x+3} \right)^{x+2}$$

$$5.8 \lim_{x \rightarrow \infty} \left(\frac{2x+3}{2x-5} \right)^{4x}$$

$$5.9 \lim_{x \rightarrow \infty} \left(\frac{x+7}{x-9} \right)^{2x}$$

$$5.10 \lim_{x \rightarrow \infty} \left(\frac{3x-1}{3x+2} \right)^{5x} \quad 5.11 \lim_{x \rightarrow \infty} \left(\frac{3x+2}{3x+7} \right)^{x-4} \quad 5.12 \lim_{x \rightarrow 1} (2-x)^{\frac{2x^2}{1-x}}$$

$$5.13 \lim_{x \rightarrow 0} \left(\frac{x+2}{2} \right)^{\frac{x^2+1}{2x}} \quad 5.14 \lim_{x \rightarrow \infty} \left(\frac{3x}{1+3x} \right)^{4x} \quad 5.15 \lim_{x \rightarrow \infty} \left(\frac{6x+1}{6x-2} \right)^{2x}$$

$$5.16 \lim_{x \rightarrow \infty} \left(\frac{4x+3}{4x+8} \right)^{5x} \quad 5.17 \lim_{x \rightarrow \infty} \left(\frac{2x-1}{2x+1} \right)^{3x} \quad 5.18 \lim_{x \rightarrow 0} (1-3x)^{\frac{2+x}{x}}$$

$$5.19 \lim_{x \rightarrow \infty} \left(\frac{5x+1}{5x+6} \right)^{4x-1} \quad 5.20 \lim_{x \rightarrow \infty} \left(\frac{1+x^2}{2+x^2} \right)^{\frac{x^2+1}{x}} \quad 5.21 \lim_{x \rightarrow 3} (3x-8)^{\frac{2}{x-3}}$$

$$5.22 \lim_{x \rightarrow 2} (2x-3)^{\frac{x^2}{x-2}} \quad 5.23 \lim_{x \rightarrow \infty} \left(\frac{5x+4}{5x-1} \right)^{2x} \quad 5.24 \lim_{x \rightarrow \infty} \left(\frac{x-1}{x} \right)^{x+1}$$

$$5.25 \lim_{x \rightarrow 1} (3x-2)^{\frac{x}{x-1}} \quad 5.26 \lim_{x \rightarrow 0} (1+x^2)^{\frac{1+x^2}{x^2}} \quad 5.27 \lim_{x \rightarrow \infty} \left(\frac{x+1}{x} \right)^{5x-2}$$

$$5.28 \lim_{x \rightarrow \infty} \left(\frac{2x+1}{2x+4} \right)^{3x} \quad 5.29 \lim_{x \rightarrow 2} (3x-5)^{\frac{x^2}{x-2}} \quad 5.30 \lim_{x \rightarrow \infty} \left(\frac{x+10}{x+6} \right)^{5x}$$

6. Вычислить пределы выражений, содержащих факториалы:

$$6.1 \lim_{n \rightarrow \infty} \frac{(n+1)!+n!}{(n+2)!} \quad 6.2 \lim_{n \rightarrow \infty} \frac{(n+1)!+n!}{(n+1)!-n!} \quad 6.3 \lim_{n \rightarrow \infty} \frac{n!+2 \cdot (n-1)!}{(n+1)!}$$

$$6.4 \lim_{n \rightarrow \infty} \frac{2 \cdot (n+1)!}{n!+(n+1)!} \quad 6.5 \lim_{n \rightarrow \infty} \frac{(n-1)!+n!}{2 \cdot n!} \quad 6.6 \lim_{n \rightarrow \infty} \frac{n!(n+3)}{2(n+1)!-n!}$$

$$6.7 \lim_{n \rightarrow \infty} \frac{n!+(n+1)!}{2n!+3(n+1)!} \quad 6.8 \lim_{n \rightarrow \infty} \frac{(n-1)!-n!}{(n+1)!} \quad 6.9 \lim_{n \rightarrow \infty} \frac{2n!}{n!+(n-1)!}$$

$$6.10 \lim_{n \rightarrow \infty} \frac{(n+1)!+(n+2)!}{n!-(n+1)!} \quad 6.11 \lim_{n \rightarrow \infty} \frac{(n+1)!}{(n-1)!+n!} \quad 6.12 \lim_{n \rightarrow \infty} \frac{3(n+1)!}{(n+3)!}$$

$$6.13 \lim_{n \rightarrow \infty} \frac{(n+2)!}{2(n+1)!} \quad 6.14 \lim_{n \rightarrow \infty} \frac{(n+2) \cdot (n-1)!}{2(n+1) \cdot n!} \quad 6.15 \lim_{n \rightarrow \infty} \frac{5(n+3)!}{(n+4)!}$$

$$6.16 \lim_{n \rightarrow \infty} \frac{2(n+2)^3(n+1)!}{n^2 \cdot (n+2)!} \quad 6.17 \lim_{n \rightarrow \infty} \frac{(n+1)! \cdot (2n)!}{(2n+1)! \cdot n!} \quad 6.18 \lim_{n \rightarrow \infty} \frac{(n+3)^3 \cdot (n+2)!}{4n^2 \cdot (n+3)!}$$

$$6.19 \lim_{n \rightarrow \infty} \frac{(2n+1)! \cdot n!}{n \cdot (n+1)! \cdot (2n-1)!} \quad 6.20 \lim_{n \rightarrow \infty} \frac{(n+3)! \cdot n^2}{(n+1)^2 \cdot (n+2)!} \quad 6.21 \lim_{n \rightarrow \infty} \frac{(n+1)!+(n+2)!}{(n+3)!}$$

$$6.22 \lim_{n \rightarrow \infty} \frac{(n+2)! - (n+1)!}{(n+2)!}$$

$$6.25 \lim_{n \rightarrow \infty} \frac{n \cdot (n+1)!}{4(n+1)^2 \cdot n!}$$

$$6.28 \lim_{n \rightarrow \infty} \frac{n^3 \cdot (3n)!}{(3n+3)!}$$

$$6.23 \lim_{n \rightarrow \infty} \frac{3n \cdot (n+2)!}{(n+1)^2 \cdot (n+1)!}$$

$$6.26 \lim_{n \rightarrow \infty} \frac{n^2 \cdot (2n)!}{(2n+2)!}$$

$$6.29 \lim_{n \rightarrow \infty} \frac{(3n+3)!}{n^2 \cdot (3n+1)!}$$

$$6.24 \lim_{n \rightarrow \infty} \frac{n^2 \cdot (n+2)!}{(n+1)^3 \cdot (n+1)!}$$

$$6.27 \lim_{n \rightarrow \infty} \frac{3n \cdot (2n)!}{(2n+1)!}$$

$$6.30 \lim_{n \rightarrow \infty} \frac{(2n+2)!}{(n+1)^2 \cdot (2n)!}$$

7. Найти область определения и точки разрыва функции $y = f(x)$, исследовать их характер.

$$7.1 y = \frac{x^3 + 4}{x^2}$$

$$7.2 y = \frac{x^2 - x + 1}{x - 1}$$

$$7.3 y = \frac{2}{x^2 + 2x}$$

$$7.4 y = \frac{4x^2}{x + 3}$$

$$7.5 y = \frac{12x}{x^2 - 9}$$

$$7.6 y = \frac{x^2 - 3x + 3}{x - 1}$$

$$7.7 y = \frac{4 - x^3}{x^2}$$

$$7.8 y = \frac{x^2 - 4x + 1}{x - 4}$$

$$7.9 y = \frac{x}{(1+x)^2}$$

$$7.10 y = \frac{x^2}{x^2 - 1}$$

$$7.11 y = \frac{4}{x^2 + 2x - 3}$$

$$7.12 y = \frac{\sqrt[3]{x^3 + 2}}{x}$$

$$7.13 y = \frac{e^{2-x}}{2-x}$$

$$7.14 y = \frac{x}{\sqrt[3]{1-x^2}}$$

$$7.15 y = \frac{x^2}{(x-1)^2}$$

$$7.16 y = \frac{1}{x} - \frac{1}{x+1}$$

$$7.17 y = \frac{1}{x-1} - \frac{1}{x}$$

$$7.18 y = \frac{4x^2 + 9}{4x + 8}$$

$$7.19 y = \left(\frac{x}{x+4} \right)^2$$

$$7.20 y = \frac{8x}{4-x^2}$$

$$7.21 y = \frac{e^{x+3}}{x+3}$$

$$7.22 y = \frac{16}{x^2(x-4)}$$

$$7.23 y = \frac{2}{x^2 + 2x}$$

$$7.24 y = \frac{x^2 - 6x + 3}{x - 3}$$

$$7.25 y = \frac{(x+1)^2}{x^2 + 2x}$$

$$7.26 y = \frac{x^3}{x^3 + 1}$$

$$7.27 y = \frac{x^3}{x^4 - 1}$$

$$7.28 y = \frac{x^3 - 3x}{x^2 - 1}$$

$$7.29 y = \frac{x^3 - 4}{2x}$$

$$7.30 y = \left(1 + \frac{1}{x} \right)^2$$

8. Найти область определения и точки разрыва функции $y = f(x)$, исследовать их характер. Построить график функции $y = f(x)$.

$$8.1 y = \begin{cases} e^x, & x \leq 0 \\ 3x + 2, & x > 0 \end{cases}$$

$$8.2 y = \begin{cases} 2 & x < -1 \\ 2 - 2x & -1 \leq x \leq 1 \\ \ln x & x > 1 \end{cases}$$

$$8.3 y = \begin{cases} 4 & x < 0 \\ \sqrt{16 - x^2} & 0 \leq x \leq 4 \\ 1/(x-4) & x > 4 \end{cases}$$

$$\begin{aligned}
8.4 \quad y &= \begin{cases} 1/x & x \leq 1 \\ x^2 & x > 1 \end{cases} & 8.5 \quad y &= \begin{cases} x & x \leq 0 \\ 1-x & 0 < x \leq 1 \\ \frac{1}{1-x} & x > 1 \end{cases} & 8.6 \quad y &= \begin{cases} x+2 & x \leq -2 \\ 2-x & -2 < x \leq 0 \\ x^2+2 & x > 0 \end{cases} \\
8.7 \quad y &= \begin{cases} 3 & x < 0 \\ \sqrt{9-x^2} & 0 \leq x \leq 3 \\ 1/(x-3) & x > 3 \end{cases} & 8.8 \quad y &= \begin{cases} (x+1)^2 & x \leq 0 \\ \frac{1}{x-1} & x > 0 \end{cases} & 8.9 \quad y &= \begin{cases} 2x & x \leq 0 \\ x^2+1 & 0 < x \leq 1 \\ 2 & x > 1 \end{cases} \\
8.10 \quad y &= \begin{cases} e^x & x \leq 0 \\ 2x-1 & x > 0 \end{cases} & 8.11 \quad y &= \begin{cases} x^2+1 & x < 0 \\ 1-x & 0 \leq x \leq 2 \\ 2 & x > 2 \end{cases} & 8.12 \quad y &= \begin{cases} x^2 & x < 1 \\ 1/x & x \geq 1 \end{cases} \\
8.13 \quad y &= \begin{cases} \frac{1}{x+1} & x \leq 0 \\ \sqrt{x} & x \geq 0 \end{cases} & 8.14 \quad y &= \begin{cases} -1/x & x \leq 1 \\ 2^x & x > 1 \end{cases} & 8.15 \quad y &= \begin{cases} \arctg x & x < 0 \\ 1/(x-2) & 0 \leq x \leq 3 \\ 4-x & x > 3 \end{cases} \\
8.16 \quad y &= \begin{cases} x^2+1 & x < 0 \\ \cos x & 0 \leq x \leq \pi/2 \\ \pi-x & x > \pi/2 \end{cases} & 8.17 \quad y &= \begin{cases} 3^x & x < 1 \\ 1/x & 1 \leq x \leq 3 \\ 4-x & x > 3 \end{cases} & 8.18 \quad y &= \begin{cases} 1/x & x < 0 \\ \sin x & 0 \leq x \leq 2\pi \\ \pi-x & x > 2\pi \end{cases} \\
8.19 \quad y &= \begin{cases} \frac{1}{x-2} & x \leq 4 \\ \sqrt{x} & x > 4 \end{cases} & 8.20 \quad y &= \begin{cases} x-2 & x < 0 \\ 2 & x = 0 \\ x^2-2 & x > 0 \end{cases} & 8.21 \quad y &= \begin{cases} x^2 & x \leq 0 \\ x & 0 < x \leq 2 \\ 1 & x > 2 \end{cases} \\
8.22 \quad y &= \begin{cases} -1 & x < 0 \\ \sqrt{1-x^2} & 0 \leq x \leq 1 \\ 1/(x-1) & x > 1 \end{cases} & 8.23 \quad y &= \begin{cases} 1/x & x < 0 \\ x & 0 \leq x \leq 2 \\ 3 & x > 2 \end{cases} & 8.24 \quad y &= \begin{cases} 1/(x+1) & x < 0 \\ 2^x & x \geq 0 \end{cases} \\
8.25 \quad y &= \begin{cases} -2 & x < 0 \\ \sqrt{4-x^2} & 0 \leq x \leq 2 \\ 1/(x-2) & x > 2 \end{cases} & 8.26 \quad y &= \begin{cases} x^2-4 & x < -1 \\ 3x & -1 \leq x \leq 3 \\ 5 & x > 3 \end{cases} & 8.27 \quad y &= \begin{cases} 1/x & x < 1 \\ \ln x & x \geq 1 \end{cases} \\
8.28 \quad y &= \begin{cases} 1/x & x < 0 \\ -\sqrt{x} & 0 \leq x \leq 1 \\ x^2 & x > 1 \end{cases} & 8.29 \quad y &= \begin{cases} -1/(x+1) & x < -1 \\ \sqrt{1-x^2} & -1 \leq x \leq 0 \\ 1 & x > 0 \end{cases} & 8.30 \quad y &= \begin{cases} x^2 & x < 0 \\ \sqrt{x} & 0 \leq x \leq 1 \\ 1/(x-1) & x > 1 \end{cases}
\end{aligned}$$

9. Найти производные функций, заданных явно, используя простейшие правила:

$$\begin{aligned}
9.1 \text{ а) } y &= 3x^2 + \frac{2}{x^3} - \sqrt{2} & \text{б) } y &= \frac{x^3}{4+x^2} & 9.2 \text{ а) } y &= 2x^3 + \sqrt[3]{x} - \ln 3 & \text{б) } y &= \frac{x^2-x+1}{x-1} \\
9.3 \text{ а) } y &= 2x^4 + \sqrt[3]{x^2} - \sin 2 & \text{б) } y &= \frac{2}{x^2+2x} & 9.4 \text{ а) } y &= x^2 - \frac{4}{\sqrt{x}} + \sqrt[3]{2} & \text{б) } y &= \frac{4x^2}{3+x^2} \\
9.5 \text{ а) } y &= \frac{4}{x} - x^3 - 2\cos 2 & \text{б) } y &= \frac{12x}{9+x^2} & 9.6 \text{ а) } y &= \frac{4}{x^2} - 3x^2 - 6e^2 & \text{б) } y &= \frac{x^2-3x+3}{x-1} \\
9.7 \text{ а) } y &= 4x^4 + \sqrt[3]{x^2} - \ln 3 & \text{б) } y &= \frac{4-x^3}{x^2} & 9.8 \text{ а) } y &= 3x^5 - \sqrt[3]{x^4} + \sin 4 & \text{б) } y &= \frac{x^2-4x+1}{x-4}
\end{aligned}$$

9.9 a) $y = 2x^4 + \frac{4}{x^5} - \sqrt{3}$ б) $y = \frac{x^2}{2x^3 + 1}$ 9.10 a) $y = 3x^2 + 4\sqrt[3]{x^2} - \ln 9$ б) $y = \frac{x^2}{3x + 4}$
 9.11 a) $y = 2x^3 - \frac{5}{\sqrt{x^3}} + \sqrt[3]{6}$ б) $y = \frac{x^3}{x^2 + 6}$ 9.12 a) $y = 2x^4 + \sqrt[5]{x} + \ln 4$ б) $y = \frac{4x^3 - 3x}{4x^2 - 1}$
 9.13 a) $y = 2x^5 + \frac{3}{x^4} - \sqrt[3]{2}$ б) $y = \frac{3x^2 - 7}{2x + 1}$ 9.14 a) $y = 6x^3 - \frac{3}{\sqrt{x^5}} + \sqrt[3]{4}$ б) $y = \frac{17 - x^2}{4x - 5}$
 9.15 a) $y = \frac{4}{x^2} - 2x^4 + \cos 3$ б) $y = \frac{x^2 + 1}{4x^2 - 3}$ 9.16 a) $y = \frac{3}{x^4} + 3\sqrt{x} - 3e^4$ б) $y = \frac{x^3 - 4x}{3x^2 - 4}$
 9.17 a) $y = 6x^3 + \sqrt[3]{x^4} - \ln 5$ б) $y = \frac{4x^2 + 9}{4x + 8}$ 9.18 a) $y = 3x^4 - \sqrt[3]{x^5} + \sin 6$ б) $y = \frac{x^2 - 3}{3x^2 - 2}$
 9.19 a) $y = 2x^6 + \frac{3}{x^4} - \sqrt{5}$ б) $y = \frac{2x^2 - 6}{x - 2}$ 9.20 a) $y = 4x^5 + 2\sqrt[4]{x^3} - \ln 3$ б) $y = \frac{x^3 - 5x}{5 - 3x^2}$
 9.21 a) $y = 2x^6 - \frac{4}{\sqrt{x^5}} + \sqrt[3]{3}$ б) $y = \frac{2 - x^2}{9x^2 - 4}$ 9.22 a) $y = 2x^6 + \sqrt[5]{x^2} + \ln 2$ б) $y = \frac{x^2 + 16}{9x^2 - 8}$
 9.23 a) $y = 4x^5 + \frac{3}{x^6} - \sqrt[5]{2}$ б) $y = \frac{21 - x^2}{7x + 9}$ 9.24 a) $y = 3x^6 - \frac{3}{\sqrt[3]{x^5}} + \sqrt[3]{2}$ б) $y = \frac{2x^2 - 1}{x^2 - 2}$
 9.25 a) $y = \frac{4}{x^3} - 3x^8 + \cos 2$ б) $y = \frac{x^2 - 11}{4x - 3}$ 9.26 a) $y = \frac{4}{x^5} + 5\sqrt{x^3} - 4e^3$ б) $y = \frac{x^2}{1 - 2x^3}$
 9.27 a) $y = 6x^5 + \sqrt[4]{x^7} - \ln 3$ б) $y = \frac{2x^2 - 9}{x^2 - 1}$ 9.28 a) $y = 5x^6 - \sqrt[4]{x^5} + \sin 3$ б) $y = \frac{x^2 + 2x}{2x + 1}$
 9.29 a) $y = 6x^5 + \frac{4}{x^8} - \sqrt{2}$ б) $y = \frac{3x^2 - 10}{4x^2 - 1}$ 9.30 a) $y = 2x^8 + 2\sqrt[4]{x^5} - \ln 6$ б) $y = \frac{x^2}{x^3 - 2}$

10. Найти производные функций, заданных явно, используя правило нахождения производной сложной функции:

10.1 a) $y = \sqrt[3]{x^2 + 4x + 5}$ б) $y = \frac{\arctg^3 4x}{\ln(6x - 1)}$ 10.2 a) $y = (2x - 1) \cdot e^{-3x}$ б) $y = \frac{\sqrt{\arcsin 3x}}{\ln(5x - 1)}$
 10.3 a) $y = \frac{2 - x^2}{\sqrt{3 + 4x^2}}$ б) $y = \operatorname{ctg} 3x \cdot \cos^4 7x$ 10.4 a) $y = x^2 \cdot \sqrt{16 - 4x}$ б) $y = \frac{\cos^3 4x}{\sin 4x + 1}$
 10.5 a) $y = \frac{2x + 3}{\sqrt[4]{3x + 5}}$ б) $y = (\cos 4x + 2) \sin 3x$ 10.6 a) $y = x^2 \cdot \ln(3x + 1)$ б) $y = \frac{e^{-2x} + 3}{x^3 - 4x + 1}$
 10.7 a) $y = (2x + 1)^3 \arctg 4x$ б) $y = \frac{\cos^3 4x}{\ln(5x + 1)}$ 10.8 a) $y = (2x + 3) \sqrt{4x - 2}$ б) $y = \frac{e^{-3x^2}}{(3x - 2)}$
 10.9 a) $y = e^{-4x} \cdot \ln(2x - 4)$ б) $y = \frac{\sin^3 4x}{\sqrt[4]{5x - 1}}$ 10.10 a) $y = 3 \sin^2 4x \cdot \operatorname{tg} 3x$ б) $y = \frac{\arcsin 4x}{\sqrt[3]{\arctg x}}$
 10.11 a) $y = \sin 2x \cdot \sqrt{x^2 + x}$ б) $y = \frac{\arctg^2 3x}{6x^3 + 1}$ 10.12 a) $y = (x^2 + 1) \cdot e^{3x}$ б) $y = \frac{\sqrt{\arcsin 2x}}{x^4}$

10.13 a) $y = \frac{\sin 2x}{\sqrt[3]{x^2 - 1}}$ б) $y = \operatorname{tg} 3x \cdot \ln^2 4x$ 10.14 a) $y = \cos \sqrt{1 - \ln^2 x}$ б) $y = \frac{x^3}{\sqrt{x^4 + 1}}$
 10.15 a) $y = \frac{\sqrt{2x - 1}}{(x + 1)^2}$ б) $y = \sqrt{x^2 + 1} \cdot \cos 6x$ 10.16 a) $y = x^3 \cdot \ln \sqrt{2x + x^2}$ б) $y = \frac{e^{\sqrt{x}}}{x^4 + 1}$
 10.17 a) $y = (x + 1)^2 \cdot \operatorname{arctg} 2x$ б) $y = \frac{\cos^2 3x}{\ln \sqrt{x}}$ 10.18 a) $y = \sqrt{x^3} \cdot \sin \sqrt{x + 2}$ б) $y = \frac{\sin^2 x}{1 + \operatorname{tg} x}$
 10.19 a) $y = e^{x^3} \cdot \ln(x^2 + 4)$ б) $y = \operatorname{arctg} \left(\frac{1}{x^2 + 1} \right)$ 10.20 a) $y = \cos^2 3x \cdot \ln 3x$ б) $y = \frac{\sin 4x}{\sqrt[3]{x^2 + 1}}$
 10.21 a) $y = \operatorname{tg} 2x \cdot \sqrt{3x + 4}$ б) $y = \frac{\ln^2 3x}{x + \cos 2x}$ 10.22 a) $y = (x^2 + 2x)e^{-3x^2}$ б) $y = \frac{\sqrt{\sin 4x}}{(1 + x^2)^3}$
 10.23 a) $y = \frac{\ln \sin x}{\sqrt[3]{x^3 + 1}}$ б) $y = \operatorname{tg}(e^x) \cdot (4x + 3)^2$ 10.24 a) $y = \sin(3x + 2)e^{\cos x}$ б) $y = \frac{\arcsin(x^3)}{\sqrt{x^2 + 1}}$
 10.25 a) $y = \frac{\sqrt{\operatorname{tg} x}}{\sin(e^{2x})}$ б) $y = (x^2 + 2\sqrt{x}) \operatorname{arctg} 3x$ 10.26 a) $y = \sqrt{1 + \cos^3 2x}$ б) $y = \operatorname{arctg} \frac{x}{\sqrt{x^2 + 1}}$
 10.27 a) $y = \ln \sqrt{\frac{e^x}{1 + e^x}}$ б) $y = e^{\sin 2x} \operatorname{arctg} \sqrt{x}$ 10.28 a) $y = \arcsin \frac{x}{x + 1}$ б) $y = \sin(\ln x)(x^2 + 2x)^3$
 10.29 a) $y = \operatorname{arctg} \sqrt{\frac{1 - x}{1 + x}}$ б) $y = e^{\cos x} \operatorname{arctg} \left(\frac{1}{\sqrt{x}} \right)$ 10.30 a) $y = \ln \frac{\sqrt{x^2 + x + 1}}{x}$ б) $y = \frac{\operatorname{tg}(\ln x)}{\sqrt{2x + 3}}$

11. Найти производную степенно-показательной функции:

11.1 $y = (\cos 3x)^{2x}$ 11.2 $y = (\sin 2x)^{4x}$ 11.3 $y = (3x)^{\operatorname{tg} 4x}$
 11.4 $y = (2x + 1)^{\sin 3x}$ 11.5 $y = (\operatorname{tg} 4x)^{3x}$ 11.6 $y = (\operatorname{ctg} 3x)^{4x}$
 11.7 $y = (\arcsin 3x)^{5x}$ 11.8 $y = (\ln(2x - 1))^{3x}$ 11.9 $y = (3x - 1)^{5x + 2}$
 11.10 $y = (3x - 1)^{2x - 4}$ 11.11 $y = (\sin x)^{x^2}$ 11.12 $y = \left(\frac{x}{x + 1} \right)^x$
 11.13 $y = (\sqrt{x})^{\sin x}$ 11.14 $y = (1 + 3x)^{\frac{2}{\ln x}}$ 11.15 $y = (x + 1)^{\frac{1}{x}}$
 11.16 $y = x^{\sin \ln x}$ 11.17 $y = (\arcsin 2x)^{3x}$ 11.18 $y = (\cos x)^{x^2}$
 11.19 $y = (x^2 + 1)^{\sqrt{x}}$ 11.20 $y = x^{\operatorname{arctg} \sqrt{x}}$ 11.21 $y = (1 + 2x)^{\sin x}$
 11.22 $y = (x^3 + x)^{\operatorname{tg} x}$ 11.23 $y = (2x)^{\ln(x^2 + 1)}$ 11.24 $y = (\sin 2x)^{3x + 4}$
 11.25 $y = (\operatorname{tg} 2x)^{\ln(x^2)}$ 11.26 $y = (1 + \sqrt{x})^{\cos x}$ 11.27 $y = (2x + 3)^{4x}$
 11.28 $y = x^{\sin \sqrt{x}}$ 11.29 $y = (4x)^{2x + 3}$ 11.30 $y = (2x + 1)^{\ln \sin x}$

12. Найти производную функции, заданной параметрически.

$$12.1 \begin{cases} x = \sin 2t \\ y = \cos 2t \end{cases}$$

$$12.2 \begin{cases} x = \operatorname{tg} 3t \\ y = \operatorname{ctg} 3t \end{cases}$$

$$12.3 \begin{cases} x = (2t - 1)/t \\ y = \sqrt{t^3} \end{cases}$$

$$12.4 \begin{cases} x = \ln^2 4t \\ y = \sqrt{\ln t} \end{cases}$$

$$12.5 \begin{cases} x = \sin 3t \\ y = \operatorname{ctg} 3t \end{cases}$$

$$12.6 \begin{cases} x = \operatorname{tg}^2 t \\ y = \sin 2t \end{cases}$$

$$12.7 \begin{cases} x = \operatorname{tg} 4t \\ y = \operatorname{ctg} 2t \end{cases}$$

$$12.8 \begin{cases} x = 3 \sin 2t \\ y = \cos 4t \end{cases}$$

$$12.9 \begin{cases} x = \arcsin 2t \\ y = \operatorname{arctg} 2t \end{cases}$$

$$12.10 \begin{cases} x = \ln 5t \\ y = \lg 3t \end{cases}$$

$$12.11 \begin{cases} x = e^{\sin t} \\ y = e^{\cos t} \end{cases}$$

$$12.12 \begin{cases} x = \sqrt{\sin t} \\ y = \cos \sqrt{t} \end{cases}$$

$$12.13 \begin{cases} x = \ln(t^2 + 1) \\ y = 1 + \ln^2 t \end{cases}$$

$$12.14 \begin{cases} x = \cos t + t \sin t \\ y = \sin t - t \cos t \end{cases}$$

$$12.15 \begin{cases} x = \frac{t+1}{t} \\ y = \frac{t-1}{t} \end{cases}$$

$$12.16 \begin{cases} x = \frac{1}{1+4t^2} \\ y = \operatorname{arctg} 2t \end{cases}$$

$$12.17 \begin{cases} x = \cos^2 t \\ y = \ln \sin t \end{cases}$$

$$12.18 \begin{cases} x = 2t^3 + t \\ y = \ln t \end{cases}$$

$$12.19 \begin{cases} x = \frac{1}{2+t} \\ y = \ln(2t+t^2) \end{cases}$$

$$12.20 \begin{cases} x = \ln \cos t \\ y = e^{\sin t} \end{cases}$$

$$12.21 \begin{cases} x = \frac{\cos t}{1 + \cos t} \\ y = \frac{\sin t}{1 + \cos t} \end{cases}$$

$$12.22 \begin{cases} x = t\sqrt{1-t^2} \\ y = \arcsin t \end{cases}$$

$$12.23 \begin{cases} x = \frac{t^2+1}{t^3} \\ y = \sin(t^2+t) \end{cases}$$

$$12.24 \begin{cases} x = \ln(\operatorname{tg} t) \\ y = \frac{1}{\sin^2 t} \end{cases}$$

$$12.25 \begin{cases} x = \sqrt{1-t^2} \\ y = \frac{t}{\sqrt{1-t^2}} \end{cases}$$

$$12.26 \begin{cases} x = \arcsin \sqrt{t} \\ y = \sqrt{1+\sqrt{t}} \end{cases}$$

$$12.27 \begin{cases} x = \operatorname{arctg} t \\ y = \ln \left(\frac{\sqrt{1+t^2}}{t+1} \right) \end{cases}$$

$$12.28 \begin{cases} x = \operatorname{arctg}(e^t) \\ y = \sqrt{e^{2t} + 1} \end{cases}$$

$$12.29 \begin{cases} x = \ln(1-t^2) \\ y = \arcsin \sqrt{1-t^2} \end{cases}$$

$$12.30 \begin{cases} x = \ln \left(\frac{1-t}{1+t} \right) \\ y = \sqrt{1-t^2} \end{cases}$$

13. Вычислить пределы, используя правило Лопиталя.

$$13.1 \text{ а) } \lim_{x \rightarrow 1} \frac{x^2 - 7x + 6}{2x^2 + 5x - 7}$$

$$\text{б) } \lim_{x \rightarrow 0} \frac{e^x + e^{-x} - 2 \cos x}{x^2}$$

$$13.2 \text{ а) } \lim_{x \rightarrow 2} \frac{2x^2 - 3x - 2}{x^2 + 6x - 16}$$

$$\text{б) } \lim_{x \rightarrow 0} \frac{x \cdot \operatorname{ctg} x - 1}{x^2}$$

$$13.3 \text{ a) } \lim_{x \rightarrow 6} \frac{2x^2 - 9x - 18}{x^2 - 7x + 6}$$

$$13.4 \text{ a) } \lim_{x \rightarrow 5} \frac{2x^2 - 11x + 5}{x^2 - 7x + 10}$$

$$13.5 \text{ a) } \lim_{x \rightarrow 1} \frac{4x^2 + x - 5}{x^2 - 2x - 1}$$

$$13.6 \text{ a) } \lim_{x \rightarrow -3} \frac{2x^2 + 5x - 3}{3x^2 + 10x + 3}$$

$$13.7 \text{ a) } \lim_{x \rightarrow 7} \frac{x^2 - 5x - 14}{2x^2 - 9x - 35}$$

$$13.8 \text{ a) } \lim_{x \rightarrow 4} \frac{x^2 + 3x - 28}{x^2 - 4x}$$

$$13.9 \text{ a) } \lim_{x \rightarrow 1} \frac{2x^2 - x - 1}{3x^2 - x - 2}$$

$$13.10 \text{ a) } \lim_{x \rightarrow -2} \frac{x^3 + 3x^2 + 2x}{x^2 - x - 6}$$

$$13.11 \text{ a) } \lim_{x \rightarrow 2} \frac{x^2 - x - 2}{7x - 3x^2 - 2}$$

$$13.12 \text{ a) } \lim_{x \rightarrow 3} \frac{2x^2 - 4x - 6}{7x - x^2 - 12}$$

$$13.13 \text{ a) } \lim_{x \rightarrow 1} \frac{2x^2 + 3x - 5}{x^2 - 4x + 3}$$

$$13.14 \text{ a) } \lim_{x \rightarrow 1} \frac{2x^2 - x - 1}{x^2 - 3x + 2}$$

$$13.15 \text{ a) } \lim_{x \rightarrow 2} \frac{2x^2 - 3x - 2}{-x^2 + 5x - 6}$$

$$13.16 \text{ a) } \lim_{x \rightarrow 3} \frac{2x^2 - 4x - 6}{5x - x^2 - 6}$$

$$13.17 \text{ a) } \lim_{x \rightarrow 1} \frac{2x^2 + 3x - 5}{3x - 3}$$

$$13.18 \text{ a) } \lim_{x \rightarrow 2} \frac{x^2 + x - 6}{2x^2 - 6x + 4}$$

$$13.19 \text{ a) } \lim_{x \rightarrow 4} \frac{x^2 - 16}{x^2 - 3x - 4}$$

$$13.20 \text{ a) } \lim_{x \rightarrow -3} \frac{2x^2 + 5x - 3}{x + 3}$$

$$6) \lim_{x \rightarrow \infty} \frac{x + 2 \ln x}{x}$$

$$6) \lim_{x \rightarrow 0} \frac{1 - \cos(x^2)}{x^4}$$

$$6) \lim_{x \rightarrow 0} \frac{e^x - e^{\sin x}}{x^2}$$

$$6) \lim_{x \rightarrow 0} \frac{\sin^2 2x - \sin^2 x}{x^2}$$

$$6) \lim_{x \rightarrow 0} \frac{\ln(\sin x)}{\ln(\sin 2x)}$$

$$6) \lim_{x \rightarrow 0} \frac{\ln(\cos x)}{\ln(\cos 2x)}$$

$$6) \lim_{x \rightarrow 0} \frac{e^{2x} - 1}{\ln(1 + 2x)}$$

$$6) \lim_{x \rightarrow \pi/4} \frac{1 - \operatorname{tg} x}{\cos 2x}$$

$$6) \lim_{x \rightarrow 0} \frac{e^{2x} - \cos x}{x^2}$$

$$6) \lim_{x \rightarrow 0} \frac{\operatorname{tg} x - x \cos x}{x^2}$$

$$6) \lim_{x \rightarrow 0} \frac{\cos 2x - 1}{\ln(1 + 2x)}$$

$$6) \lim_{x \rightarrow \infty} \frac{2 \ln(x^2 + 1)}{x^3}$$

$$6) \lim_{x \rightarrow 0} \frac{\ln(2 \sin x)}{\ln(\sin 2x)}$$

$$6) \lim_{x \rightarrow 0} \frac{\ln(\cos 2x)}{\ln(\cos 3x)}$$

$$6) \lim_{x \rightarrow 0} \frac{e^x - \cos 2x}{x^2}$$

$$6) \lim_{x \rightarrow \infty} \frac{\ln(e^x + x)}{\ln(3 + 2x)}$$

$$6) \lim_{x \rightarrow 0} \frac{\sin^2 x - \operatorname{tg} 2x}{x^2}$$

$$6) \lim_{x \rightarrow 0} \frac{e^{2x} - e^{\sin x}}{x}$$

$$13.21 \text{ a) } \lim_{x \rightarrow 6} \frac{x^2 - 9x + 18}{3x^2 - 17x - 6}$$

$$13.22 \text{ a) } \lim_{x \rightarrow 6} \frac{2x^2 - 9x - 18}{x^2 - 7x + 6}$$

$$13.23 \text{ a) } \lim_{x \rightarrow 5} \frac{2x^2 - 11x + 5}{x^2 - 7x + 10}$$

$$13.24 \text{ a) } \lim_{x \rightarrow 7} \frac{2x^2 - 13x - 7}{x^2 - 9x + 14}$$

$$13.25 \text{ a) } \lim_{x \rightarrow 1} \frac{3x^2 - 4x + 1}{2x^2 + 5x - 7}$$

$$13.26 \text{ a) } \lim_{x \rightarrow 3} \frac{2x^2 - 5x - 3}{x^2 - 5x + 6}$$

$$13.27 \text{ a) } \lim_{x \rightarrow 1} \frac{x^2 - 3x + 2}{3x^2 + 4x - 7}$$

$$13.28 \text{ a) } \lim_{x \rightarrow 2} \frac{x^2 + 6x - 16}{3x^2 - 5x - 2}$$

$$13.29 \text{ a) } \lim_{x \rightarrow 3} \frac{3x^2 - 10x + 3}{x^2 - 2x - 3}$$

$$13.30 \text{ a) } \lim_{x \rightarrow -1} \frac{2x^2 + 5x + 3}{x^2 - 4x - 5}$$

$$6) \lim_{x \rightarrow 4} \frac{\sqrt{1+2x} - 3}{\sqrt{x} - 2}$$

$$6) \lim_{x \rightarrow 0} \frac{e^{3x} - e^{2x} - x}{x^2}$$

$$6) \lim_{x \rightarrow -1} \frac{\sqrt{2+x} + x}{\ln(2+x)}$$

$$6) \lim_{x \rightarrow 0} \frac{\sin(\sin x)}{\sqrt{1+x} - 1}$$

$$6) \lim_{x \rightarrow 0} \frac{\ln^2(1+x)}{x^2}$$

$$6) \lim_{x \rightarrow 0} \frac{3x^2 + 6x}{\sin 3x}$$

$$6) \lim_{x \rightarrow \pi} \frac{1 + \cos x}{\sin^2 x}$$

$$6) \lim_{x \rightarrow 0} \frac{\sqrt{9+x} - 3}{\arctg 2x}$$

$$6) \lim_{x \rightarrow \pi} \frac{\cos 3x - \cos x}{\tg 2x}$$

$$6) \lim_{x \rightarrow 0} \frac{\cos 2x - \cos x}{1 - \cos x}$$

14. Вычислить пределы, используя правило Лопиталья.

$$14.1 \lim_{x \rightarrow 0} (x^2 \cdot e^{1/x^2})$$

$$14.2 \lim_{x \rightarrow \infty} (x + \sqrt{x})^{\frac{1}{x}}$$

$$14.3 \lim_{x \rightarrow 0} (\tg x \cdot \ln \sin x)$$

$$14.4 \lim_{x \rightarrow 1} \left(\frac{1}{\ln x} - \frac{x}{\ln x} \right)$$

$$14.5 \lim_{x \rightarrow \pi/2} (2x - \pi) \cdot \ln \tg x$$

$$14.6 \lim_{x \rightarrow 0} \left(\ln \frac{1}{x} \right)^x$$

$$14.7 \lim_{x \rightarrow 0} \left(\frac{1}{x \cdot \sin x} - \frac{1}{x^2} \right)$$

$$14.8 \lim_{x \rightarrow 0} \left(\tg x \cdot \ln \frac{1}{x} \right)$$

$$14.9 \lim_{x \rightarrow 0} (\sin x)^x$$

$$14.10 \lim_{x \rightarrow 0} (x \cdot \ln^2 x)$$

$$14.11 \lim_{x \rightarrow 0} (\ln \cos x) \cdot \ctg x$$

$$14.12 \lim_{x \rightarrow 0} x^2 \cdot e^{\frac{1}{\sin x}}$$

$$14.13 \lim_{x \rightarrow 0} x \cdot \ln \tg x$$

$$14.14 \lim_{x \rightarrow \infty} x \cdot \ln \left(1 + \frac{1}{x^2} \right)$$

$$14.15 \lim_{x \rightarrow 0} \left(\frac{1}{\arctg x} - \frac{1}{x} \right)$$

$$14.16 \lim_{x \rightarrow \infty} x \cdot \sin \left(\frac{1}{x} \right)$$

$$14.17 \lim_{x \rightarrow 0} (\ctg x)^{\sin x}$$

$$14.18 \lim_{x \rightarrow 0} \left(\frac{1}{x} - \frac{2}{\sin x} \right)$$

$$14.19 \lim_{x \rightarrow 0} \left(x^4 \cdot e^{1/x^4} \right)$$

$$14.20 \lim_{x \rightarrow 1} \ln x \cdot \ln(1-x)$$

$$14.21 \lim_{x \rightarrow \infty} x \cdot \ln \left(1 + \frac{3}{x} \right)$$

$$14.22 \lim_{x \rightarrow \infty} (1 + xe^x)^{\frac{1}{x}}$$

$$14.23 \lim_{x \rightarrow 0} x \ln^3 x$$

$$14.24 \lim_{x \rightarrow \infty} x^{\frac{1}{\sqrt{x}}}$$

$$14.25 \lim_{x \rightarrow \infty} x \cdot (e^{2/x} - e^{1/x})$$

$$14.26 \lim_{x \rightarrow 0} \operatorname{ctgx} \cdot \operatorname{arctgx}$$

$$14.27 \lim_{x \rightarrow \infty} (2 + x)^{\frac{1}{x}}$$

$$14.28 \lim_{x \rightarrow 0} \left(\operatorname{ctgx} - \frac{1}{x} \right)$$

$$14.29 \lim_{x \rightarrow 0} \left(\frac{1}{x} - \frac{1}{e^x - 1} \right)$$

$$14.30 \lim_{x \rightarrow 0} \operatorname{tgx} \cdot \ln 2x$$

15. Составить уравнения касательной и нормали к графику функции $y = f(x)$ в точке с абсциссой x_0 .

$$15.1 y = \frac{1}{x^2 + 1}, \quad x_0 = 1$$

$$15.2 y = \frac{1}{x^3 + 1}, \quad x_0 = 0$$

$$15.3 y = x + \frac{1}{x}, \quad x_0 = 1$$

$$15.4 y = \frac{(4x - x^2)}{4}, \quad x_0 = 2$$

$$15.5 y = 2x^2 + 3x - 1, \quad x_0 = -2$$

$$15.6 y = x - x^3, \quad x_0 = -1$$

$$15.7 y = x^2 + 8\sqrt{x} - 32, \quad x_0 = 4$$

$$15.8 y = x + x\sqrt{x}, \quad x_0 = 1$$

$$15.9 y = 4x - x^2, \quad x_0 = 3$$

$$15.10 y = \sqrt{4 - 2x^2}, \quad x_0 = 1$$

$$15.11 y = \frac{1 + \sqrt{x}}{1 - \sqrt{x}}, \quad x_0 = 4$$

$$15.12 y = \frac{x^2 - 3x + 6}{x^2}, \quad x_0 = 3$$

$$15.13 y = 2x^2 - 3x + 1, \quad x_0 = 1$$

$$15.14 y = \sqrt{x} - 3 \cdot \sqrt[3]{x}, \quad x_0 = 64$$

$$15.15 y = x^2 + \sqrt{x^3}, \quad x_0 = 1$$

$$15.16 y = x^2 + x + 1, \quad x_0 = -1$$

$$15.17 y = \frac{2 + \sqrt{x}}{2 - \sqrt{x}}, \quad x_0 = 9$$

$$15.18 y = \frac{x^2 - 2x + 2}{x^2}, \quad x_0 = 2$$

$$15.19 y = 2x^2 + 3, \quad x_0 = -1$$

$$15.20 y = 3 \cdot \sqrt[4]{x} - \sqrt{x}, \quad x_0 = 1$$

$$15.21 y = 2x + \frac{1}{x}, \quad x_0 = 1$$

$$15.22 y = \frac{x^3 + 2}{x^3 - 2}, \quad x_0 = 2$$

$$15.23 y = x^2 - x - 1, \quad x_0 = 1$$

$$15.24 y = 3 \cdot \sqrt[3]{x^2} - 2x + 2, \quad x_0 = 1$$

$$15.25 y = \frac{1}{3x + 2}, \quad x_0 = 2$$

$$15.26 y = \frac{2x}{x^2 + 1}, \quad x_0 = 1$$

$$15.27 y = \frac{x^2 - 3x + 3}{3}, \quad x_0 = 3$$

$$15.28 y = \frac{1 + 3x^2}{3 + x^2}, \quad x_0 = 1$$

$$15.29 y = \frac{3x - 2x^3}{3}, \quad x_0 = 1$$

$$15.30 y = \frac{x^2 - 2x - 3}{4}, \quad x_0 = 4$$

16. Найти наибольшее и наименьшее значения функции на отрезке $[a, b]$.

$$16.1 y = x^3 - 3x^2 + 4 \quad a = 0, \quad b = 4$$

$$16.2 y = x^2 + \frac{16}{x} - 16 \quad a = 1, \quad b = 4$$

- 16.3 $y = x^3 - 2x^2 + 6$ $a=0, b=3$ 16.4 $y = 4 - x - \frac{4}{x^2}$ $a=1, b=4$
- 16.5 $y = x^3 - 5x^2 + 4$ $a=1, b=4$ 16.6 $y = 2\sqrt{x} - x$ $a=0, b=4$
- 16.7 $y = \frac{10x+10}{x^2+2x+2}$ $a=-1, b=2$ 16.8 $y = 1 - \sqrt[3]{x^2-2x}$ $a=0, b=2$
- 16.9 $y = x^3 - 3x^2 + 6$ $a=1, b=4$ 16.10 $y = 2x - 3 \cdot \sqrt[3]{x^2}$ $a=-1, b=1$
- 16.11 $y = x^3 - 7x^2 + 2$ $a=2, b=5$ 16.12 $y = x^2(x-2)^2$ $a=0, b=2$
- 16.13 $y = 1 + \sqrt[3]{x^2+2x}$ $a=-2, b=0$ 16.14 $y = x - 4\sqrt{x} + 5$ $a=1, b=9$
- 16.15 $y = \frac{10x}{1+x^2}$ $a=0, b=3$ 16.16 $y = 3 - x - \frac{4}{(x+2)^2}$ $a=-1, b=2$
- 16.17 $y = x^3 - 2x^2 + 4$ $a=0, b=3$ 16.18 $y = x - 4\sqrt{x+2} + 8$ $a=-1, b=7$
- 16.19 $y = x^3 - 4x^2 + 6$ $a=1, b=4$ 16.20 $y = \frac{x^3-9x^2}{4} + 6x - 9$ $a=0, b=4$
- 16.21 $y = x^3 - 4x^2 + 5$ $a=1, b=3$ 16.22 $y = \frac{4x}{4+x^2}$ $a=-4, b=2$
- 16.23 $y = x^3 - 6x^2 + 6$ $a=2, b=4$ 16.24 $y = \frac{4x^2}{3+x^2}$ $a=-1, b=1$
- 16.25 $y = x^3 - 2x^2 + 2$ $a=0, b=3$ 16.26 $y = -\frac{x^2}{2} + \frac{8}{x} + 8$ $a=-4, b=-1$
- 16.27 $y = 2x^3 - 3x^2 - 4$ $a=0, b=2$ 16.28 $y = 2\sqrt{x-1} - x + 2$ $a=1, b=5$
- 16.29 $y = 2 - 12x^2 - 8x^3$ $a=-2, b=0$ 16.30 $y = 3\sqrt[3]{(x-3)^2} - 2x + 6$ $a=2, b=4$

17. Найти локальные экстремумы, интервалы возрастания и убывания функции $y = f(x)$.

- 17.1 $y = \ln(4 - x^2)$ 17.2 $y = xe^{-x}$ 17.3 $y = \sqrt{x} + \sqrt{4-x}$
- 17.4 $y = (2 + x^2) \cdot e^{-x^2}$ 17.5 $y = \frac{x^3}{\sqrt{x^4+1}}$ 17.6 $y = \frac{x}{\sqrt[3]{(x-2)^2}}$
- 17.7 $y = \arctg(x^2)$ 17.8 $y = \sqrt[3]{x^2-2x}$ 17.9 $y = x\sqrt{x+3}$
- 17.10 $y = x + 2\arctg x$ 17.11 $y = \sqrt[3]{1-x^2}$ 17.12 $y = \sqrt[3]{1-x^3}$
- 17.13 $y = \frac{e^x}{1+x}$ 17.14 $y = \frac{x}{\sqrt{x^2+1}}$ 17.15 $y = \frac{x^2}{\sqrt{x^2+1}}$
- 17.16 $y = \ln\left(\frac{\sqrt{x^2+1}-1}{x}\right)$ 17.17 $y = \frac{x}{\ln x}$ 17.18 $y = \frac{4}{\sqrt{4-x^2}}$

$$17.19 \ y = \frac{8}{x\sqrt{x^2 - 4}}$$

$$17.22 \ y = \frac{1}{x \ln x}$$

$$17.25 \ y = x - 2 \ln x$$

$$17.28 \ y = \frac{1 + \sqrt{x}}{3 + x}$$

$$17.20 \ y = \ln(x^2 + 2x + 2)$$

$$17.23 \ y = x^2 e^{2/x}$$

$$17.26 \ y = x e^{-x^2/2}$$

$$17.29 \ y = (x - 1)e^x$$

$$17.21 \ y = \frac{\ln x}{x}$$

$$17.24 \ y = \frac{1}{e^x - 1}$$

$$17.27 \ y = \ln\left(\frac{x}{x-1}\right)$$

$$17.30 \ y = \frac{1}{x} \cdot e^{1/x}$$

18. Провести полное исследование и построить график неперiodической функции

$y = f(x)$:

- 1) найти область определения функции;
- 2) найти точки разрыва;
- 3) исследовать функцию на чётность, нечётность;
- 4) найти точки пересечения графика с осями координат;
- 5) найти асимптоты графика функции;
- 6) найти интервалы возрастания и убывания, локальные экстремумы функции;
- 7) найти интервалы выпуклости, вогнутости и точки перегиба;
- 8) построить график.

$$18.1 \ y = x^3 - 3x^2.$$

$$18.4 \ y = \frac{(x-2)^2 \cdot (x+4)}{4}.$$

$$18.7 \ y = \frac{1}{3} \cdot x^3 - x^2 + 4.$$

$$18.10 \ y = 12x^2 - 8x^3 - 2.$$

$$18.13 \ y = (x-1)^2(x-3)^2.$$

$$18.16 \ y = x^3 + 6x^2 + 9x + 8.$$

$$18.19 \ y = -x^4 + 8x^2 + 9.$$

$$18.22 \ y = (1 - x^2)^3.$$

$$18.25 \ y = x^3 - 3x^2 - 9x + 10.$$

$$18.28 \ y = \frac{x^3}{3} - x^2 + 4.$$

$$18.2 \ y = \frac{6x^2 - x^4}{9}.$$

$$18.5 \ y = x^4 - 2x^2 + 3.$$

$$18.8 \ y = 2x^3 - 3x^2 - 4.$$

$$18.11 \ y = \frac{4x^3 - x^4}{5}.$$

$$18.14 \ y = x^3 - 6x^2 + 9x - 3.$$

$$18.17 \ y = x^3 - 6x^2 + 9x - 4.$$

$$18.20 \ y = x^2(x-2)^2.$$

$$18.23 \ y = \frac{(x^2 - 4)^2}{16}.$$

$$18.26 \ y = x^3 - 12x.$$

$$18.29 \ y = 3x^5 - 5x^4 + 4.$$

$$18.3 \ y = (x-1)^2 \cdot (x+2).$$

$$18.6 \ y = 2x^3 - 9x^2 + 12x - 9.$$

$$18.9 \ y = 2x^3 + 3x^2 - 5.$$

$$18.12 \ y = 3x^2 - 2 - x^3.$$

$$18.15 \ y = x^4 - 5x^2 + 4.$$

$$18.18 \ y = 16x^3 + 12x^2 - 5.$$

$$18.21 \ y = 2x^3 - 3x^2 - 12x - 1.$$

$$18.24 \ y = x^3 - 6x^2 + 16.$$

$$18.27 \ y = \frac{(x^2 - 5)^3}{125}.$$

$$18.30 \ y = 2x + \frac{x^2}{2} - \frac{x^3}{3}.$$

19. Провести полное исследование и построить график неперiodической функции

$y = f(x)$:

- 1) найти область определения функции;
- 2) найти точки разрыва;
- 3) исследовать функцию на чётность, нечётность;

- 4) найти точки пересечения графика с осями координат;
- 5) найти асимптоты графика функции;
- 6) найти интервалы возрастания и убывания, локальные экстремумы функции;
- 7) найти интервалы выпуклости, вогнутости и точки перегиба;
- 8) построить график.

$$19.1 \quad y = \frac{x^2 - x - 6}{x - 2}.$$

$$19.2 \quad y = \frac{x^2}{2} + \frac{1}{x}.$$

$$19.3 \quad y = x^2 + \frac{2}{x}.$$

$$19.4 \quad y = \frac{8}{x^2 - 4}.$$

$$19.5 \quad y = \frac{16}{x^2(x - 4)}.$$

$$19.6 \quad y = \frac{x^3}{x^4 - 1}.$$

$$19.7 \quad y = \frac{4x - 12}{(x - 2)^2}.$$

$$19.8 \quad y = \frac{x^3}{x^3 + 1}.$$

$$19.9 \quad y = \frac{1 - x^3}{x^2}.$$

$$19.10 \quad y = \frac{x^2 - 1}{x^2 + 1}.$$

$$19.11 \quad y = \frac{x^3}{x^2 - 3}.$$

$$19.12 \quad y = \frac{x}{2 - x^3}.$$

$$19.13 \quad y = \frac{x^2}{x^3 - 1}.$$

$$19.14 \quad y = \frac{x}{x^2 - 1}.$$

$$19.15 \quad y = \frac{x^2 - 6x + 3}{x - 3}.$$

$$19.16 \quad y = \frac{x}{x^3 + 2}.$$

$$19.17 \quad y = \frac{x^3 - 3x}{x^2 - 1}.$$

$$19.18 \quad y = \frac{4}{x^2 + 2x - 3}.$$

$$19.19 \quad y = \frac{x^3}{2(x - 1)^2}.$$

$$19.20 \quad y = \frac{x}{(1 - x^2)^2}.$$

$$19.21 \quad y = \frac{x^4}{x^3 - 1}.$$

$$19.22 \quad y = \frac{4x}{4 + x^2}.$$

$$19.23 \quad y = \frac{4x^2}{3 + x^2}.$$

$$19.24 \quad y = \frac{x^2 - 4x + 1}{x - 4}.$$

$$19.25 \quad y = \frac{x^4 - 3}{x}.$$

$$19.26 \quad y = \frac{x^2 - 6x + 9}{(x - 1)^2}.$$

$$19.27 \quad y = \frac{x^4}{x^3 + 1}.$$

$$19.28 \quad y = \frac{(x - 1)^2}{x^2 + 1}.$$

$$19.29 \quad y = \frac{3x - 2}{x^3}.$$

$$19.30 \quad y = \frac{x^2 - 2x + 2}{x - 1}.$$

20. Провести полное исследование и построить график неперiodической функции

$y = f(x)$:

- 1) найти область определения функции;
- 2) найти точки разрыва;
- 3) исследовать функцию на чётность, нечётность;
- 4) найти точки пересечения графика с осями координат;
- 5) найти асимптоты графика функции;
- 6) найти интервалы возрастания и убывания, локальные экстремумы функции;
- 7) найти интервалы выпуклости, вогнутости и точки перегиба;
- 8) построить график.

$$20.1 \quad y = (x - 1)\sqrt[3]{x^2}.$$

$$20.2 \quad y = \frac{x^2}{\sqrt{x^2 + 1}}.$$

$$20.3 \quad y = \frac{x^2}{\sqrt[3]{x^3 - 4}}.$$

$$20.4 \quad y = \frac{1}{x \cdot \ln x}.$$

$$20.5 \quad y = \frac{\sqrt[3]{x^3 + 2}}{x}.$$

$$20.6 \quad y = \frac{\ln x}{x}.$$

$$20.7 \quad y = \sqrt[3]{x^2 - 2x}.$$

$$20.8 \quad y = \arctg(x^2).$$

$$20.9 \quad y = x \cdot \arctg x.$$

$$20.10 \quad y = \ln(4 - x^2).$$

$$20.11 \quad y = \sqrt{x^3 - 3x}.$$

$$20.12 \quad y = \sqrt{8 + x} - \sqrt{8 - x}.$$

$$20.13 \quad y = x \cdot \sqrt{x + 3}.$$

$$20.14 \quad y = x + 2\arctg x.$$

$$20.15 \quad y = \sqrt[3]{1 - x^2}.$$

$$\mathbf{20.16} \quad y = \frac{x^3}{\sqrt{x^4 + 1}}.$$

$$\mathbf{20.19} \quad y = \frac{x}{\sqrt[3]{(x-2)^2}}.$$

$$\mathbf{20.22} \quad y = \ln\left(\frac{x-1}{x}\right).$$

$$\mathbf{20.25} \quad y = \frac{8}{x \cdot \sqrt{x^2 - 4}}.$$

$$\mathbf{20.28} \quad y = \sqrt[3]{x+1} + \sqrt[3]{x-1}.$$

$$\mathbf{20.17} \quad y = \sqrt{x} + \sqrt{4-x}.$$

$$\mathbf{20.20} \quad y = \frac{x}{\sqrt{x^2 + 1}}.$$

$$\mathbf{20.23} \quad y = x \cdot \sqrt{1-x^2}.$$

$$\mathbf{20.26} \quad y = \sqrt[3]{x \cdot (x-1)^2}.$$

$$\mathbf{20.29} \quad y = \frac{4}{\sqrt{4-x^2}}.$$

$$\mathbf{20.18} \quad y = \sqrt[3]{1-x^3}.$$

$$\mathbf{20.21} \quad y = \sqrt[3]{x^3 - 6x^2}.$$

$$\mathbf{20.24} \quad y = \frac{x}{\sqrt[3]{x^2 - 1}}.$$

$$\mathbf{20.27} \quad y = x^2 \cdot \ln x.$$

$$\mathbf{20.30} \quad y = \ln(x^2 + 2x + 2).$$