

**ТИПОВОЙ РАСЧЕТ**  
**«Дифференциальное исчисление**  
**функции одной действительной переменной»**

**Задание 1.** Найти производную функции.

1.1.  $y = (2x + 2)^7 + \frac{1}{\sqrt[7]{x^2}} + \sqrt{8x}$ .

1.2.  $y = (2x + 5)^5 + \frac{1}{\sqrt[4]{x^3}} + \sqrt{3x}$ .

1.3.  $y = (7x - 5)^4 + \frac{1}{7\sqrt[5]{x^2}} + \sqrt{5x}$ .

1.4.  $y = (2x - 7)^6 + \frac{1}{\sqrt[6]{x^5}} + \sqrt{7x}$ .

1.5.  $y = (3x - 1)^7 + \frac{1}{\sqrt{x^7}} + \sqrt{2x}$ .

1.6.  $y = (2x - 3)^{10} + \frac{1}{\sqrt[7]{x^3}} + \sqrt{7x + 1}$ .

1.7.  $y = (9x + 5)^8 + \frac{1}{\sqrt[5]{x^3}} + \sqrt{15x}$ .

1.8.  $y = (3x + 5)^7 + \frac{1}{\sqrt[5]{x^7}} + \sqrt{13x - 1}$ .

1.9.  $y = (7x + 5)^{11} + \frac{1}{\sqrt[8]{x^3}} + \sqrt{17x}$ .

1.10.  $y = (5x - 1)^7 + \frac{1}{\sqrt{x^3}} + \sqrt{10x - 2}$ .

1.11.  $y = (3x + 2)^5 + \frac{1}{\sqrt[7]{x^4}} + \sqrt{11x}$ .

1.12.  $y = (3x - 5)^6 + \frac{1}{\sqrt[7]{x^5}} + \sqrt{13x - 3}$ .

$$1.13. y = (7x+2)^9 + \frac{1}{\sqrt[11]{x^7}} + \sqrt{2x+5}.$$

$$1.14. y = (9x-5)^{10} + \frac{1}{\sqrt[13]{x^8}} + \sqrt{3x+8}.$$

$$1.15. y = (5+11x)^7 + \frac{4}{\sqrt[7]{x^3}} + \sqrt{5x-2}.$$

$$1.16. y = (3-4x)^8 + \frac{3}{\sqrt[7]{x^6}} + \sqrt{13x}.$$

$$1.17. y = (5-2x)^{13} + \frac{11}{x^3\sqrt{x^2}} + \sqrt{2x+5}.$$

$$1.18. y = (1-7x)^7 + \frac{5}{\sqrt[7]{x^9}} + \sqrt{2x-15}.$$

$$1.19. y = (1-5x)^5 + \frac{1}{8^{10}\sqrt{x^7}} + \sqrt{8x+2}.$$

$$1.20. y = (9-2x)^6 + \frac{1}{\sqrt[9]{x^8}} + \sqrt{5x+17}.$$

$$1.21. y = (3-5x)^7 + \frac{1}{2x^5\sqrt{x^2}} + \sqrt{15x}.$$

$$1.22. y = (7-2x)^6 + \frac{10}{\sqrt[9]{x^7}} + \sqrt{3x-3}.$$

$$1.23. y = (3x-2)^5 + \frac{1}{5^8\sqrt{x^5}} + \sqrt{3-5x}.$$

$$1.24. y = (2x-10)^8 + \frac{1}{\sqrt[11]{x^3}} + \sqrt{3x+2}.$$

$$1.25. y = (2x-3)^7 + \frac{3}{x^7\sqrt{x^2}} + \sqrt{2-11x}.$$

$$1.26. y = (5x+5)^7 + \frac{1}{\sqrt[12]{x^7}} + \sqrt{15x-3}.$$

$$1.27. y = (5x+1)^5 + \frac{5}{\sqrt{x^7}} + \sqrt{11x-7}.$$

$$1.28. y = (3x+3)^3 + \frac{1}{\sqrt[3]{x^7}} + \sqrt{9x}.$$

$$1.29. y = (7x+2)^4 + \frac{1}{7x^7\sqrt{x^3}} + \sqrt{10x}.$$

$$1.30. y = (5x+7)^5 + \frac{7}{x^2\sqrt{x^3}} + \sqrt{11x+1}.$$

**Задание 2.** Найти производную функции.

$$2.1. y = \ln(\sqrt{1+x} + x^2) + \ln 4.$$

$$2.2. y = \ln(\sqrt{1+2x} + 5x^2) + \ln 5.$$

$$2.3. y = \ln(\sqrt{2x-5} - x^3) + \ln 10.$$

$$2.4. y = \ln(\sqrt{1+5x} - 3x) + \ln 7.$$

$$2.5. y = \ln(\sqrt{x-7} + 3x^3) + \ln 3.$$

$$2.6. y = 3\ln(\sqrt{7x-3} + x^3) + \ln 8.$$

$$2.7. y = \frac{1}{3}\ln(\sqrt{2x-3} + 7x^2) + \ln 9.$$

$$2.8. y = 5\ln(\sqrt{2x+2} + 3x^3) + \ln 11.$$

$$2.9. y = \frac{1}{5}\ln(\sqrt{3x-1} + 5x) + \ln 13.$$

$$2.10. y = 2\ln(\sqrt{3x+1} + 6x^2) + \ln 15.$$

$$2.11. y = \frac{1}{2}\ln(\sqrt{2-3x} - 5x^3) + \ln 12.$$

$$2.12. y = \ln(\sqrt{5+3x} - 10x^2) + \ln 2.$$

$$2.13. y = \ln(\sqrt{3+5x} + x^5) + \ln 6.$$

$$2.14. y = \ln(\sqrt{7-x} - x^2) + \ln 14.$$

$$2.15. y = \ln(\sqrt{5-2x} - 3x^2) + \ln 15.$$

$$2.16. y = \ln(\sqrt{2+2x} + 3x^2) + \ln 16.$$

$$2.17. y = \ln(\sqrt{2x-5} - 7x^2) + \ln 3.$$

$$2.18. y = \ln(\sqrt{2x+7} + 7x^3) + \ln 19.$$

$$2.19. y = 7 \ln(\sqrt{7x-1} + 7x^2) + \ln 20.$$

$$2.20. y = \frac{1}{7} \ln(\sqrt{1-7x} - x^5) + \ln 15.$$

$$2.21. y = \ln(x^3 - \sqrt{3-3x} + 3x^3) + \ln 3.$$

$$2.22. y = \ln(x^2 + \sqrt{3x+11}) + \ln 5.$$

$$2.23. y = \ln(\sqrt{1-x} - x^2) + \ln 11.$$

$$2.24. y = 9 \ln(\sqrt{2+x} + 5x^3) + \ln 10.$$

$$2.25. y = \frac{1}{9} \ln(\sqrt{3-x} - x^5) + \ln 13.$$

$$2.26. y = 3 \ln(\sqrt{5+2x} - x^3) + \ln 7.$$

$$2.27. y = \frac{1}{3} \ln(\sqrt{1+9x} - 5x^2) + \ln 9.$$

$$2.28. y = \ln(\sqrt{9x-3} + 9x^3) + \ln 5.$$

$$2.29. y = \ln(\sqrt{5+7x} + 11x^5) + \ln 7.$$

$$2.30. y = \ln(\sqrt{5-x} + 17x^2) + \ln 2.$$

**Задание 3.** Найти производную функции.

$$3.1. y = \cos 5x \cdot 3^{9x}(x^2 + 4).$$

$$3.2. y = \sin(3x + 1) \cdot 5^{3x}(x^2 - 3).$$

$$3.3. y = \sin 2x \cdot 2^{7x}(x^2 - 1).$$

$$3.4. y = \cos(3x - 5) \cdot 3^{3x}(x^2 - 5).$$

$$3.5. y = \cos 7x \cdot 5^{9x}(4 - x^2).$$

- 3.6.  $y = \sin(5x + 1) \cdot 2^{5x}(1 + x^2)$ .
- 3.7.  $y = \cos(3x + 2) \cdot 2^{9x}(1 - 7x^2)$ .
- 3.8.  $y = \cos 3x \cdot 5^{7x}(3 - 5x^2)$ .
- 3.9.  $y = \sin(2x - 7) \cdot 9^{3x}(x^2 + 11)$ .
- 3.10.  $y = \sin 5x \cdot 7^{3x}(x^2 + 5)$ .
- 3.11.  $y = \sin(2 - 3x) \cdot 3^{5x}(2x^2 + 3)$ .
- 3.12.  $y = \cos(1 - 3x) \cdot 7^{5x}(3x^2 - 2)$ .
- 3.13.  $y = \cos(3x + 7) \cdot 4^{7x}(5 - x^2)$ .
- 3.14.  $y = \cos 11x \cdot 3^{7x}(11 + 3x^2)$ .
- 3.15.  $y = \sin(7x - 3) \cdot 2^{7x}(x^2 + 9)$ .
- 3.16.  $y = \sin(3 - 5x) \cdot 2^{9x}(9 - x^2)$ .
- 3.17.  $y = \sin 11x \cdot 2^{3x}(x^2 - 13)$ .
- 3.18.  $y = \operatorname{tg} 5x \cdot 7^{9x}(3x^2 - 4)$ .
- 3.19.  $y = \operatorname{tg} 7x \cdot 5^{9x}(4 - 7x^2)$ .
- 3.20.  $y = \operatorname{tg} 2x \cdot 9^{5x}(4 - x^2)$ .
- 3.21.  $y = \operatorname{ctg} 7x \cdot 5^{7x}(1 - 5x^2)$ .
- 3.22.  $y = \operatorname{ctg}(3x + 2) \cdot 5^{2x}(2 + x^2)$ .
- 3.23.  $y = \operatorname{ctg}(5x - 1) \cdot 11^x(3 - 2x^2)$ .
- 3.24.  $y = \operatorname{tg} 9x \cdot 4^{2x}(x^2 + 15)$ .
- 3.25.  $y = \operatorname{tg}(2x - 1) \cdot 4^{3x}(7 - 2x^2)$ .
- 3.26.  $y = \operatorname{tg} 11x \cdot 7^{2x}(x^2 - 11)$ .
- 3.27.  $y = \operatorname{ctg} 2x \cdot 9^{3x}(2x^2 - 7)$ .
- 3.28.  $y = \operatorname{ctg}(2 - 3x) \cdot 4^{7x}(15 - x^2)$ .
- 3.29.  $y = \operatorname{ctg}(2 - 3x) \cdot 4^{7x}(15 - x^2)$ .
- 3.30.  $y = \operatorname{tg}(5x + 1) \cdot 5^{2x}(3x^2 - 3)$ .

**Задание 4.** Найти производную функции.

$$4.1. y = \frac{x^3 + \sin x}{x^2 + 5} + e^{-2}.$$

$$4.2. y = \frac{x - \cos x}{5 - x^2} + e^{-5}.$$

$$4.3. y = \frac{2 \sin x - x^3}{x^2 + 3} + e^{-3}.$$

$$4.4. y = \frac{x^3 - \cos x}{x^2 - 3} + e^{-4}.$$

$$4.5. y = \frac{\operatorname{tg} x - x^5}{x^2 + 1} + e^{-7}.$$

$$4.6. y = \frac{x^3 - \operatorname{tg} x}{1 - x^2} + e^{-6}.$$

$$4.7. y = \frac{\operatorname{tg} x - 2x}{\operatorname{tg} x + 3} + e^{11}.$$

$$4.8. y = \frac{x^2 + 3 \sin x}{x^2 - 5} + e^{-11}.$$

$$4.9. y = \frac{x^5 - \cos 5x}{3 - x^2} + e^{-13}.$$

$$4.10. y = \frac{\sin 3x - x^3}{x^5 + 1} + e^9.$$

$$4.11. y = \frac{x^3 + \cos 3x}{x^3 - 1} + e^{-9}.$$

$$4.12. y = \frac{x^3 + \operatorname{tg} x}{x^2 + 1} + e^{13}.$$

$$4.13. y = \frac{\operatorname{tg} x - x^2}{x^5 - 3} + e^5.$$

$$4.14. y = \frac{x^2 - \operatorname{ctg} x}{x^2 + 2} + e^2.$$

$$4.15. y = \frac{x^4 + \operatorname{ctg} x}{x^2 - 7} + e^3.$$

$$4.16. y = \frac{7 - x^2}{\sin x + \cos x} + e^4.$$

$$4.17. y = \frac{x^3 - 5}{\cos x - \sin x} + e^7.$$

$$4.18. y = \frac{x^5 - 5}{x^3 - \cos x} + e^{-10}.$$

$$4.19. y = \frac{5 + x^4}{x^4 + \cos x} + e^{10}.$$

$$4.20. y = \frac{\operatorname{tg} x + x^4}{x^2 + 11} + e^{12}.$$

$$4.21. y = \frac{\sin x + \cos x}{\cos x - \sin x} + e^{-12}.$$

$$4.22. y = \frac{\operatorname{tg} x + 1}{\operatorname{tg} x - 1} + e^{15}.$$

$$4.23. y = \frac{x^5 + \sin 2x}{x^2 + 2} + e^{-15}. \quad 4.24. y = \frac{\cos x - \sin x}{\cos x + \sin x} + 2e^3.$$

$$4.25. y = \frac{\operatorname{tg} 3x}{x^2 + 7} + 3e^{-5}. \quad 4.26. y = \frac{\operatorname{tg} 2x + x}{x^3 - 5} + 2e^{-7}.$$

$$4.27. y = \frac{x^5 + 1}{\sin x + 3} + 7e^{-3}. \quad 4.28. y = \frac{\operatorname{ctg} x - 5}{x^5 + 5} + 5e^{-4}.$$

$$4.29. y = \frac{2x^7 + 1}{3 \cos x - x} + 4e^{-9}. \quad 4.30. y = \frac{3x^3 + \sin 2x}{x^5 - 3} + 3e^5.$$

**Задание 5.** Найти производную функции.

$$5.1. y = \cos^5(2^x + x) + \operatorname{tg} \frac{1 - e^x}{1 + e^x} + \cos \ln 2.$$

$$5.2. y = \sin^6(x - 3^x) + \operatorname{tg} \frac{e^{2x}}{1 - e^x} + \sin \ln 2.$$

$$5.3. y = \cos^3(x - 2^x) + \operatorname{ctg} \frac{e^x}{1 + e^x} + \cos \ln 3.$$

$$5.4. y = \sin^5(5^x + 1) + \operatorname{ctg} \frac{1 + e^{2x}}{e^{2x}} + \operatorname{ctg} \ln 3.$$

$$5.5. y = \cos^6(1 - 5^x) + \operatorname{tg} \frac{e^x}{1 - e^x} + \cos \ln 3.$$

$$5.6. y = \cos^4(x + 5^x) + \operatorname{ctg} \frac{1 - e^x}{e^x} + \sin \ln 3.$$

$$5.7. y = \sin^3(x - 5^x) + \operatorname{tg} \frac{e^{3x}}{1 - e^x} + \operatorname{tg} \ln 5.$$

$$5.8. y = \operatorname{tg}^4(x + 3^x) + \sin \frac{1 - e^x}{1 + e^x} + \operatorname{ctg} \ln 5.$$

$$5.9. y = \operatorname{tg}^6(x + 2^x) + \cos \frac{1 - e^x}{1 + e^x} + \cos \ln 5.$$

$$5.10. y = \cos^2(2^x - 3) + \sin \frac{e^{2x}}{1 + e^x} + \sin \ln 5.$$

$$5.11. y = \operatorname{tg}^2(3 + 2^x) - \cos \frac{1 + e^{2x}}{e^{2x}} + \operatorname{tg} \ln 9.$$

$$5.12. y = \operatorname{ctg}^2(3 - 5^x) - \sin \frac{e^{3x}}{1 + e^{3x}} + \operatorname{ctg} \ln 9.$$

$$5.13. y = \cos^3(5^x - 2) - \sin \frac{1 - e^x}{e^{5x}} + \sin \ln 4.$$

$$5.14. y = \sin^2(2 - 3^x) + \cos \frac{e^{4x}}{1 + e^{4x}} + \cos \ln 4.$$

$$5.15. y = \operatorname{tg}^5(5^x - 3x) + \sin \frac{1 + e^{3x}}{e^{3x}} + \operatorname{tg} \ln 4.$$

$$5.16. y = \operatorname{ctg}^4(3x - 3^x) + \cos \frac{e^{3x}}{1 - e^{3x}} + \operatorname{ctg} \ln 4.$$

$$5.17. y = \sin^4(5^x - x) + \operatorname{tg} \frac{e^{2x}}{1 - e^{2x}} + \sin \ln 7.$$

$$5.18. y = \sin^7(7^x + x) - \operatorname{ctg} \frac{1 - e^{2x}}{1 + e^{2x}} + \operatorname{tg} \ln 7.$$

$$5.19. y = \cos^7(3^x - x) + \operatorname{tg} \frac{e^x + 1}{1 - e^x} + \operatorname{ctg} \ln 7.$$

$$5.20. y = \operatorname{tg}^7(7^x - x) + \sin \frac{1 - e^{3x}}{1 + e^{3x}} + \sin \ln 8.$$

$$5.21. y = \operatorname{ctg}^7(x - 7^x) + \cos \frac{1 + e^{5x}}{e^{5x}} + \cos \ln 8.$$

$$5.22. y = \cos^6(x - 5^x) + \operatorname{tg} \frac{e^{4x}}{1 - e^{4x}} + \operatorname{tg} \ln 8.$$

$$5.23. y = \sin^8(2x - 3^x) + \operatorname{tg} \frac{e^{4x} - 1}{e^{4x} + 1} + \operatorname{ctg} \ln 8.$$



$$5.24. y = \operatorname{tg}^8(3x + 2^x) + \sin \frac{1 + e^{4x}}{e^{4x}} + \sin \ln 9.$$

$$5.25. y = \operatorname{ctg}^8(2^x - 3x) + \cos \frac{e^{4x}}{1 + e^{4x}} + \cos \ln 9.$$

$$5.26. y = \cos^8(7^x + x) + \operatorname{tg} \frac{e^{5x} - 1}{e^{5x} + 1} + \operatorname{tg} \ln 9.$$

$$5.27. y = \sin^9(3x - 2^x) - \operatorname{ctg} \frac{e^{2x}}{1 - e^{2x}} + \operatorname{ctg} \ln 9.$$

$$5.28. y = \cos^9(5 - 3^x) + \operatorname{tg} \frac{e^{5x}}{1 - e^{5x}} + \sin \ln 10.$$

$$5.29. y = \operatorname{tg}^9(7 - 7^x) + \sin \frac{1 + e^{5x}}{1 - e^{5x}} + \cos \ln 10.$$

$$5.30. y = \operatorname{ctg}^9(3 + 3^x) + \cos \frac{1 - e^{5x}}{e^{5x}} + \operatorname{tg} \ln 10.$$

**Задание 6.** Найти производную функции.

$$6.1. y = \arccos \sqrt{1 - x^3}. \quad 6.16. y = \frac{1}{3} \operatorname{tg}^3 x.$$

$$6.2. y = \operatorname{ctg} \sqrt{x}. \quad 6.17. y = x^2 10^{2x}.$$

$$6.3. y = 2 \cos^2(x + 2). \quad 6.18. y = \operatorname{arccotg} \frac{1 + x}{1 - x}.$$

$$6.4. y = \sqrt{1 - (\arccos x)^2}. \quad 6.19. y = \ln^2 x - \ln(\ln x).$$

$$6.5. y = \frac{\sin x}{2 \cos^2 x}. \quad 6.20. y = \sqrt{\ln x + 1} + \ln(\sqrt{x} + 1).$$

$$6.6. y = \frac{1}{(1 + \sin 4x)^3}. \quad 6.21. y = \operatorname{tg}^2 5x.$$

$$6.7. y = \frac{1}{(1 + \cos 2x)^3}. \quad 6.22. y = \sin^2(x^3).$$

6.8.  $y = \ln(x + \sqrt{x^2 + 4})$ .

6.9.  $y = \sin^4 5x$ .

6.10.  $y = \operatorname{arctg} x^2$ .

6.11.  $y = \ln \frac{1+x}{\sqrt{1+x^2}}$ .

6.12.  $y = \ln^2(1 - \cos x)$ .

6.13.  $y = \arcsin \frac{1}{\sqrt{x}}$ .

6.14.  $y = \operatorname{arctg} 3^{\sqrt{x}}$ .

6.15.  $y = \ln(\arcsin \sqrt{x})$ .

6.23.  $y = \arcsin(\ln x)$ .

6.24.  $y = \operatorname{arctg}\left(\ln \frac{1}{x}\right)$ .

6.25.  $y = \ln \cos \frac{x-1}{x}$ .

6.26.  $y = \frac{1}{\ln^2 x}$ .

6.27.  $y = x \sin\left(\ln x - \frac{\pi}{4}\right)$ .

6.28.  $y = \sqrt{\sin x^2}$ .

6.29.  $y = x^2 \sin \frac{1}{x}$ .

6.30.  $y = \frac{x}{1 + e^{\frac{1}{x}}}$ .

**Задание 7.** Найти производную функции.

7.1.  $y = x^{\operatorname{tg} x}$ .

7.2.  $y = \sqrt[x]{x}$ .

7.3.  $y = \left(\frac{x}{2}\right)^{2x}$ .

7.4.  $y = x^{e^x}$ .

7.5.  $y = x^x$ .

7.6.  $y = (\sin x)^x$ .

7.7.  $y = x^{x^3}$ .

7.8.  $y = (\ln x)^x$ .

7.16.  $y = x^{\operatorname{ctg} x}$ .

7.17.  $y = \sqrt[2x]{x}$ .

7.18.  $y = x^{2^x}$ .

7.19.  $y = x^{-x^3}$ .

7.20.  $y = x^{\operatorname{arctg} x}$ .

7.21.  $y = (\ln x)^{3^x}$ .

7.22.  $y = x^{\operatorname{arctg} x}$ .

7.23.  $y = x^{e^{\cos x}}$ .

7.9.  $y = x^{\frac{1}{x}}$ .

7.10.  $y = (\cos x)^{\sin x}$ .

7.11.  $y = x^{\sin x}$ .

7.12.  $y = (\cos x)^{\frac{1}{x}}$ .

7.13.  $y = (x+1)^{\frac{1}{\sin x}}$ .

7.14.  $y = x^{\arcsin x}$ .

7.15.  $y = x^{\arccos x}$ .

7.24.  $y = x^{\sin x^3}$ .

7.25.  $y = x^{2x^2+1}$ .

7.26.  $y = x^{\operatorname{ctg} x}$ .

7.27.  $y = (x^4 + 1)^{\operatorname{tg} x}$ .

7.28.  $y = \left(\frac{1}{x}\right)^{3x}$ .

7.29.  $y = (\operatorname{tg} x)^{4e^x}$ .

7.30.  $y = x^{\cos x^2}$ .

**Задание 8.** Найти производную функции.

8.1.  $y = \log_2 \frac{\sqrt{x+5}}{x^2+x+1}$ .

8.16.  $y = \ln(\sqrt{x-1} + \sqrt{x^2+1})$ .

8.2.  $y = \ln^2 \cos x$ .

8.17.  $y = \ln\left(\arccos \frac{1}{\sqrt{x}}\right)$ .

8.3.  $y = \sqrt{\ln(3x^2+2x)}$ .

8.18.  $y = \ln(\arccos \sqrt{1-e^{4x}})$ .

8.4.  $y = \arcsin \frac{x}{\sqrt{1+x^2}}$ .

8.19.  $y = \log_2 \frac{1}{\sqrt{1-x^4}}$ .

8.5.  $y = \ln \frac{x}{\sqrt{1-x^2}}$ .

8.20.  $y = \ln \arccos 2x$ .

8.6.  $y = \ln^4 \frac{1}{x^2}$ .

8.21.  $y = \ln \ln^3 \ln^2 x$ .

8.7.  $y = \ln \operatorname{tg}\left(\frac{\pi}{4} + \frac{x}{2}\right)$ .

8.22.  $y = \ln \frac{\ln x}{\sin \frac{1}{x}}$ .

8.8.  $y = \log_3(x^2-1)$ .

8.23.  $y = \log_4 \log_2 \operatorname{tg} x$ .

8.9.  $y = \ln^2 \sin x$ .

8.10.  $y = \ln^2(1 + \cos x)$ .

8.11.  $y = \ln \frac{x^2}{1-x^2}$ .

8.12.  $y = \log_2(3x^2 + 1)$ .

8.13.  $y = \ln \operatorname{tg} x$ .

8.14.  $y = \left(1 + \ln \frac{1}{x}\right)^5$ .

8.15.  $y = \ln \ln \frac{1}{\sqrt{x}}$ .

8.24.  $y = \ln \frac{1+x}{\sqrt{1+x^2}}$ .

8.25.  $y = \ln^2 \arcsin \sqrt[3]{x}$ .

8.26.  $y = \ln^2 \cos^3(4x-1)$ .

8.27.  $y = \ln \ln \ln x$ .

8.28.  $y = \ln \sqrt{\frac{1+\operatorname{tg} x}{1-\operatorname{tg} x}}$ .

8.29.  $y = \ln(x + \sqrt{x^2 - 1})$ .

8.30.  $y = \ln \frac{1+x^2}{1-x^2}$ .

**Задание 9.** Найти производную  $y'_x$ .

9.1. 
$$\begin{cases} x = e^t \cos t, \\ y = e^{2t} \sin t. \end{cases}$$

9.16. 
$$\begin{cases} x = a \cos^2 t, \\ y = b \sin^2 t. \end{cases}$$

9.2. 
$$\begin{cases} x = \frac{3t}{1+t^3}, \\ y = \frac{3t^2}{1+t^3}. \end{cases}$$

9.17. 
$$\begin{cases} x = 4(t - \sin t), \\ y = 4(1 - \cos t). \end{cases}$$

9.3. 
$$\begin{cases} x = \cos^3 t, \\ y = \sin^3 t. \end{cases}$$

9.18. 
$$\begin{cases} x = t \ln t, \\ y = \frac{\ln t}{t}. \end{cases}$$

9.4. 
$$\begin{cases} x = \ln \operatorname{ctg} t, \\ y = \frac{1}{\cos^2 t}. \end{cases}$$

9.19. 
$$\begin{cases} x = \sqrt{1-t^2}, \\ y = \arcsin t. \end{cases}$$

$$9.5. \begin{cases} x = e^{3t} \cos 2t, \\ y = e^t \sin 2t. \end{cases}$$

$$9.6. \begin{cases} x = \sqrt{1-t^2}, \\ y = tg \sqrt{1+t}. \end{cases}$$

$$9.7. \begin{cases} x = \sqrt{1-t}, \\ y = t \operatorname{tg} t. \end{cases}$$

$$9.8. \begin{cases} x = \ln \operatorname{tg} t, \\ y = \frac{1}{\sin^2 t}. \end{cases}$$

$$9.9. \begin{cases} x = t - \sin t, \\ y = 1 - \cos t. \end{cases}$$

$$9.10. \begin{cases} x = (\arcsin t)^2, \\ y = \frac{t}{\sqrt{1-t^2}}. \end{cases}$$

$$9.11. \begin{cases} x = \frac{1}{t+1}, \\ y = \left( \frac{t}{t+1} \right)^2. \end{cases}$$

$$9.12. \begin{cases} x = \ln \sqrt{\frac{1-t}{1+t}}, \\ y = \sqrt{1-t^2}. \end{cases}$$

$$9.13. \begin{cases} x = \sin t, \\ y = \ln \cos t. \end{cases}$$

$$9.20. \begin{cases} x = \ln \sin t, \\ y = \sqrt{1-t^2}. \end{cases}$$

$$9.21. \begin{cases} x = \ln(t^2 + 1), \\ y = \sqrt{t^2 + 1}. \end{cases}$$

$$9.22. \begin{cases} x = \operatorname{tg} t + \operatorname{ctg} t, \\ y = t \cos t. \end{cases}$$

$$9.23. \begin{cases} x = \frac{t+1}{t}, \\ y = \frac{t-1}{t}. \end{cases}$$

$$9.24. \begin{cases} x = 2(1 - \sin t), \\ y = 2(t - \cos t). \end{cases}$$

$$9.25. \begin{cases} x = 2 \operatorname{tg} t, \\ y = 2 \sin^2 t + \sin 2t. \end{cases}$$

$$9.26. \begin{cases} x = \cos^2 t, \\ y = \operatorname{tg}^2 t. \end{cases}$$

$$9.27. \begin{cases} x = \ln t, \\ y = \operatorname{arctg} t. \end{cases}$$

$$9.28. \begin{cases} x = \cos t, \\ y = \ln \sin t. \end{cases}$$

$$9.14. \begin{cases} x = \ln(t-2), \\ y = t + \sin t. \end{cases}$$

$$9.15. \begin{cases} x = \ln(4+t^2), \\ y = \sqrt{4+t^2}. \end{cases}$$

**Задание 10.** Найти  $y', y''$ .

$$10.1. y = \operatorname{arctg} x.$$

$$10.2. y = e^{-x} \sin x.$$

$$10.3. y = (x-2)e^{2x}.$$

$$10.4. y = x^2 \ln x.$$

$$10.5. y = \frac{a}{2} \left( e^{\frac{x}{a}} + e^{-\frac{x}{a}} \right).$$

$$10.6. y = \sqrt{2x-x^2}.$$

$$10.7. y = \cos e^x + \sin e^x.$$

$$10.8. y = x^2 \sin \frac{1}{x}.$$

$$10.9. y = \frac{1+x}{1-x}.$$

$$10.10. y = \ln \sin x.$$

$$10.11. y = \frac{1-x}{1+x}.$$

$$10.12. y = \ln(1+x^2).$$

$$9.29. \begin{cases} x = \operatorname{arctg} t, \\ y = \frac{t^2}{2}. \end{cases}$$

$$9.30. \begin{cases} x = \sin t - t \cos t, \\ y = \cos t + t \sin t. \end{cases}$$

$$10.16. y = \frac{1}{x^2-4}.$$

$$10.17. y = x^2 \cos \frac{1}{x}.$$

$$10.18. y = \ln \sqrt[3]{1+x^2}.$$

$$10.19. y = \frac{1+x}{\sqrt{x}}.$$

$$10.20. y = x^3 \ln x.$$

$$10.21. y = \ln \cos x.$$

$$10.22. y = \arcsin \frac{1}{x}.$$

$$10.23. y = x^2 \ln x.$$

$$10.24. y = (1+x^2)e^x.$$

$$10.25. y = \operatorname{arctg} x - x.$$

$$10.26. y = \frac{x^3}{x^2+12}.$$

$$10.27. y = \sqrt[3]{x+2}.$$

$$10.13. y = \frac{x+1}{x^2+1}.$$

$$10.28. y = \ln(1+x^3).$$

$$10.14. y = \arctg \frac{1}{x}.$$

$$10.29. y = \sin^2 x.$$

$$10.15. y = \frac{1}{2} x^2 e^x.$$

$$10.30. y = e^{-x^2}.$$

**Задание 11.** Составить уравнение касательной и нормали к кривым в точке  $x_0$ .

$$11.1. y = \sqrt{5+2x}, \quad x_0 = 2.$$

$$11.2. y = \frac{x^2}{x+1}, \quad x_0 = 1.$$

$$11.3. y = \frac{1}{1+x^2}, \quad x_0 = 2.$$

$$11.4. y = \frac{\sin x}{2-x}, \quad x_0 = 0.$$

$$11.5. y = \frac{2x}{1+x^2}, \quad x_0 = \sqrt{2}.$$

$$11.6. y = \frac{3x+1}{2x-1}, \quad x_0 = -1.$$

$$11.7. y = \sqrt{5-x^2}, \quad x_0 = 1.$$

$$11.8. y = \sqrt{4+2x-x^2}, \quad x_0 = 3.$$

$$11.9. y = \arctg 2x, \quad x_0 = 0.$$

$$11.10. y = \frac{x^2+1}{x-3}, \quad x_0 = 4.$$

$$11.11. y = \cos 2x - 2 \sin x, \quad x_0 = \pi.$$

$$11.12. y = \cos\left(2x - \frac{\pi}{2}\right) + 2, \quad x_0 = \frac{\pi}{2}.$$

$$11.13. y = \sqrt[3]{x-1}, \quad x_0 = 2.$$

$$11.14. y = \ln x, \quad x_0 = 1.$$

$$11.15. y = \frac{1}{x} \operatorname{arctg} x, \quad x_0 = 1.$$

$$11.16. y = 3^x + 3^{-2x}, \quad x_0 = 1.$$

$$11.17. y = \operatorname{tg} 2x, \quad x_0 = 0.$$

$$11.18. y = \sin(x + \pi) + 1, \quad x_0 = \frac{\pi}{4}.$$

$$11.19. y = x^2 \ln x, \quad x_0 = 1.$$

$$11.20. y = \cos^2 x, \quad x_0 = \frac{\pi}{4}.$$

$$11.21. y = x^2 e^{-x}, \quad x_0 = 1.$$

$$11.22. y = \sqrt{x} + 1, \quad x_0 = 4.$$

$$11.23. y = \ln(2e - x), \quad x_0 = e.$$

$$11.24. y = \frac{1}{3x + 2}, \quad x_0 = 2.$$

$$11.25. y = \cos x - \frac{2}{\pi} x^2, \quad x_0 = \frac{\pi}{2}.$$

$$11.26. y = \sqrt[3]{x^2} - 20, \quad x_0 = -8.$$

$$11.27. y = \frac{\sqrt{x}}{x + 4}, \quad x_0 = 4.$$

$$11.28. y = 8\sqrt[4]{x} - 70, \quad x_0 = 16.$$

$$11.29. y = (x^2 - 5x + 7)e^x, \quad x_0 = 0.$$

$$11.30. y = 2x + \frac{1}{x}, \quad x_0 = 1.$$



**Задание 12.** Составить уравнения касательных к графику функции  $y = \frac{ax+b}{cx+d}$ , параллельных или перпендикулярных к прямой  $Ax + By + C = 0$ .

12.1.  $y = \frac{x+1}{x-1}$ , параллельно прямой  $2x + y - 2 = 0$ .

12.2.  $y = \frac{x-3}{x+1}$ , параллельно прямой  $x - y + 3 = 0$ .

12.3.  $y = \frac{x-3}{x+1}$ , параллельно прямой  $4x - y + 3 = 0$ .

12.4.  $y = \frac{-x+3}{x+1}$ , параллельно прямой  $x + y + 4 = 0$ .

12.5.  $y = \frac{-x+3}{x+1}$ , параллельно прямой  $4x + y - 3 = 0$ .

12.6.  $y = \frac{3x+2}{2x+2}$ , параллельно прямой  $2x - y + 4 = 0$ .

12.7.  $y = \frac{-3x+2}{-2x+4}$ , параллельно прямой  $2x + y - 4 = 0$ .

12.8.  $y = \frac{5x-1}{3x+3}$ , параллельно прямой  $2x - y + 7 = 0$ .

12.9.  $y = \frac{5x+3}{x+6}$ , параллельно прямой  $6x - 2y + 3 = 0$ .

12.10.  $y = \frac{5x+3}{-x-6}$ , параллельно прямой  $6x + 2y - 4 = 0$ .

12.11.  $y = \frac{4x+1}{4x+5}$ , параллельно прямой  $8x - 2y + 5 = 0$ .

12.12.  $y = \frac{4x-1}{4x-5}$ , параллельно прямой  $8x + 2y - 5 = 0$ .

12.13.  $y = \frac{6x-5}{3x+5}$ , параллельно прямой  $10x - 2y + 15 = 0$ .

12.14.  $y = \frac{7x+3}{2x-2}$ , параллельно прямой  $10x + 2y - 13 = 0$ .

12.15.  $y = \frac{9x-3}{x+1}$ , параллельно прямой  $3x - y + 7 = 0$ .

12.16.  $y = \frac{x-8}{x+4}$ , перпендикулярно к прямой  $6x + 2y - 7 = 0$ .

12.17.  $y = \frac{4x+6}{4x+3}$ , перпендикулярно к прямой  $6x - 2y + 7 = 0$ .

12.18.  $y = \frac{3x+1}{x+3}$ , перпендикулярно к прямой  $4x + 2y - 9 = 0$ .

12.19.  $y = \frac{-5x+1}{-2x+4}$ , перпендикулярно к прямой  $4x - 2y + 9 = 0$ .

12.20.  $y = \frac{7x+1}{2x-2}$ , перпендикулярно к прямой  $3x - 3y + 1 = 0$ .

12.21.  $y = \frac{8x+4}{6x+1}$ , перпендикулярно к прямой  $-4x + y - 7 = 0$ .

12.22.  $y = \frac{8x-4}{6x-1}$ , перпендикулярно к прямой  $8x + 2y - 11 = 0$ .

12.23.  $y = \frac{10x+7}{5x-9}$ , перпендикулярно к прямой  $10x - 2y + 21 = 0$ .

12.24.  $y = \frac{10x+7}{-5x+9}$ , перпендикулярно к прямой  $5x + y - 10,5 = 0$ .

12.25.  $y = \frac{3x+3}{x+7}$ , перпендикулярно к прямой  $4x - 2y + 19 = 0$ .

12.26.  $y = \frac{3x-1}{x-2}$ , перпендикулярно к прямой  $10x - 2y + 9 = 0$ .

12.27.  $y = \frac{6x-1}{2x+5}$ , перпендикулярно прямой  $4x + 2y - 15 = 0$ .

12.28.  $y = \frac{2x+2}{2x-1}$ , перпендикулярно к прямой  $12x - 2y + 21 = 0$ .

12.29.  $y = \frac{2x+2}{-2x+1}$ , перпендикулярно к прямой  $12x + 2y - 21 = 0$ .

12.30.  $y = \frac{3x-1}{x+2}$ , перпендикулярно к прямой  $14x + 2y - 25 = 0$ .

**Задание 13.** Тело движется прямолинейно по закону  $S(t)$ .  
Найти скорость и ускорение тела в момент времени  $t_0$ .

13.1.  $S(t) = t^2 + 8\sqrt{(t+3)^3} - 2t + 1$ ,  $t_0 = 1$ .

13.2.  $S(t) = 2t^2 + 4\sqrt{(t+2)^3} + 3t + 4$ ,  $t_0 = 2$ .

13.3.  $S(t) = 5t^2 - \sqrt{(t-3)^3} + t - 1$ ,  $t_0 = 4$ .

13.4.  $S(t) = 4t^2 + \sqrt{(t+3)^3} - 2t + 7$ ,  $t_0 = 0$ .

13.5.  $S(t) = t^3 + \sqrt[3]{(t-1)^4} - \frac{3}{2}t^2 + 2$ ,  $t_0 = 2$ .

13.6.  $S(t) = 3t^2 + 3\sqrt[3]{(t+2)^4} + 4t - 3$ ,  $t_0 = 6$ .

13.7.  $S(t) = 2t^3 - 2\sqrt{(t-3)^3} - \frac{t^2}{2} - 5$ ,  $t_0 = 4$ .

13.8.  $S(t) = \frac{t^3}{3} + 6\sqrt[3]{(t+7)^4} - t^2 - 3$ ,  $t_0 = 1$ .

13.9.  $S(t) = \frac{2}{3}t^3 + \sqrt{(t-1)^3} - 2t^2 + 2t - 3$ ,  $t_0 = 2$ .

13.10.  $S(t) = 7t^2 - 4\sqrt{(t+5)^3} - 3t + 10$ ,  $t_0 = 4$ .

13.11.  $S(t) = \frac{t^3}{6} - 3\sqrt{(t+3)^3} + 8t + 10$ ,  $t_0 = 4$ .

13.12.  $S(t) = 7t^2 - 9\sqrt[3]{(t-1)^4} - 5t - 3$ ,  $t_0 = 2$ .

13.13.  $S(t) = \frac{5}{6}t^3 + 4\sqrt{(t-3)^3} - 8t - 7$ ,  $t_0 = 4$ .

$$13.14. S(t) = \frac{3}{2}t^2 + 5\sqrt{(t+1)^3} - 9t - 5, \quad t_0 = 3.$$

$$13.15. S(t) = 4t^2 - 9\sqrt[3]{(t+3)^4} + 9t + 1, \quad t_0 = 5.$$

$$13.16. S(t) = \frac{2}{3}t^2 - 3\sqrt{(t-4)^4} - 2t^2 - t - 4, \quad t_0 = 5.$$

$$13.17. S(t) = 5t^2 - 3\sqrt{(t+4)^3} - 4t - 1, \quad t_0 = 5.$$

$$13.18. S(t) = 4t^2 + 5\sqrt{(t-6)^3} - 80t + 3, \quad t_0 = 7.$$

$$13.19. S(t) = 10t^2 - 3\sqrt[3]{(t+1)^4} + 7t + 7, \quad t_0 = 0.$$

$$13.20. S(t) = 2t^2 - 10\sqrt{(t-2)^3} + 90t - 4, \quad t_0 = 6.$$

$$13.21. S(t) = 5t^2 + 3\sqrt[3]{(t-1)^4} - 20t + 1, \quad t_0 = 9.$$

$$13.22. S(t) = t^3 - 6\sqrt[3]{(t+6)^4} + 93t - 4, \quad t_0 = 2.$$

$$13.23. S(t) = t^2 + 8\sqrt{(t+3)^3} - 2t + 1, \quad t_0 = 7.$$

$$13.24. S(t) = \frac{7}{18}t^3 - \sqrt[3]{(t-2)^4} - 2t^2 + 10, \quad t_0 = 3.$$

$$13.25. S(t) = \frac{5}{9}t^3 - 2\sqrt[3]{(t+25)^4} + 12t^2 + 200, \quad t_0 = 1.$$

$$13.26. S(t) = 6t^2 - 3\sqrt{(t+2)^3} + 4t - 3, \quad t_0 = 2.$$

$$13.27. S(t) = 3t^2 - 6\sqrt{(t+1)^3} + 7t + 9, \quad t_0 = 0.$$

$$13.28. S(t) = \frac{t^3}{3} + 3\sqrt[3]{(t+1)} - 2t^2 + t - 1, \quad t_0 = 0.$$

$$13.29. S(t) = \frac{t^2}{4} + \sqrt{(t-2)^3} + 2t - 7, \quad t_0 = 11.$$

$$13.30. S(t) = \frac{t^3}{6} + 3\sqrt[3]{(t+8)^4} + \frac{t^2}{2} - 38, \quad t_0 = 0.$$

**Задание 14.** Найти приращение  $\Delta y$  и дифференциал  $dy$  функции  $y = f(x)$  при переходе от точки  $x_0$  к  $x$ .

14.1.  $y(x) = 3x^2 - 4x + 5$ ,  $x_0 = 1$ ,  $x = 1,2$ .

14.2.  $y(x) = 4x^2 - 3x + 2$ ,  $x_0 = 1$ ,  $x = 1,3$ .

14.3.  $y(x) = 3x^2 - x$ ,  $x_0 = 1$ ,  $x = 1,2$ .

14.4.  $y(x) = 2x^2 + 5x - 1$ ,  $x_0 = 3$ ,  $x = 3,4$ .

14.5.  $y(x) = x^3 - 7x + 3$ ,  $x_0 = 0$ ,  $x = 0,3$ .

14.6.  $y(x) = (x + 9)^3$ ,  $x_0 = 2$ ,  $x = 2,3$ .

14.7.  $y(x) = \sqrt{x}$ ,  $x_0 = 0,25$ ,  $x = 0,251$ .

14.8.  $y(x) = 2x^3 + x^2 + 3x$ ,  $x_0 = 1$ ,  $x = 1,2$ .

14.9.  $y(x) = \frac{x}{1+x^2}$ ,  $x_0 = 1$ ,  $x = 1,3$ .

14.10.  $y(x) = x^4 - x + 8$ ,  $x_0 = 0$ ,  $x = 0,4$ .

14.11.  $y(x) = (x + 3)(x^2 - 2)$ ,  $x_0 = 3$ ,  $x = 3,5$ .

14.12.  $y(x) = 10x + 0,3$ ,  $x_0 = 1$ ,  $x = 1,2$ .

14.13.  $y(x) = x^2 - 5x - 7$ ,  $x_0 = -2$ ,  $x = -2,2$ .

14.14.  $y(x) = \frac{1}{4}x^4 + x^2 - 1$ ,  $x_0 = 1$ ,  $x = 1,6$ .

14.15.  $y(x) = (x^2 - 3)^4$ ,  $x_0 = 0$ ,  $x = 0,2$ .

14.16.  $y(x) = 5x^2 + 7x$ ,  $x_0 = 5$ ,  $x = 5,9$ .

14.17.  $y(x) = x^3 - x^2 + 1$ ,  $x_0 = 1$ ,  $x = 1,2$ .

14.18.  $y(x) = x^3 + x^2 + x$ ,  $x_0 = 3$ ,  $x = 3,6$ .

- 14.19.  $y(x) = 9x^4 - 7x^2 + 9$ ,  $x_0 = 1$ ,  $x = 1,2$ .
- 14.20.  $y(x) = 3x^3 - 7x + 1$ ,  $x_0 = 0$ ,  $x = 0,2$ .
- 14.21.  $y(x) = 5x^3 - 2$ ,  $x_0 = 5$ ,  $x = 5,7$ .
- 14.22.  $y(x) = (x^2 + 2)^2$ ,  $x_0 = 1$ ,  $x = 1,2$ .
- 14.23.  $y(x) = x^2 - 13x$ ,  $x_0 = 3$ ,  $x = 3,5$ .
- 14.24.  $y(x) = \frac{x}{x^2 - 2}$ ,  $x_0 = 1$ ,  $x = 1,2$ .
- 14.25.  $y(x) = x^3 + 12x^2$ ,  $x_0 = 0$ ,  $x = 0,2$ .
- 14.26.  $y(x) = x^5$ ,  $x_0 = 7$ ,  $x = 7,12$ .
- 14.27.  $y(x) = x^5 + 2x - 8$ ,  $x_0 = 2$ ,  $x = 2,4$ .
- 14.28.  $y(x) = x^2 - 4x$ ,  $x_0 = 1$ ,  $x = 1,2$ .
- 14.29.  $y(x) = 9x^3 + \log_3 27$ ,  $x_0 = 5$ ,  $x = 5,6$ .
- 14.30.  $y(x) = 5x - 4x^3$ ,  $x_0 = 1$ ,  $x = 1,8$ .

**Задание 15.** Вычислить приближенно (с помощью дифференциала).

- 15.1.  $\sqrt[3]{8,06}$ .
- 15.2.  $\sqrt[4]{16,02}$ .
- 15.3.  $(1,021)^{14}$ .
- 15.4.  $\frac{1}{\sqrt{4,016}}$ .
- 15.5.  $\sqrt{0,98^3}$ .
- 15.16.  $\frac{1}{\sqrt{9,02}}$ .
- 15.17.  $\sqrt{(1,02)^3}$ .
- 15.18.  $(3,02)^5$ .
- 15.19.  $\arcsin(-0,04)$ .
- 15.20.  $\sqrt[4]{81,01}$ .

15.6.  $\sqrt[3]{(1,03)^2}$ .

15.7.  $(2,997)^5$ .

15.8.  $\arcsin 0,08$ .

15.9.  $\sqrt[4]{17}$ .

15.10.  $\operatorname{arctg} 0,98$ .

15.11.  $\ln 1,01$ .

15.12.  $\sqrt[5]{31}$ .

15.13.  $\sqrt[3]{7,98}$ .

15.14.  $\sqrt[4]{81,02}$ .

15.15.  $(0,99)^{12}$ .

15.21.  $\operatorname{arctg} 1,02$ .

15.22.  $\ln 0,99$ .

15.23.  $\sqrt[5]{242}$ .

15.24.  $\sqrt[3]{27,01}$ .

15.25.  $\sqrt[4]{15,99}$ .

15.26.  $(0,98)^{10}$ .

15.27.  $e^{0,2}$ .

15.28.  $\sqrt{1,01^3}$ .

15.29.  $\sqrt{120}$ .

15.30.  $e^{-0,3}$ .

**Задание 16.** Записать многочлен Тейлора 3-й степени для данной функции  $y = f(x)$  в окрестности точки  $x_0$ .

16.1.  $y = \sin^2 x, x_0 = 0$ .

16.16.  $y = \cos^2 x, x_0 = 0$ .

16.2.  $y = \ln x, x_0 = 1$ .

16.17.  $y = \ln 2x, x_0 = 1$ .

16.3.  $y = \log_5 x, x_0 = 5$ .

16.18.  $y = e^x, x_0 = 1$ .

16.4.  $y = e^{x^2}, x_0 = 0$ .

16.19.  $y = e^{-x}, x_0 = 0$ .

16.5.  $y = e^{x^2}, x_0 = 1$ .

16.20.  $y = x^4, x_0 = 1$ .

16.6.  $y = \sin x, x_0 = \frac{\pi}{2}$ .

16.21.  $y = \cos x, x_0 = \frac{\pi}{2}$ .

16.7.  $y = \sin 3x, x_0 = 0.$

16.22.  $y = \cos 5x, x_0 = 0.$

16.8.  $y = \sin 2x, x_0 = \frac{\pi}{2}.$

16.23.  $y = \cos 3x, x_0 = 0.$

16.9.  $y = e^{\sin x}, x_0 = 0.$

16.24.  $y = e^{\cos x}, x_0 = 0.$

16.10.  $y = e^{3x}, x_0 = 1.$

16.25.  $y = e^{-x^2}, x_0 = 1.$

16.11.  $y = x^5, x_0 = 1.$

16.26.  $y = \frac{1}{x}, x_0 = 1.$

16.12.  $y = \sin 2x, x_0 = \frac{\pi}{2}.$

16.27.  $y = \cos^2 x, x_0 = 1.$

16.13.  $y = \sin^2 x, x_0 = 1.$

16.28.  $y = e^{2x}, x_0 = 1.$

16.14.  $y = \log_5 x, x_0 = 1.$

16.29.  $y = e^x, x_0 = 1.$

16.15.  $y = \cos 3x, x_0 = \frac{\pi}{2}.$

16.30.  $y = \ln x, x_0 = 2.$

**Задание 17.** Вычислить предел, используя правило Лопиталья.

17.1.  $\lim_{x \rightarrow 0} \frac{\sin^2 3x}{x^2}.$

17.16.  $\lim_{x \rightarrow 0} \frac{e^x - 1}{\sin 2x}.$

17.2.  $\lim_{x \rightarrow 1} \frac{x - 1}{\ln x}.$

17.17.  $\lim_{x \rightarrow 0} \frac{1 - \cos ax}{1 - \cos bx}.$

17.3.  $\lim_{x \rightarrow 0} \frac{1 - \cos x}{x^2}.$

17.18.  $\lim_{x \rightarrow 0} \frac{x - \sin x}{x^3}.$



$$17.4. \lim_{x \rightarrow 0} \frac{\operatorname{tg} x - \sin x}{x - \sin x}.$$

$$17.5. \lim_{x \rightarrow 0} \frac{\ln x}{\operatorname{ctg} x}.$$

$$17.6. \lim_{x \rightarrow 0+0} x^x.$$

$$17.7. \lim_{x \rightarrow 0} (\sin x)^{\operatorname{tg} x}.$$

$$17.8. \lim_{x \rightarrow 0} \frac{e^{ax} - e^{bx}}{\sin x}.$$

$$17.9. \lim_{x \rightarrow 0} \frac{x - \operatorname{arctg} x}{x^3}.$$

$$17.10. \lim_{x \rightarrow \frac{\pi}{6}} \frac{1 - 2 \sin x}{\cos 3x}.$$

$$17.11. \lim_{x \rightarrow \frac{\pi}{4}} \frac{1 - \operatorname{tg} x}{\cos 2x}.$$

$$17.12. \lim_{x \rightarrow 1} \frac{\ln x}{1 - x^3}.$$

$$17.13. \lim_{x \rightarrow \infty} \left(1 + \frac{3}{x}\right)^x.$$

$$17.19. \lim_{x \rightarrow \infty} \frac{\ln x}{x}.$$

$$17.20. \lim_{x \rightarrow \pi} (\pi - x) \operatorname{tg} \frac{x}{2}.$$

$$17.21. \lim_{x \rightarrow 0} x \ln x.$$

$$17.22. \lim_{x \rightarrow \frac{\pi}{6}} \frac{1 - 2 \sin x}{\cos 3x}.$$

$$17.23. \lim_{x \rightarrow \frac{\pi}{2a}} \frac{1 - \sin ax}{(2ax - \pi)^2}.$$

$$17.24. \lim_{x \rightarrow 0} \frac{a^x - e^x}{\operatorname{tg} x}.$$

$$17.25. \lim_{x \rightarrow 1} \frac{\ln x}{1 - x^3}.$$

$$17.26. \lim_{x \rightarrow 0} \frac{e^{2x} - 1}{\ln(1 + 2x)}.$$

$$17.27. \lim_{x \rightarrow 1} x^{\frac{1}{1-x}}.$$

$$17.28. \lim_{x \rightarrow 0} (\sin x)^{\operatorname{tg} x}.$$

$$17.14. \lim_{x \rightarrow 0} (e^{2x} + x)^{\frac{1}{x}}.$$

$$17.29. \lim_{x \rightarrow 0} \left( \frac{1}{x \sin x} - \frac{1}{x^2} \right).$$

$$17.15. \lim_{x \rightarrow 0} (1 - e^{2x}) \operatorname{ctg} x.$$

$$17.30. \lim_{x \rightarrow 0} \frac{e^{2x} - 1}{\ln(1 + 2x)}.$$

**Задание 18.** Найти наибольшее и наименьшее значения функции  $y = f(x)$  на отрезках.

18.1.  $y(x) = \frac{1}{3}x^3 - 4x^2 + 12x + 1$ ,  $[0;3]$ ,  $[-1;1]$ .

18.2.  $y(x) = \frac{1}{4}x^4 + \frac{4}{3}x^3 - \frac{9}{2}x^2 - 36x$ ,  $[-5;8]$ ,  $[-1;4]$ .

18.3.  $y(x) = \frac{1}{3}x^3 - x^2 - 3x - 2$ ,  $[-3;5]$ ,  $[-4;0]$ .

18.4.  $y(x) = \frac{2}{4}x^4 + \frac{4}{3}x^3 - 16x^2 - 64x$ ,  $[-5;5]$ ,  $[-6;-1]$

18.5.  $y(x) = 2x^3 - 8x^2 - 6x + 4$ ,  $[-2;5]$ ,  $[1;4]$ .

18.6.  $y(x) = \frac{49}{2}x^2 - \frac{8}{3}x^3 - 45x - 3$ ,  $[0;6]$ ,  $[-2;2]$ .

18.7.  $y(x) = \frac{1}{3}x^3 + \frac{7}{2}x^2 + 6x - 13$ ,  $[-2;0]$ ,  $[-7;0]$ .

18.8.  $y(x) = 7x^2 - \frac{1}{3}x^3 - 49x + 4$ ,  $[-3;10]$ ,  $[8;9]$ .

18.9.  $y(x) = \frac{1}{4}x^4 + \frac{13}{3}x^3 - \frac{1}{2}x^2 - 13x$ ,  $[-15;2]$ ,  $[-2;3]$ .

18.10.  $y(x) = \frac{31}{2}x^2 - x^3 + 22x - 7$ ,  $[-1;12]$ ,  $[2;13]$ .

18.11.  $y(x) = 2x^3 + 14x^2 + 32x - 3$ ,  $[-5;0]$ ,  $[-2.5;1]$ .

18.12.  $y(x) = \frac{25}{2}x^2 - \frac{1}{4}x^4 - \frac{4}{3}x^3 + 100x$ ,  $[-7;7]$ ,  $[3;6]$ .

18.13.  $y(x) = \frac{1}{3}x^3 + 5x^2 - 24x + 6$ ,  $[-13;1]$ ,  $[-15;7]$ .

$$18.14. y(x) = 7x^3 + \frac{5}{2}x^2 - 4x + 11, [-2;0], \left[\frac{1}{5};3\right].$$

$$18.15. y(x) = \frac{1}{3}x^3 + 3x^2 - 27x + 6, [-15;5], [0;6].$$

$$18.16. y(x) = 18x^2 - 396x - \frac{1}{4}x^4 + \frac{11}{3}x^3, [-8;12], [0;7].$$

$$18.17. y(x) = 12x^3 + 57x^2 + 18x - 27, [-4;5], [-4;-2].$$

$$18.18. y(x) = \frac{4}{3}x^3 + 10x^2 + 24x + 1, [-4;1], [-2,5;0].$$

$$18.19. y(x) = \frac{35}{3}x^3 + \frac{69}{2}x^2 - 36x + 17, [-3;2], [0;7].$$

$$18.20. y(x) = 50x^2 + 200x - \frac{1}{4}x^4 - \frac{2}{3}x^3, [-12;12], [0;15].$$

$$18.21. y(x) = 6x^3 - \frac{87}{2}x^2 + 84x - 11, [-2;5], [2;7].$$

$$18.22. y(x) = \frac{153}{2}x^2 - 5x^3 - 162x + 21, [-3;10], [5;11].$$

$$18.23. y(x) = \frac{2}{3}x^3 + \frac{35}{2}x^2 + 143x - 13, [-13;0], [-9;-4].$$

$$18.24. y(x) = x^3 + 28x^2 - 220x + 13, [-25;5], [0;7].$$

$$18.25. y(x) = \frac{1}{4}x^4 + \frac{7}{3}x^3 - \frac{121}{2}x^2 - 847x + 21, [-15;21], [9;12].$$

$$18.26. y(x) = \frac{26}{3}x^3 + 43x^2 - 72x - 1, [-5;2], [-10;0].$$

$$18.27. y(x) = \frac{85}{3}x^3 - 32x^2 - 77x + 2, [-2;2], [1;9].$$

$$18.28. y(x) = \frac{3}{2}x^4 + x^3 - 192x^2 - 192x + 72, [-10;10], [2;9].$$

$$18.29. y(x) = \frac{1}{3}x^3 + \frac{15}{2}x^2 - 496x - 7, [-32;17], [0;3].$$

$$18.30. y(x) = 494x - \frac{1}{3}x^3 - \frac{7}{2}x^2 + 5, [-30;20], [15;25].$$

**Задание 19.** Найти асимптоты и схематически построить график функции.

$$19.1. y = \frac{x^3 - 3x^2 + 7}{x^4 - 4}.$$

$$19.16. y = \frac{4}{x^4 - 2x^2}.$$

$$19.2. y = \frac{x}{\sqrt{1 - x^2}}.$$

$$19.17. y = \frac{(x+1)^3}{(x+2)^2}.$$

$$19.3. y = \sqrt{\frac{1-x}{x}}.$$

$$19.18. y = \sqrt{\frac{x}{x-2}}.$$

$$19.4. y = \frac{6(x^2 - 4)}{3x^2 + 8}.$$

$$19.19. y = \frac{\sqrt{4 + x^2}}{2x}.$$

$$19.5. y = \frac{\sqrt{1+x^2}}{x}.$$

$$19.20. y = \frac{\sqrt{9x^4 + 1}}{|x|}.$$

$$19.6. y = \frac{x^2 - 2x}{x - 1}.$$

$$19.21. y = 2x - \frac{1}{x^2}.$$

$$19.7. y = \frac{\sqrt{4x^4 + 1}}{|x|}.$$

$$19.22. y = \frac{4 + x^2}{x^3 - 9x}.$$

$$19.8. y = x + \frac{1}{x^2}.$$

$$19.23. y = \frac{x}{2x-1} + x.$$

$$19.9. y = \frac{2x^4 + x^3 + 1}{x^3}.$$

$$19.24. y = \frac{2x^2 + 3x - 5}{x(x-4)}.$$

$$19.10. y = \frac{x^2 - 6x + 3}{x - 3}.$$

$$19.11. y = \frac{x^5}{x^4 - 1}.$$

$$19.12. y = \frac{x^2 + 1}{\sqrt{x^2 - 1}}.$$

$$19.13. y = \frac{x}{x^2 - 4x + 3}.$$

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

$$19.15. y = \frac{x^2 - 1}{x^2 - 5x + 6}.$$

$$19.25. y = \frac{x^2 + 5}{x^2 - 1} + 2x.$$

$$19.26. y = \frac{x^4}{(1+x)^2}.$$

$$19.27. y = \frac{1}{2x^2 + x - 1}.$$

$$19.28. y = \frac{x^2}{4 - x^2}.$$

$$19.29. y = \frac{2x^2 - 9}{\sqrt{x^2 - 1}}.$$

$$19.30. y = \frac{x^2 - 11}{4x - 3}.$$

**Задание 20.** Провести полное исследование и построить график функции  $y = f(x)$ .

$$20.1. \text{ а) } y = \frac{x^2}{x - 2}; \quad \text{ б) } y = (x + 2)e^{-x};$$

$$\text{ в) } y = \sqrt[3]{x + 1} - \sqrt[3]{x - 1}.$$

$$20.2. \text{ а) } y = \frac{x^2 - 4x + 1}{x - 4}; \quad \text{ б) } y = xe^x;$$

$$\text{ в) } y = \sqrt[3]{x^2 - 2x}.$$

$$20.3. \text{ а) } y = \frac{x^2 - 5x}{1 - x}; \quad \text{ б) } y = (x - 2)e^{3-x};$$

$$\text{ в) } y = \sqrt[3]{(x + 1)^2} + \sqrt[3]{(x - 1)^2}.$$

20.4. а)  $y = \frac{6-2x^2}{x-2}$ ;

б)  $y = (x-1)e^{2x}$ ;

в)  $y = \frac{1}{\sqrt[3]{x+1}} + \frac{1}{\sqrt[3]{x-1}}$ .

20.5. а)  $y = \frac{3x^2}{2-x}$ ;

б)  $y = (2-x)e^x$ ;

в)  $y = \sqrt[3]{1-x^3}$ .

20.6. а)  $y = \frac{7x-x^2}{x-3}$ ;

б)  $y = xe^{-2x}$ ;

в)  $y = \sqrt[3]{x+1} + \sqrt[3]{x-1}$ .

20.7. а)  $y = \frac{x^2}{3-x}$ ;

б)  $y = (x+1)e^{2x}$ ;

в)  $y = \sqrt[3]{x^3+1} + \sqrt[3]{x^3-1}$ .

20.8. а)  $y = \frac{x^2+16}{4x}$ ;

б)  $y = (3-x)e^{x-2}$ ;

в)  $y = \frac{x^3}{\sqrt{x^4+1}}$ .

20.9. а)  $y = \frac{x^2-x+1}{1-x}$ ;

б)  $y = (4-x)e^{x-3}$ ;

в)  $y = \frac{x}{\sqrt{x^2+1}}$ .

**20.10. a)**  $y = \frac{x^2}{x+2};$

б)  $y = xe^{3x};$

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

**20.11. a)**  $y = \frac{2x^2}{x-1};$

б)  $y = (x-3)e^{-x};$

в)  $y = \frac{x^3}{\sqrt[3]{x^3-4}}.$

**20.12. a)**  $y = \frac{3x^2}{x-2};$

б)  $y = (x-5)e^{2x};$

в)  $y = \frac{x^3}{\sqrt[3]{(x^3+2)^2}}.$

**20.13. a)**  $y = \frac{x^2-3x+3}{x-1};$

б)  $y = xe^{-x};$

в)  $y = \frac{x^2}{\sqrt{x^2+1}}.$

**20.14. a)**  $y = \frac{x^2}{x+1};$

б)  $y = (x+1)e^{-2x};$

в)  $y = \frac{\sqrt[3]{x^3+2}}{x}.$

**20.15. a)**  $y = \frac{3-x^2}{x+2};$

б)  $y = (x+4)e^{2x};$



$$\text{в) } y = \frac{x}{\sqrt{(x^3 + 1)^2}}.$$

$$20.16. \text{ а) } y = \frac{x^2}{x-5};$$

$$\text{б) } y = (x+1)e^{-x};$$

$$\text{в) } y = \frac{x^2}{\sqrt{|x^2 - 1|}}.$$

$$20.17. \text{ а) } y = \frac{x^2 - x + 1}{x-1};$$

$$\text{б) } y = xe^{2x-1};$$

$$\text{в) } y = \frac{\sqrt{|x^2 - 3|}}{x}.$$

$$20.18. \text{ а) } y = \frac{-x^2 - 4}{2x};$$

$$\text{б) } y = (x-1)e^{-x};$$

$$\text{в) } y = \sqrt[3]{|x^2 - 1|}.$$

$$20.19. \text{ а) } y = \frac{x^2}{4+x};$$

$$\text{б) } y = (x-3)e^{x-2};$$

$$\text{в) } y = \sqrt{|x^2 - 2|}^3.$$

$$20.20. \text{ а) } y = \frac{2x^2 - 6}{x-2};$$

$$\text{б) } y = (x-4)e^{x-3};$$

$$\text{в) } y = \sqrt{8x^2 - x^4}.$$

$$20.21. \text{ a) } y = \frac{x^2}{5-x};$$

$$\text{б) } y = xe^{2-x};$$

$$\text{в) } y = \frac{x-2}{\sqrt{x^2+1}}.$$

$$20.22. \text{ a) } y = \frac{x^2-4x+1}{4-x};$$

$$\text{б) } y = (x+2)e^{2x};$$

$$\text{в) } y = \sqrt[3]{x^3-x^2-x+1}.$$

$$20.23. \text{ a) } y = \frac{x^2}{x-3};$$

$$\text{б) } y = (x-4)e^x;$$

$$\text{в) } y = \sqrt{(x-1)(x-2)(x-3)}.$$

$$20.24. \text{ a) } y = \frac{x^2+11}{x-5};$$

$$\text{б) } y = (x-4)e^{-x};$$

$$\text{в) } y = \sqrt[3]{x^2} - \sqrt[3]{x^2+1}.$$

$$20.25. \text{ a) } y = \frac{x^2+4}{2x};$$

$$\text{б) } y = (x-1)e^x;$$

$$\text{в) } y = \sqrt{\frac{|1+x|^3}{x}}.$$

$$20.26. \text{ a) } y = \frac{x^2-5x}{x-1};$$

$$\text{б) } y = (5-x)e^{2x};$$

$$\text{в) } y = \frac{x}{\sqrt[3]{x^2-1}}.$$

$$20.27. \text{ a) } y = \frac{3x - x^2 - 3}{x - 1};$$

$$\text{б) } y = (x - 2)e^{2-x};$$

$$\text{в) } y = -\sqrt{8x^2 - x^4}.$$

$$20.28. \text{ a) } y = \frac{x^2}{2 - x};$$

$$\text{б) } y = (3 - x)e^{-x};$$

$$\text{в) } y = \frac{x^2 \sqrt{x^2 - 1}}{2x^2 - 1}.$$

$$20.29. \text{ a) } y = \frac{x^2 - 3}{x + 2};$$

$$\text{б) } y = (x - 4)e^{4-x};$$

$$\text{в) } y = 1 - x + \sqrt{\frac{x^3}{3 + x}}.$$

$$20.30. \text{ a) } y = \frac{2x^2}{1 - x};$$

$$\text{б) } y = (x - 1)e^{3x-1};$$

$$\text{в) } y = \sqrt[3]{\frac{x^2}{x+1}}.$$