Derivatives

Compute $\frac{\mathrm{d}f}{\mathrm{d}x}$ of following functions:

1. $f(x) = \cos(x^2)$
2. $f(x) = \cos^2(x)$
3. $f(x) = \arctan(\sqrt{x})$
4. $f(x) = \cos^3(3x^2 + 2x)$
5. $f(x) = \ln(x + \sqrt{1 + x^2})$

Derivative of multiplication

Compute $\frac{\mathrm{d}f}{\mathrm{d}x}$ of following functions:

6. $f(x) = x \ln x$
7. $f(x) = x^2 \cos x$
8. $f(x) = (x + 1)(x + 5)^8$
9. $f(x) = (x - 2)\sqrt[3]{x^2 - 4}$
10. $f(x) = (x^3 + 2)e^{4x}$
11. $f(x) = (x + 6)\sqrt{x + 1}$
12. $f(x) = \frac{1}{\tan(x)}$
13. $f(x) = \sqrt{x}\,\operatorname{cotan}(x)$
14. $f(x) = e^x \sin(5x)$
15. $f(x) = (x^2 + 1)^2 e^{2x}$

Derivative of division

Compute $\frac{\mathrm{d}f}{\mathrm{d}x}$ of following functions:

16. $f(x) = \frac{x+1}{x-1}$
17. $f(x) = \frac{x^4+3}{3x}$
18. $f(x) = \frac{x+2}{\sqrt{5-x}}$
19. $f(x) = \frac{x^2+3}{x+5}$

L'Hospital's rule for limits

Let $L = \lim \frac{f(x)}{g(x)} = "\frac{\infty}{\infty}" \vee "\frac{0}{0}"$
than $L = \lim \frac{f'(x)}{g'(x)}$ if the limit exists

1. $\lim\limits_{x\to 0} \frac{\sin x}{x}$
2. $\lim\limits_{x\to 0} \frac{2 \arcsin x}{3x}$
3. $\lim\limits_{x\to 2} \frac{\tan(\pi x)}{x-2}$
4. $\lim\limits_{x\to 4} \frac{\sqrt{1+2x}-3}{\sqrt{x}-2}$
5. $\lim\limits_{x\to 0} \frac{1-\cos^2 x}{x^2}$
6. $\lim\limits_{x\to \infty} \frac{e^x}{x^2}$
7. $\lim\limits_{x\to \infty} \frac{x+\sin x}{x}$
8. $\lim\limits_{x\to 0^+} x \ln x$
9. $\lim\limits_{x\to \infty} x \sin\left(\frac{\pi}{x}\right)$
10. $\lim\limits_{x\to 0^+} \sqrt{x} \ln(\sqrt{x})$
11. $\lim\limits_{x\to \pi} \ln(x - \pi)^2$

Higher derivatives

Compute $\frac{\mathrm{d}y}{\mathrm{d}x}$ and $\frac{\mathrm{d}^2y}{\mathrm{d}x^2}$ of following functions:

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