Derivatives (repetition)

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

1. $f(x) = \cos(x^2)$
2. $f(x) = \cos^2(x)$

3. $f(x) = \frac{1}{\tan(x)}$
4. $f(x) = \sqrt{x}\,\cotan(x)$

5. $f(x) = e^x \sin(5x)$
6. $f(x) = (x^2 + 1)^2 e^{2x}$

L'Hopital's rule for limits

Let $L = \lim \frac{f(x)}{g(x)} = \text{"}\frac{\infty}{\infty}\text{"} \vee \text{"}\frac{0}{0}\text{"}$
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 $\frac{\mathrm{d}^2 y}{\mathrm{d}x^2}$ of following functions:

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

3. $y(x) = \frac{1 + x}{1 - x}$