Problem 1. Find whether the following functions are differentiable at the given points.

1. * $f(x) = |x-1| + |x+1|$ at $x = -1$ and $x = 1$.
2. $f(x) = \dfrac{1-2x}{3+x}$ at $x = -3$.
3. $f(x) = |x| + |x-2|$ at $x = 0$ and $x = 2$.
4. $f(x) = \sqrt{9-x}$ at $x = 9$.
5. $f(x) = \begin{cases} x^2+1 & \text{if } x \le 1\ , \\ 3-x & \text{if } 1 < x \le 4\ , \\ \sqrt{x} & \text{if } x > 4\ , \end{cases}$ at $x = 1$ and $x = 4$.

Problem 2. Use differentiation formulas to differentiate the following functions.

1. * $h(t) = \dfrac{6t+1}{6t-1}$.
2. $f(x) = \dfrac{\sqrt{x}}{2+x}$.
3. $g(s) = \dfrac{s^2+1}{s^3-1}$.
4. * $f(\theta) = \sec\theta \tan\theta$.
5. $g(\theta) = \theta \cos\theta \sin\theta$.
6. $h(t) = \dfrac{t \sin t}{1+t}$.

Problem 3. Find the equations of tangent and normal lines to the following curves at the given point.

1. * $y = x + \sqrt{x}$ at $(1, 2)$.
2. $y = \dfrac{1}{1+x^2}$ at $(-1, 1/2)$.
3. $y = \dfrac{2x}{x+1}$ at $(1, 1)$.
4. $y = (1+x)\cos x$ at $(0, 1)$.

Problem 4. Evaluate the following limits.

1. $\lim\limits_{x\to 0} \dfrac{\sin 4x}{x \cos x}$.
2. $\lim\limits_{x\to 0} \dfrac{\cos x - 1}{2 \sin x}$.