1. Find the derivatives of the following functions:

a) $x^3 \sin x$ b) $\dfrac{17 \tan x}{x^3 - 4}$ c) $\dfrac{23e^x}{x^3 + 33e^x}$ d) $2x^{-2} + 3\sqrt{x} - \dfrac{9}{x^4}$

2. a) Compute $\lim\limits_{x \to 0} \dfrac{e^x - 1}{x}$ and $\lim\limits_{x \to 0} \dfrac{\sin x}{x}$.

b) Compute $\lim\limits_{x \to 0} \dfrac{e^{5x} - 1}{3x}$ and $\lim\limits_{x \to 0} \dfrac{\sin 7x}{6x}$.

c) Compute $\lim\limits_{x \to 0} \dfrac{\left(\sin(4x)\right)^2 \sin 7x}{\left(e^{3x} - 1\right)^2 x \left(\cos(5x)\right)}$.

3. Here is the graph of a function, F. Label any points on the graph which occur in your discussion of the questions below.

a) Where is F not continuous? Why?

b) Where is F not differentiable? Why?

c) Sketch a graph of F' wherever F' is defined.
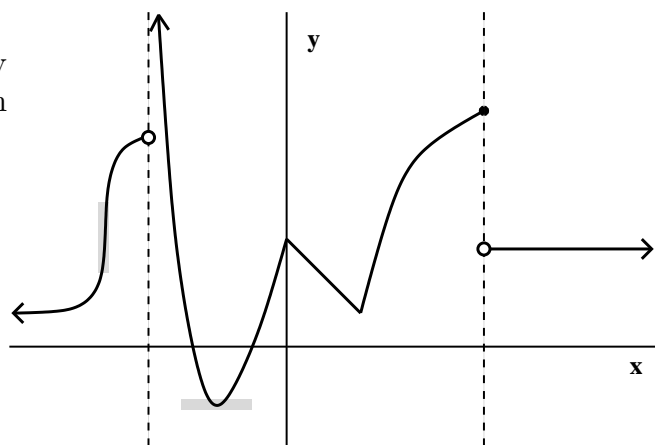
Graph of $y = F(x)$

4. Suppose that $f(x)$ and $g(x)$ are differentiable functions, and the following information is known about them:

$$f(2) = -3 \qquad f'(2) = 5 \qquad g(2) = 1 \qquad g'(2) = 2 \qquad g(0) = 2 \qquad g'(0) = 4$$

a) If $F(x) = \dfrac{f(x)}{g(x)}$, compute $F(2)$ and $F'(2)$.

b) If $G(x) = x^3 f(x) - 7g(x)$, compute $G(2)$ and $G'(2)$.

c) If $H(x) = \dfrac{3 + e^x}{g(x)}$, compute $H(0)$ and $H'(0)$.

5. A graph of $y = x^3 - 3x$ looks approximately like what's shown to the right. The person who drew the graph carelessly forgot to show the axes and scales, etc. *Use calculus* to find the exact coordinates of the points **A** and **B** which are, as shown, at the top and bottom of the bumps on the graph.