Problem 1 Differentiate with respect to \( \theta \): \( q(\theta) = (\theta^2 + 1) \tan \theta \)

Problem 2 Find \( \frac{d}{dx}(\cot x) \). (Work through the derivative as the book did in Example 5 on p.159 to get the equation on p.158)

Problem 3 Find values for the constants \( a, b, \) and \( c \) that will make \( f(x) = \cos x \) and \( g(x) = a + bx + cx^2 \) satisfy the conditions \( f(0) = g(0), f'(0) = g'(0), \) and \( f''(0) = g''(0) \).

Problem 4 Find \( \lim_{x \to 0} \frac{3x - \tan 7x}{2x} \).
Problem 5  Find all values of constants $m$ and $b$ for which the function

$$y = \begin{cases} 
\sin x, & x < \pi \\
mx + b, & x \geq \pi 
\end{cases}$$

is

(a) continuous at $x = \pi$

(b) differentiable at $x = \pi$

Problem 6  Does the function

$$f(x) = \begin{cases} 
\frac{1 - \cos x}{x}, & x \neq 0 \\
0, & x = 0 
\end{cases}$$

have a derivative at $x = 0$? Explain.
Find values for the constants $a$, $b$, and $c$ that will make $f(x) = \cos x$ and $g(x) = a + bx + cx^2$ satisfy the conditions $f(0) = g(0)$, $f'(0) = g'(0)$, and $f''(0) = g''(0)$. 
Find \( \lim_{x \to 0} \frac{3x-\tan 7x}{2x} \).
Find all values of constants $m$ and $b$ for which the function

$$y = \begin{cases} 
\sin x, & x < \pi \\
mx + b, & x \geq \pi 
\end{cases}$$

is

(a) continuous at $x = \pi$

(b) differentiable at $x = \pi$
Does the function

\[ f(x) = \begin{cases} \frac{1 - \cos x}{x}, & x \neq 0 \\ 0, & x = 0 \end{cases} \]

have a derivative at \( x = 0 \)? Explain.