1) Given that $f$ is a differentiable function and $f(1) = -1$ and $f'(1) = 4$, what is the Linear approximation for $f(x)$ near $x = 1$?

What does $f'(x)$ represent?

What does your Linear approximation represent?

2) Find the first derivative for each curve described below:

$y = \sin x$  \hspace{2cm}  $y = \csc x$

$y = \cos x$  \hspace{2cm}  $y = \sec x$

$y = \tan x$  \hspace{2cm}  $y = \cot x$

3) Find the first derivative for each curve described below:

$y = \sin 3x$  \hspace{2cm}  $y = \csc^2(x + 3)^3$

$y = \cos(x + 4)^2$  \hspace{2cm}  $y = \sec(4 - x)$

$y = \tan^3(4x + 1)^3$  \hspace{2cm}  $y = \cot(2x)^3$
1980 AB 7
Let \( p \) and \( q \) be real numbers and let \( f \) be the function defined by:
\[
f(x) = \begin{cases} 
1 + 2p(x-1) + (x-1)^2, & \text{for } x \leq 1 \\
qx + p, & \text{for } x > 1
\end{cases}
\]

a. Find the value of \( q \), in terms of \( p \), for which \( f \) is continuous at \( x = 1 \).
b. Find the values of \( p \) and \( q \) for which \( f \) is continuous at \( x = 1 \).
c. If \( p \) and \( q \) have the values determined in part b, is \( f'' \) a continuous function? Justify your answer.

1981 AB 1
Let \( f \) be the function defined by \( f(x) = x^4 - 3x^2 + 2 \).

a. Find the zeros of \( f \).
b. Write an equation of the line tangent to the graph of \( f \) at the point where \( x = 1 \).
c. Find the \( x \)-coordinate of each point at which the line tangent to the graph of \( f \) is parallel to the line \( y = -2x + 4 \).

1981 AB 5 BC 2
Let \( f \) be a function defined by \( f(x) = \begin{cases} 
2x + 1, & \text{for } x \leq 2 \\
\frac{1}{2}x^2 + k, & \text{for } x > 2
\end{cases} \).

a. For what values of \( k \) will \( f \) be continuous at \( x = 2 \)? Justify your answer.
b. Using the value of \( k \) found in part a, determine whether \( f \) is differentiable at \( x = 2 \). Use the definition of the derivative to justify your answer.
c. Let \( k = 4 \). Determine whether \( f \) is differentiable at \( x = 4 \). Justify your answer.

1994 AB 3
Consider the curve defined by \( x^2 + xy + y^2 = 27 \).

a. Write an expression for the slope of the curve at any point \((x,y)\).
b. Determine whether the lines tangent to the curve at the \( x \)-intercepts of the curve are parallel.
c. Find the points on the curve where the lines tangent to the curve are vertical.