Math 105a
Quiz 8
2/6/04

Please show all your work in order to receive partial credit.

1. Find derivatives for the following functions.

   (a) \( f(x) = 5^x + x \)
       \[ f'(x) = (\ln 5)5^x + 1 \]

   (b) \( f(x) = 4 \cdot 2^x + x^3 - 3^x \)
       \[ f'(x) = (4 \ln 2)2^x + 3x^2 \]

   (c) \( f(x) = e^x + x^e + (e^3)^x \)
       \[ f'(x) = e^x + e^{x-1} + (\ln e^3)(e^3)^x = e^x + e^{x-1} + 3e^{3x} \]

2. Consider \( f(x) = 4 + 2x - e^x \).

   (a) For what value of \( x \) is \( f'(x) = 0 \)?
       \[ f'(x) = 2 - e^x \]
       Set \( f'(x) \) equal to 0 and solve for \( x \):
       \[ 2 - e^x = 0 \]
       \[ e^x = 2 \]
       \[ x = \ln 2 \]

   (b) On what interval is \( f \) increasing?
       From (a) we know that \( f'(\ln 2) = 0 \). We can create a sign chart to determine the interval for which \( f' \) is positive.

       \[ f' \]
       \[ + \quad - \]
       \[ f \quad \text{increasing} \quad \text{decreasing} \]

       \[ f'(x) > 0 \] for \( x < \ln 2 \). Therefore, \( f \) is increasing on \((-\infty, \ln 2)\).

   (c) On what interval is \( f \) concave down?
       \[ f''(x) = -e^x < 0 \] for all values of \( x \). Therefore, \( f \) is concave down for all real numbers.