1. Find the derivative of the following functions. You do NOT need to simplify.

(a) \( f(x) = e^{7x^2 - 5x} \)

(b) \( g(x) = 9x^2 e^{6x} + e^{-x^2/3} \)

(c) \( h(x) = \frac{e^{9x-3}}{e^{4x} + 2} \)

(d) \( k(x) = (3e^{-2x} + e^{7x})^5 \)

(e) \( f(x) = (\ln 9x)^3 \)

(f) \( g(x) = \ln \sqrt[3]{5x^2 - 3x} \)

(g) \( h(x) = e^{2x} \ln x^3 - \ln(4x^3 - 7) \)

(h) \( k(x) = \frac{\ln(x^4 - 3x^2)}{e^{4x+1}} \)

(i) \( f(x) = \ln(e^x - 5x) + x \ln x \)

2. True or False

(a) If \( f(x) = \ln 5 \), then \( f'(x) = \frac{1}{5} \).

(b) If \( f(x) = e^x \), then \( f'(x) = e^x \).

(c) \( \ln(x + y) = \ln x + \ln y \).

3. How long will it take an investment of $2000 to grow to $7500 if the investment earns interest at the rate of 9% per year compounded monthly?

4. Determine the intervals where \( f(x) = x^2 e^{-x} \) is increasing and where it is decreasing.

5. Find the absolute extrema of \( f(x) = x - \ln x \) on \( \left[ \frac{1}{2}, 3 \right] \). Round all answers to two decimal places.

6. Polonium-210 has a half-life of 140 days. Suppose a sample of this substance has a mass of 300 mg.

(a) Find the decay constant. Round answer to five decimal places.

(b) Find the mass remaining after one year. (NOTE: 1 year = 365 days.)

(c) How long will it take for the sample to decay to a mass of 200 mg?
1. (a) \( f'(x) = (14x - 5)e^{7x^2 - 5x} \)

(b) \( g'(x) = 54x^2 e^{6x} + 18x e^{6x} - \frac{2}{3} x e^{-x^2/3} \)

(c) \( h'(x) = \frac{(e^{4x} + 2)(9e^{9x-3}) - e^{9x-3}(4e^{4x})}{(e^{4x} + 2)^2} \)

(d) \( k'(x) = 5(3e^{-2x} + e^{7x})^4(-6e^{-2x} + 7e^{7x}) \)

(e) \( f'(x) = 3(ln 9x)^2 \cdot \frac{1}{x} \)

(f) \( g'(x) = \frac{1}{(5x^2 - 3x)^{1/3}} \cdot \frac{1}{3} (5x^2 - 3x)^{-2/3} (10x - 3) \)

(g) \( h'(x) = e^{2x} \cdot \frac{3x}{x} + 2e^{2x} \ln x^3 - \frac{12x^2}{4x^3 - 7} \)

(h) \( k'(x) = \frac{e^{4x+1} \cdot 4x^3 - 6x}{x^4 - 3x^2} - \ln(x^4 - 3x^2) \cdot 4e^{4x+1} \cdot (e^{4x+1})^2 \)

(i) \( f'(x) = \frac{e^x - 5}{e^x - 5x} + 1 + \ln x \)

2. (a) F
(b) F
(c) F

3. 14.74 years

4. decreasing: \((-\infty, 0) \cup (2, \infty)\)
   increasing: \((0, 2)\)

5. absolute minimum = 1 and absolute maximum = 1.90

6. (a) 0.00495
(b) 49.26 grams
(c) approximately 82 days