Midterm 3 Mock Exam A

(1) Compute the derivative of \( f(x) = x^2 e^x + 1 \).

(2) Use logarithmic differentiation to compute the derivative of \( h(s) = \frac{(s + 1)^7 e^{3s}}{(2s - 4)^3} \).

(3) Compute the integral \( \int \frac{1}{x^2} dx \).

(4) Compute the integral \( \int (3x^2 + 1)e^{x^2 + x} dx \).

(5) Find all points where the tangent to the graph of \( g(x) = x \ln x \) is horizontal.

(6) A manufacturer estimates that the marginal cost of producing \( q \) units of a certain commodity is \( C'(q) = 3q^2 - 24q + 48 \) dollars per unit. If the cost of producing 10 units is $5000, what is the cost of producing 30 units?

(7) The population of a certain bacterial colony \( t \) hours after antibiotic treatment is begun is given by the formula

\[
P(t) = \frac{100e^{0.03t}}{t + 1} \]

(a) What will the population be 5 hours after treatment is begun? 10 hours? 20 hours?

(b) Will the population of the colony ever be reduced to zero?

(8) A study indicates that \( t \) months from now the population of a certain town will be growing at the rate of \( P'(t) = 5 + 3t^{2/3} \) people per month. Use a definite integral to compute how much the population of the town will rise over the next 8 months.

(9) Simplify the following:

(a) \( (25x^6)^{3/2} \)

(b) \( \log_3 27(2x + 5)^7 \)

(10) Compute the integral \( \int y^3 \left(2y + \frac{1}{y}\right) dy \).