

Each problem is worth 10 points. Be sure to show all work for full credit. Please circle all answers and keep your work as legible as possible. All answers must be reasonably simplified for full credit. Batteries not included. Good luck!

- Using the definition of the derivative, show that the derivative of a constant function is 0.
- State and prove either the product rule or the quotient rule.
- Hungary is one of the only countries in the world whose population is currently shrinking. If the population is decreasing by .2% per year, and in 1990 the population was 10.8 million, at what rate (in people per year) will the population be shrinking at the beginning of 1995?
- Find an equation of the line tangent to the function $f(x) = \cos 0 - x^2 + x$ at the point (0,1).
- Find the slope of the line tangent to $y^3 - xy = -6$ at the point (7,2).
- If the depth of water in Boston harbor is given by:

$$d(t) = 5 + 4.9 \cos\left(\frac{\pi}{6}t\right)$$

where t is the time in hours after midnight and the depth is measured in meters, at what rate (in meters per hour) is the water level changing at 8pm?

7 Find y' if

$$y = \frac{(7x+3)^4 (5x^5 - x^2)^3}{e^x}$$

8. a) If $f(x) = \ln(\sec x + \tan x)$, what is $f'(x)$?

b) Find a function whose derivative is $\csc x$. (Hint: $\csc x = 1/\sin x$)

9. Given that the derivative of $\sinh x$ is $\cosh x$ and the derivative of $\cosh x$ is $\sinh x$, find the derivative of $\coth x$.

10. Given that $f(2)=7$ and $f'(2)=3$ and $f(x)g(x)=1$ for all values of x and that f and g are both differentiable everywhere, find $g'(2)$. (Hint: first take the derivative of $f(x)g(x)=1$ and solve for $g'(x)$.)

Extra Credit (5 points possible):

Find y' if

$$f(x) = \sqrt{1 - \sqrt{2 - \sqrt{3 - x}}}$$