

**Second Examination**  
*Thursday, February 23, 2017*

**Instructions:** This exam should be done on your own paper. Your name should be on each sheet and on the back of the last sheet; the answers should appear written carefully and in order. If in doubt, show intermediate steps: Full credit may not be given, even for correct answers, unless work is arranged clearly and explained. This exam is closed book. You may leave after handing in your exam paper, but be sure to check your answers carefully. You may keep this exam sheet.

1. Compute an equation for the tangent line to the graph of the function  $f(x) = x^2$  at  $x = 1$ .

*(16 points)*

2. Compute  $f'(x)$  in each of these cases.

*(6 points apiece)*

(a)  $f(x) = (x^2 - 5x + 6)$       (b)  $f(x) = \frac{x^3 - x}{(x + 1)^2}$       (c)  $f(x) = x \sin(\pi x)$

(d)  $f(x) = x^2 e^{-x}$       (e)  $f(x) = \arctan(x - x_0)$       (f)  $f(x) = \frac{\sin(x)}{x}$

(g)  $f(x) = x \ln(x)$       (h)  $f(x) = \log_{10}(x^3 + x^2)$

3. Use logarithmic differentiation to compute  $f'(x)$ , where  $f(x) = \frac{(x^2 + 2x + 1)^{\frac{1}{5}}}{(x^3 - x)^{\frac{3}{4}}}$ .

*(16 points)*

4. The amount of recoverable petroleum in barrels in a certain geological formation after  $T$  years is calculated to be approximately  $P(T)$ .

*(20 points)*

(a) What are the units of  $\frac{dP}{dT}$ ?

(b) Would you expect  $\frac{dP}{dT}$  to be positive or negative? Why?

(c) Suppose  $\left. \frac{dP}{dT} \right|_{T=10} \approx -1000$ , and  $P(10) \approx 10,000$ . What would you estimate  $P(11)$  to be?