

## MATH 31A (Butler)

### Practice for Midterm I

Try to answer the following questions without the use of book, notes or calculator. Time yourself and try to finish the questions in less than 50 minutes.

1. (a) Find  $\lim_{t \rightarrow 0} \frac{\left(\frac{1}{\sqrt{9+2t}} - \frac{1}{3}\right)}{\sin(3t)}$ .

(b) Find  $\lim_{x \rightarrow 0} \left(\frac{1}{3x} - \frac{1}{x(x+3)}\right)$ .

2. Let  $g(x) = \begin{cases} x \cos x - 2x + 3 & \text{if } x \leq 0; \\ bx + 3 & \text{if } x > 0. \end{cases}$

(a) Show that  $g(x)$  is continuous at  $x = 0$  for *any* value of  $b$ .

(b) For what value of  $b$  does  $g'(0)$  exist?

(c) For the answer in part (b), what is the value of  $g'(0)$ ?

3. Find the tangent line of  $y = 2x + 4\sqrt{x} - \pi^2$  parallel to the line  $y = 3x + 7$ .

4. Express  $\frac{d^2}{dx^2}(f(x)g(x))$  in terms of  $f(x)$ ,  $f'(x)$ ,  $f''(x)$ ,  $g(x)$ ,  $g'(x)$  and  $g''(x)$ .

5. Given that  $f(1) = 2$ ,  $f'(1) = -1$ ,  $g(1) = 3$  and  $g'(1) = 2$  find  $h(1)$  and  $h'(1)$  where  $h(x) = x^2 f(x) - 3\sqrt{x}g(x)$ .

6. The position of a particle on a strip is given by  $s(t) = t^3 - 5t^2 + 6t - 4$  ( $s(t)$  is measured in inches and  $t$  is measured in seconds).

(a) What is the position of the particle at  $t = 1$ ? (Give the units.)

(b) What is the (instantaneous) velocity of the particle at  $t = 1$ ? (Give the units.)

(c) What is the acceleration of the particle at  $t = 1$ ? (Give the units.) Does this mean the speed the particle is moving is going up or down?