Print Name ________________________________

APPM 1350 **Exam 2** **Fall 2016**

On the front of your bluebook, please write: your name, student ID, lecture number, instructor name, and a grading key for problems 1ab, 1cd, 2, 3, 4, and 5. This exam is worth 100 points and has 5 questions on both sides of this paper.

- Include this exam sheet in your bluebook. However, nothing on this exam sheet will be graded. Make sure all of your work is in your bluebook.
- **Show all work and simplify your answers!** Name any theorem that you use. Answers with no justification will receive no points.
- Please begin each problem on a new page.
- No notes or papers, calculators, cell phones, or electronic devices are permitted.

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1. (28 pts, 7 pts each) The following four problems are not related. Be sure to simplify your answers.
   (a) Let $f(x) = \tan^2(\pi x)$. Find $f'(1/4)$
   (b) Find the derivative of $g(x) = \dfrac{x^2}{\sqrt{3x^2+4}}$ at $x = 2$.
   (c) Consider the curve $Ax^2 + By^2 = 40$.
      i. Use implicit differentiation to find dy/dx.
      ii. Suppose the curve has the tangent line $y = 2 + \frac{2}{9}(x+1)$ at the point $(-1, 2)$. Find the constants A and B.
   (d) Find the derivative of $y = x^2|x-1|$. Express your answer as a piecewise defined function without absolute value signs.
2. (12 pts) At noon, ship A is 60 km west of ship B. Ship A is sailing south at 15 km/h and ship B is sailing north at 5 km/h. How fast is the distance between the ships changing at 4:00 PM?
3. (24 pts) Consider the function $y = x\sqrt{6-x}$.
   (a) Find the domain of the function. Express your answer in interval notation.
   (b) Find the x- and y-intercepts of the function.
   (c) The first derivative is $y' = \dfrac{12-3x}{2\sqrt{6-x}}$. On what intervals is y increasing? decreasing?
   (d) Find x and y coordinates of the local maximum and minimum extrema, if any.
   (e) The second derivative is $y'' = \dfrac{3x-24}{4(6-x)^{3/2}}$. On what intervals is y concave up? concave down?
   (f) Find the x and y coordinates of the inflection points, if any.
   (g) Sketch a graph of y. Clearly label any intercepts, local extrema, and inflection points.

TURN OVER—More problems on the back!

4. (12 pts) If 1200 cm^2 of material is available to make a box with a square base and an open top, find the largest possible volume of the box.

5. (24 pts, 6pts each) The following four problems are not related and do not require justification.

   (a) The linearization function for $f(x) = (1+x)^k$ at $a = 0$ is $L(x) = 1 + kx$. Suppose $L(x)$ is used to estimate the value of $\sqrt[3]{0.94^2}$.

      i. What values of k and x should be used?

      ii. What is the estimated value? Simplify your answer.

   (b) Consider the function $y = \dfrac{6x^2 - 15x - 2}{2x - 3}$.

      i. Find the slant asymptote(s) of y or write "None" if none exists.

      ii. Write down (but do not evaluate) the appropriate limit(s) to confirm your answer for part (i).

   (c) Suppose $g(x)$ is differentiable for all x. Which of the following statements A1 to A4 *must* be true? Write down the numbers of all statements that are necessarily true. If none of the statements are true, write "None".

   A1: g is continuous on the interval $[-3, 10]$.

   A2: g has absolute maximum and minimum values on the interval $[-3, 10]$.

   A3: $g(c) = 0$ for some value of c.

   A4: $g'(c) = 0$ for a number c in $(-3, 10)$.

   (d) Suppose $-2 \leq h'(x) \leq 2$ for all x. Which of the following statements B1 to B4 *must* be true? Write down the numbers of all statements that are necessarily true. If none of the statements are true, write "None".

   B1: $h(c)$ exists for all values of c.

   B2: $h(c) = 0$ for some value of c.

   B3: $h'(c) = 0$ for a number c in $(-2, 2)$.

   B4: $h'(c) = \dfrac{h(2) - h(-2)}{4}$ for a number c in $(-2, 2)$.