APPM 1350 **Exam 3** **Fall 2017**

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

- Make sure all of your work is in your bluebook. Nothing on this exam sheet will be graded. Please begin each problem on a new page.
- **Show all work and simplify your answers!** Name any theorem that you use. Answers with no justification will receive no points.
- Notes, papers, calculators, cell phones, and other electronic devices are not permitted.

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1. (30 pts) Evaluate and fully simplify all answers.

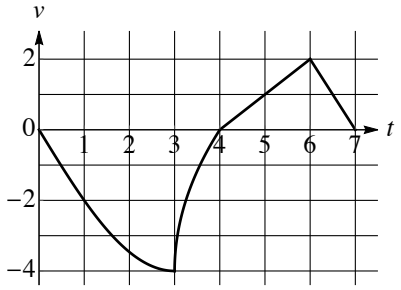
   (a) $\displaystyle\int \frac{\sqrt[3]{1+\sqrt{t}}}{\sqrt{t}}\,dt$

   (b) $\displaystyle\int_e^{e^2} \frac{2}{x\ln(x^2)}\,dx$

   (c) $\displaystyle\int_{-\frac{\pi}{4}}^{\frac{\pi}{4}} \left|\sin^3(\theta)+\cos^2(\theta)\sin(\theta)\right|\,d\theta$

   (d) Consider the function $f(x)=\displaystyle\int_1^{x^2}\sqrt{1+t^3}\,dt$. Find $f'(2)$.

2. (15 pts) The graph below shows the velocity v (in cm/sec) of an object moving up and down for $t=0$ to 7 sec. (For parts (a) to (c) no explanation is necessary.)



   (a) On which interval(s) was the acceleration negative? Express your answer in interval notation.

   (b) At what time was the object farthest away from the starting point?

   (c) Did the object end up above, below, or at the starting position?

   (d) What was the average velocity of the object on $[5,7]$? Justify your answer.

TURN OVER—More problems on the back!

3. (16 pts) The following problems are not related.

   (a) Express $\lim_{n\to\infty} \sum_{i=1}^{n} \frac{i^4}{n^5}$ as a definite integral and use it to find the value of the limit.

   (b) Evaluate the upper sum for $f(x) = (x-1)^2, -3 \le x \le 3$, with $n = 3$ equal subintervals.

4. (24 pts) The following problems are not related.

   (a) Write the following expression in sigma notation and find the sum.

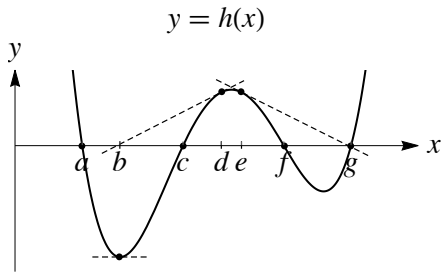
$$\left(1^3 + 10\right) + \left(2^3 + 20\right) + \left(3^3 + 30\right) + \cdots + \left(20^3 + 200\right)$$

   (b) Consider the function

$$f(x) = \frac{(1-x)(2+x)^2(3-x/2)}{(4+x)^2}.$$

   Use logarithmic differentiation to find $f'(0)$.

   (c) Suppose Newton's Method is used to find a root of the function $h(x)$. The tangent lines at $x = b, d$, and e are shown. (No explanation is necessary for the following questions.)



   i. For which of the initial approximations $x_1 = a, b, c, d, e, f$, and g will Newton's Method fail to find a root? List all that apply.

   ii. Which of the initial approximations $x_1 = b, d, e$, and g will lead to a second approximation x_2 that equals one of the roots of h? List all that apply.

5. (15 pts) Let $f(x) = \dfrac{5e^x}{4 - e^x}$.

   (a) Find the domain of f in interval notation.

   (b) Find the inverse function f^{-1}. (You may assume that f is one-to-one.)

   (c) If $\left(f^{-1}\right)'(5/3) = 1/f'(a)$, what is the value of a? (*Hint:* It is not necessary to differentiate the functions to find the answer.)

Formulas

$$\sum_{i=1}^{n} i = \frac{n(n+1)}{2} \qquad \sum_{i=1}^{n} i^2 = \frac{n(n+1)(2n+1)}{6} \qquad \sum_{i=1}^{n} i^3 = \left(\frac{n(n+1)}{2}\right)^2$$