

DEPARTMENT OF MATHEMATICS  
BROOKLYN COLLEGE

FINAL EXAMINATIONS—FALL 2007  
MATHEMATICS 3.3

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PART I: ANSWER ALL 3 QUESTIONS (44 pts).  
SHOW ALL YOUR WORK.

(16 pts) 1. Find  $dy/dx$  for each of the following:

(a)  $y = (x^2 + 3x + 5)^7 \sin 2x$       (b)  $x \cos y = y - x^2$

(c)  $y = \frac{x^2 - 8e^x}{\sqrt{x}}$       (d)  $y = (\tan x)^x$

(16 pts) 2. Find each of the following:

(a)  $\int (x^2 + 2x + 4)\sqrt{x} dx$

(b)  $\int \sec^2 2x \tan 2x dx$

(c)  $\int_1^2 (x - 3)(x^2 - 6x + 5)^3 dx$

(d)  $\int_1^e \frac{\ln x}{x} dx$

(12 pts) 3. Let  $f(x) = 3x^4 + 4x^3$ .

- (a) Find the intervals of increase or decrease.
- (b) Find the local maximum and local minimum values, if they exist.
- (c) Find the intervals of concavity, and the inflection points, if they exist.
- (d) Carefully sketch the graph of the function  $f$  and indicate the points identified in parts (b) and (c) on the graph.

**Please turn over!**

**PART II: ANSWER FOUR OF THE FIVE QUESTIONS  
(56 pts). SHOW ALL YOUR WORK.**

(14pts) 4. (a) Use the *definition* of the derivative to find  $f'(x)$  for  
 $f(x) = 3\sqrt{3x}$ .

(b) Find the area under the curve  $y = 2 \sin x + \sin 2x$   
(above the x-axis) between  $x = 0$  and  $x = \pi$ .

(14pts) 5. (a) An open box is to be made from a 10 *in* by 16 *in* piece of  
styrofoam by cutting out squares of equal size from the  
four corners and bending up the sides. What size should  
the squares be to obtain a box with largest possible  
volume?

(b) Evaluate:

$$\lim_{x \rightarrow \infty} \sqrt{\frac{2 - 5x + 12x^3}{3x^3 + 4x^2 + 1}}$$

(14pts) 6. (a) A rocket is fired straight up from a tower 110 *ft* above the  
ground with an initial velocity of 224 *ft/s*. (Assume the  
acceleration due to gravity is  $-32 \text{ ft/s}^2$ ).

When does the rocket reach its maximum height? and  
at this time, how far is the rocket above the ground?

(b) Evaluate:

$$\lim_{x \rightarrow 2} \frac{\sqrt{x} - \sqrt{2}}{x^2 - x - 2}$$

**Please turn over!**

(14pts) 7. (a) Water flows into an inverted conical tank, which is 10 ft deep with base diameter 10 ft, at a rate of  $2 \text{ ft}^3$  per minute. How fast is the water level rising when the water is 6 ft deep? (Volume of a cone:  $V = \frac{1}{3}\pi r^2 h$ )

(b) Find an equation of the tangent line to the graph  $y = x \ln x$  at the point  $(1, 0)$ .

(14pts) 8. (a) Find the absolute maximum and absolute minimum of  $f(x) = 5x^{2/3} - 2x^{5/3}$  on the interval  $[-1, 2]$ .

(b) Evaluate:

$$\lim_{x \rightarrow 0} \frac{\tan 7x}{\sin 3x}$$

Carefully show your work – the correct answer by itself will earn no credit.

**Kindly indicate on the cover of your examination booklet the number of the problem in Part II that you omitted.**

**End of Examination**