

**QUEENS COLLEGE
DEPARTMENT OF MATHEMATICS
Final Examination**

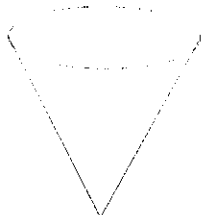
$2\frac{1}{2}$ Hours

Mathematics 142

Spring 2008

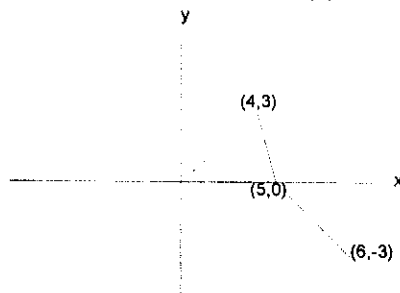
Instructions: Answer all questions. Show all work. No calculator that does indefinite integrals may be used on this exam. In particular, no TI calculator above the 86 may be used for this exam.

- 1) Water is flowing into a conical tank (shown below) at the rate of 25π cubic feet per minute.



The tank has a base radius of 30 feet and a height of 60 feet. Find the rate at which the water level is rising when the water level is 20 feet deep. (The volume of a cone is $V = \frac{1}{3}\pi r^2 h$.)

- 2) Let $g(x) = \int_1^x f(t) dt$, where the graph of $f(t)$ is given below.



- a) Compute $g(1)$.
 - b) Compute $g(5)$.
 - c) Compute $g(6)$.
 - d) Where does the maximum of $g(x)$ occur?
- 3) Let R be the region bounded by the curves $f(x) = e^{\sqrt{x}}$ and $g(x) = e^2$ and the y -axis.
- a) Set up the integral(s) needed to find the area between the curves and use your calculator to find the area to 3 decimal places.
 - b) Set up, but do not evaluate, the integral(s) needed to find the volume of the region formed by rotating R around the line $y=12$.
 - c) Set up, but do not evaluate, the integral(s) needed to find the volume of the region formed by rotating R around the line $x=12$.
 - d) Find the length of $f(x)$ from $(1, e)$ to the point of intersection of the two curves, accurate to 3 decimal places.
- 4) Find $\frac{dy}{dx}$ for each of the following:
- a) $y = x \sin^{-1}(2^x)$
 - b) $y = \frac{e^{x^2}}{x}$
 - c) $y = \ln(4x + \tan^{-1} 2x)$
 - d) $y = x^{\sec x}$

(continued on other side)

5) Integrate each of the following:

a) $\int \frac{x+1}{x} dx$

b) $\int \frac{x^2 dx}{\sqrt{4x^3+1}}$

c) $\int \frac{e^{2x}}{\sqrt{1-e^{4x}}} dx$

d) $\int \frac{x dx}{9+x^4}$

e) $\int (e^{5x} + x^{-2} \csc^2(\frac{\pi}{x})) dx$

6) A cup of coffee at a temperature of 150 degrees Fahrenheit is brought into a room where the temperature is 70 degrees. If the temperature of the coffee after 2 minutes is 130°, after how many minutes will the temperature of the coffee be 100° ? Use Newton's Law of Cooling to do this.

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