

Instructions: Write your name and I.D. number above. Show all work on these pages, and make sure that your final answer is clearly shown. No **books**, **calculators**, or **tables** are allowed. Check that this exam contains pages 1–6. Good luck, and have a nice holiday!

Circle the name of your instructor:

<u>Instructor</u>	<u>Section</u>	<u>Time</u>
Bendel	23	8:00
DiBenedetto	31	9:00
DiBenedetto	41	10:00
Chopp	57	11:00
Welland	61	12:00
Chopp	77	1:00

Some Useful Formulas

Area of a circle	$A = \pi r^2$	Surface Area of a sphere	$A = 4\pi r^2$
Circum. of a circle	$C = 2\pi r$	Volume of a cone	$V = \frac{1}{3} \pi r^2 h$
Area of a trapezoid	$A = \frac{1}{2} h(b_1 + b_2)$	Volume of a cylinder	$V = \pi r^2 h$
Volume of a sphere	$V = \frac{4}{3} \pi r^3$	Lateral surface area of a cylinder	$A = 2\pi r h$

Prob.	Possible points	Score
1	25	
2	25	
3	20	
4	20	
5	20	
6	20	
7	20	
8	15	
9	15	
10	20	
TOTAL	200	

1. Compute the following derivatives.

(a) $\frac{d}{dx}(3x^7 - x + 1)$ (5 pts.)

(b) $\frac{d}{dx}(x^3 - 1) \cos(3x + 1)$ (5 pts.)

(c) $\frac{d}{dx} \frac{x^2 - 1}{\sqrt{2x^2 + 1}}$ (5 pts.)

(d) $\frac{d}{dx} \sqrt[5]{x + \sqrt{x}}$ (5 pts.)

(e) $\frac{d}{dx} \int_0^{\sin(x)} t(t^2 + 1) dt$ (5 pts.)

2. Compute the following integrals:

(a) $\int_0^1 7x^{\frac{1}{2}} + 2x - 1 dx$ (5 pts.)

(b) $\int_2^4 \frac{x^3 + 2x - 1}{\sqrt{x}} dx$ (5 pts.)

(c) $\int \frac{2x + 2}{(x^2 + 2x + 1)^2} dx$ (5 pts.)

(d) $\int_{\pi/4}^{\pi} \sin(x) \cos^2(x) dx$ (5 pts.)

(e) $\int x^2 \sqrt{1+x} dx$ (5 pts.)

3. Use implicit differentiation to find the tangent and normal lines to the graph of $y^3 - x^3 + 2xy = 2$ that pass through the point $(1, 2)$. (20 pts.)
4. The function $f(x) = x^3 + 4x - 1$ has a root in the interval $[0, 1]$ — why? Use $x = 1/2$ as a first estimate for this root and then use Newton's method to determine a next estimate. (20 pts.)

5. The height of a cone is decreasing at the rate of 5 cm/sec while its radius is increasing at 2 cm/sec. When the radius is 4 cm and the height is 5 cm, at what rate is the volume changing; is it increasing or decreasing? (20 pts.)

6. A right triangle with hypotenuse $\sqrt{3}$ is revolved about one of its sides to generate a cone. Find the maximum volume of the cone; verify that it is a maximum. (20 pts.)

7. A ball is thrown straight upwards with a speed of 40ft/sec from the top of a building. The ball strikes the ground with a velocity of 280ft/sec. How tall is the building? (20 pts.)

8. You will learn in B-14-2 that the natural logarithm of 2, $\ln(2)$ satisfies:

$$\ln(2) = \int_1^2 \frac{1}{t} dt.$$

Use Riemann sums with 3 evenly spaced intervals to approximate this integral; use the left hand end points for the x^* 's. (15 pts.)

9. Choose an appropriate function and use linear approximation at an appropriate value to estimate $\sqrt{17}$. (15pts.)

10. Sketch the graphs of $f(x) = -x + 1$ and $g(x) = x^2 - x$ and find the area of the region above the graph of $g(x)$ and below that of $f(x)$. (20 pts.)