Name:_____

Student ID(see bubble sheet):_____

Section:_____

Instructor:_____

Math 113 (Calculus II)
Exam 2 Part B

Mar. 5,6. Mar. 7 Late Day

TWO PART

Instructions:

- For questions which require a written answer, show all your work. Full credit will be given only if the necessary work is shown justifying your answer.
- Simplify your answers.
- Calculators are not allowed.
- Should you have need for more space than is allocated to answer a question, use the back of the page the problem is on and indicate this fact.
- Please do not talk about the test with other students until after the last day to take the exam.

#	Possible	Earned
MC	**36**	
10	**12**	
11	**12**	
12	**16**	
13	**6**	
14	**6**	
15	**6**	
16	**6**	
Total	**100**	

Part B: Short Answer. *Evaluate or give the best response in the blank provided. Work will not be graded in this section. Only the answer will be graded. Questions are worth 2 points each.*

10. (12 points)

a) $\int \frac{1}{x\sqrt{\ln x}} dx =$

b) $\int_0^2 \ln(x) dx =$

c) Set up the integral (**but do not evaluate it**) that gives the arc length of the curve $xy = 2$ from $(1, 2)$ to $(2, 1)$

d) Three functions f, g, and h are defined to have the value zero outside $[0, 1]$. Circle each function that gives a probability density function, and cross out each function that does not.

$f(x) = x$ on $[0, 1]$; $g(x) = 2x$ on $[0, 1]$; and $h(x) = 3x - 1$ on $[0, 1]$.

e) The function $f(x) = xe^{-x}$, for $x \geq 0$, and $f(x) = 0$ for $x < 0$ is a probability density function. Find $P(2 \leq X \leq 3)$.

f) Set up the integral (**but do not evaluate it**) for the surface area of the surface obtained by rotating the curve $y = 1 + 2x^2, 1 \leq x \leq 4$ about the x-axis.

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Part C: Show all work in the space provided.

11. (12 points)

a. (2 points) Let C be the curve $y = 1/x$ for $1 \leq x \leq 5$. Set up an integral (**but do not evaluate it**) that expresses the arc length of C.

b. (3 points) Let S be the surface obtained by rotating C about the x-axis. Set up an integral that expresses the surface area of S.

c. (2 points) A surface G (called **Gabriel's horn**) is obtained by rotating the curve $y = 1/x$ for $1 \leq x \leq \infty$ about the x-axis. Write an improper integral that expresses the surface area of G.

d. (3 points) Use the Comparison Theorem to show that your answer to part c is divergent.

e. (2 points) An improper integral is defined as a limit (in this case, a limit that diverges). Write the answer to part c as a limit.

12. (16 points)

A car applies its the brakes at time $t = 0$ and at half-second intervals its velocity $v(t)$ is measured in meters per second. The results are given in the table below.

time (s)	speed (m/s)
0.0	10
0.5	9
1.0	5
1.5	1
2.0	0

a. (2 points) Use the trapezoid rule with $n = 4$ to estimate the total braking distance.

b. (4 points) The derivative of acceleration $v''(t)$ is sometimes called the *jerk*. Assuming that $|v''(t)|$ during braking never exceeded 20 m/s^3, and using the trapezoid rule error bound

$$|E_T| \leq \frac{K(b-a)^3}{12n^2} \quad \text{for} \quad \left|v''(x)\right| \leq K,$$

give a maximum possible error for your estimate in part a.

c. (2 points) Use the midpoint rule **with $n = 2$** to estimate the total braking distance.

d. (4 points) Under the same assumptions as part b and using the midpoint rule error bound

$$|E_M| \leq \frac{K(b-a)^3}{24n^2} \quad \text{for} \quad \left|v''(x)\right| \leq K,$$

give a maximum possible error for your estimate in part c.

(cont.)

e. (4 points) Use Simpson's Rule with $n = 4$ to estimate the total braking distance.

13. (6 points) The curve $y = \sqrt{9 - x^2}, -2 \leq x \leq 2$, is an arc of the circle $x^2 + y^2 = 9$. Find the area of the surface obtained by rotating this arc about the x-axis.

14. (6 points) A cubical tank of height 5 meters is filled with a fluid of density 2000 kg/m^3. Calculate the hydrostatic force on one vertical square face of the tank. (Acceleration due to gravity is 9.8 m/s^2.)

15. (6 points) (a) Find the centroid of a system with three particles: a particle of mass 1 at point $(0, 0)$, a particle of mass 2 at point $(2, 0)$, and a particle of mass 6 at point $(0, 3)$.

(b) Find the centroid of the region bounded by the curves $y = x^2$ and $y = 4x$.

16. (6 points) Find $\displaystyle\int_0^\infty \frac{x^2}{9+x^6}dx$. (You may want to use the substitution $u = x^3$ and write the improper integral as a limit.)

END OF PART B