

**Do NOT turn over this page until instructed to begin.**

**Name:**

**Section:**

**Binghamton ID Number:**

### Instructions

Write clear, careful, neat solutions to the questions in the space provided.

No books, no notes, no electronic devices (calculators, cell phones, smart watches, etc.) allowed!

Write all your work on the test—nothing else will be graded. **You must show all your work and justify your answers.** Your work must be legible, and the final answers must be reasonably simplified.

On some problems you may be asked to use a specific method to solve the problem (for instance, “Use the Fundamental Theorem of Calculus to find...”). On all other problems, you may use any method we have covered. You may not use methods that we have not covered.

### Wandering Eyes Policy

You must keep your eyes on your own work at all times. If you are found looking around, you will be warned once, and only once. A second infraction may result in automatic zero on this test, and possibly a referral to the Harpur College Academic Honesty Committee.

### Duration of the Test

This is a timed test designed for one class period. You will start the test when your proctor tells you to start, and you will finish the test when your proctor tells you to stop, when the class period is over.

1	2	3	4	5	6	7	8	9	Total
15 pts	15 pts	8 pts	5 pts	5 pts	10 pts	15 pts	12 pts	15 pts	100 pts

1. (15 points) Find the most general antiderivatives.

(a)  $\int (3x - 5)(x^2 + 1) dx$

(b)  $\int \frac{\sec^2(x)}{\sqrt{5 \tan(x) + 3}} dx$

(c)  $\int x^3 \sqrt{x^2 + 9} dx$

2. (15 points) Evaluate and simplify.

(a)  $\int_0^2 x^2 - 2\sqrt{x} \, dx$

(b)  $\int_0^{\pi/2} \sin(x) \cos(x) \, dx$

(c)  $\int_0^{\sqrt{4\pi}} x \sin(x^2) \, dx$

3. (8 points) For each function  $g(x)$  given below, compute the derivative  $g'(x)$ .

(a)  $g(x) = \int_{x^2+1}^{10} \frac{\sin(t^2)}{t-1} dt$

$g'(x) = \dots$

(b)  $g(x) = x + \int_2^{10} t^2 + 3t dt$

$g'(x) = \dots$

4. (5 points) Express the following limit as an integral:

$$\lim_{n \rightarrow \infty} \sum_{i=1}^n \left[ \sqrt{\left(1 + \frac{8i}{n}\right)^2 + 3 \left(1 + \frac{8i}{n}\right)} \right] \left(\frac{8}{n}\right)$$

5. (5 points) An oil tanker has developed a leak. Oil is leaking from the tanker at a rate of  $r(t) = 800 - 6t^2$  liters per minute. How much oil has leaked out of the tanker after 10 minutes?

6. (10 points) A particle is moving along the  $x$ -axis, with its initial position at the origin and initial velocity  $-12$  meters per second. It is known that the acceleration of the particle, at all times  $t$  after the initial time, is  $a(t) = 6t - 9$ .

(a) Find the position  $s(t)$  of the particle at arbitrary time  $t$ .

(b) Are there any times at which the particle is not moving? If so, find them. If not, explain briefly.

7. (15 points) A box with square base and open top is to be constructed. Material for the sides costs 2 dollars per square foot and material for the reinforced bottom costs 5 dollars per square foot. What are the dimensions of the largest volume box you can build for 375 dollars? [Be sure to draw a picture, define your symbols, and show your work.]

8. (12 points) Let  $f(x)$  be a function such that  $\int_2^8 g(x) dx = 5$  and  $\int_2^4 g(x) dx = -6$ .

Below is a list of integrals. For each part:

- If you have enough information to evaluate the integral, then do so, showing your work.
- If you don't have enough information to evaluate the integral, write "can't be done". You do not need to explain why it can't be done

(a)  $\int_8^4 g(x) dx$

(b)  $\int_1^2 g(2x) dx$

(c)  $\int_2^8 3g(x) + 4 dx$

(d)  $\int_2^8 (g(x))^2 dx$



9. (15 points) All three parts of the problem concern the integral

$$\int_2^3 \sqrt{x-1} \, dx.$$

(a) Draw the graph of  $f(x) = \sqrt{x-1}$  along with the rectangles required to compute the Riemann sum  $R_4$  using right-hand points.

(b) Write down the Riemann sum  $R_4$  explicitly as a sum of real numbers. **Do not simplify.**

(c) Is the Riemann sum  $R_4$  *greater than*, *less than*, or *equal to* the definite integral? Explain briefly.