

On the front of your bluebook print (1) your name, (2) your student ID number and (3) a grading table. Show all your work in your bluebook and box in your final answers where appropriate. A correct answer with no supporting work may receive no credit, while an incorrect answer with some correct work may receive partial credit. Textbooks, class notes, calculators and crib sheets are not permitted. Please start each of the five problems on a new page.

1. (30 points) Calculate the following integrals.

(a)  $\int \cos(3x) dx$

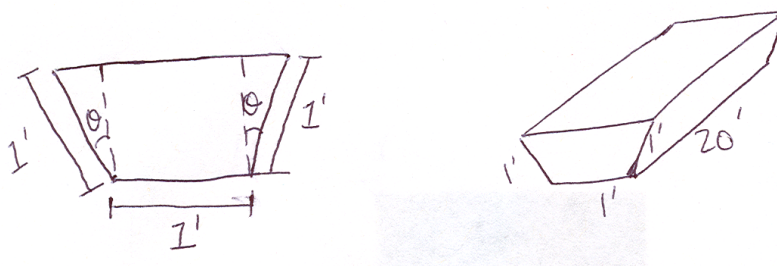
(d)  $\int_9^4 \frac{1 - \sqrt{u}}{\sqrt{u}} du$

(b)  $\int \left( \sqrt[5]{x^2} - \frac{1}{x^2} + 2 \right) dx$

(e)  $\int_x^{x^2} 2t dt$

(c)  $\int (1 + \sin^2 x) dx$

2. (15 points) About how accurately should you measure the radius of a circle to be sure of calculating the area to within 1%?
3. (20 points) The trough here is to be made to the dimensions shown. Only the angle  $\theta$  can be varied. What value of  $\theta$  will maximize the trough's volume? How do you know this value of  $\theta$  gives the largest (and not the smallest) possible volume?



4. (25 points) Consider the integral  $\int_1^2 \frac{1}{x} dx$ .
- (a) Estimate the value of the integral by computing the Riemann sum with four equally spaced subintervals. Use the left hand endpoint of each subinterval to compute the height of the corresponding rectangle.
- (b) Use the Trapezoidal rule with four equally spaced subintervals to estimate the value of the integral.
- (c) If the error for the Trapezoidal rule is given by

$$|E_T| \leq \frac{b-a}{12} h^2 M$$

where  $M$  is any upper bound for  $|f''|$  on  $[a, b]$ , find the number of subintervals needed to estimate  $\int_1^2 \frac{1}{x} dx$  to within  $10^{-4}$ .

5. (10 points) State the Fundamental Theorem of Calculus, Parts I and II.