

Calculators, mobile phones, pagers and all other mobile communication equipment are not allowed.

Answer the following questions. Each question weighs 4 points.

1. Evaluate the following limit, if exists:  $\lim_{x \rightarrow 2} \frac{x^2 - 4x + 4}{x^2 + x - 6}$

2. Let

$$f(x) = \begin{cases} \frac{x^3 - 1}{\sqrt{x} - 1} & \text{if, } x > 1, \\ A + \cos(x - 1) & \text{if, } x \leq 1. \end{cases}$$

Find the value of the constant  $A$ , so that  $f$  is continuous at  $x = 1$ .

3. If  $f(x) = \sqrt[3]{3x - \sin^2(4x)}$ , find  $f'(x)$ .

4. The area of a circular region increases at a rate of  $6 \text{ cm}^2/\text{sec}$ . Find the rate at which its radius changes, when its area is  $9 \text{ cm}^2$ .

5. Evaluate:

(a)  $\int (17 + \sin 4x)^{12} \cos 4x \, dx.$

(b)  $\int_0^1 (x + 2\sqrt{1-x^2}) \, dx.$

6. Find the average value,  $f_{av}$ , of  $f(x) = 2x + 6x|x|$  on the interval  $[0, 2]$ .

7. Show that  $f(x) = 2x + \int_0^x \sqrt{t^2 + 1} \, dt + \int_0^1 \sqrt{s^2 + 1} \, ds$  is an increasing function on  $\mathbb{R}$

8. Find the arc length of the graph of the equation  $y = \frac{1}{8}x^4 + \frac{1}{4x^2}$  from  $x = 1$  to  $x = 4$ .

9. Find the area of the region bounded by the  $y$ -axis, the curve  $y = \sqrt{x}$ , and the tangent line to the curve at the point  $P(4, 2)$ .

10. The region bounded by the graphs of the equations  $y = \sqrt{x+2}$ ,  $x = 0$ ,  $y = 0$  and  $y = 1$  is revolved about the  $x$ -axis. Set up an integral that can be used to find the volume of the resulting solid.