

Name \_\_\_\_\_ Rec. Instr. \_\_\_\_\_  
 Signature \_\_\_\_\_ Rec. Time \_\_\_\_\_

Math 220  
 Exam 2  
 October 12, 2023

No books, calculators, or notes are allowed. Please make sure that your cell phone is turned off. You will have 75 minutes to complete the exam. Unless instructed otherwise, show your work on each problem.

Problem	Points	Points Possible	Problem	Points	Points Possible
1		20	6		6
2		10	7		7
3		10	8		8
4		10	9		9
5		10	10		10
			<b>Total Score</b>		100

1. (5 points each) Find the following derivatives. You **do not need to simplify** your answers or show your work. However, showing your work may help you earn partial credit if your answer is incorrect.

A.  $\frac{d}{dx} (\ln(x) \cdot \arctan(x^5))$

B.  $\frac{d}{dx} \left( \frac{2^x}{e^x + 1} \right)$

C.  $\frac{d^2}{d\theta^2} \tan(\theta)$

D.  $\frac{d}{d\theta} \cos(\sin(2\theta^3))$

**2. A.** (7 points) Find the linearization of  $g(x) = \ln(x)$  at  $x = 1$ .

**B.** (3 points) Use your answer from Part **A** to estimate  $\ln(1.07)$ .

**3.** (10 points) Find the absolute maximum and absolute minimum of  $w(x) = 2x^3 + 3x^2 - 12x + 1$  on  $[0, 2]$ .

**4.** (10 points) Find the derivative of  $h(x) = x^{7x^2}$ .

**5.** (10 points) If  $\sin(xy^2) = x^2$ , compute  $\frac{dy}{dx}$  in terms of  $x$  and  $y$ .

6. (6 points) The surface area of a sphere is  $A = 4\pi r^2$ , where  $r$  denotes the radius of the sphere. Find a formula for the differential  $dA$  in terms of  $r$  and  $dr$ .
7. (7 points) Suppose that the position of an object is given by  $s(t) = e^{t^3-t}$  meters at time  $t$  seconds. Find the instantaneous velocity of the object at time  $t = 1$  second. (Include units with your answer.)
8. (8 points) Let  $p(t)$  denote the position of a particle in cm after  $t$  seconds. Suppose that we are unable to write down a nice formula for  $p(t)$ , but we happen to know that when  $t = 5$  seconds, the particle has position 3 cm and velocity  $-2$  cm/s. Find the linearization of  $p(t)$  at  $t = 5$  seconds, and use it to approximate the location of the particle when  $t = 5.2$  seconds. (Include units with your answer.)

**9.** (9 points) The volume of a sphere is  $V = \frac{4\pi r^3}{3}$ , where  $r$  denotes the radius of the sphere. If the radius of a sphere is increasing at a constant rate of  $\frac{1}{2}$  m/s, find the rate at which the volume is increasing when the radius is 2 m. (Include units with your answer.)

**10.** (10 points) The base of a triangle is increasing at a rate of 5 ft/s, and the height of the triangle is increasing at a rate of 2 ft/s. Find the rate at which the area of the triangle is changing when the base is 3 ft and the height is 4 ft. (Include units with your answer.)