

**Directions:** Answer the following questions in the space provided. You may not use a calculator. If you do not show your work, you will receive no credit. The point value of each question is indicated. **WRITE YOUR FINAL ANSWER ON THE ANSWER LINE WHEN APPROPRIATE. IF YOU DO NOT FOLLOW DIRECTIONS YOU WILL BE PENALIZED!**

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1. Compute the derivatives of the following:

(a) (7 points)  $f(x) = 10x^3 - \sqrt{5}x^2 + 7x - \frac{1}{x} + \pi^2$

(a) \_\_\_\_\_

(b) (7 points)  $g(x) = x^2 \sin x$

(b) \_\_\_\_\_

(c) (7 points)  $h(x) = \frac{x^2 - 2}{\sqrt{2x + 1}}$

(c) \_\_\_\_\_

(d) (7 points)  $F(x) = e^{3x^2 - 7x + 1}$

(d) \_\_\_\_\_

(e) (7 points)  $G(x) = \ln(\cos x)$

(e) \_\_\_\_\_

Points earned: \_\_\_\_\_ out of a possible 35 points

2. Let  $F(x) = f(x)g(x)$ ,  $G(x) = \frac{f(x)}{g(x)}$  and  $H(x) = f(g(x))$ . If  $f(1) = 5$ ,  $f'(1) = 3$ ,  $f'(2) = -4$ ,  $g(1) = 2$ ,  $g'(1) = -1$  and  $g'(5) = 7$ , compute the following:

(a) (5 points)  $F'(1)$

(a) \_\_\_\_\_

(b) (5 points)  $G'(1)$

(b) \_\_\_\_\_

(c) (5 points)  $H'(1)$

(c) \_\_\_\_\_

Points earned: \_\_\_\_\_ out of a possible 15 points

3. (10 points) At what point(s) on the curve

$$y = \frac{x}{x^2 + 9}$$

is the tangent line horizontal?

3. \_\_\_\_\_

Points earned: \_\_\_\_\_ out of a possible 10 points

4. (15 points) Find the equation of the line tangent to

$$(x^2 + y^2)^2 = 4x^2y$$

at the point  $(1, 1)$ . (*HINT*: Use implicit differentiation.)

4. \_\_\_\_\_

Points earned: \_\_\_\_\_ out of a possible 15 points

5. A particle moves so that its position (in meters) is given by

$$f(t) = \sin^2 t$$

where  $t$  is measured in seconds. Find equations that give

(a) (5 points) the velocity and

(a) \_\_\_\_\_

(b) (5 points) acceleration

(b) \_\_\_\_\_

of the particle at time  $t$ .

Points earned: \_\_\_\_\_ out of a possible 10 points

6. (15 points) Oil spilled from a ruptured tanker spreads out in a circle whose area increases at a constant rate of 6 square miles per hour. How fast is the radius of the spill increasing when the area is 9 square miles?

6. \_\_\_\_\_

Points earned: \_\_\_\_\_ out of a possible 15 points