

Answer the problems on **separate** paper. You do not need to rewrite the problem statements on your answer sheets. Do your own work. Show **all relevant steps** which lead to your solutions. Attach this question sheet to the front of your answer sheets.

1. (6pts) Using the definition, find the derivative of $f(x) = 2x^2 - 5x$.
2. (40pts) Using the rules of differentiation, find the derivative of each of the following functions. Simplify the results, where appropriate. Write the final form of each of the derivatives using positive exponents only.
 - a. $a(x) = -8x^3 + 4x^{7/4} - \frac{3}{x^5}$
 - b. $b(x) = \frac{2x-3}{x^2+4x}$
 - c. $c(x) = -3xe^{-3x} - e^{-3x} + 3$
 - d. $d(x) = \sin^{-1} x^2 - \sin x^2$
 - e. $e(x) = \ln \sqrt{x^2 - x}$
3. (8pts) Let $f(x) = x^2 \sin 3x$. Find (and simplify) $f''(x)$.
4. (8pts) Let $f(x) = 2x - \sqrt{x+1}$. Find the equation of the tangent line to the graph of $y = f(x)$ at $x = 3$.
5. (8pts) Let $s(t) = 2t^2 - 10t + 3$, $1 \leq t \leq 5$, describe the position of a moving body. Find:
 - a. where the object is advancing
 - b. where the object is retreating
 - c. the total distance the body travels.
6. (8pts) A person standing at the top of a tower throws a rock straight up. It is observed that 3 seconds after the person releases the rock that it reaches its maximum height and 9 seconds later it strikes the ground at the base of the tower. Find:
 - a. What was the initial velocity of the rock?
 - b. What was the initial height of the rock when it was released from the person's hand?
 - c. What was the maximum height which the rock reached during its flight?
 - d. What was the velocity of the rock when it struck the ground?
7. (8pts) Find y' for the following implicitly defined function:
 - a. $x^3 - 3xy - y^3 = 11$

8. (8pts) Find the equation of the tangent line to the curve defined by $x^2 + 3y^2 = 5x - 3$ at the point (2,1).
9. (8pts) A truck leaves Chicago at 8:00 am and heads due east, traveling at 60 mph. A car leaves Chicago at 9:00 am and heads due north, traveling at 75 mph. At 1:00 pm they are both the same distance from Chicago. At 1:00 pm, how fast is the distance between the two vehicles increasing?