Name:

1. **(50 points)** Find $\frac{dy}{dx}$. You do not need to simplify your answers.

   a. $y = x\cos(x)$

   b. $y = \tan(x^2 + 1)$

   c. $y = \frac{\sqrt{x}}{x^3+1}$

   d. $y = \ln(5x - 15)$

   e. $y = 3^x$

f. $y = x^{10} - 9x^3 + 15x - 3$

g. $y = \sin^3(x^2)$

h. $y = (\sin x)^x$.

i. $y = \sqrt{\dfrac{(x^2+1)^5 e^x x^9}{x^2+2}}$

j. $\sin(xy) = 5x$

2. (**10 points**) Find the equation of the tangent line to the curve

$$2x - xy^2 = -6$$

at the point $(3, 2)$.

3. (**10 points**) Find the linear approximation to the function $f(x) = x^{3/4}$ at x=16. Then use this linear approximation to estimate $15^{3/4}$.

4. (**5 points**) Evaluate this limit by *first expressing it as a derivative*:

$$\lim_{h \to 0} \frac{\sqrt[4]{16 + h} - 2}{h}.$$

5. (**10 points**) Let $r(x) = f(g(h(x)))$, where $h(1) = 2$, $h'(2) = -1$, $g(2) = 3$, $h'(1) = 4$, $g'(2) = 5$, and $f'(3) = 6$. Find $r'(1)$.

6. (**15 points**) The angle of elevation of the sun is decreasing at a rate of 0.25 radians/hour. How fast is the length of the shadow cast by a 4 foot tall pole increasing when the angle of elevation of the sun is $\pi/6$? (FYI: $\cos(\pi/6) = \sqrt{3}/2$, $\sin(\pi/6) = 1/2$.)