Name: Key _____ / 25

Please circle your section: 901 (Gossell) 902 (Gossell) 903 (Graves-McCleary)

No aids (book, calculator, etc.) are permitted. **Show all work for full credit.**

1. **[12 points]** Find $\frac{dy}{dx}$ for each expression. You do not have to simplify.

   a. $y = \sec(2x) + \tan(x^2)$

   $\frac{dy}{dx} = \sec(2x)\tan(2x)\cdot 2 + \sec^2(x^2)\cdot 2x$

   b. $y = (\cos(4-3x))^8$

   $\frac{dy}{dx} = 8(\cos(4-3x))^7 \cdot (-\sin(4-3x))(-3)$

   c. $y = \csc(x)\cot(x)$

   $\frac{dy}{dx} = (-\csc(x)\cot(x))(\cot(x)) + (\csc(x))(-\csc^2(x))$

   d. $y = \frac{12\sin(x)}{\sqrt{x^3-4x^2}} = 12\sin(x)(x^3-4x^2)^{-\frac{1}{2}}$

   $\frac{dy}{dx} = 12\cos(x)(x^3-4x^2)^{-\frac{1}{2}} + 12\sin(x)\left(-\frac{1}{2}(x^3-4x^2)^{-\frac{3}{2}}(3x^2-8x)\right)$

2. [5 points] Suppose the function $h(x)$ is defined in terms of two other functions, $f(x)$ and $g(x)$, as follows:

$$h(x) = (f(x))^3 - g\left(x^2\right).$$

Find h′(1), given that $f(1) = 2$, $f'(1) = 3$, $g(1) = 4$, and $g'(1) = 5$.

$h'(x) = 3(f(x))^2 \cdot f'(x) - g'(x^2) \cdot 2x$

$h'(1) = 3(2)^2 \cdot (3) - 5 \cdot 2(1) = 36 - 10 = \boxed{26}$

3. [8 points] Given the function $r(x) = (x^2 - 10x + 9)^5$.

a. Find $r'(x)$ using the chain rule.

$r'(x) = \boxed{5(x^2 - 10x + 9)^4 (2x - 10)}$

b. Find all x-values when the tangent line to $r(x)$ is **horizontal**.

$0 = 5(x^2 - 10x + 9)^4 (2x - 10) \Rightarrow x^2 - 10x + 9 = 0$ or $2x - 10 = 0$

$(x - 1)(x - 9) = 0$ $\quad x = 5$

$x = 1$ $\quad x = 9$