Name: _____

Directions: Closed book, closed notes, no calculators.   Put all phones, etc., away.   You will need only a pencil or pen.

1. (15 points) Answer the questions about the functions graphed below.
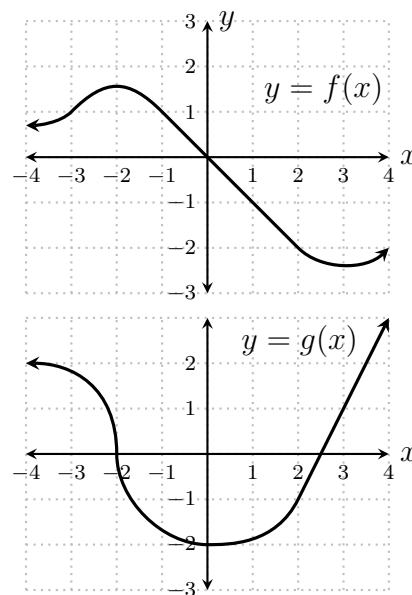
   (a) $f'(-2) =$

   (b) $f'(0) =$

   (c) $\lim\limits_{x \to -2} g'(x) =$

   (d) If $h(x) = f(x)g(x)$, then $h'(0) =$

   (e) If $h(x) = f\big(g(x)\big)$, then $h'(3) =$

2. (8 points) Find the derivatives of the following functions.

   (a) $f(x) = x^4 - 3x + \pi^2$

   (b) $f(x) = \sin^{-1}(x)$

   (c) $f(x) = e^{-x}$

   (d) $f(x) = \sin(\pi x)$

3. (10 points) Find the equation of the tangent line to the graph of $y = \tan(x)$ at the point where $x = \pi/4$.

4. (30 points) Find the derivatives.

(a) $\dfrac{d}{dx}\left[\sqrt{x^4 + x^2 + 1}\right] =$

(b) $\dfrac{d}{dx}\left[x^2 \cos\left(x^2\right)\right] =$

(c) $\dfrac{d}{dx}\left[\dfrac{e^x}{x}\right] =$

(d) $\dfrac{d}{dx}\left[\dfrac{1}{\sqrt{3x+1}}\right] =$

(e) $\dfrac{d}{dx}\left[\ln\left(\sec\left(e^x\right)\right)\right] =$

5. (7 points) $\lim\limits_{h \to 0} \dfrac{\ln(x+h) - \ln(x)}{h} =$

6. (10 points) Suppose $y = x\ln(x) - x$.

   (a) $\dfrac{dy}{dx} =$

   (b) $\dfrac{d^2y}{dx^2} =$

   (c) $\dfrac{d^3y}{dx^3} =$

7. (10 points) Find all x for which the tangent to $f(x) = \dfrac{x^2 - 6x + 10}{x - 3}$ at $\left(x, f(x)\right)$ has slope 0.

8. (10 points) A function $f(x)$ is graphed below. Sketch the graph of its derivative $f'(x)$.