MATH 1310 - 009 — Midterm 1   Name: _____

Date: 09/08/2017

Instructor: Ethan Levien

No phones, calculators, or notes! Remember to show all your work.
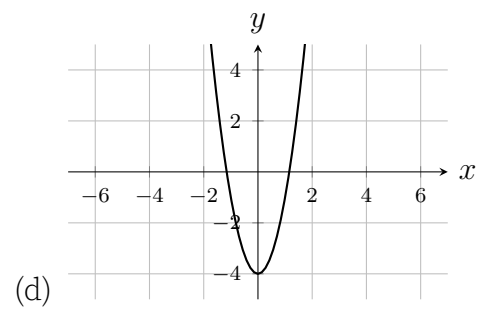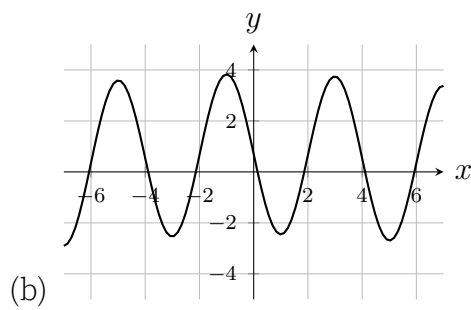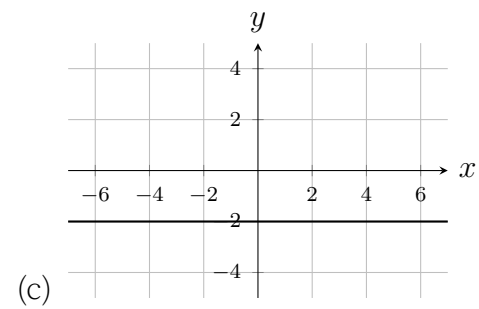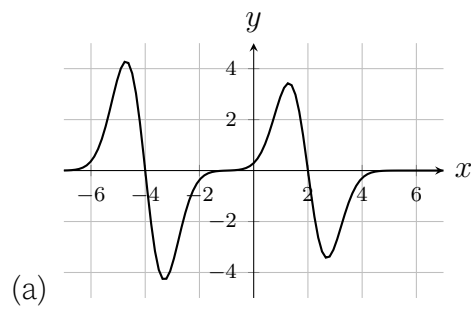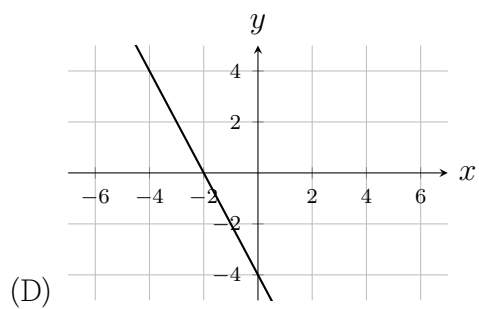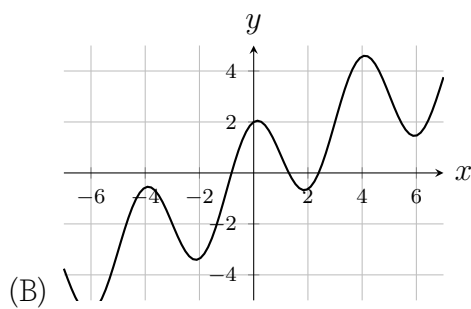
1. (20 points) Compute the derivative of $f(x) = 4x - x^2$ using the limit-based definition.

2. (20 points) Determine if the derivative of

$$f(x) = \begin{cases} 3x - 1, & x < 2 \\ x^2 - 1, & x \geq 3 \end{cases}$$

exists at $x = 3$.

3. (30 points) Match the graphs of the four functions ((A)–(D)) given with the graphs of their derivatives ((a)–(d)). Explain your answer. For example, identify some distinct feature(s) of the graphs.

(A)

(C)

(B)

(D)

(a)

(c)

(b)

(d)
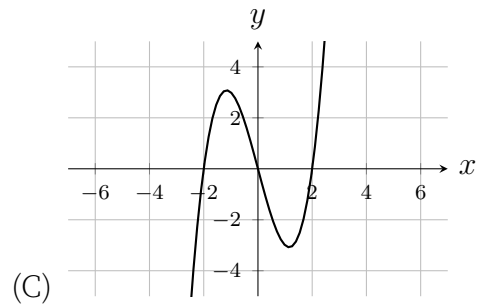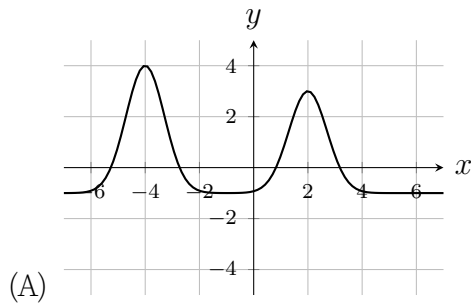
4. (30 points) Compute the following derivatives using the derivative rules

   (a) $\frac{d}{dx}\left(4x^4 - 2x^3 + 1\right)$

   (b) $\frac{d}{dx}\cos(\cos(x))$

   (c) $\frac{d}{dx}e^{\cos(x^2)}$

   (d) $\frac{d}{dx}\ln\left(\frac{1}{x}\right)$

   (e) $\frac{d}{dx}\cos\left(x^2 + \sin(x)\right)$

   (f) $\frac{d}{dx}\frac{1}{\cos(3x)}$

5. (20 points) Consider the curve defined by the equation $\sqrt{xy + 1} = x - 1$

   (a) Find an expression for $\frac{dy}{dx}$

   (b) Demonstrate that the point $(x, y) = (6, 4)$ lies on this curve.

   (c) Find the slope dy/dx of the tangent line to the curve at the point in (b).

6. (20 points) Use the linear approximation of $f(x) = \sqrt[3]{x}$ to estimate the value of $\sqrt[3]{8.001}$. Leave your answer as an expression involving sums and fractions of whole numbers. Hint: a easy-to-compute nearby point is $\sqrt[3]{8} = 2$. Show your work.

Problem	Points	Score
1	20	
2	20	
3	30	
4	30	
5	20	
6	20	
	Total:	