INSTRUCTIONS: This exam is a **closed book exam**. You may **not** use your text, homework, or other aids except for a 3×5-inch notecard. You may use an allowable calculator, **TI-83 or TI-84** to

- perform operations on real numbers,
- evaluate functions at specific values, and
- examine at graphs and/or tables.

A TI-89, TI-Nspire, or a calculator with a computer algebra system, any technology with wireless or Internet capability (i.e. laptops, tablets, smart phones or watches), a QWERTY keyboard, or a camera are **not allowed**. Unless otherwise stated, you must **show all of your work** including all steps needed to solve each problem and explain your reasoning in order to earn full credit. This means that **correct answers using incorrect reasoning may not receive any credit**.
Turn off all noise-making devices and all devices with an internet connection and put them away. Put away all headphones, earbuds, etc.

This exam consists of 7 problems on 8 pages. Make sure all problems and pages are present.

The exam is worth 70 points in total.

You have **60 minutes** to work starting from the signal to begin. Good luck!

Exam 1 Grade by Problem Number

No.	Out of	Pts.
1	10	
2	11	
3	15	
4	8	
5	10	
6	10	
7	6	
Total	70	

Current Course Grade by Category

Category	Out of	Current
Exam 1	100%	
Exam 2	100%	
WebAssign	100%	
Quiz/HW	100%	
Overall 10 Week Grade	100%	

1. (*2 points each*) Answer the following multiple choice questions by circling your answer. **No justification or explanation is required**.

   (i) A cylindrical container of fixed radius r is being filled with water. Which of the following equations expresses the relationship between the rate of change of the volume V of the water in the container (with respect to time) and the rate of change of the height h of the water in the container (with respect to time)?

   a. $\dfrac{dV}{dt} = \pi r^2 \cdot \dfrac{dh}{dt}$

   b. $V = \pi r^2 h$

   c. $\dfrac{dV}{dt} = 2\pi r h + \pi r^2 \cdot \dfrac{dh}{dt}$

   d. $V = 2\pi r h$

   e. $\dfrac{dh}{dt} = \pi r^2 h$

   (ii) Suppose $f'(c) = 0$ and $f''(x) < 0$ for all x around c. Which of the following is true?

   a. $f(c)$ is an inflection point.

   b. $f(c)$ is a local minimum.

   c. $f(c)$ is a local maximum.

   d. $f'(c)$ is positive.

   e. $f'(c)$ is negative.

   (iii) Suppose the function $g(t) = 6t^2 - 0.75^3$ represents the height of a golfball above the ground (in yards) t seconds since the ball was struck (only for values of t between 0 and 8). By solving which of the following equations can we determine the value of t for which the height of the ball above the ground is maximized?

   a. $g'(t) = 12t - 2.25t^2$

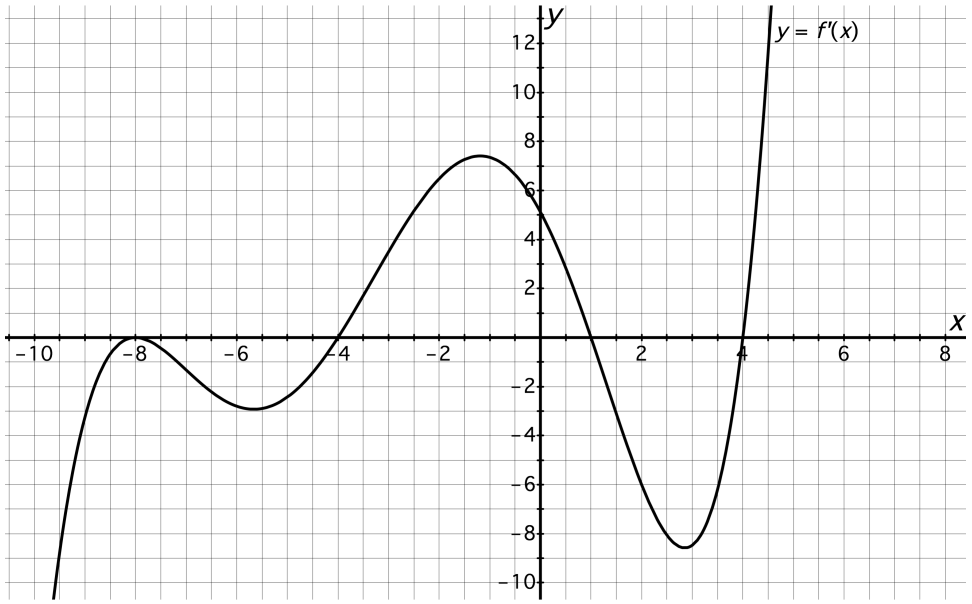
   b. $0 = 12t - 2.25t^2$

   c. $g(t) = 6t^2 - 0.75^3$

   d. $0 = 6t^2 - 0.75^3$

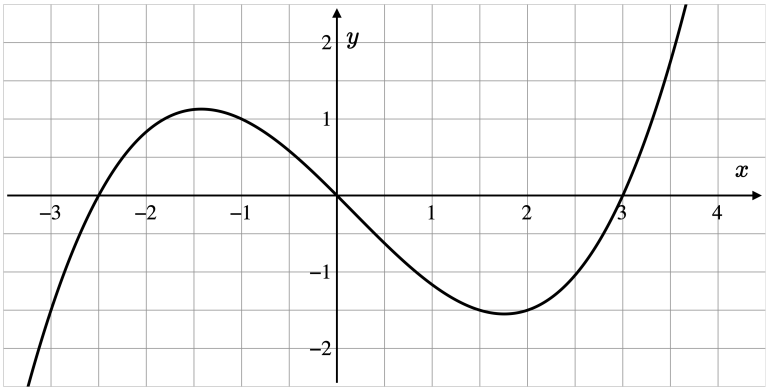
   e. $g''(t) = 12 - 4.5t$

(iv) Below is a graph of a derivative function $y = f'(x) = \dfrac{df}{dx}$. Based on this graph, for what value(s) of x does $f(x)$ have a local minimum value?



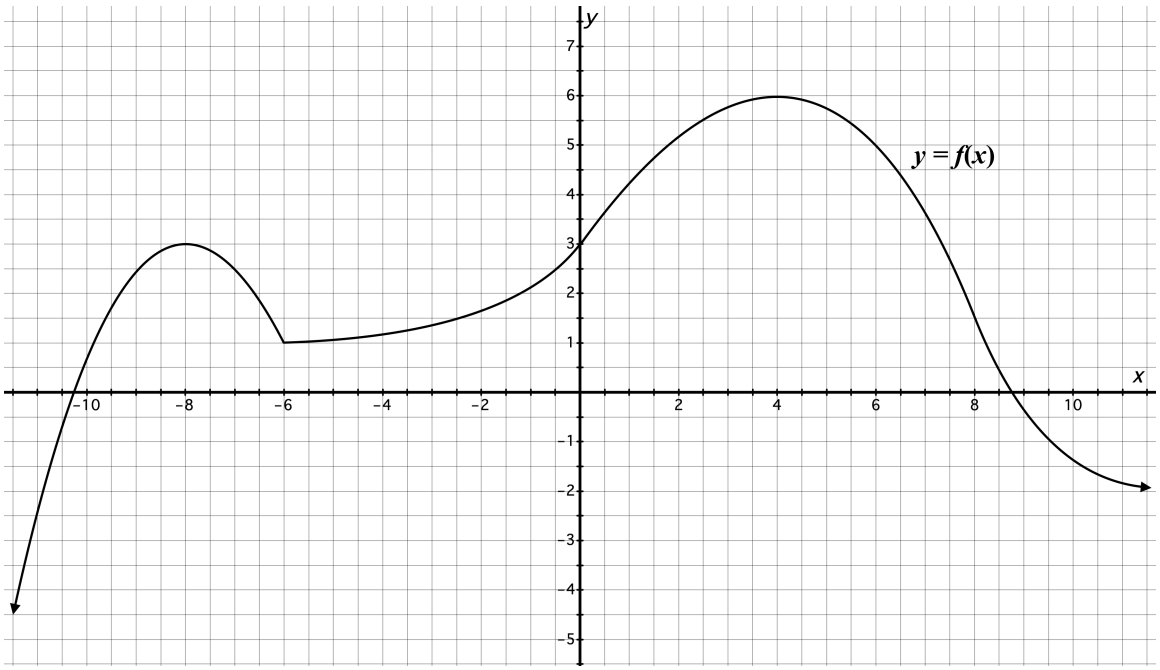
a. $x = -5.7$ and $x = 2.8$
b. $x = -4$ and $x = 4$
c. $x = 1$
d. $x = -8$, $x = -4$, $x = 1$, and $x = 4$
e. $f(x)$ does not have a minimum value.

(v) Consider the following graph of $f(x) = x\sin(x)$ on the domain $[-3, 3]$. How many values of c in $(-3, 3)$ appear to satisfy the Mean Value Theorem equation $f'(c) = \dfrac{f(b) - f(a)}{b - a}$ where $a = -3$ and $b = 3$.



a. None
b. One
c. Two
d. Three
e. Four or more

2. (*11 points*) The graph of the function f is shown below. Interpret the graph as it looks to answer the following questions.



(a) (*6 points*) Use the above graph to fill in the following table with the signs of $f'(x)$ and $f''(x)$ on the indicated intervals. Use a "+" sign to indicate the values are always positive and a "−" sign to indicate the values are always negative.

	$(-10,-8)$	$(-8,-6)$	$(-6,-0)$	$(0,4)$	$(4,8)$	$(8,10)$
Sign of $f'(x)$						
Sign of $f''(x)$						

(b) (*3 points*) List the x-coordinates of all critical points.

(c) (*2 points*) List the coordinates of all inflection points.

3. (*5 points each*) Compute the following derivatives. Do not simplify.

   (a) Let $f(\theta) = 4^{\cos(\theta)}$. Find $f'(\theta)$.

   (b) Let $y = e^x \cdot \sec(x)$. Find $\dfrac{dy}{dx}$.

   (c) Let $g(t) = \ln(t^6)$. Find $g''(t)$.

4. (*8 points*) Find $\dfrac{dy}{dx}$ for the curve $x^4 - \cos(y) = \sin(x)$. Your answer for $\dfrac{dy}{dx}$ should contain both x and y.

5. (*10 points*) Use calculus to determine the following for the function

$$f(x) = x^3 - 9x^2 - 48x + 18.$$

(a) (*6 points*) Find the x-coordinates of all critical points of f. Work must be shown to receive credit.

(b) (*4 points*) Determine the absolute maximum and absolute minimum value of $f(x)$ on the interval $[-5, 15]$. Work must be shown to receive credit.

6. (*10 points*) A stone thrown into a pond produces a circular ripple. If the radius of the ripple increases at a rate of 1.5 ft/sec, how fast is the area growing when the radius is 8 feet? State your answer as an exact value (i.e., in terms of π).

7. (*6 points*) Suppose that f is continuous and differentiable on the interval $[3,\ 8]$. Also suppose that $f(3) = 2$ and $f'(x) \leq 2$ for all x in the interval $[3,\ 8]$. What is the largest possible value for $f(8)$? Justify your response.