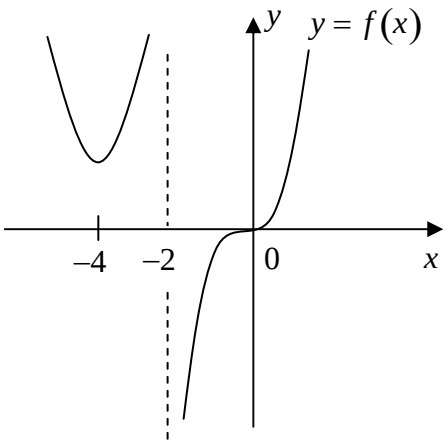
Circle the correct answer for problems 1 and 2. Place your answer for problem 3 in the space provided. You must show your work to receive any credit.

(8 pts) 1. Given below is the graph of a function, $y = f(x)$. Which of the following statements are true?



I. $f'(x) > 0$ when $-4 < x < -2$, $-2 < x < 0$, and $x > 0$

II. $f'(x) < 0$ when $x < -4$ and $-2 < x < 0$

III. $f''(x) > 0$ when $x < -2$ and $x > 0$

IV. $f''(x) < 0$ when $x < -4$ and $-2 < x < 0$

A. I and III

B. II and IV

C. I and IV

D. II and III

E. I, III, and IV

(8 pts) 2. Given $f(x) = x - \frac{4}{x^2}$. Find and classify the first order critical value(s).

A. $x = 2$ (gives a rel. min) and $x = -2$ (gives a rel. max)

B. $x = -2$ only (gives a rel. max)

C. $x = 2$ only (gives a rel. min)

D. $x = 2$ (gives a rel. max) and $x = -2$ (gives a rel. min)

E. There are no first order critical values

(10 pts) 3. Find the absolute maximum and the absolute minimum of $f(x) = (x^2 - 9)^2$ on the interval $[-2, 5]$.

Abs. Min. = ____

Abs. Max. = ____

Place your answers in the spaces provided. You must show your work to receive any credit

(22 pts) 4. Let $f(x) = x^4 + 4x^3 - 8$.

Find on what intervals the graph of f is increasing, decreasing, concave upwards, and concave downwards. Also, find the $x-$coordinates (only) of relative maximum, relative minimum, and inflection value(s). If there is none for any part, write "none". Do not graph.

.

Increasing:	Relative Max: $x =$
Decreasing:	Relative Min: $x =$
Concave up:	Inflection: $x =$
Concave down:	

Place your answers in the spaces provided. You must show your work to receive any credit.

5. Let $f(x)=\dfrac{x+3}{2x^2-5x-3}$. Answer each of the following. If no answer exists for any part, write "none".

(4 pts) (a) Find the vertical asymptote(s)

$x =$ ____

(2 pts) (b) Find the $\lim_{x\to\infty}\dfrac{x+3}{2x^2-5x-3}$

$\lim_{x\to\infty} f(x) =$ ____

(4 pts) (c) Find the *x*- and *y*- intercepts.

x-intercept(s): ____

y-intercep ____

6. An apple grower finds that if he plants 20 trees per acre, each tree will yield 90 bushels of apples. He also estimates that for each additional tree that he plants per acre, the yield of each tree will decrease by 3 bushels.

(4 pts) (a) If *x* represents the number of additional trees that are planted, express the yield, Y, as a function of *x*.

$Y(x) =$ ____

(6 pts) (b) Use calculus to find the total number of trees he should plant per acre to maximize his yield.

____

Place your answers in the spaces provided. You must show your work to receive any credit.

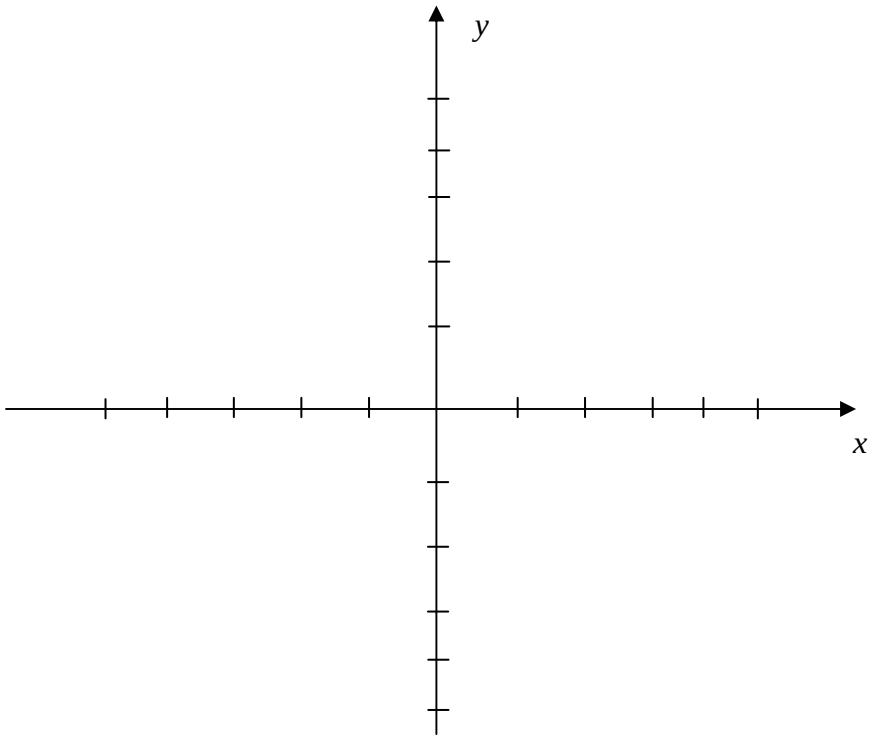
(12 pts) 7. Use the following information:

$$f(x)=\frac{x^2-16}{x^2-9};\qquad f'(x)=\frac{14x}{\left(x^2-9\right)^2};\qquad f''(x)=\frac{-2\left(21x^2+63\right)}{\left(x^2-9\right)^3}$$

The first order critical value is $x=0$. There are no second order critical values.
Following is the sign chart for $f(x)$:

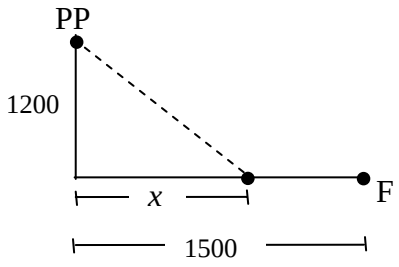
	$-\infty$	-3	0	3	∞
f'	–	–	+	+	
f''	–	+	+	–	
f					

Graph **neatly** the function $f(x)$. You must find and label asymptote(s), *x*- and *y*- intercepts, and/or critical points for full credit.



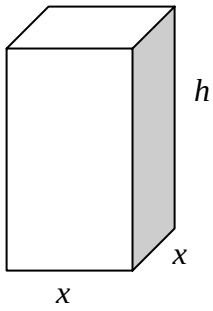
Place your answers in the spaces provided. You must show your work to receive any credit.

(8 pts) 8. A cable is to be run from a power plant on one side of a river 1200 meters wide to a factory on the other side, 1500 meters downstream (see the figure). The cost of running the cable under the water is \$25 per meter, while the cost on land is \$20 per meter. Let x represent the distance shown below in the figure. Set up the function that would be used to minimize the total cost of running the cable from the power plant to the factory in terms of x. DO NOT SOLVE.



$C(x) =$

(12 pts) 9. A closed rectangular box is to have a square base and be made for a total of \$48. The top and bottom of the box is to be made from material which costs \$2 per square foot and the sides from material costing \$3 per square foot. Find the dimensions of the box that will have maximum volume and be made for a total of \$48.



$x =$

$h =$

ANSWERS

1. A

2. B

3. Abs. Min. = 0 ; Abs. Max. = 256

4.

Increasing: $(-3,0)\cup(0,\infty)$	Relative Max: x = None
Decreasing: $(-\infty,-3)$	Relative Min: x = -3
Concave up: $(-\infty,-2)\cup(0,\infty)$	Inflection: x = -2, 0
Concave down: $(-2,0)$	

5. (a) $x=-\frac{1}{2},3$

   (b) 0

   (c) $(-3,0)$; $(0,-1)$

6. (a) $Y(x)=(20+x)(90-3x)$

   (b) 25 trees

7. VA: $x=\pm 3$; HA: $y=1$; $x-\text{int}:(\pm 4,0)$; $y-\text{int}:\left(0,\frac{16}{9}\right)$; Graph does not cross HA

   Finish graph (not shown)

8. $C(x)=25\sqrt{x^2+1200^2}+20(1500-x)$

9. $x=2$ *ft.*; $h=\frac{4}{3}$ *ft.*