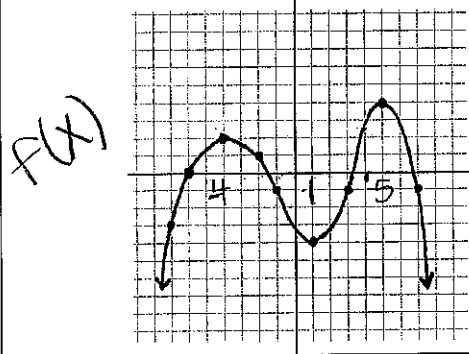


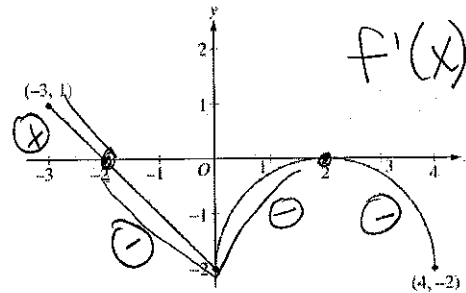
AP Calculus AB
Unit 2 - Day 4 - Assignment

Name: Answer Key*

Pictured below is the graph of a function, $f(x)$. Answer questions 1 - 6 that follow about $f'(x)$.



Pictured below is the graph of $f'(x)$ on the interval $[-3, 4]$. Answer the following questions 7 - 12 about $f(x)$.



1) Approximate the value of $f'(4)$.

$(5, 4)$ & $(3, -1)$
 $f'(4) \approx \frac{-1 - 4}{3 - 5} = \frac{-5}{-2} \approx \boxed{\frac{5}{2}}$

7) On what open interval(s) is the graph of $f(x)$ increasing? Justify your reasoning.

$f'(x)$ positive \rightarrow above x-axis
 $(-3, -2)$

2) At what value(s) of x is $f'(x) = 0$. Justify your answer.

$x = -4$ $x = 1$ $x = 5$
 (rel. max) (rel. min) (rel. max)

8) On what open interval(s) is the graph of $f(x)$ decreasing? Justify your answer.

$f'(x)$ neg \rightarrow below x-axis
 $(-2, 2) \cup (2, 4)$

3) On what open interval(s) is $f'(x) < 0$? Justify your answer.

neg \rightarrow Decr $f(x)$
 $(-4, -1) \cup (5, \infty)$

9) At what value(s) of x does the graph of $f(x)$ have a horizontal tangent? Justify your answer.

$x = -2, x = 2$ } when $f'(x) = 0$
 on x-axis

4) On what open interval(s) is $f'(x) > 0$? Justify your answer.

pos \rightarrow $f(x)$ incr
 $(-\infty, -4) \cup (1, 5)$

10) At what value(s) of x does the graph of $f(x)$ have a relative maximum? Justify your answer.

$f'(x) = 0$ & $\oplus \rightarrow \ominus$ $x = -2$

5) At what value(s) of x does the graph of $f'(x)$ go from being below the x-axis to above the x-axis? Justify your answer.

$\ominus \rightarrow \oplus$
 decr \rightarrow incr $x = 1$

11) At what value(s) of x does the graph of $f(x)$ have a relative minimum? Justify your answer.

NO rel. min

6) At what value(s) of x does the graph of $f'(x)$ go from being above the x-axis to below the x-axis? Justify your answer.

$\oplus \rightarrow \ominus$
 incr \rightarrow decr $x = -4$ $x = 5$

12) What is the slope of the normal line to the graph of $f(x)$ at $x = 4$? Justify your reasoning.

$f'(4) = -2$ \leftarrow slope of tangent
 normal slope = $\boxed{\frac{1}{2}}$

For exercises 13 – 15, determine on what intervals the given function is increasing or decreasing. Also, identify the coordinates of any relative extrema of the function. Show your work and justify your reasoning.

13) $f(x) = 2x^3 + 3x^2 - 12x$

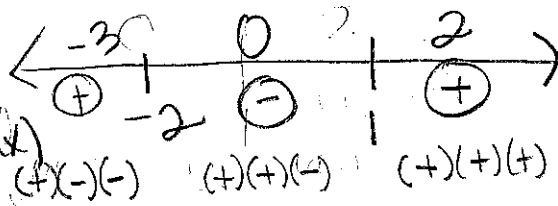
$f'(x) = 6x^2 + 6x - 12$

$6x^2 + 6x - 12 = 0$

$6(x^2 + x - 2) = 0$

$6(x+2)(x-1) = 0$

$x = 1, x = -2$



increasing $\rightarrow (-\infty, -2) \cup (1, \infty)$

decreasing $\rightarrow (-2, 1)$

rel. min at $(1, -7)$

relative max at $(-2, 20)$

$2(-2)^3 + 3(-2)^2 - 12(-2)$

$f'(x) = 0$ & goes from \ominus to \oplus

$f'(x)$ is \oplus

$f'(x)$ is \ominus

$f'(x)$ goes from \oplus to \ominus

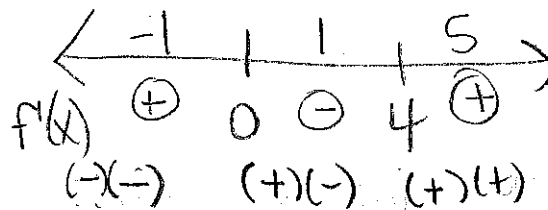
14) $g(x) = x^3 - 6x^2 + 15$

$g'(x) = 3x^2 - 12x$

$3x^2 - 12x = 0$

$3x(x-4) = 0$

$x = 0, x = 4$



increasing $\rightarrow (-\infty, 0) \cup (4, \infty)$

decreasing $\rightarrow (0, 4)$

rel. max at $(0, 15)$, rel. min at $(4, -17)$

15) $h(x) = (x+2)^2(x-1)$

$(x^2+4x+4)(x-1) = x^3 - x^2 + 4x^2 - 4x - 4$

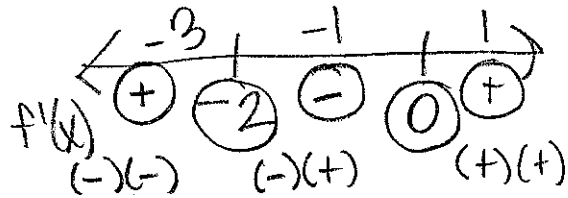
$f(x) = x^3 + 3x^2 - 4$

$f'(x) = 3x^2 + 6x$

$3x^2 + 6x = 0$

$3x(x+2) = 0$

$x=0 \quad x=-2$



increasing $\rightarrow (-\infty, -2) \cup (0, \infty)$

decreasing $\rightarrow (-2, 0)$

rel. max at $(-2, 0)$

rel. max at $(0, -4)$

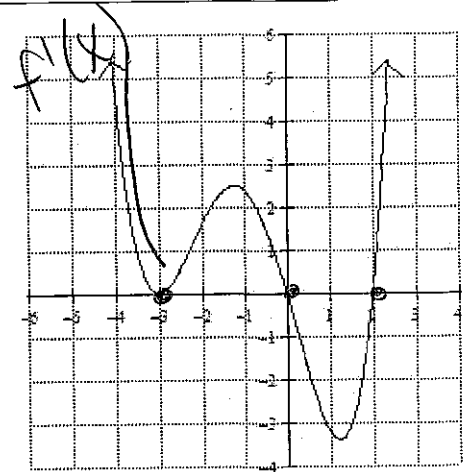
16) Pictured to the right is the graph of $f'(x)$. On what interval(s) is the graph of $f(x)$ increasing or decreasing? Justify your reasoning.

$f'(x) > 0$ (above x-axis)

increasing $\rightarrow (-\infty, -3) \cup (-3, 0) \cup (2, \infty)$

decreasing $\rightarrow (0, 2)$

$f'(x) < 0$ (below x-axis)



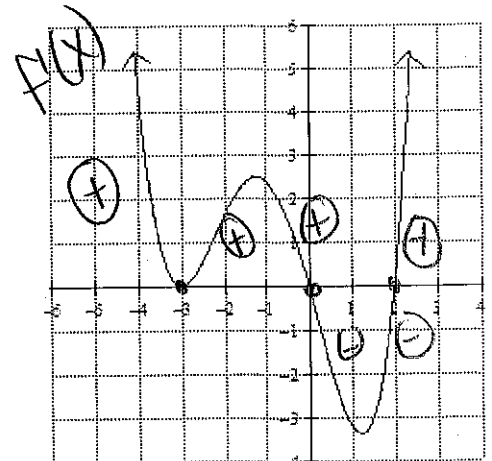
17) Pictured to the right is the graph of $f'(x)$. At what value(s) of x does the graph of $f(x)$ have a relative maximum/minimum? Justify your reasoning.

rel. max at $x=0$

$\oplus \rightarrow \ominus$

rel. min at $x=2$

$\ominus \rightarrow \oplus$



NO max/min at $x=-3$ (didn't change signs)