Relating Graphs of *f* and *f'*
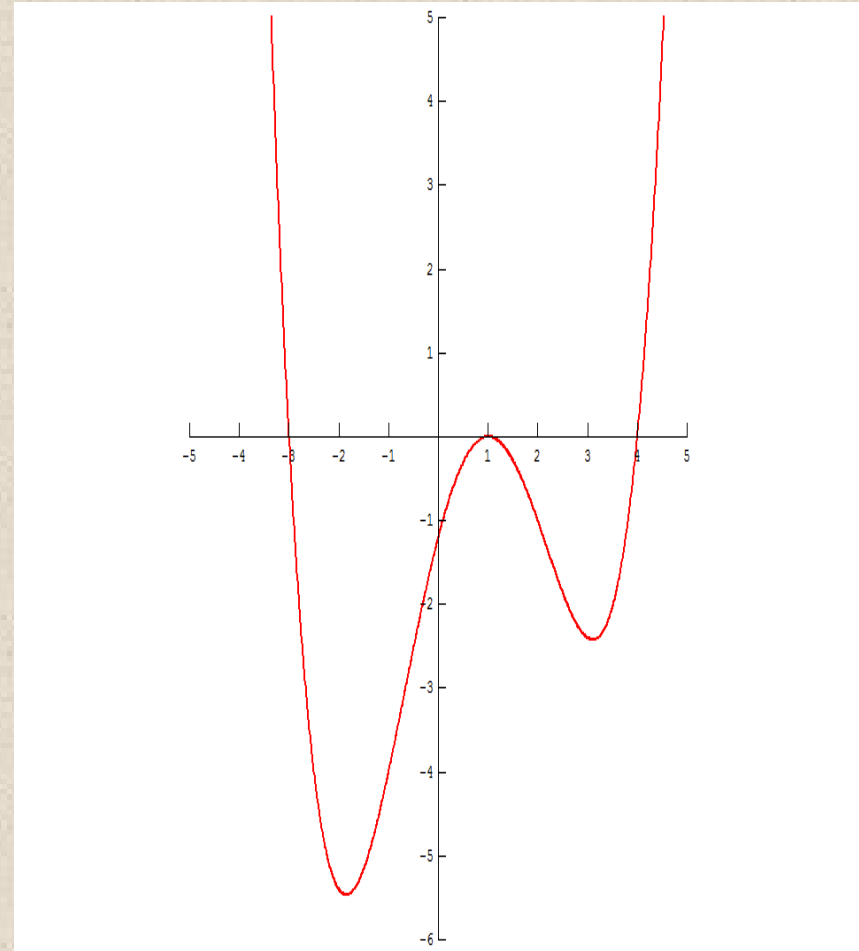
Do Now: Answer each of the following questions.

1. When the function, f, is increasing, what does that mean about the derivative, f'?

2. When the function, f, is decreasing, what does that mean about the derivative, f'?

3. When the function, f, reaches a maximum at a smooth point, what does that mean about the derivative, f'?

4. When the function, f, reaches a minimum at a cusp, what does that mean about the derivative, f'?

5. When the function, f, changes from concave up to concave down, what does that mean about the derivative, f', and the second derivative, f''?

6. When the derivative, f', has a positive slope, what does that mean about the second derivative, f''?

When the function is…(and the graph of the function…)	Then the derivative is… (and the graph of the derivative …)	And the second derivative is…
Increasing (has a positive slope) and concave up		
Increasing (has a positive slope) and is concave down		
Decreasing (has a negative slope) and concave up		
Decreasing (has a negative slope) and concave down		
At a relative maximum (smooth curve) and concave down		
At a relative minimum (smooth curve) and concave up		
At a relative maximum (cusp) and concave up		
At a relative minimum (cusp) and concave down		
Changing from concavity from down to up		
Changing from concavity from up to down		

| When the function is…(and the graph of the function…)	Then the derivative is… (and the graph of the derivative …)	And the second derivative is…
Increasing (has a positive slope) and concave up	Positive (the graph of f' is above the x-axis and has a positive slope)	Positive
Increasing (has a positive slope) and is concave down	Positive (the graph of f' is above the x-axis and has a negative slope)	Negative
Decreasing (has a negative slope) and concave up	Negative (the graph of f' is below the x-axis and has a positive slope)	Positive
Decreasing (has a negative slope) and concave down	Negative (the graph of f' is below the x-axis and has a negative slope)	Negative
At a relative maximum (smooth curve) and concave down	Zero (crossing the x-axis from above to below)	Negative
At a relative minimum (smooth curve) and concave up	Zero (crossing the x-axis from negative to positive)	Positive
At a relative maximum (cusp) and concave up	Undefined	Positive/undefined
At a relative minimum (cusp) and concave down	Undefined	Negative/undefined
Changing from concavity from down to up	At a minimum, could be positive or negative	Zero -Crossing x-axis from below to above
Changing from concavity from up to down	At a maximum, could be positive or negative	Zero – crossing x-axis from above to below axis

Using the previous information about the *f, f'* and *f''*, answer the following questions based on the graph of *f* on the right.

1. On what interval(s) is *f'* positive?
2. On what interval(s) is *f'* negative?
3. On what interval(s) is *f''* positive?
4. On what interval(s) is *f''* negative?
5. On what interval(s) are both *f'* and *f''* positive?
6. On what interval(s) are both *f'* and *f''* negative?
7. On what interval(s) is *f'* positive and *f''* negative?
8. On what interval(s) is *f'* negative and *f''* positive?

Using the previous information about the *f, f'* and *f''*, answer the following questions based on the graph of *f'* on the right.
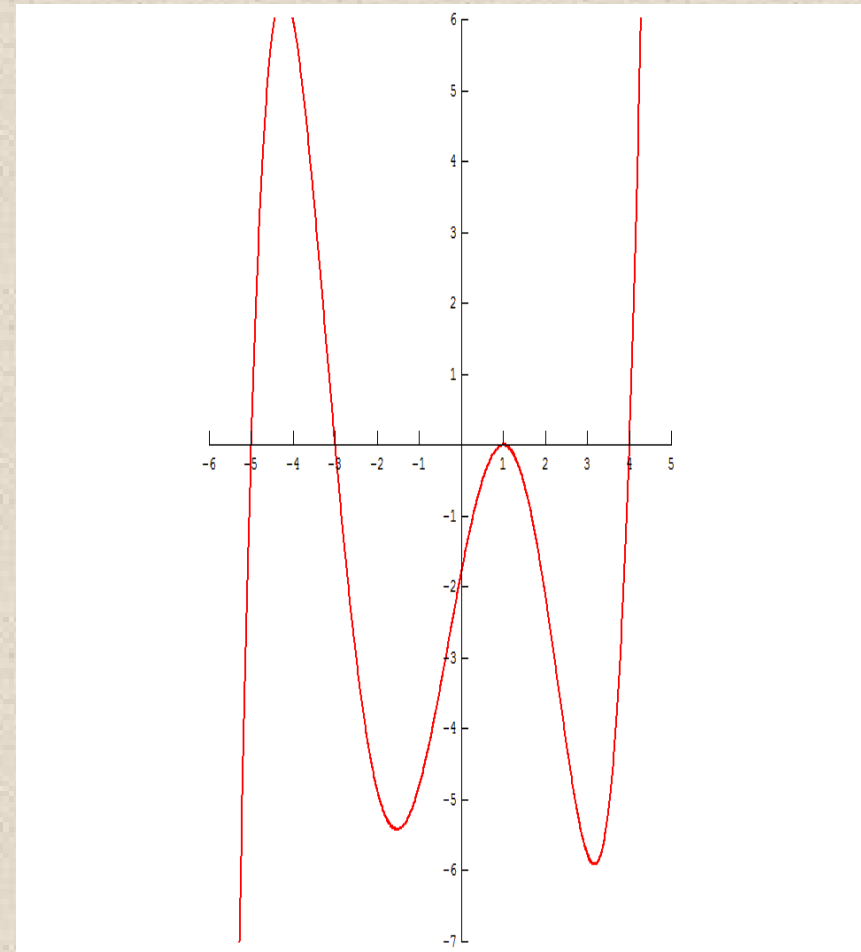
1. For what value(s) of x does *f* have a horizontal tangent?
2. For what value(s) fo x does *f* have a relative maximum?
3. For what value(s) of x does *f* have a relative minimum?
4. On what interval(s) is *f* increasing?
5. On what interval(s) is *f* decreasing?
6. For what value(s) of *x* does *f* have a point of inflection?
7. On what intervals(s) is *f* concave up?
8. On what interval(s) is *f* concave down?
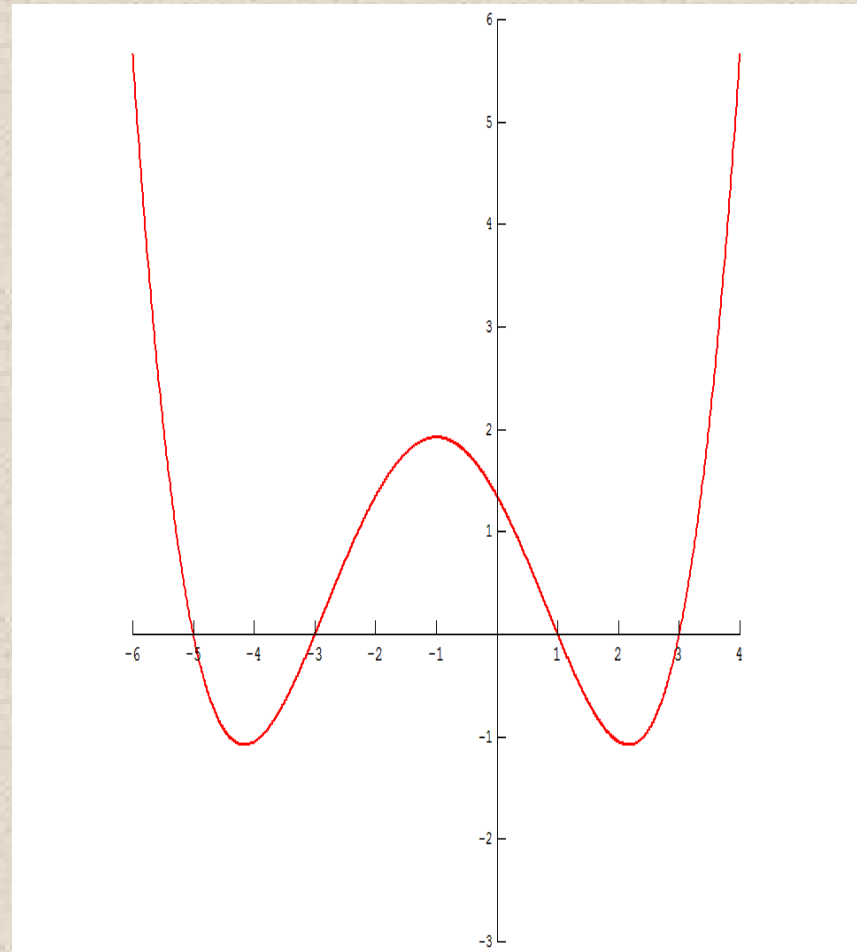
Practice Problems

Base your answers to each of the following questions based on the graph of **f** at right (justufy with a sentence):
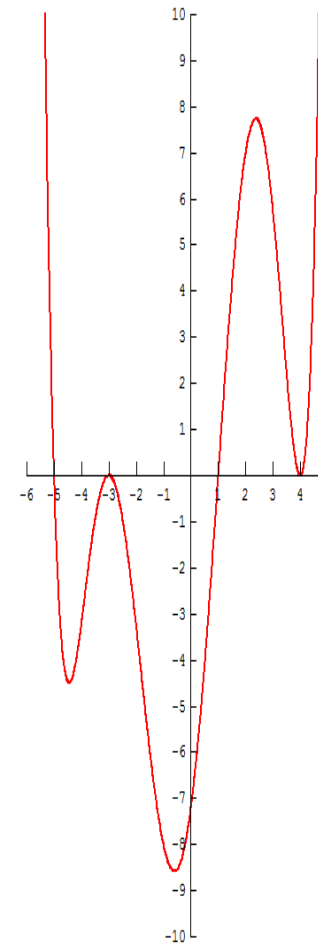
1. On what interval(s) is *f'* positive?
2. On what interval(s) is *f'* negative?
3. On what interval(s) is *f''* positive?
4. On what interval(s) is *f''* negative?
5. On what interval(s) are both *f'* and *f''* positive?
6. On what interval(s) are both *f'* and *f''* negative?
7. On what interval(s) is *f'* positive and *f''* negative?
8. On what interval(s) is *f'* negative and *f''* positive?

Practice Problems

Base your answers to the following questions based on the graph of **f'** at right (justify with a sentence):

1. For what value(s) of x does *f* have a horizontal tangent?
2. For what value(s) fo x does *f* have a relative maximum?
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5. On what interval(s) is *f* decreasing?
6. For what value(s) of *x* does *f* have a point of inflection?
7. On what intervals(s) is *f* concave up?
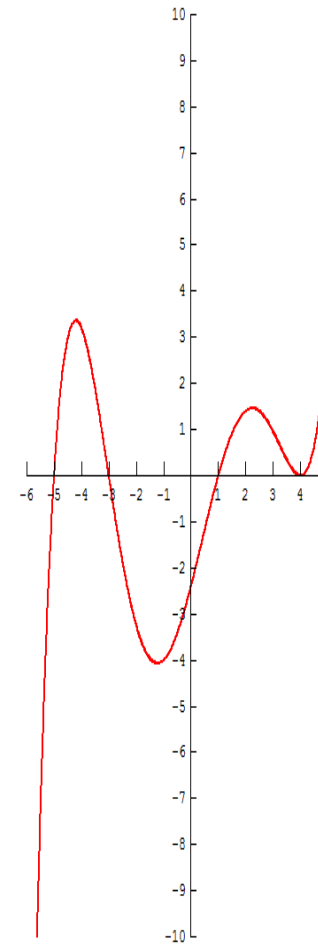8. On what interval(s) is *f* concave down?

Practice

Base your answers to the following questions based on the graph of **f'** at right (justify with a sentence):

1. For what value(s) of x does *f* have a horizontal tangent?
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6. For what value(s) of *x* does *f* have a point of inflection?
7. On what intervals(s) is *f* concave up?
8. On what interval(s) is *f* concave down?

Practice

Base your answers to the following questions based on the graph of **f'** at right (justify with a sentence):

1. For what value(s) of x does *f* have a horizontal tangent?
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7. On what intervals(s) is *f* concave up?
8. On what interval(s) is *f* concave down?