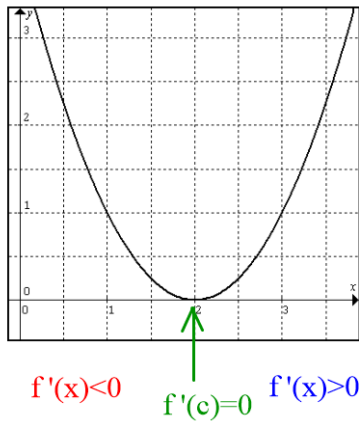## 3.3 Increasing and Decreasing and the First Derivative test

ObJ: Define and apply the first derivative test; Find where a function is increasing and decreasing

Formal definition:

f '(x)<0   f '(c)=0   f '(x)>0

Informal definition:

In Calculus: A function is increasing when :
                A function is decreasing when:

 A function potentially changes from increasing to decreasing:

Steps: When you have a polynomial or rational function, **find the critical values**, **use a sign chart** to find the values where the function is increasing, decreasing or constant. Test values go into the derivative!

Ex 1. Find where f(x) is increasing, decreasing or constant. $f(x)=x^3+3x^2$

Now try: Find where f(x) is increasing, decreasing or constant. $f(x) = x^{\frac{2}{3}}(x-5)$

The First derivative test:

Let c be a critical number of f, which is continuous on the open interval containing c and differentiable on the interval except possibly at c, then...

1.

2.

Ex 2.   Find all extrema for $f(x) = (x^2-3) e^x$

Also, where is the function increasing, decreasing or constant. Justify all answers (**note a sign chart is never considered as justification**)

Find f'
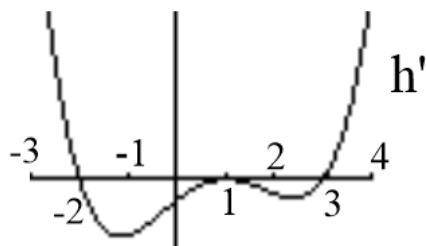Find critical Values
Do sign chart
Use FDT
Do table

EX 3. At what x values does f have extrema (identify the type) and on what intervals is f is increasing or decreasing if
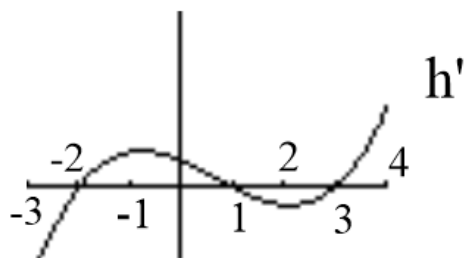
$$f'(x)=(x-5)(x+3)(x-3)$$

Justify all answers.

Ex 4. The function h(x) is defined on (-3,4) and the graph below is the graph of h'(x). Find the x coordinate of all relative maxima of h(x).
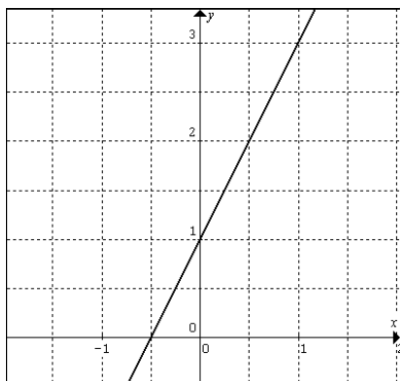
You try. The graph of h'(x) is shown. For what values of x is h(x) increasing?
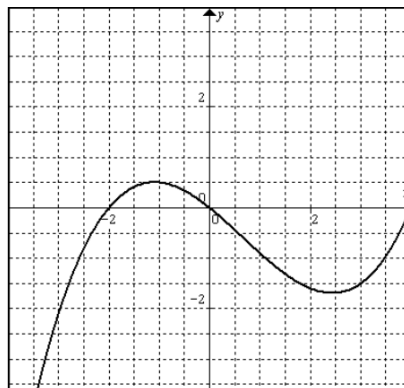

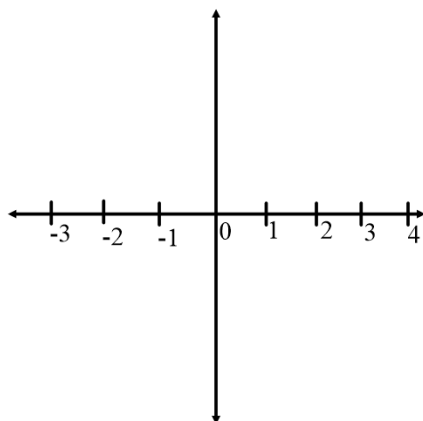Ex 5. This is the graph of f(x). Sketch the graph of f'(x).

a.

b.

Ex 6. Sketch the graph of a function whose derivative satisfies the following properties:

x	$(-\infty,-1)$	-1	(-1,1)	1	(1,3)	3	$(3,\infty)$
f'(x)	Positive	0	Negative	0	Negative	0	Positive

Ex7. If g is a diff 'ble function such that g(x)<0 for all real numbers x. Find the x coordinate of all relative maxima and relative minima of the function f if
$$f'(x) = (x^2 - 4)g(x)$$