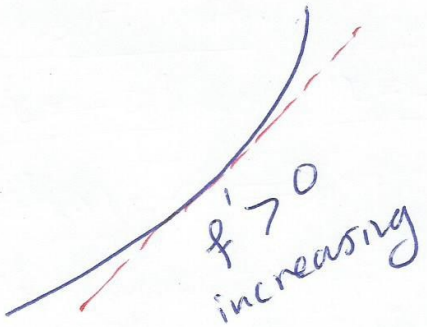
*Important theorems:

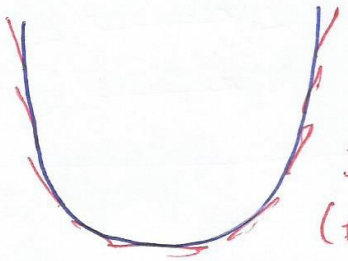
1- If $f'>0$ on interval I, then f is increasing on I.

2- If $f'<0$ on interval I, then f is decreasing on I.

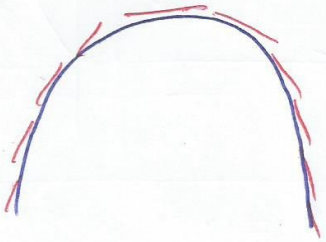
3- If $f''>0$ on interval I, then f is concave up on I.

4- If $f''<0$ on interval I, then f is concave down on I.





concave up



concave down

Ex8 Sketch (Graph) for $y = x^3 - 3x^2$.

Solution:

① y-intercept ($x=0$) $\Rightarrow$ $\boxed{y=0}$

x-intercept ($y=0$)

$\Rightarrow 0 = x^3 - 3x^2$

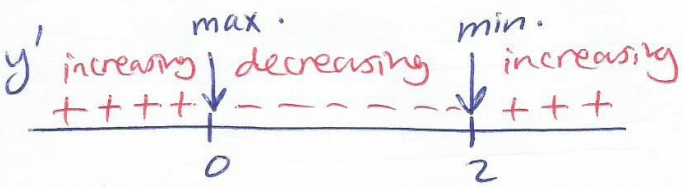
$0 = x^2(x-3) \Rightarrow \boxed{x=0}$ or $\boxed{x=3}$

$\Rightarrow$

(2) $y' = 3x^2 - 6x$

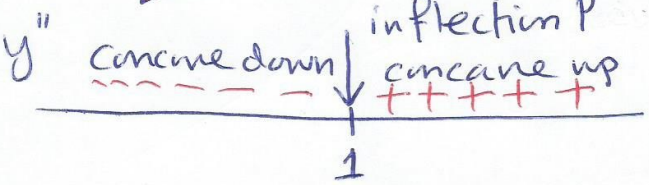
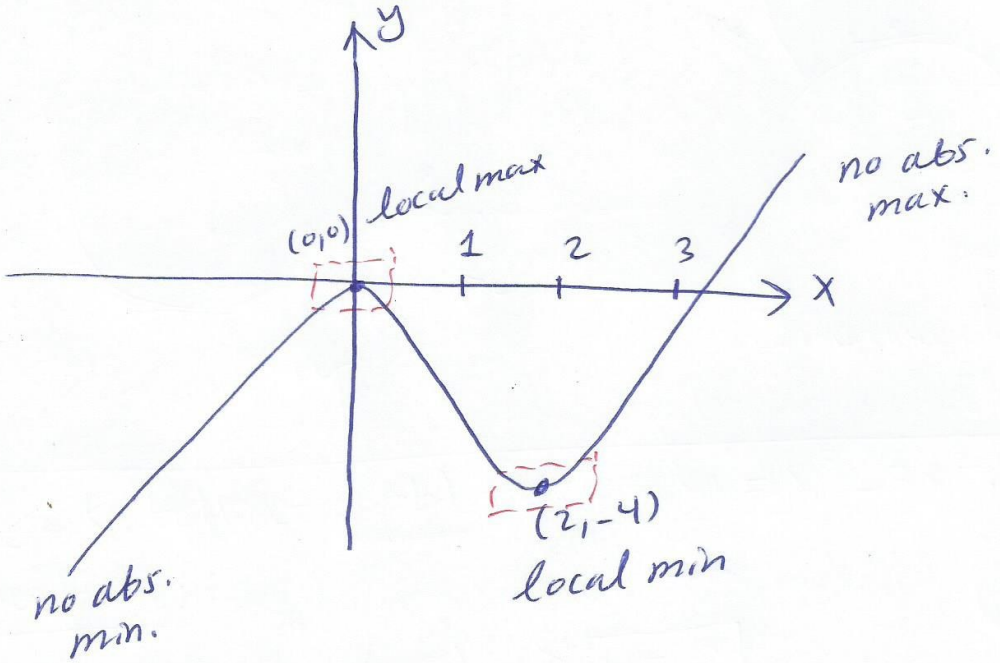
$= 3x(x-2)$

$\boxed{x=0}$ or $\boxed{x=2}$



(3) $y'' = 6x - 6 = 6(x-1)$

$\boxed{x=1}$



(4)