FACTORISING A THIRD DEGREE POLYNOMIAL

$Example$: $x^3 - 6x^2 + 11x - 6$

Step 1: Use your calculator to find the first factor

- Mode Setup 3: Table
- Enter Equation
- Start -5 End +5 Steps 1 =
- Look At Your $y - Value\ f(x)$, If It Is 0, Then Your $x - Value$ Is A Factor

$\therefore\therefore x - 1\ is\ a\ factor\ of\ the\ above\ expression$

$(x - 1)(\quad\quad\quad\quad)$

- First arrow x *times what number will give you the first term*

x x $\boldsymbol{x^2} = x^3$

- Second arrow – 1 x ____ = - 6 $\therefore -1$ x + 6 = **- 6**

$(x - 1)(x^2 \quad\quad\quad - 6\ )$

-1 x $x^2 = -x^2$

We want $-6x^2 \rightarrow -x^2 - \boldsymbol{5x^2} = -6x^2$

$(x - 1)(x^2 - 5x^2 - 6\ )$

$(x - 1)(x - 2\ )(x - 3) = 0$

$(x - 1) = 0 \qquad x = 1$

$(x - 2) = 0 \qquad x = 2$

$(x - 3) = 0 \qquad x = 3$

Average Gradient

First Principles

$$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$

let h = 0

Between 2 points

f(x) = 1st x value substituted into equation

f (x + h) = 2nd x value substituted into equation

$h = x_2 - x_1$

Use the average gradient formula

Limits

- *Factorize first and simplify where possible.*
- *Substitute value into the term after it has been factorized*

Differentiation

$$If\ y = x^n\ then\ \frac{dy}{dx} = nx^{n-1}$$

$$If\ f(x) = k\ then\ f'(x) = 0 \rightarrow k\ being\ a\ constant$$

Use rules

$y \rightarrow \frac{dy}{dx}$

$f(x) \rightarrow f'(x)$

$Dx \rightarrow\ =$

Tangents

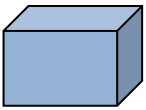
- A tangent is a straight line
- To find *m* (gradient) you need to find f'(x)
- If you are only given the *x-coordinate,* subs into original equation(curve) to find *y-coordinate*
- Use the equation: $y - y1 = m(x - x1)$

Rate of change

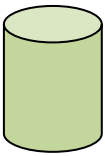
Velocity = $\frac{ds}{dt}$ where *s* is distance
where *t* is time

- Initial velocity is where t = 0
- Maximum height is where the derivative d'(t) = 0

Max/Min



Perimeter = 2 (*l* + *b*)
SA = 2 (*lb* + *lh* + *bh*)
V = *l* x *b* x *h*



SA = $2\pi rh + 2\pi r^2$
V = $\pi r^2 h$

For Maximum Area or Volume: Let f'(x) = 0

Graphs

General Equation $\rightarrow y = ax^3 + bx^2 + cx + d$

Steps to sketching a Calculus Graph

1) **Shape**: a > 0  a < 0 

2) **Turning Point**: Let f'(x) = 0

Find the y − intercepts by substituting the x − intercepts into the original equation

3) **x – intercept:** let y = o
- Factorize using factor theorem
- Solve for x

4) **y-intercept**: let x = 0

5) **Point of inflection**: let f''(x) = 0

Finding the equation of a Calculus Graph

***Given*: Three x-intercepts and one other point.**

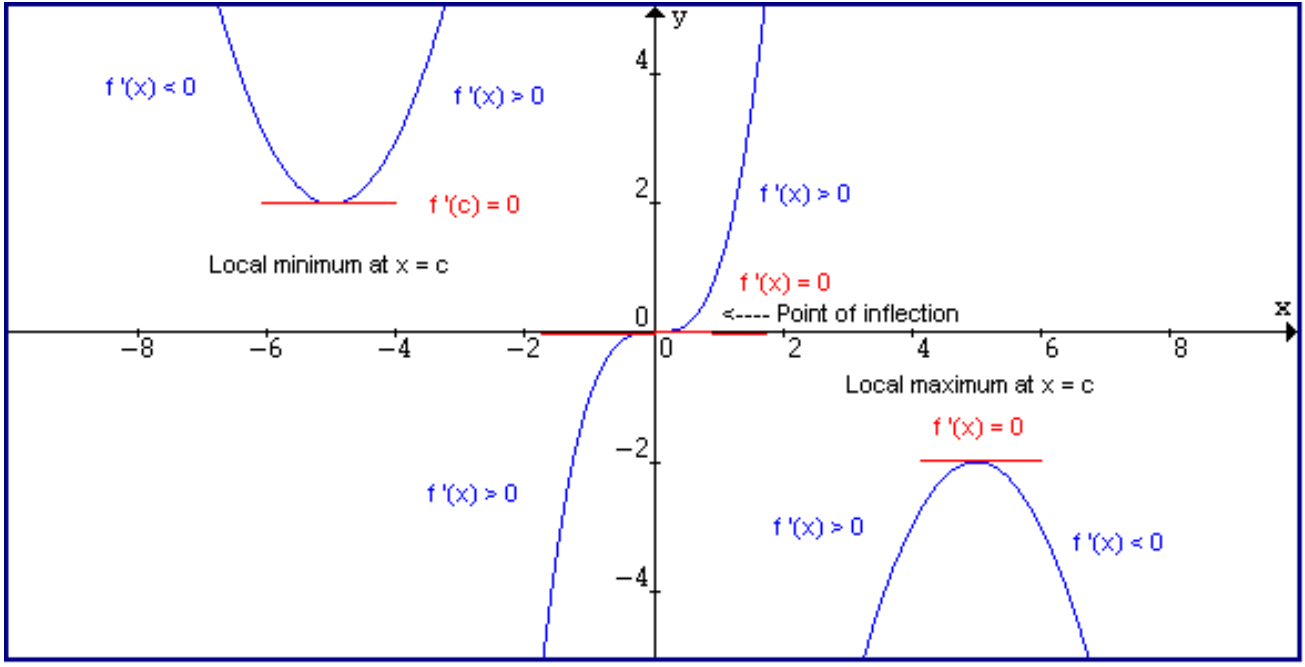
Use: $y = a(x - x_1)(x - x_2)(x - x_3)$

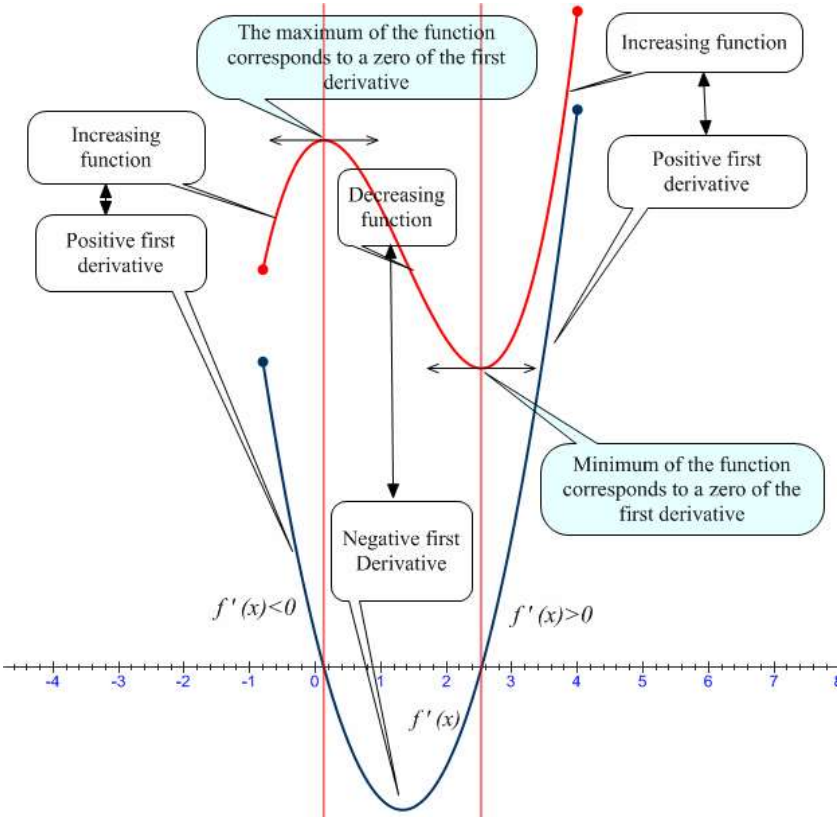
To take note whether your
a value is positive or negative

***Given*: The coordinates of a stationery point (TP) and one other point**

Use

- *The derivative of the given equation and substitute the x value into the derivative and make it equal to 0.*
- *Use one other co-ordinate to find any other unknown values.*


f '(x) < 0
f '(x) > 0
f '(c) = 0
Local minimum at x = c
f '(x) > 0
f '(x) = 0
<---- Point of inflection
f '(x) > 0
Local maximum at x = c
f '(x) = 0
f '(x) > 0
f '(x) < 0
y
x
4
2
0
−2
−4
−8
−6
−4
−2
0
2
4
6
8


The maximum of the function corresponds to a zero of the first derivative
Increasing function
Increasing function
Positive first derivative
Decreasing function
Positive first derivative
Minimum of the function corresponds to a zero of the first derivative
Negative first Derivative
f ' (x)<0
f ' (x)>0
-4
-3
-2
-1
0
1
2
3
4
5
6
7
f ' (x)