Guide to: Iteration

maths Links

Explanation:

To show that an equation f(x) = 0 has a root between x = a and x = b, evaluate f(a) and f(b), state that there is a **change of sign** (one positive, one negative) and f(x) is continuous. An iterative formula $\mathbf{x_{n+1} = g(x_n)}$ is formed by rearranging f(x) = 0 to isolate one x term.

To iterate efficiently on a calculator, type the starting value x_0 and press **=**, then enter the formula using the **ANS** key in place of x_n. Press **=** repeatedly to generate x_1, x_2, x_3, writing down full calculator displays at each step.

Example 1: Show $x^3 + 2x - 6 = 0$ has a root between 1 and 2, and rearrange to $x = \sqrt[3]{(6 - 2x)}$.

Solution:

Let $f(x) = x^3 + 2x - 6$:

$f(1) = 1^3 + 2(1) - 6 =$ **-3 (< 0)**

$f(2) = 2^3 + 2(2) - 6 =$ **$+6$ (> 0)**

Change of sign shows a root lies in (1, 2).

Rearrange: $x^3 = 6 - 2x \Rightarrow$ **$x = \sqrt[3]{(6 - 2x)}$**

Example 2: Use $x_{n+1} = \sqrt[3]{(6 - 2x_n)}$ with $x_0 = 1.5$ to find x_1, x_2, x_3 (3 d.p.).

Solution:

Type **1.5 =**, then **$\sqrt[3]{(6 - 2 \times ANS)}$**:

$x_1 = \sqrt[3]{(6 - 2(1.5))} = \sqrt[3]{3} =$ **1.4422...**

$x_2 = \sqrt[3]{(6 - 2(1.4422...))} =$ **1.4605...**

$x_3 = \sqrt[3]{(6 - 2(1.4605...))} =$ **1.4548...**

Answer: $x_1 = 1.442$, $x_2 = 1.461$, $x_3 = 1.455$

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