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## How to solve a cubic equation by factorising

Solve:  $2x^3 - 5x^2 - 10 = 23x$

$\therefore 2x^3 - 5x^2 - 23x - 10 = 0$

let  $f(x) \equiv 2x^3 - 5x^2 - 23x - 10$

$f(1) = -36, f(-1) = 6, f(2) = -60$

$f(-2) = -16 - 20 + 46 - 10 = 0$

$\therefore (x+2)$  is a factor of  $f(x)$

$\therefore (x+2)(Ax^2 + Bx + C) = 0$

By inspection

$\therefore (x+2)(2x^2 - 9x - 5) = 0$

For B:  $Bx^2 + 4x^2 \equiv -5x^2 \Rightarrow B = -9$

If  $f(x)$  is a polynomial and  $f(p) = 0$   
then  $x - p$  is a factor of  $f(x)$

$$\begin{array}{r}
 \phantom{x+2} \rightarrow 2x^2 - 9x - 5 \\
 x+2 \overline{) 2x^3 - 5x^2 - 23x - 10} \\
 \underline{- 2x^3 + 4x^2} \phantom{- 23x - 10} \\
 \phantom{- 2x^3 +} 4x^2 - 23x \phantom{- 10} \\
 \phantom{- 2x^3 +} \underline{- 4x^2 + 18x} \phantom{- 10} \\
 \phantom{- 2x^3 +} \phantom{4x^2 -} -5x - 10 \\
 \phantom{- 2x^3 +} \phantom{4x^2 -} \underline{- 5x - 10} \\
 \phantom{- 2x^3 +} \phantom{4x^2 -} \phantom{-5x -} 0
 \end{array}$$

Long division method for the quadratic factor

$\therefore (x+2)(2x+1)(x-5) = 0$

$\therefore x+2=0, 2x+1=0, x-5=0$

$\therefore x = -2, x = -\frac{1}{2}, x = 5$

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