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1. Determine which of the following polynomials has (x + 1) a factor:

(i) x^3+x^2+x+1

Solution:

Let $p(x) = x^3+x^2+x+1$

The zero of x+1 is -1. [x+1 = 0 means x = -1]

$p(-1) = (-1)^3+(-1)^2+(-1)+1$

$= -1+1-1+1$

$= 0$

∴By factor theorem, x+1 is a factor of x^3+x^2+x+1

(ii) $x^4+x^3+x^2+x+1$

Solution:

Let $p(x)= x^4+x^3+x^2+x+1$

The zero of x+1 is -1. . [x+1= 0 means x = -1]

$p(-1) = (-1)^4+(-1)^3+(-1)^2+(-1)+1$

$= 1-1+1-1+1$

$= 1 \neq 0$

∴By factor theorem, x+1 is not a factor of $x^4 + x^3 + x^2 + x + 1$

(iii) $x^4+3x^3+3x^2+x+1$

Solution:

Let $p(x)= x^4+3x^3+3x^2+x+1$

The zero of x+1 is -1.

$p(-1)=(-1)^4+3(-1)^3+3(-1)^2+(-1)+1$

$=1-3+3-1+1$

$=1 \neq 0$

∴By factor theorem, x+1 is not a factor of $x^4+3x^3+3x^2+x+1$

(iv) $x^3 – x^2 – (2+\sqrt{2})x + \sqrt{2}$

Solution:

Let $p(x) = x^3 – x^2 – (2+\sqrt{2})x + \sqrt{2}$

The zero of x+1 is -1.

$p(-1) = (-1)^3 – (-1)^2 – (2+\sqrt{2})(-1) + \sqrt{2} = -1 – 1 + 2 + \sqrt{2} + \sqrt{2}$

$= 2\sqrt{2} \neq 0$

∴By factor theorem, x+1 is not a factor of $x^3 – x^2 – (2+\sqrt{2})x + \sqrt{2}$

2. Use the Factor Theorem to determine whether g(x) is a factor of p(x) in each of the following cases:

(i) $p(x) = 2x^3 + x^2 – 2x – 1$, $g(x) = x+1$

Solution:

$p(x) = 2x^3 + x^2 – 2x – 1$, $g(x) = x+1$

$g(x) = 0$

$\Rightarrow x+1 = 0$

$\Rightarrow x = -1$

∴Zero of g(x) is -1.

Now,

$p(-1) = 2(-1)^3 + (-1)^2 – 2(-1) – 1$

$= -2+1+2-1$

$= 0$

∴By factor theorem, g(x) is a factor of p(x).

(ii) $p(x) = x^3 + 3x^2 + 3x + 1$, $g(x) = x+2$

Solution:

$p(x) = x^3 + 3x^2 + 3x + 1$, $g(x) = x+2$

$g(x) = 0$

$\Rightarrow x+2 = 0$

$\Rightarrow x = -2$

$\therefore$ Zero of g(x) is -2.

Now,

$p(-2) = (-2)^3+3(-2)^2+3(-2)+1$

$= -8+12-6+1$

$= -1 \neq 0$

$\therefore$By factor theorem, g(x) is not a factor of p(x).

(iii) $p(x)=x^3-4x^2+x+6$, $g(x) = x-3$

Solution:

$p(x) = x^3-4x^2+x+6$, $g(x) = x -3$

$g(x) = 0$

$\Rightarrow x-3 = 0$

$\Rightarrow x = 3$

$\therefore$ Zero of g(x) is 3.

Now,

$p(3) = (3)^3-4(3)^2+(3)+6$

$= 27-36+3+6$

$= 0$

$\therefore$By factor theorem, g(x) is a factor of p(x).