

# Mathematics

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(Chapter - 2) (Polynomials)  
(Class X)

## Exercise 2.3

### Question 1:

Divide the polynomial  $p(x)$  by the polynomial  $g(x)$  and find the quotient and remainder in each of the following:

(i)  $p(x) = x^3 - 3x^2 + 5x - 3$ ,  $g(x) = x^2 - 2$

(ii)  $p(x) = x^4 - 3x^2 + 4x + 5$ ,  $g(x) = x^2 + 1 - x$

(iii)  $p(x) = x^4 - 5x + 6$ ,  $g(x) = 2 - x^2$

### Answer 1:

(i)  $p(x) = x^3 - 3x^2 + 5x - 3$ ,  $g(x) = x^2 - 2$

Therefore,

Quotient =  $x - 2$

And remainder =  $7x - 9$

$$\begin{array}{r} x-3 \\ x^2-2 \overline{) x^3-3x^2+5x-3} \\ \underline{x^3 \quad -2x} \phantom{-3} \\ -3x^2+7x-3 \\ \underline{-3x^2 \quad +6} \phantom{-3} \\ 7x-9 \end{array}$$

(ii)  $p(x) = x^4 - 3x^2 + 4x + 5$ ,  $g(x) = x^2 + 1 - x$

Therefore,

Quotient =  $x^2 + x - 3$

And remainder = 8

$$\begin{array}{r} x^2+x-3 \\ x^2-x+1 \overline{) x^4+0x^3-3x^2+4x+5} \\ \underline{x^4 - x^3 + x^2} \phantom{+5} \\ -x^3-4x^2+4x+5 \\ \underline{-x^3 \quad +x^2} \phantom{+5} \\ -3x^2+3x+5 \\ \underline{-3x^2+3x-3} \phantom{+5} \\ 8 \end{array}$$

(iii)  $p(x) = x^4 - 5x + 6$ ,  $g(x) = 2 - x^2$

Therefore,

Quotient =  $-x^2 - 2$

And remainder =  $-5x + 10$

$$\begin{array}{r} -x^2-2 \\ -x^2+2 \overline{) x^4+0x^2-5x+6} \\ \underline{x^4-2x^2} \phantom{+6} \\ 2x^2-5x+6 \\ \underline{2x^2 \quad -4} \phantom{+6} \\ -5x+10 \end{array}$$

### Question 2:

Check whether the first polynomial is a factor of the second polynomial by dividing the second polynomial by the first polynomial:

(i)  $t^2 - 3$ ,  $2t^4 + 3t^3 - 2t^2 - 9t - 12$

(ii)  $x^2 + 3x + 1$ ,  $3x^4 + 5x^3 - 7x^2 + 2x + 2$

(iii)  $x^3 - 3x + 1$ ,  $x^5 - 4x^3 + x^2 + 3x + 1$

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or  $x^2 - \frac{5}{3}$  is a factor of  $p(x)$ .

$$\begin{array}{r} x^2 + 0x - \frac{5}{3} \overline{) 3x^4 + 6x^3 - 2x^2 - 10x - 5} \\ \underline{3x^4 + 0x^3 - 5x^2} \phantom{- 10x - 5} \\ 6x^3 + 3x^2 - 10x - 5 \\ \underline{6x^3 + 0x^2 - 10x} \phantom{- 5} \\ 3x^2 + 0x - 5 \\ \underline{3x^2 + 0x - 5} \\ 0 \end{array}$$

$$\begin{aligned} 3x^4 + 6x^3 - 2x^2 - 10x - 5 &= \left(x^2 - \frac{5}{3}\right)(3x^2 + 6x + 3) \\ &= 3\left(x^2 - \frac{5}{3}\right)(x^2 + 2x + 1) \end{aligned}$$

Now,

$$\begin{aligned} p(x) &= 3\left(x^2 - \frac{5}{3}\right)(x^2 + 2x + 1) \\ &= 3\left(x^2 - \frac{5}{3}\right)[x^2 + x + x + 1] \\ &= 3\left(x^2 - \frac{5}{3}\right)[x(x + 1) + 1(x + 1)] \\ &= 3\left(x^2 - \frac{5}{3}\right)(x + 1)(x + 1) \end{aligned}$$



Hence, the zeroes of  $3x^4 + 6x^3 - 2x^2 - 10x - 5$  are  $\sqrt{\frac{5}{3}}$ ,  $-\sqrt{\frac{5}{3}}$ ,  $-1$  and  $-1$ .

## Question 4:

On dividing  $x^3 - 3x^2 + x + 2$  by a polynomial  $g(x)$ , the quotient and remainder were  $x - 2$  and  $-2x + 4$ , respectively. Find  $g(x)$ .

## Answer 4:

Given that:

$$\text{Divisor} = g(x)$$

$$\text{Quotient} = x - 2$$

$$\text{Dividend} = x^3 - 3x^2 + x + 2$$

$$\text{Remainder} = -2x + 4$$

We know that:

$$\text{Dividend} = \text{Divisor} \times \text{Quotient} + \text{Remainder}$$

Therefore,

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$$x^3 - 3x^2 + x + 2 = g(x) \times (x - 2) - (-2x + 4)$$

$$\Rightarrow x^3 - 3x^2 + x + 2 - (-2x + 4) = g(x) \times (x - 2)$$

$$\Rightarrow \frac{x^3 - 3x^2 + x + 2 - (-2x + 4)}{(x - 2)} = g(x)$$

$$\begin{array}{r} x^2 - x + 1 \\ x-2 \overline{) x^3 - 3x^2 + 3x - 2} \\ \underline{x^3 - 2x^2} \phantom{+ 3x - 2} \\ -x^2 + 3x - 2 \\ \underline{-x^2 + 2x} \phantom{- 2} \\ +x - 2 \\ \underline{+x - 2} \\ 0 \end{array}$$

Therefore,  $g(x) = x^2 - x + 1$

## Question 5:

Give examples of polynomials  $p(x)$ ,  $g(x)$ ,  $q(x)$  and  $r(x)$ , which satisfy the division algorithm and

(i)  $\deg p(x) = \deg q(x)$       (ii)  $\deg q(x) = \deg r(x)$       (iii)  $\deg r(x) = 0$

## Answer 5:

According to Euclid's division lemma,  $(x) = g(x) \times q(x) + r(x)$ , where  $q(x) \neq 0$ , degree of  $r(x) = 0$  or degree of  $r(x) < \text{degree } g(x)$ .

(i) degree of  $p(x) = \text{degree of } q(x)$

The degree of dividend and quotient can be equal, if the divisor is a constant (degree 0) term. Therefore

$$\text{Let } p(x) = 3x^2 - 6x + 5$$

$$\text{Let } g(x) = 3$$

$$\text{Therefore, } q(x) = x^2 - 2x + 1 \text{ and } r(x) = 2$$

(ii) degree of  $q(x) = \text{degree of } r(x)$

$$\text{Let } p(x) = 2x^2 - 4x + 3$$

$$\text{Let } g(x) = x^2 - 2x + 1$$

$$\text{Therefore, } q(x) = 2 \text{ and } r(x) = 1$$

(iii) degree of  $r(x) = 0$

$$\text{Let } p(x) = 2x^2 - 4x + 3$$

$$\text{Let } g(x) = x^2 - 2x + 1$$

$$\text{Therefore, } q(x) = 2 \text{ and } r(x) = 1$$