NCERT Solutions for Class 10 Maths Unit 2

Polynomials Class 10
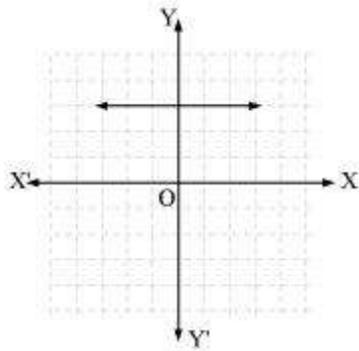
Unit 2 Polynomials Exercise 2.1, 2.2, 2.3 2.4, 2.4 Solutions

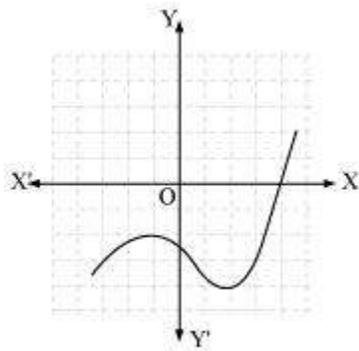**Exercise 2.1 :** Solutions of Questions on Page Number : **28**

Q1 :

The graphs of $y = p(x)$ are given in following figure, for some polynomials $p(x)$. Find the number of zeroes of $p(x)$, in each case.
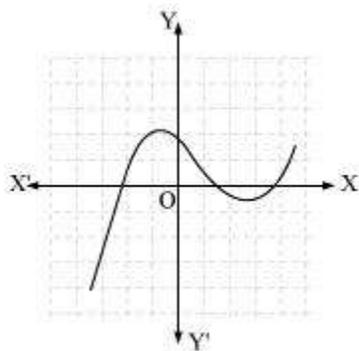
(i)

(ii)

(iii)

(iv)
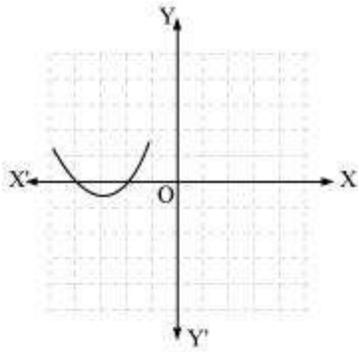
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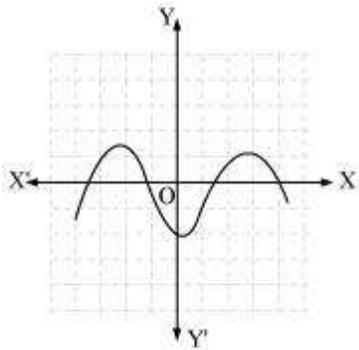
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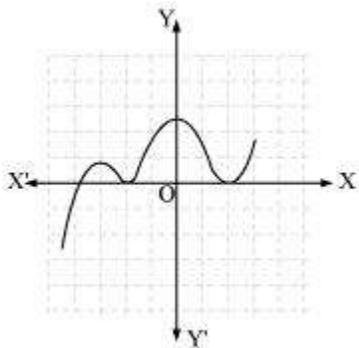
Answer :

(i) The number of zeroes is 0 as the graph does not cut the x-axis at any point.

(ii) The number of zeroes is 1 as the graph intersects the x-axis at only 1 point.

(iii) The number of zeroes is 3 as the graph intersects the x-axis at 3 points.

(iv) The number of zeroes is 2 as the graph intersects the x-axis at 2 points.

(v) The number of zeroes is 4 as the graph intersects the x-axis at 4 points.

(vi) The number of zeroes is 3 as the graph intersects the x-axis at 3 points.

Exercise 2.2 : Solutions of Questions on Page Number : **33**

Q1 :

Find the zeroes of the following quadratic polynomials and verify the relationship between the zeroes and the coefficients.

$(i) x^2 - 2x - 8$ $(ii) 4s^2 - 4s + 1$ $(iii) 6x^2 - 3 - 7x$

$(iv) 4u^2 + 8u$ $(v) t^2 - 15$ $(vi) 3x^2 - x - 4$

Answer :

(i) $x^2 - 2x - 8 = (x-4)(x+2)$

The value of $x^2 - 2x - 8$ is zero when $x - 4 = 0$ or $x + 2 = 0$, i.e., when $x = 4$ or $x = -2$

Therefore, the zeroes of $x^2 - 2x - 8$ are 4 and - 2.

Sum of zeroes = $4 - 2 = 2 = \dfrac{-(-2)}{1} = \dfrac{-(\text{Coefficient of } x)}{\text{Coefficient of } x^2}$

Product of zeroes $= 4 \times (-2) = -8 = \dfrac{(-8)}{1} = \dfrac{\text{Constant term}}{\text{Coefficient of } x^2}$

(ii) $4s^2 - 4s + 1 = (2s-1)^2$

The value of $4s^2 - 4s + 1$ is zero when $2s - 1 = 0$, i.e., $s = \dfrac{1}{2}$

Therefore, the zeroes of $4s^2 - 4s + 1$ are $\dfrac{1}{2}$ and $\dfrac{1}{2}$.

Sum of zeroes = $\dfrac{1}{2} + \dfrac{1}{2} = 1 = \dfrac{-(-4)}{4} = \dfrac{-(\text{Coefficient of } s)}{(\text{Coefficient of } s^2)}$

Product of zeroes $= \dfrac{1}{2} \times \dfrac{1}{2} = \dfrac{1}{4} = \dfrac{\text{Constant term}}{\text{Coefficient of } s^2}$

(iii) $6x^2 - 3 - 7x = 6x^2 - 7x - 3 = (3x+1)(2x-3)$

The value of $6x^2 - 3 - 7x$ is zero when $3x + 1 = 0$ or $2x - 3 = 0$, i.e., $x = \dfrac{-1}{3}$ or $x = \dfrac{3}{2}$

Therefore, the zeroes of $6x^2 - 3 - 7x$ are $\dfrac{-1}{3}$ and $\dfrac{3}{2}$.

Sum of zeroes = $\dfrac{-1}{3} + \dfrac{3}{2} = \dfrac{7}{6} = \dfrac{-(-7)}{6} = \dfrac{-(\text{Coefficient of } x)}{\text{Coefficient of } x^2}$

Product of zeroes = $\dfrac{-1}{3} \times \dfrac{3}{2} = \dfrac{-1}{2} = \dfrac{-3}{6} = \dfrac{\text{Constant term}}{\text{Coefficient of } x^2}$

(iv) $4u^2 + 8u = 4u^2 + 8u + 0$

$= 4u(u + 2)$

The value of $4u^2 + 8u$ is zero when $4u = 0$ or $u + 2 = 0$, i.e., $u = 0$ or $u = -2$

Therefore, the zeroes of $4u^2 + 8u$ are 0 and - 2.

Sum of zeroes = $0 + (-2) = -2 = \dfrac{-(8)}{4} = \dfrac{-(\text{Coefficient of } u)}{\text{Coefficient of } u^2}$

Product of zeroes = $0 \times (-2) = 0 = \dfrac{0}{4} = \dfrac{\text{Constant term}}{\text{Coefficient of } u^2}$

(v) $t^2 - 15$

$= t^2 - 0t - 15$

$= \left(t - \sqrt{15}\right)\left(t + \sqrt{15}\right)$

The value of t^2 - 15 is zero when $t - \sqrt{15} = 0$ or $t + \sqrt{15} = 0$, i.e., when

Q2 :

Find a quadratic polynomial each with the given numbers as the sum and product of its zeroes respectively.

(i) $\dfrac{1}{4}, -1$ (ii) $\sqrt{2}, \dfrac{1}{3}$ (iii) $0, \sqrt{5}$

(iv) $1, 1$ (v) $-\dfrac{1}{4}, \dfrac{1}{4}$ (vi) $4, 1$

Answer :

(i) $\dfrac{1}{4}, -1$

Let the polynomial be $ax^2 + bx + c$, and its zeroes be α and β.

$$\alpha + \beta = \frac{1}{4} = \frac{-b}{a}$$

$$\alpha\beta = -1 = \frac{-4}{4} = \frac{c}{a}$$

If $a = 4$, then $b = -1$, $c = -4$

Therefore, the quadratic polynomial is $4x^2 - x - 4$.

(ii) $\sqrt{2}, \dfrac{1}{3}$

Let the polynomial be $ax^2 + bx + c$, and its zeroes be α and β.

$$\alpha + \beta = \sqrt{2} = \frac{3\sqrt{2}}{3} = \frac{-b}{a}$$

$$\alpha\beta = \frac{1}{3} = \frac{c}{a}$$

If $a = 3$, then $b = -3\sqrt{2}$, $c = 1$

Therefore, the quadratic polynomial is $3x^2 - 3\sqrt{2}\,x + 1$.

(iii) $0, \sqrt{5}$

Let the polynomial be $ax^2 + bx + c$, and its zeroes be α and β.

$$\alpha + \beta = 0 = \frac{0}{1} = \frac{-b}{a}$$

$$\alpha \times \beta = \sqrt{5} = \frac{\sqrt{5}}{1} = \frac{c}{a}$$

If $a = 1$, then $b = 0$, $c = \sqrt{5}$

Therefore, the quadratic polynomial is $x^2 + \sqrt{5}$.

(iv) 1, 1

Let the polynomial be $ax^2 + bx + c$, and its zeroes be α and β.

$$\alpha + \beta = 1 = \frac{1}{1} = \frac{-b}{a}$$

$$\alpha \times \beta = 1 = \frac{1}{1} = \frac{c}{a}$$

If $a = 1$, then $b = -1$, $c = 1$

Therefore, the quadratic polynomial is $x^2 - x + 1$.

(v) $-\dfrac{1}{4}, \dfrac{1}{4}$

Let the polynomial be $ax^2 + bx + c$, and its zeroes be α and

Exercise 2.3 2.4 : Solutions of Questions on Page Number : **36**

Q1 :

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

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

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

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

Answer :

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

$q(x) = x^2 - 2$

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

Quotient $= x - 3$

Remainder $= 7x - 9$

(ii) $p(x) = x^4 - 3x^2 + 4x + 5 = x^4 + 0.x^3 - 3x^2 + 4x + 5$

$q(x) = x^2 + 1 - x = x^2 - x + 1$

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

Quotient = $x^2 + x - 3$

Remainder = 8

(iii) $p(x) = x^4 - 5x + 6 = x^4 + 0.x^2 - 5x + 6$

$q(x) = 2 - x^2 = -x^2 + 2$

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

Quotient = $- x^2 - 2$

Remainder = $- 5x + 10$

Q2 :

Verify that the numbers given alongside of the cubic polynomials below are their zeroes. Also verify the relationship between the zeroes and the coefficients in each case:

(i) $2x^3 + x^2 - 5x + 2;\quad \dfrac{1}{2}, 1, -2$

(ii) $x^3 - 4x^2 + 5x - 2;\quad 2, 1, 1$

Answer :

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

Zeroes for this polynomial are $\dfrac{1}{2}, 1, -2$

$$p\left(\dfrac{1}{2}\right) = 2\left(\dfrac{1}{2}\right)^3 + \left(\dfrac{1}{2}\right)^2 - 5\left(\dfrac{1}{2}\right) + 2$$

$$= \dfrac{1}{4} + \dfrac{1}{4} - \dfrac{5}{2} + 2$$

$$= 0$$

$$p(1) = 2 \times 1^3 + 1^2 - 5 \times 1 + 2$$

$$= 0$$

$$p(-2) = 2(-2)^3 + (-2)^2 - 5(-2) + 2$$

$$= -16 + 4 + 10 + 2 = 0$$

Therefore, $\dfrac{1}{2}$, 1, and - 2 are the zeroes of the given polynomial.

Comparing the given polynomial with $ax^3 + bx^2 + cx + d$, we obtain $a = 2, b = 1, c = -5, d = 2$

We can take $\alpha = \dfrac{1}{2}, \beta = 1, \gamma = -2$

$$\alpha + \beta + \gamma = \dfrac{1}{2} + 1 + (-2) = -\dfrac{1}{2} = \dfrac{-b}{a}$$

$$\alpha\beta + \beta\gamma + \alpha\gamma = \dfrac{1}{2} \times 1 + 1(-2) + \dfrac{1}{2}(-2) = \dfrac{-5}{2} = \dfrac{c}{a}$$

$$\alpha\beta\gamma = \dfrac{1}{2} \times 1 \times (-2) = \dfrac{-1}{1} = \dfrac{-(2)}{2} = \dfrac{-d}{a}$$

Therefore, the relationship between the zeroes and the coefficients is verified.

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

Zeroes for this polynomial are 2, 1, 1.

$$p(2) = 2^3 - 4(2^2) + 5(2) - 2$$

$$= 8 - 16 + 10 - 2 = 0$$

$$p(1) = 1^3 - 4(1)^2 + 5(1) - 2$$

$$= 1 - 4 + 5 - 2 = 0$$

Therefore, 2, 1, 1 are the zeroes of the given polynomial.

Comparing the given polynomial with $ax^3 + bx^2 + cx + d$, we obtain $a = 1, b = -4, c = 5, d = -2$.

Verification of the relationship between zeroes and coefficient of the given polynomial

$$\text{Sum of zeroes} = 2 + 1 + 1 = 4 = \frac{-(-4)}{1} = \frac{-b}{a}$$

$$\text{Multiplication of zeroes taking two at a time} = (2)(1) + (1)(1) + (2)(1) = 2 + 1 + 2 = 5 \quad = \frac{(5)}{1} = \frac{c}{a}$$

$$\text{Multiplication of zeroes} = 2 \times 1 \times 1 = 2 \quad = \frac{-(-2)}{1} = \frac{-d}{a}$$

Hence, the relationship between the zeroes and the coefficients is verified.

Q3 :

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

Answer :

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

$t^2 - 3 = t^2 + 0.t - 3$

$$
\require{enclose}
\begin{array}{r}
2t^2 + 3t + 4 \\
t^2 + 0.t - 3 \enclose{longdiv}{2t^4 + 3t^3 - 2t^2 - 9t - 12} \\
2t^4 + 0.t^3 - 6t^2 \\
\hline
-\quad -\quad + \\
\hline
3t^3 + 4t^2 - 9t - 12 \\
3t^3 + 0.t^2 - 9t \\
\hline
-\quad -\quad + \\
\hline
4t^2 + 0.t - 12 \\
4t^2 + 0.t - 12 \\
\hline
-\quad -\quad + \\
\hline
0
\end{array}
$$

Since the remainder is 0,

Hence, $t^2 - 3$ is a factor of $2t^4 + 3t^3 - 2t^2 - 9t - 12$.

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

$$
\begin{array}{r}
3x^2 - 4x + 2 \\
x^2 + 3x + 1 \overline{)\ 3x^4 + 5x^3 - 7x^2 + 2x + 2} \\
3x^4 + 9x^3 + 3x^2 \\
\hline
-\quad -\quad - \\
\hline
-4x^3 - 10x^2 + 2x + 2 \\
-4x^3 - 12x^2 - 4x \\
+\quad +\quad + \\
\hline
2x^2 + 6x + 2 \\
2x^2 + 6x + 2 \\
\hline
0
\end{array}
$$

Since the remainder is 0,

Hence, $x^2 + 3x + 1$ is a factor of $3x^4 + 5x^3 - 7x^2 + 2x + 2$.

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

$$
\begin{array}{r}
x^2 - 1 \\
x^3 - 3x + 1 \overline{)\ x^5 - 4x^3 + x^2 + 3x + 1} \\
x^5 - 3x^3 + x^2 \\
\hline
-\quad +\quad - \\
\hline
-x^3 \qquad\quad + 3x + 1 \\
-x^3 \qquad\quad + 3x - 1 \\
+\qquad\qquad -\quad + \\
\hline
2
\end{array}
$$

Since the remainder $\neq 0$,

Hence, $x^3 - 3x + 1$ is not a factor of $x^5 - 4x^3 + x^2 + 3x + 1$.

Q4 :

Find a cubic polynomial with the sum, sum of the product of its zeroes taken two at a time, and the product of its zeroes as 2, - 7, - 14 respectively.

Answer :

Let the polynomial be $ax^3 + bx^2 + cx + d$ and the zeroes be $\alpha, \beta,$ and γ.

It is given that

$$\alpha + \beta + \gamma = \frac{2}{1} = \frac{-b}{a}$$

$$\alpha\beta + \beta\gamma + \alpha\gamma = \frac{-7}{1} = \frac{c}{a}$$

$$\alpha\beta\gamma = \frac{-14}{1} = \frac{-d}{a}$$

If $a = 1$, then $b = -2$, $c = -7$, $d = 14$

Hence, the polynomial is $x^3 - 2x^2 - 7x + 14$.

Q5 :

Obtain all other zeroes of $3x^4 + 6x^3 - 2x^2 - 10x - 5$, if two of its zeroes are $\sqrt{\dfrac{5}{3}}$ and $-\sqrt{\dfrac{5}{3}}$.

Answer :

$$p(x) = 3x^4 + 6x^3 - 2x^2 - 10x - 5$$

Since the two zeroes are $\sqrt{\dfrac{5}{3}}$ and $-\sqrt{\dfrac{5}{3}}$,

$$\therefore \left(x - \sqrt{\frac{5}{3}}\right)\left(x + \sqrt{\frac{5}{3}}\right) = \left(x^2 - \frac{5}{3}\right)$$ is a factor of $3x^4 + 6x^3 - 2x^2 - 10x - 5$.

Therefore, we divide the given polynomial by $x^2 - \dfrac{5}{3}$.

$$x^2 + 0.x - \frac{5}{3} \overline{\smash{\big)}\ 3x^4 + 6x^3 - 2x^2 - 10x - 5}\ \overset{\displaystyle 3x^2 + 6x + 3}{}$$

$$3x^4 + 0x^3 - 5x^2$$

$$- \quad - \quad +$$

$$6x^3 + 3x^2 - 10x - 5$$

$$6x^3 + 0x^2 - 10x$$

$$- \quad - \quad +$$

$$3x^2 + 0x - 5$$

$$3x^2 + 0x - 5$$

$$- \quad - \quad +$$

$$0$$

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

$$= 3\left(x^2 - \frac{5}{3} \right)\left(x^2 + 2x + 1 \right)$$

We factorize $x^2 + 2x + 1$

$$= (x+1)^2$$

Therefore, its zero is given by $x + 1 = 0$

$x = - 1$

As it has the term $(x+1)^2$, therefore, there will be 2 zeroes at $x = - 1$.

Hence, the zeroes of the given polynomial are $\sqrt{\frac{5}{3}}, -\sqrt{\frac{5}{3}}$, - 1 and - 1.

Q6 :

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 :

$$p(x) = x^3 - 3x^2 + x + 2 \qquad \text{(Dividend)}$$

$g(x) = ?$ (Divisor)

Quotient = $(x - 2)$

Remainder = (- 2x + 4)

Dividend = Divisor × Quotient + Remainder

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

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

$$x^3 - 3x^2 + 3x - 2 = g(x)(x - 2)$$

$g(x)$ is the quotient when we divide $\left(x^3 - 3x^2 + 3x - 2\right)$ by $(x - 2)$

$$
\require{enclose}
\begin{array}{r}
x^2 - x + 1 \\
x - 2 \enclose{longdiv}{x^3 - 3x^2 + 3x - 2} \\
\underline{x^3 - 2x^2} \\
-\quad + \\
\hline
-x^2 + 3x - 2 \\
-x^2 + 2x \\
\underline{+\quad -} \\
x - 2 \\
x - 2 \\
\underline{-\quad +} \\
0
\end{array}
$$

$$\therefore g(x) = \left(x^2 - x + 1\right)$$

Q7 :

Give examples of polynomial $p(x)$, $g(x)$, $q(x)$ 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 :

According to the division algorithm, if $p(x)$ and $g(x)$ are two polynomials with

$g(x) \neq 0$, then we can find polynomials $q(x)$ and $r(x)$ such that

$p(x) = g(x) \times q(x) + r(x)$,

where $r(x) = 0$ or degree of $r(x) <$ degree of $g(x)$

Degree of a polynomial is the highest power of the variable in the polynomial.

(i) deg $p(x)$ = deg $q(x)$

Degree of quotient will be equal to degree of dividend when divisor is constant (i.e., when any polynomial is divided by a constant).

Let us assume the division of $6x^2 + 2x + 2$ by 2.

Here, $p(x) = 6x^2 + 2x + 2$

$g(x) = 2$

$q(x) = 3x^2 + x + 1$ and $r(x) = 0$

Degree of $p(x)$ and $q(x)$ is the same i.e., 2.

Checking for division algorithm,

$p(x) = g(x) \times q(x) + r(x)$

$6x^2 + 2x + 2 = 2(3x^2 + x + 1)$

$= 6x^2 + 2x + 2$

Thus, the division algorithm is satisfied.

(ii) deg $q(x)$ = deg $r(x)$

Let us assume the division of $x^3 + x$ by x^2,

Here, $p(x) = x^3 + x$

$g(x) = x^2$

$q(x) = x$ and $r(x) = x$

Clearly, the degree of $q(x)$ and $r(x)$ is the same i.e., 1.

Checking for division algorithm,

$p(x) = g(x) \times q(x) + r(x)$

$x^3 + x = (x^2) \times x + x$

$x^3 + x = x^3 + x$

Thus, the division algorithm is satisfied.

(iii) deg $r(x) = 0$

Degree of remainder will be 0 when remainder comes to a constant.

Let us assume the division of $x^3 + 1$ by x^2.

Here, $p(x) = x^3 + 1$

$g(x) = x^2$

$q(x) = x$ and $r(x) = 1$

Clearly, the degree of $r(x)$ is 0.

Checking for division algorithm,

$p(x) = g(x) \times q(x) + r(x)$

$x^3 + 1 = (x^2) \times x + 1$

$x^3 + 1 = x^3 + 1$

Thus, the division algorithm is satisfied.

Exercise 2.4 : Solutions of Questions on Page Number : 37

Q1 :

If the zeroes of polynomial $x^3 - 3x^2 + x + 1$ **are** $a - b, a, a + b$ **, find** *a* **and** *b***.**

Answer :

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

Zeroes are *a* - *b*, *a* + *a* + *b*

Comparing the given polynomial with $px^3 + qx^2 + rx + t$, we obtain

$p = 1, q = -3, r = 1, t = 1$

$\text{Sum of zeroes} = a - b + a + a + b$

$\dfrac{-q}{p} = 3a$

$\dfrac{-(-3)}{1} = 3a$

$3 = 3a$

$a = 1$

The zeroes are $1 - b, 1, 1 + b$.

$\text{Multiplication of zeroes} = 1(1-b)(1+b)$

$\dfrac{-t}{p} = 1 - b^2$

$\dfrac{-1}{1} = 1 - b^2$

$1 - b^2 = -1$

$1 + 1 = b^2$

$b = \pm\sqrt{2}$

Hence, $a = 1$ and $b = \sqrt{2}$ or $-\sqrt{2}$.

Q2 :

]It two zeroes of the polynomial $x^4 - 6x^3 - 26x^2 + 138x - 35$ **are** $2 \pm \sqrt{3}$ **, find other zeroes.**

Answer :

Given that $2 + \sqrt{3}$ and $2 - \sqrt{3}$ are zeroes of the given polynomial.

Therefore, $\left(x - 2 - \sqrt{3}\right)\left(x - 2 + \sqrt{3}\right) = x^2 + 4 - 4x - 3$

$= x^2 - 4x + 1$ is a factor of the given polynomial

For finding the remaining zeroes of the given polynomial, we will find the quotient by dividing $x^4 - 6x^3 - 26x^2 + 138x - 35$ by $x^2 - 4x + 1$.

$$
\begin{array}{r}
x^2 - 2x - 35 \\
x^2 - 4x + 1 \overline{)\, x^4 - 6x^3 - 26x^2 + 138x - 35} \\
x^4 - 4x^3 + \quad x^2 \\
-\quad + \quad - \\
\hline
-2x^3 - 27x^2 + 138x - 35 \\
-2x^3 + 8x^2 - \quad 2x \\
+ \quad - \quad + \\
\hline
-35x^2 + 140x - 35 \\
-35x^2 + 140x - 35 \\
+ \quad - \quad + \\
\hline
0
\end{array}
$$

Clearly, $x^4 - 6x^3 - 26x^2 + 138x - 35 = \left(x^2 - 4x + 1\right)\left(x^2 - 2x - 35\right)$

It can be observed that $\left(x^2 - 2x - 35\right)$ is also a factor of the given polynomial.

And $\left(x^2 - 2x - 35\right) = (x - 7)(x + 5)$

Therefore, the value of the polynomial is also zero when $x - 7 = 0$ or $x + 5 = 0$

Or $x = 7$ or - 5

Hence, 7 and - 5 are also zeroes of this polynomial.

Q3 :

If the polynomial $x^4 - 6x^3 + 16x^2 - 25x + 10$ is divided by another polynomial $x^2 - 2x + k$, the remainder comes out to be *x + a*, find *k* and *a*.

Answer :

By division algorithm,

Dividend = Divisor × Quotient + Remainder

Dividend - Remainder = Divisor × Quotient

$x^4 - 6x^3 + 16x^2 - 25x + 10 - x - a = x^4 - 6x^3 + 16x^2 - 26x + 10 - a$ will be perfectly divisible by $x^2 - 2x + k$.

Let us divide $x^4 - 6x^3 + 16x^2 - 26x + 10 - a$ by $x^2 - 2x + k$

$$
\begin{array}{r}
x^2 - 4x + (8-k) \\
x^2 - 2x + k \overline{)\, x^4 - 6x^3 + 16x^2 - 26x + 10 - a} \\
x^4 - 2x^3 + kx^2 \\
\underline{-\quad + \quad -\qquad\qquad} \\
-4x^3 + (16-k)x^2 - 26x \\
-4x^3 + \qquad 8x^2 - 4kx \\
\underline{+\quad -\qquad\quad +\qquad} \\
(8-k)x^2 - (26-4k)x + 10 - a \\
(8-k)x^2 - (16-2k)x + (8k - k^2) \\
\underline{-\qquad\quad +\qquad\quad -\qquad} \\
(-10+2k)x + (10 - a - 8k + k^2)
\end{array}
$$

It can be observed that $(-10+2k)x + (10 - a - 8k + k^2)$ will be 0.

Therefore, $(-10+2k) = 0$ and $(10 - a - 8k + k^2) = 0$

For $(-10+2k) = 0$,

$2k = 10$

And thus, $k = 5$

For $(10 - a - 8k + k^2) = 0$

10 - *a* - 8 × 5 + 25 = 0

10 - *a* - 40 + 25 = 0

- 5 - a = 0

Therefore, a = - 5

Hence, k = 5 and a = - 5