

NCERT SOLUTIONS

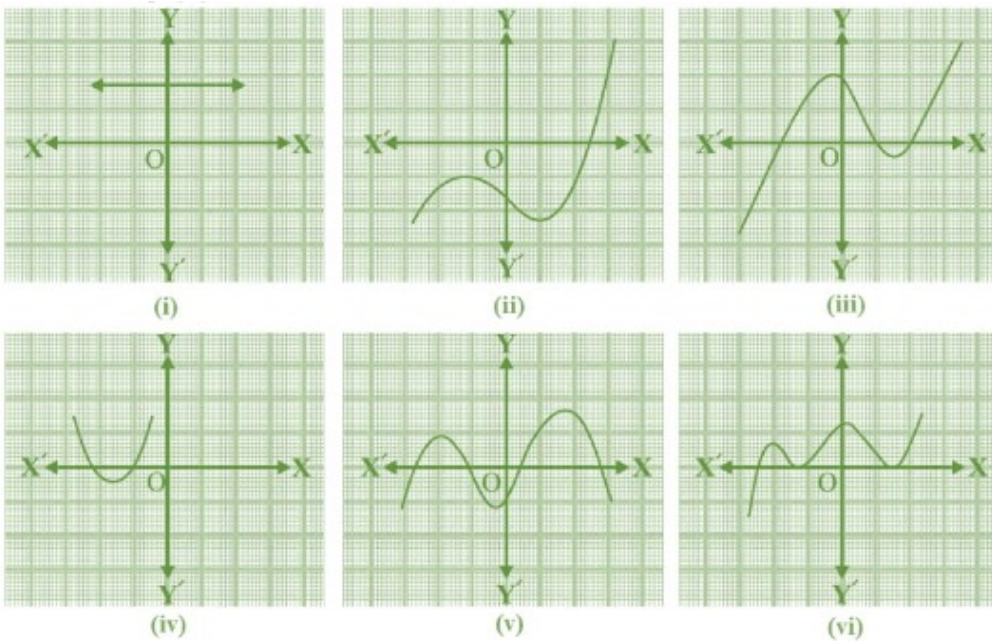
CLASS - 10th



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Exercise 2.1

Q1 The graphs of $y = p(x)$ are given in Figure below, for some polynomials $p(x)$. Find the number of zeroes of $p(x)$, in each case.



- 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

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. The value of $x^2 - 2x - 8$ is zero if $x + 2 = 0$ or $x - 4 = 0$

$$\Rightarrow x = -2 \text{ or } x = 4$$

Therefore, the zeroes of

$$\begin{aligned} x^2 - 2x - 8 \text{ are } -2 \text{ and } 4. \text{ Now } (-2) + 4 &= 2 = \frac{-(-2)}{1} = \frac{-(\text{Coefficient of } x)}{\text{Coefficient of } x^2} \\ (-2) \times 4 &= -8 = \frac{-8}{1} = \frac{\text{Constant term}}{\text{Coefficient of } x^2} \end{aligned}$$

(ii)

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

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

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

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

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

(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.,

$$x = \frac{-1}{3} \text{ or } x = \frac{3}{2}$$

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

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

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

(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 .

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

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

(v)

$$t^2 - 15$$

$$= t^2 - 0.1 - 15$$

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

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

Therefore, the zeroes of $t^2 - 15$ are $\sqrt{15}$ and $-\sqrt{15}$.

$$\text{Sum of zeroes} = \sqrt{15} + (-\sqrt{15}) = 0 = \frac{-0}{1} = \frac{-(\text{Coefficient of } t)}{(\text{Coefficient of } t^2)}$$

$$\text{Product of zeroes} = (\sqrt{15})(-\sqrt{15}) = -15 = \frac{-15}{1} = \frac{\text{Constant term}}{\text{Coefficient of } x^2}$$

$$\text{(vi) } 3x^2 - x - 4$$

$$= (3x - 4)(x + 1)$$

The value of $3x^2 - x - 4$ is zero when $3x - 4 = 0$ or $x + 1 = 0$, i.e.,

when $x = \frac{4}{3}$ or $x = -1$

Therefore, the zeroes of $3x^2 - x - 4$ are $\frac{4}{3}$ and -1

$$\text{Sum of zeroes} = \frac{4}{3} + (-1) = \frac{1}{3} = \frac{-(-1)}{3} = \frac{-(\text{Coefficient of } x)}{\text{Coefficient of } x^2}$$

$$\text{Product of zeroes} = \frac{4}{3}(-1) = \frac{-4}{3} = \frac{\text{Constant term}}{\text{Coefficient of } x^2}$$

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Q2 Find a quadratic polynomial each with the given numbers as the sum and product of its zeroes respectively.

$$\text{(i) } \frac{1}{4}, -1$$

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

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

$$\text{(iv) } 1, 1$$

$$\text{(v) } -\frac{1}{4}, \frac{1}{4}$$

$$\text{(vi) } 4, 1$$

Answer. (i) Let α and β are the zeroes of the polynomial $ax^2 + bx + c$, then we have

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

$$\text{On comparing, } \alpha\beta = -1 = \frac{-c}{a} = \frac{C}{a}$$

$$a=4, b=-1, \text{ and } c=-4$$

(ii) Let α and β are the zeroes of the polynomial $ax^2 + bx + c$, then we have

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

On comparing,

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

$$a = 3, b = -3\sqrt{2} \text{ and } c = 1$$

Hence, the required quadratic polynomial is $x^2 + 0. x + \sqrt{5}$

(iii) Let α and β are the zeroes of the polynomial $ax^2 + bx + c$. then we have

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

$$\text{on comparing } \alpha\beta = \sqrt{5} = \frac{\sqrt{5}}{1} = \frac{c}{a}$$

Hence, the required quadratic polynomial is : $x^2 + 0.x + \sqrt{5}$

(iv) Let α and β are the zeroes Of the polynomial $ax^2 + bx + c$, then we have

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

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

on comparing, $a = 1$, $b = -1$ and $c = 1$

Hence. the required quadratic polynomial is $x^2 - x + 1$

(v) Let α and β are the zeroes Of the polynomial $ax^2 + bx + c$, then we have

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

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

on comparing,

$a=4, b=1$, and $c=1$

Hence. the required quadratic polynomial is $4x^2 + x + 1$

(vi) Let α and β are the zeroes Of the polynomial $ax^2 + bx + c$, then we have

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

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

on comparing ,

$a=1, b=-4$ and $c=1$

Hence, the required quadratic polynomial is $x^2 - 4x + 1$

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Exercise 2.3

Q1 Divide the polynomial $p(x)$ by the polynomial $g(x)$ and find the quotient and remainder in each of the following :

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

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

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

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

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

Quotient = $x - 3$

Remainder = $7x - 9$

(ii)

$$p(x) = x^4 - 3x^2 + 4x + 5 = x^4 + 0 \cdot x^3 - 3x^2 + 4x + 5$$

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

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

Quotient = $x^2 + x - 3$

Remainder = 8

(iii)

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

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

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

Quotient = $-x^2 - 2$
 Remainder = $-5x + 10$

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Q2 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) $t^2 - 3, 2t^4 + 3t^3 - 2t^2 - 9t - 12$

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

$$\begin{array}{r}
 2t^2 + 3t + 4 \\
 t^2 + 0t - 3 \overline{) 2t^4 + 3t^3 - 2t^2 - 9t - 12} \\
 \underline{2t^4 + 0t^3 - 6t^2} \\
 3t^3 + 4t^2 - 9t - 12 \\
 \underline{3t^3 + 0t^2 - 9t} \\
 4t^2 + 0t - 12 \\
 \underline{4t^2 + 0t - 12} \\
 0
 \end{array}$$

Since the remainder is 0,

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

(ii)

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

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

Since the remainder is 0,

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

(iii)

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

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

Since the remainder $\neq 0$,

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

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Q3 Obtain all other zeroes of $3x^4 + 6x^3 - 2x^2 - 10x - 5$, if two of its zeroes are $\sqrt{\frac{5}{3}}$ and $-\sqrt{\frac{5}{3}}$.

$$\text{Answer. } p(x) = 3x^4 + 6x^3 - 2x^2 - 10x - 5$$

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

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

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

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

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

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 .

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Q4 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.

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

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

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

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

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

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

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

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

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

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

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

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Q5 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 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, $p(x) = 6x^2 + 2x + 2$

$$g(x) = 2$$

$$q(x) = 3x^2 + x + 1 \text{ and } r(x) = 0$$

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 ,

$$\text{Here, } p(x) = x^3 + x$$

$$g(x) = x^2$$

$$q(x) = x \text{ and } r(x) = x$$

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 .

$$\text{Here, } p(x) = x^3 + 1$$

$$g(x) = x^2$$

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

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.

Q1 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) $2x^3 + x^2 - 5x + 2$; $\frac{1}{2}, 1, -2$

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

Answer.

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

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

$$\begin{aligned} P\left(\frac{1}{2}\right) &= 2\left(\frac{1}{2}\right)^3 + \left(\frac{1}{2}\right)^2 - 5\left(\frac{1}{2}\right) + 2 \\ &= \frac{1}{4} + \frac{1}{4} - \frac{5}{2} + 2 \\ &= 0 \end{aligned}$$

$$\begin{aligned} p(1) &= 2 \times 1^3 + 1^2 - 5 \times 1 + 2 \\ &= 0 \end{aligned}$$

$$\begin{aligned} p(-2) &= 2(-2)^3 + (-2)^2 - 5(-2) + 2 \\ &= -16 + 4 + 10 + 2 = 0 \end{aligned}$$

Therefore, $\frac{1}{2}, 1$, 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 $\alpha = \frac{1}{2}, \beta = 1, \gamma = -2$

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

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

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

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 $2, 1, 1$.

$$\begin{aligned} p(2) &= 2^3 - 4(2^2) + 5(2) - 2 \\ &= 8 - 16 + 10 - 2 = 0 \end{aligned}$$

$$\begin{aligned} p(1) &= 1^3 - 4(1)^2 + 5(1) - 2 \\ &= 1 - 4 + 5 - 2 = 0 \end{aligned}$$

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

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

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

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

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

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Q2 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 α, β , and γ

It is given that

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

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

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

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

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

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Q3 If the zeroes of the 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

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

sum of zeroes = $a-b+a+a+b$

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

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

$$3=3a$$

$$a=1$$

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

Multiplication of zeroes = $1(1-b)(1+b)$

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

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

$$1 - b^2 = -1$$

$$1 + 1 = b^2$$

$$b = \pm\sqrt{2}$$

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Q4 If 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, $(x - 2 - \sqrt{3})(x - 2 + \sqrt{3}) = x^2 + 4 - 4x - 3$

$= x^2 - 4x + 1$ 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 $x^2 - 4x + 1$

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

$$\text{Clearly, } x^4 - 6x^3 - 26x^2 + 138x - 35 = (x^2 - 4x + 1)(x^2 - 2x - 35)$$

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

$$\text{And } (x^2 - 2x - 35) = (x - 7)(x + 5)$$

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.

