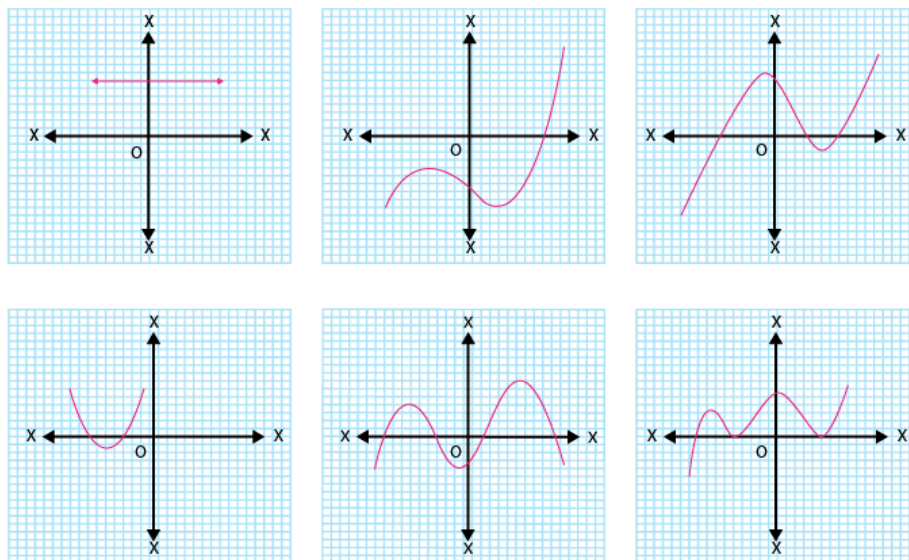


NCERT Solution For Class 10 Maths Chapter 2- Polynomials

Exercise 2.1

1. The graphs of $y = p(x)$ are given in Fig. 2.10 below, for some polynomials $p(x)$. Find the number of zeroes of $p(x)$, in each case.



Solutions:

Graphical method to find zeroes:-

Total number of zeroes in any polynomial equation = total number of times the curve intersects x-axis.

- (i) In the given graph, the number of zeroes of $p(x)$ is 0 because the graph is parallel to x-axis does not cut it at any point.
- (ii) In the given graph, the number of zeroes of $p(x)$ is 1 because the graph intersects the x-axis at only one point.
- (iii) In the given graph, the number of zeroes of $p(x)$ is 3 because the graph intersects the x-axis at any three points.
- (iv) In the given graph, the number of zeroes of $p(x)$ is 2 because the graph intersects the x-axis at two points.
- (v) In the given graph, the number of zeroes of $p(x)$ is 4 because the graph intersects the x-axis at four points.
- (vi) In the given graph, the number of zeroes of $p(x)$ is 3 because the graph intersects the x-axis at three points.

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Exercise 2.2

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

Solutions:

(i) $x^2 - 2x - 8$

$$\Rightarrow x^2 - 4x + 2x - 8 = x(x-4) + 2(x-4) = (x-4)(x+2)$$

Therefore, zeroes of polynomial equation $x^2 - 2x - 8$ are (4, -2)

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

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

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

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

Therefore, zeroes of polynomial equation $4s^2 - 4s + 1$ are (1/2, 1/2)

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

$$\text{Product of zeros} = (1/2) \times (1/2) = 1/4 = (\text{Constant term})/(\text{Coefficient of } s^2)$$

(iii) $6x^2 - 3 - 7x$

$$\Rightarrow 6x^2 - 7x - 3 = 6x^2 - 9x + 2x - 3 = 3x(2x - 3) + 1(2x - 3) = (3x+1)(2x-3)$$

Therefore, zeroes of polynomial equation $6x^2 - 3 - 7x$ are (-1/3, 3/2)

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

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

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

$$\Rightarrow 4u(u+2)$$

Therefore, zeroes of polynomial equation $4u^2 + 8u$ are (0, -2).

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

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

(v) $t^2 - 15$

$$\Rightarrow t^2 = 15 \text{ or } t = \pm\sqrt{15}$$

Therefore, zeroes of polynomial equation $t^2 - 15$ are $(\sqrt{15}, -\sqrt{15})$

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

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

(vi) $3x^2 - x - 4$

$$\Rightarrow 3x^2 - 4x + 3x - 4 = x(3x - 4) + 1(3x - 4) = (3x - 4)(x + 1)$$

Therefore, zeroes of polynomial equation $3x^2 - x - 4$ are $(4/3, -1)$

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

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

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

(i) $1/4, -1$

Solution:

From the formulas of sum and product of zeroes, we know,

$$\text{Sum of zeroes} = \alpha + \beta$$

$$\text{Product of zeroes} = \alpha \beta$$

$$\text{Sum of zeroes} = \alpha + \beta = 1/4$$

$$\text{Product of zeroes} = \alpha \beta = -1$$

\therefore If α and β are zeroes of any quadratic polynomial, then the quadratic polynomial equation can be written directly as:-

$$x^2 - (\alpha + \beta)x + \alpha\beta = 0$$

$$x^2 - (1/4)x + (-1) = 0$$

$$4x^2 - x - 4 = 0$$

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

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

Solution:

Sum of zeroes = $\alpha + \beta = \sqrt{2}$

Product of zeroes = $\alpha \beta = 1/3$

\therefore If α and β are zeroes of any quadratic polynomial, then the quadratic polynomial equation can be written directly as:-

$$x^2 - (\alpha + \beta)x + \alpha\beta = 0$$

$$x^2 - (\sqrt{2})x + (1/3) = 0$$

$$3x^2 - 3\sqrt{2}x + 1 = 0$$

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

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

Solution:

Given,

Sum of zeroes = $\alpha + \beta = 0$

Product of zeroes = $\alpha \beta = \sqrt{5}$

\therefore If α and β are zeroes of any quadratic polynomial, then the quadratic polynomial equation can be written directly as:-

$$x^2 - (\alpha + \beta)x + \alpha\beta = 0$$

$$x^2 - (0)x + \sqrt{5} = 0$$

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

(iv) $1, 1$

Solution:

Given,

Sum of zeroes = $\alpha + \beta = 1$

Product of zeroes = $\alpha \beta = 1$

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∴ If α and β are zeroes of any quadratic polynomial, then the quadratic polynomial equation can be written directly as:-

$$x^2 - (\alpha + \beta)x + \alpha\beta = 0$$

$$x^2 - x + 1 = 0$$

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

(v) -1/4, 1/4

Solution:

Given,

$$\text{Sum of zeroes} = \alpha + \beta = -1/4$$

$$\text{Product of zeroes} = \alpha\beta = 1/4$$

∴ If α and β are zeroes of any quadratic polynomial, then the quadratic polynomial equation can be written directly as:-

$$x^2 - (\alpha + \beta)x + \alpha\beta = 0$$

$$x^2 - (-1/4)x + (1/4) = 0$$

$$4x^2 + x + 1 = 0$$

Thus, $4x^2 + x + 1$ is the quadratic polynomial.

(vi) 4, 1

Solution:

Given,

$$\text{Sum of zeroes} = \alpha + \beta = 4$$

$$\text{Product of zeroes} = \alpha\beta = 1$$

∴ If α and β are zeroes of any quadratic polynomial, then the quadratic polynomial equation can be written directly as:-

$$x^2 - (\alpha + \beta)x + \alpha\beta = 0$$

$$x^2 - 4x + 1 = 0$$

Thus, $x^2 - 4x + 1$ is the quadratic polynomial.

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Exercise 2.3

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

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

Solution:

Given,

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

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

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

Therefore, upon division we get,

Quotient = $x - 3$

Remainder = $7x - 9$

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

Solution:

Given,

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

Divisor = $g(x) = x^2 + 1 - x$

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

Therefore, upon division we get,
 Quotient = $x^2 + x - 3$
 Remainder = 8

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

Solution:

Given,

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

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

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

Therefore, upon division we get,
 Quotient = $-x^2 - 2$

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$$\text{Remainder} = -5x + 10$$

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

Solutions:

Given,

First polynomial = t^2-3

Second polynomial = $2t^4+3t^3-2t^2-9t-12$

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

As we can see, the remainder is left as 0. Therefore, we say that, t^2-3 is a factor of $2t^2+3t+4$.

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

Solutions:

Given,

First polynomial = x^2+3x+1

Second polynomial = $3x^4+5x^3-7x^2+2x+2$

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

As we can see, the remainder is left as 0. Therefore, we say that, $x^2 + 3x + 1$ is a factor of $3x^4 + 5x^3 - 7x^2 + 2x + 2$.

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

Solutions:

Given,

First polynomial = $x^3 - 3x + 1$

Second polynomial = $x^5 - 4x^3 + x^2 + 3x + 1$

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

As we can see, the remainder is not equal to 0. Therefore, we say that, $x^3 - 3x + 1$ is not a factor of $x^5 - 4x^3 + x^2 + 3x + 1$.

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

Solutions:

Since this is a polynomial equation of degree 4, hence there will be total 4 roots.

$\sqrt{5/3}$ and $-\sqrt{5/3}$ are zeroes of polynomial $f(x)$.

$$\therefore (x - \sqrt{5/3})(x + \sqrt{5/3}) = x^2 - (5/3) = 0$$

$(3x^2-5)=0$, is a factor of given polynomial $f(x)$.

Now, when we will divide $f(x)$ by $(3x^2-5)$ the quotient obtained will also be a factor of $f(x)$ and the remainder will be 0.

$x^2 + 2x + 1$	
$3x^2 - 5$	$3x^4 + 6x^3 - 2x^2 - 10x - 5$
	$3x^4 \quad - 5x^2$
(-)	(+)
	$+ 6x^3 + 3x^2 - 10x - 5$
	$- 6x^3 \quad - 10x$
(+)	(-)
	$3x^2 \quad - 5$
	$3x^2 \quad - 5$
(-)	(+)
	0

Therefore, $3x^4+6x^3-2x^2-10x-5 = (3x^2-5)(x^2+2x+1)$

Now, on further factorizing (x^2+2x+1) we get,

$$x^2+2x+1 = x^2+x+x+1 = 0$$

$$x(x+1)+1(x+1) = 0$$

$$(x+1)(x+1) = 0$$

So, its zeroes are given by: $x = -1$ and $x = -1$.

Therefore, all four zeroes of given polynomial equation are:

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$\sqrt{5/3}, -\sqrt{5/3}, -1$ and -1 .

Hence, is the answer.

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 $g(x)$.

Solutions:

Given,

Dividend, $p(x) = x^3-3x^2+x+2$

Quotient = $x-2$

Remainder = $-2x+4$

We have to find the value of Divisor, $g(x) = ?$

As we know,

Dividend = Divisor \times Quotient + Remainder

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

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

$$\text{Therefore, } g(x) \times (x-2) = x^3-3x^2+x+2$$

Now, for finding $g(x)$ we will divide x^3-3x^2+x+2 with $(x-2)$

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

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

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

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

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

(iii) $\text{deg } r(x) = 0$

Solutions:

According to the division algorithm, dividend $p(x)$ and divisor $g(x)$ are two polynomials, where $g(x) \neq 0$. Then we

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can find the value of quotient $q(x)$ and remainder $r(x)$, with the help of below given formula;

Dividend = Divisor \times Quotient + Remainder

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

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

Now let us proof the three given cases as per division algorithm by taking examples for each.

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

Degree of dividend is equal to degree of quotient, only when the divisor is a constant term.

Let us take an example, $3x^2+3x+3$ is a polynomial to be divided by 3.

$$\text{So, } (3x^2+3x+3)/3 = x^2+x+1 = q(x)$$

Thus, you can see, the degree of quotient is equal to the degree of dividend.

Hence, division algorithm is satisfied here.

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

Let us take an example, $p(x)=x^2+x$ is a polynomial to be divided by $g(x)=x$.

$$\text{So, } (x^2+x)/x = x+1 = q(x)$$

Also, remainder, $r(x) = 0$

Thus, you can see, the degree of quotient is equal to the degree of remainder.

Hence, division algorithm is satisfied here.

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

The degree of remainder is 0 only when the remainder left after division algorithm is constant.

Let us take an example, $p(x) = x^2+1$ is a polynomial to be divided by $g(x)=x$.

$$\text{So, } (x^2+1)/x = x = q(x)$$

And $r(x)=1$

Clearly, the degree of remainder here is 0.

Hence, division algorithm is satisfied here.

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Exercise 2.4

1. 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) $2x^3+x^2-5x+2$; $-1/2, 1, -2$

Solution:

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

And zeroes for $p(x)$ are $= 1/2, 1, -2$

$$\therefore p(1/2) = 2(1/2)^3+(1/2)^2-5(1/2)+2 = (1/4)+(1/4)-(5/2)+2 = 0$$

$$p(1) = 2(1)^3+(1)^2-5(1)+2 = 0$$

$$p(-2) = 2(-2)^3+(-2)^2-5(-2)+2 = 0$$

Hence, proved $1/2, 1, -2$ are the zeroes of $2x^3+x^2-5x+2$.

Now, comparing the given polynomial with general expression, we get;

$$\therefore ax^3+bx^2+cx+d = 2x^3+x^2-5x+2$$

$$a=2, b=1, c= -5 \text{ and } d = 2$$

As we know, if α, β, γ are the zeroes of the cubic polynomial ax^3+bx^2+cx+d , then;

$$\alpha + \beta + \gamma = -b/a$$

$$\alpha\beta + \beta\gamma + \gamma\alpha = c/a$$

$$\alpha \beta \gamma = -d/a.$$

Therefore, putting the values of zeroes of the polynomial,

$$\alpha + \beta + \gamma = 1/2 + 1 + (-2) = -1/2 = -b/a$$

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

$$\alpha \beta \gamma = 1/2 \times 1 \times (-2) = -2/2 = -d/a$$

Hence, the relationship between the zeroes and the coefficients are satisfied.

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

Solution:

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

And zeroes for $p(x)$ are 2,1,1.

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

$$p(1) = 1^3-(4 \times 1^2)+(5 \times 1)-2 = 0$$

Hence proved, 2, 1, 1 are the zeroes of x^3-4x^2+5x-2

Now, comparing the given polynomial with general expression, we get;

$$\therefore ax^3+bx^2+cx+d = x^3-4x^2+5x-2$$

$$a = 1, b = -4, c = 5 \text{ and } d = -2$$

As we know, if α, β, γ are the zeroes of the cubic polynomial ax^3+bx^2+cx+d , then;

$$\alpha + \beta + \gamma = -b/a$$

$$\alpha\beta + \beta\gamma + \gamma\alpha = c/a$$

$$\alpha \beta \gamma = -d/a.$$

Therefore, putting the values of zeroes of the polynomial,

$$\alpha + \beta + \gamma = 2+1+1 = 4 = -(-4)/1 = -b/a$$

$$\alpha\beta + \beta\gamma + \gamma\alpha = 2 \times 1 + 1 \times 1 + 1 \times 2 = 5 = 5/1 = c/a$$

$$\alpha\beta\gamma = 2 \times 1 \times 1 = 2 = -(-2)/1 = -d/a$$

Hence, the relationship between the zeroes and the coefficients are satisfied.

2. 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.

Solution:

Let us consider the cubic polynomial is ax^3+bx^2+cx+d and the values of the zeroes of the polynomials be α, β, γ .

As per the given question,

$$\alpha + \beta + \gamma = -b/a = 2/1$$

$$\alpha\beta + \beta\gamma + \gamma\alpha = c/a = -7/1$$

$$\alpha \beta \gamma = -d/a = -14/1$$

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Thus, from above three expressions we get the values of coefficient of polynomial.
 $a = 1, b = -2, c = -7, d = 14$

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

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

Solution:

We are given with the polynomial here,
 $p(x) = x^3 - 3x^2 + x + 1$

And zeroes are given as $a - b, a, a + b$

Now, comparing the given polynomial with general expression, we get;

$$\therefore px^3 + qx^2 + rx + s = x^3 - 3x^2 + x + 1$$

$$p = 1, q = -3, r = 1 \text{ and } s = 1$$

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

$$-q/p = 3a$$

Putting the values q and p .

$$-(-3)/1 = 3a$$

$$a = 1$$

Thus, the zeroes are $1 - b, 1, 1 + b$.

$$\text{Now, product of zeroes} = 1(1 - b)(1 + b)$$

$$-s/p = 1 - b^2$$

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

$$b^2 = 1 + 1 = 2$$

$$b = \sqrt{2}$$

Hence, $1 - \sqrt{2}, 1, 1 + \sqrt{2}$ are the zeroes of $x^3 - 3x^2 + x + 1$.

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

Solution:

Since this is a polynomial equation of degree 4, hence there will be total 4 roots.

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Let $f(x) = x^4 - 6x^3 - 26x^2 + 138x - 35$

Since $2 + \sqrt{3}$ and $2 - \sqrt{3}$ are zeroes of given polynomial $f(x)$.

$$\therefore [x - (2 + \sqrt{3})] [x - (2 - \sqrt{3})] = 0$$

$$(x - 2 - \sqrt{3})(x - 2 + \sqrt{3}) = 0$$

On multiplying the above equation we get,

$x^2 - 4x + 1$, this is a factor of a given polynomial $f(x)$.

Now, if we will divide $f(x)$ by $g(x)$, the quotient will also be a factor of $f(x)$ and the remainder will be 0.

$x^2 - 4x + 1$	$x^2 - 2x - 35$
	$x^4 - 6x^3 - 26x^2 + 138x - 35$ $x^4 - 4x^3 + x^2$ (-) (+) (-)
	<hr style="border: 0.5px solid black;"/> $- 2x^2 - 27x^2 + 138x - 35$ $- 2x^3 + 8x^2 - 2x$ (+) (-) (+)
	<hr style="border: 0.5px solid black;"/> $- 35x^2 + 140x - 35$ $- 35x^2 + 140x - 35$ (+) (-) (+)
	<hr style="border: 0.5px solid black;"/> 0

So, $x^4 - 6x^3 - 26x^2 + 138x - 35 = (x^2 - 4x + 1)(x^2 - 2x - 35)$

Now, on further factorizing $(x^2 - 2x - 35)$ we get,

$$x^2 - (7 - 5)x - 35 = x^2 - 7x + 5x - 35 = 0$$

$$x(x - 7) + 5(x - 7) = 0$$

$$(x + 5)(x - 7) = 0$$

So, its zeroes are given by:

$$x = -5 \text{ and } x = 7.$$

Therefore, all four zeroes of given polynomial equation are: $2 + \sqrt{3}$, $2 - \sqrt{3}$, -5 and 7 .