1. 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) Since the graph of \( p(x) \) does not cut the X-axis at all. Therefore, the number of zeroes is 0.

(v) As the graph of \( p(x) \) intersects the X-axis at only 1 point. Therefore, the number of zeroes is 1.
Since the graph of \( p(x) \) intersects the X-axis at 3 points. Hence, the number of zeroes is 3.

As the graph of \( p(x) \) intersects the X-axis at 2 points. So, the number of zeroes is 2.

Since the graph of \( p(x) \) intersects the X-axis at 4 points. Therefore, the number of zeroes is 4.

As the graph of \( p(x) \) intersects the X-axis at 3 points. So, the number of zeroes is 3.

---

### EXERCISE 2.2

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

   (i) \( x^2 - 2x - 8 \)
   
   \[
   \begin{align*}
   &\begin{align*}
   x^2 - 2x - 8 \\
   &= x^2 - 4x + 2x - 8 \quad \text{[Factorisation by splitting the middle term]} \\
   &= x(x - 4) + 2(x - 4) \\
   &= (x - 4)(x + 2)
   \end{align*}
   \end{align*}
   \]

   We know that the zeroes of the quadratic polynomial \( ax^2 + bx + c \) are the same as the roots of the quadratic equation \( ax^2 + bx + c = 0 \).

   Therefore, by equating the given polynomial to zero. We get,
\(x^2 - 2x - 8 = 0\)

\[\Rightarrow (x - 4)(x + 2) = 0\]

\[\Rightarrow x - 4 = 0 \text{ or } x + 2 = 0\]

\[\Rightarrow x = 4 \text{ or } x = -2\]

Therefore, the zeroes of \(x^2 - 2x - 8\) are 4 and -2.

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

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

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

(ii) \(4s^2 - 4s + 1 = (2s - 1)^2\) \([\text{Since}, a^2 - 2ab + b^2 = (a - b)^2]\)

We know that the zeroes of the quadratic polynomial \(ax^2 + bx + c\) are the same as the roots of the quadratic equation \(ax^2 + bx + c = 0\).

Therefore, by equating the given polynomial to zero. We get,

\[4s^2 - 4s + 1 = 0\]

\[\Rightarrow (2s - 1)^2 = 0\]

Cancelling square on both the sides,

\[\Rightarrow 2s - 1 = 0\]

\[\Rightarrow s = \frac{1}{2}\]

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

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

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

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

(iii) \(6x^2 - 3 - 7x = 6x^2 - 7x - 3\)

\[= 6x^2 - 9x + 2x - 3\]

[Factorisation by splitting the middle term]
\[= 3x(2x - 3) + (2x - 3)\]
\[= (3x + 1)(2x - 3)\]

We know that the zeroes of the quadratic polynomial \(ax^2 + bx + c\) are the same as the roots of the quadratic equation \(ax^2 + bx + c = 0\).

Therefore, by equating the given polynomial to zero. We get,
\[6x^2 - 3 - 7x = 0\]
\[\Rightarrow 3x + 1 = 0 \text{ or } 2x - 3 = 0\]
\[\Rightarrow x = -\frac{1}{3} \text{ or } x = \frac{3}{2}\]

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

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

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

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

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

We know that the zeroes of the quadratic polynomial \(ax^2 + bx + c\) are the same as the roots of the quadratic equation \(ax^2 + bx + c = 0\).

Therefore, by equating the given polynomial to zero. We get,
\[4u^2 + 8u = 0\]
\[\Rightarrow 4u = 0 \text{ or } u + 2 = 0\]
\[\Rightarrow u = 0 \text{ or } u = -2\]

So, the zeroes of \(4u^2 + 8u\) are 0 and –2.

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

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

Hence, the relationship between the zeroes and the coefficients is verified.
(v) \( t^2 - 15 = t^2 - 0. t - 15 = (t - \sqrt{15})(t + \sqrt{15}) \) [Since, \( a^2 - b^2 = (a + b)(a - b) \)]

We know that the zeroes of the quadratic polynomial \( ax^2 + bx + c \) are the same as the roots of the quadratic equation \( ax^2 + bx + c = 0 \).

Therefore, by equating the given polynomial to zero. We get,

\[ t^2 - 15 = 0 \]

\[ \Rightarrow t - \sqrt{15} = 0 \text{ or } t + \sqrt{15} = 0 \]

\[ \Rightarrow t = \sqrt{15} \text{ or } t = -\sqrt{15} \]

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

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

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

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

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

\[ = 3x^2 - 4x + 3x - 4 \text{ [Factorisation by splitting the middle term]} \]

\[ = x(3x - 4) + (3x - 4) \]

\[ = (3x - 4)(x + 1) \]

We know that the zeroes of the quadratic polynomial \( ax^2 + bx + c \) are the same as the roots of the quadratic equation \( ax^2 + bx + c = 0 \).

Therefore, by equating the given polynomial to zero. We get,

\[ 3x^2 - x - 4 = 0 \]

\[ \Rightarrow 3x - 4 = 0 \text{ or } x + 1 = 0 \]

\[ \Rightarrow x = \frac{4}{3} \text{ or } x = -1 \]

Hence, the zeroes of \( 3x^2 - x - 4 \) are \( \frac{4}{3} \) and \( -1 \).

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

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

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

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

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

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

(iv) \( 1, 1 \)

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

(vi) \( 4, 1 \)

\[ \text{Solution:} \]

(i) We know that if \( \alpha \) and \( \beta \) are the zeroes of a quadratic polynomial \( p(x) \), then, the polynomial \( p(x) \) can be written as \( p(x) = a\{x^2 - (\alpha + \beta)x + \alpha \beta\} \) or \( p(x) = a\{x^2 - (\text{Sum of the zeroes})x + \text{Product of the zeroes}\} \), where \( a \) is a non-zero real number.

\[ \text{Given: sum of the roots} = \alpha + \beta = \frac{1}{4} \text{ and product of the roots} = \alpha \beta = -1 \]

Hence, the quadratic polynomial \( p(x) \) can be written as:

\[ p(x) = a\{x^2 - \frac{1}{4}x - 1\} \]

\[ = a\left\{\frac{4x^2 - x - 4}{4}\right\} \]

By taking \( a = 4 \), we get one of the quadratic polynomials which satisfy the given conditions.

Therefore, the quadratic polynomial is \((4x^2 - x - 4)\).

(ii) We know that if \( \alpha \) and \( \beta \) are the zeroes of a quadratic polynomial \( p(x) \), then, the polynomial \( p(x) \) can be written as \( p(x) = a\{x^2 - \)
$$(\alpha + \beta)x + \alpha\beta$$ or $$p(x) = a(x^2 - \text{(Sum of the zeroes)}x + \text{Product of the zeroes})$$, where $$a$$ is a non-zero real number.

**Given:** sum of the roots $$= \alpha + \beta = \sqrt{2}$$ and product of the roots $$= \alpha\beta = \frac{1}{3}$$.

Hence, the quadratic polynomial $$p(x)$$ can be written as:

$$p(x) = a\{x^2 - \sqrt{2}x + \frac{1}{3}\}$$

$$= a\left\{\frac{3x^2 - 3\sqrt{2}x + 1}{3}\right\}$$

By taking $$a = 3$$, we get one of the quadratic polynomials which satisfy the given conditions.

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

(iii) We know that if $$\alpha$$ and $$\beta$$ are the zeroes of a quadratic polynomial $$p(x)$$, then, the polynomial $$p(x)$$ can be written as $$p(x) = a\{x^2 - (\alpha + \beta)x + \alpha\beta\}$$ or $$p(x) = a\{x^2 - \text{(Sum of the zeroes)}x + \text{Product of the zeroes}\}$$, where $$a$$ is a non-zero real number.

**Given:** sum of the roots $$= \alpha + \beta = 0$$ and product of the roots $$= \alpha\beta = \sqrt{5}$$.

Hence, the quadratic polynomial $$p(x)$$ can be written as:

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

$$= a\{x^2 + \sqrt{5}\}$$

By taking $$a = 1$$, we get one of the quadratic polynomials which satisfy the given conditions.

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

(iv) We know that if $$\alpha$$ and $$\beta$$ are the zeroes of a quadratic polynomial $$p(x)$$, then, the polynomial $$p(x)$$ can be written as $$p(x) = a\{x^2 - (\alpha + \beta)x + \alpha\beta\}$$ or $$p(x) = a\{x^2 - \text{(Sum of the zeroes)}x + \text{Product of the zeroes}\}$$, where $$a$$ is a non-zero real number.

**Given:** sum of the roots $$= \alpha + \beta = 1$$ and product of the roots $$= \alpha\beta = 1$$.

Hence, the quadratic polynomial $$p(x)$$ can be written as:
\[ p(x) = a\{x^2 - 1.x + 1\} \]

\[ = a\{x^2 - x + 1\} \]

By taking \( a = 1 \), we get one of the quadratic polynomials which satisfy the given conditions.

Therefore, the quadratic polynomial is \((x^2 - x + 1)\).

**(v)** We know that if \( \alpha \) and \( \beta \) are the zeroes of a quadratic polynomial \( p(x) \), then, the polynomial \( p(x) \) can be written as \( p(x) = a\{x^2 - (\alpha + \beta)x + \alpha\beta\} \) or \( p(x) = a\{x^2 - \text{(Sum of the zeroes)}x + \text{Product of the zeroes}\} \), where \( a \) is a non-zero real number.

**Given:** sum of the roots \( = \alpha + \beta = \frac{1}{4} \) and product of the roots \( = \alpha\beta = \frac{1}{4} \)

Hence, the quadratic polynomial \( p(x) \) can be written as:

\[ p(x) = a\{x^2 + \frac{1}{4}x + \frac{1}{4}\} \]

\[ = a\left\{\frac{4x^2 + x + 1}{4}\right\} \]

By taking \( a = 4 \), we get one of the quadratic polynomials which satisfy the given conditions.

Therefore, the quadratic polynomial is \((4x^2 + x + 1)\).

**(vi)** We know that if \( \alpha \) and \( \beta \) are the zeroes of a quadratic polynomial \( p(x) \), then, the polynomial \( p(x) \) can be written as \( p(x) = a\{x^2 - (\alpha + \beta)x + \alpha\beta\} \) or \( p(x) = a\{x^2 - \text{(Sum of the zeroes)}x + \text{Product of the zeroes}\} \), where \( a \) is a non-zero real number.

**Given:** sum of the roots \( = \alpha + \beta = 4 \) and product of the roots \( = \alpha\beta = 1 \)

Hence, the quadratic polynomial \( p(x) \) can be written as:

\[ p(x) = a\{x^2 - 4x + 1\} \]

By taking \( a = 1 \), we get one of the quadratic polynomials which satisfy the given conditions.

Therefore, the quadratic polynomial is \((x^2 - 4x + 1)\).

\[ ✦✦✦ \]
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) \( p(x) = x^3 - 3x^2 + 5x - 3 \), \( g(x) = x^2 - 2 \)

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

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

Solution:

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

   Here, both the polynomials are already arranged in the descending powers of variable.

   The polynomial \( p(x) \) can be divided by the polynomial \( g(x) \) as follows:

   \[
   \begin{array}{c|ccccc}
   & x^3 & -3x^2 & +5x & -3 \\ \hline
   x^2 - 2 & x^3 & -2x^2 \\ \hline
   & -3x^2 & +5x & -3 \\ \hline
   & & -3x^2 & +6 \\ \hline
   & & & -7x & +9 \\
   \end{array}
   \]

   Quotient = \( x - 3 \)

   Remainder = \( 7x - 9 \)

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

   Here, the polynomial \( p(x) \) is already arranged in the descending powers of variable.

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

   Here, the polynomial \( g(x) \) is not arranged in the descending powers of variable.

   Now, \( g(x) = x^2 - x + 1 \)

   The polynomial \( p(x) \) can be divided by the polynomial \( g(x) \) as follows:
Quotient = $x^2 + x - 3$

Remainder = 8

(iii) $p(x) = x^4 - 5x + 6 = x^4 + 0x^3 - 3x^2 + 4x + 5$

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

Here, the polynomial $g(x)$ is not arranged in the descending powers of variable.

Now, $g(x) = -x^2 + 2$

The polynomial $p(x)$ can be divided by the polynomial $g(x)$ as follows:

Quotient = $-x^2 - 2$

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) $t^2 - 3, 2t^4 + 3t^3 - 2t^2 - 9t - 12$
(ii) \(x^2 + 3x + 1, \ 3x^4 + 5x^3 - 7x^2 + 2x + 2\)

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

Solution:

(i) The polynomial \(2t^4 + 3t^3 - 2t^2 - 9t - 12\) can be divided by the polynomial \(t^2 - 3 = t^2 + 0 \cdot t - 3\) as follows:

\[
\begin{align*}
&\underline{2t^2 + 3t + 4} \\
&t^2 + 0 \cdot t - 3 \big| 2t^4 + 3t^3 - 2t^2 - 9t - 12 \\
&\quad - \quad - \quad + \\
&\quad 2t^4 + 0 \cdot t^3 - 6t^2 \\
&\quad - \quad - \quad + \\
&\quad 3t^3 + 4t^2 - 9t - 12 \\
&\quad - \quad - \quad + \\
&\quad 3t^3 + 0 \cdot t^2 - 9t \\
&\quad - \quad - \quad + \\
&\quad 4t^2 + 0 \cdot t - 12 \\
&\quad - \quad - \quad + \\
&\quad 4t^2 + 0 \cdot t - 12 \\
&\quad - \quad - \quad + \\
&\quad 0
\end{align*}
\]

Since the remainder is 0, hence \(t^2 - 3\) is a factor of \(2t^4 + 3t^3 - 2t^2 - 9t - 12\).

(ii) The polynomial \(3x^4 + 5x^3 - 7x^2 + 2x + 2\) can be divided by the polynomial \(x^2 + 3x + 1\) as follows:

\[
\begin{align*}
&\underline{3x^2 - 4x + 2} \\
&x^2 + 3x + 1 \big| 3x^4 + 5x^3 - 7x^2 + 2x + 2 \\
&\quad - \quad - \quad + \\
&\quad 3x^4 + 9x^3 + 3x^2 \\
&\quad - \quad - \quad + \\
&\quad -4x^3 - 10x^2 + 2x + 2 \\
&\quad - \quad - \quad + \\
&\quad -4x^3 - 12x^2 - 4x \\
&\quad + \quad + \quad + \\
&\quad 2x^2 + 6x + 2 \\
&\quad - \quad - \quad + \\
&\quad 2x^2 + 6x + 2 \\
&\quad - \quad - \quad + \\
&\quad 0
\end{align*}
\]
Since the remainder is 0, hence \( x^2 + 3x + 1 \) is a factor of \( 3x^4 + 5x^3 - 7x^2 + 2x + 2 \)

(iii) The polynomial \( x^5 - 4x^3 + x^2 + 3x + 1 \) can be divided by the polynomial \( x^3 - 3x + 1 \) as follows:

\[
\begin{array}{c|cc|c}
& x^3 & -3x & +1 \\
\hline
x^5 & -4x^3 & +x^2 & +3x & +1 \\
- & + & - & + & - & + \\
\hline
- & x^3 & +3x & +1 \\
- & x^2 & +3x & -1 \\
+ & & & & & 2
\end{array}
\]

Since the remainder is not equal to 0, hence \( x^3 - 3x + 1 \) is not a factor of \( x^5 - 4x^3 + x^2 + 3x + 1 \).

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

**Solution:**

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

It is given that the two zeroes of \( p(x) \) are \( \sqrt{5} \) and \( -\sqrt{5} \)

\[ \therefore \left( x - \frac{\sqrt{5}}{3} \right) \left( x + \frac{\sqrt{5}}{3} \right) = \left( x^2 - \frac{5}{3} \right) \text{ is a factor of } p(x) \quad \{ \text{Since, } (a - b)(a + b) = a^2 - b^2 \} \]

Therefore, on dividing the given polynomial by \( x^2 - \frac{5}{3} \), we obtain remainder as 0.
Hence, \(3x^4 + 6x^3 - 2x^2 - 10x - 5 = \left(x^2 - \frac{5}{3}\right)(3x^2 + 6x + 3)\)

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

Now, \(x^2 + 2x + 1 = (x + 1)^2\)

Thus, the two zeroes of \(x^2 + 2x + 1\) are \(-1\) and \(-1\)

Therefore, the zeroes of the given polynomial are \(\sqrt{\frac{5}{3}}, -\sqrt{\frac{5}{3}}, -1\) and \(-1\).

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 \(g(x)\).

**Solution:**

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

**Quotient** = \((x - 2)\)

**Remainder** = \((-2x + 4)\)

\(g(x)\) be the divisor.

According to the division algorithm,

Dividend = Divisor \(\times\) Quotient + Remainder

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

\[x^3 - 3x^2 + x + 2 + 2x - 4 = g(x)(x - 2)\]
\[ x^3 - 3x^2 + 3x - 2 = g(x)(x - 2) \]

Now, \( g(x) \) is the quotient when \( x^3 - 3x^2 + 3x - 2 \) is divided by \( x - 2 \). (Since, Remainder = 0)

\[
\begin{array}{c}
x^2 - x + 1 \\
\hline
x - 2) \left( x^3 - 3x^2 + 3x - 2 \right) \\
\hline
x^3 - 2x^2 \\
\hline
- x^2 + 3x - 2 \\
\hline
- x^2 + 2x \\
\hline
+ - \\
\hline
x - 2 \\
\hline
x - 2 \\
\hline
\end{array}
\]

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

6. 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) \( \deg r(x) = 0 \)

**Solution:**

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 \( g(x) \).

(i) Degree of quotient will be equal to degree of dividend when divisor is constant.

Let us consider the division of \( 2x^2 + 2x - 16 \) by 2.

Here, \( p(x) = 2x^2 + 2x - 16 \) and \( g(x) = 2 \)
\( q(x) = x^2 + x - 8 \) and \( r(x) = 0 \)

Clearly, the degree of \( p(x) \) and \( q(x) \) is the same which is 2.

**Verification:**

\[ p(x) = g(x) \times q(x) + r(x) \]
\[ 2x^2 + 2x - 16 = 2(x^2 + x - 8) + 0 \]
\[ = 2x^2 + 2x - 16 \]

Thus, the division algorithm is satisfied.

(ii) Let us consider the division of \( 4x + 3 \) by \( x + 2 \).

Here, \( p(x) = 4x + 3 \) and \( g(x) = x + 2 \)
\[ q(x) = 4 \text{ and } r(x) = -5 \]

Here, degree of \( q(x) \) and \( r(x) \) is the same which is 0.

**Verification:**

\[ p(x) = g(x) \times q(x) + r(x) \]
\[ 4x + 3 = (x + 2) \times 4 + (-5) \]
\[ 4x + 3 = 4x + 3 \]

Thus, the division algorithm is satisfied.

(iii) Degree of remainder will be 0 when remainder obtained on division is a constant.

Let us consider the division of \( 4x + 3 \) by \( x + 2 \).

Here, \( p(x) = 4x + 3 \) and \( g(x) = x + 2 \)
\[ q(x) = 4 \text{ and } r(x) = -5 \]

Here, we get remainder as a constant. Therefore, the degree of \( r(x) \) is 0.

**Verification:**

\[ p(x) = g(x) \times q(x) + r(x) \]
\[ 4x + 3 = (x + 2) \times 4 + (-5) \]
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\[4x + 3 = 4x + 3\]

Thus, the division algorithm is satisfied.

♦ ♦ ♦