# NCERT Solutions for Class 9$^{th}$ Mathematics

## Chapter 2 – POLYNOMIALS

### EXERCISE 2.1

1. Which of the following expressions are polynomials in one variable and which are not? State reasons for your answer.

(i) $4x^2 - 3x + 7$ (ii) $y^2 + \sqrt{2}$ (iii) $3\sqrt{t} + t\sqrt{2}$ (iv) $y + \frac{2}{y}$ (v) $x^{10} + y^3 + t^{50}$

**Ans** (i) $4x^2 - 3x + 7$ is a polynomial in one variable as there is only one variable i.e. 'x' and its a polynomial because power or exponent of x (2,1,0) in each term is a whole number.

(ii) $y^2 + \sqrt{2}$ is a polynomial in one variable as there is only one variable i.e. 'y' and its a polynomial because power or exponent of y (2,0) in each term is a whole number.

(iii) $3\sqrt{t} + t\sqrt{2}$ is not a polynomial in one variable as power or exponent of variable 't' in first term is 1/2, which is not a whole number.

(iv) $y + \frac{2}{y}$ is not a polynomial in one variable as power or exponent of variable 'y' in second term is -1, which is not a whole number.

(v) $x^{10} + y^3 + t^{50}$ is not a polynomial in one variable but it is a polynomial in 3 variables (x, y, t).

2. Write the coefficients of $x^2$ in each of the following:

(i) $2 + x^2 + x$ (ii) $2 - x^2 + x^3$ (iii) $\frac{\pi}{2}x^2 + x$ (iv) $\sqrt{2}x - 1$

**Ans** **Coefficient** of any term is the constant multiplying with the variable.

(i) $2 + x^2 + x$

Coefficient of $x^2$ is 1.

(ii) $2 - x^2 + x^3$

Coefficient of $x^2$ is -1.

(iii) $\frac{\pi}{2}x^2 + x$

Coefficient of $x^2$ is $\pi/2$.

(iv) $\sqrt{2}\,x - 1$

Coefficient of $x^2$ is 0.

3. Give one example each of a binomial of degree 35, and of a monomial of degree 100.

**Ans** Binomial (2 terms only) of degree 35 is $x^{35} - 7$

Monomial (1 term only) of degree 100 is $3x^{100}$.

4. Write the degree of each of the following polynomials:

(i) $5x^3 + 4x^2 + 7x$ (ii) $4 - y^2$ (iii) $5t - \sqrt{7}$ (iv) 3

**Ans** **Degree of polynomial** = Highest power of variable

(i) $5x^3 + 4x^2 + 7x$

**Degree = 3** (because highest power of x is 3)

(ii) $4 - y^2$

**Degree = 2** (because highest power of y is 2)

(iii) $5t - \sqrt{7}$

**Degree = 1** (because highest power of t is 1)

(iv) 3

**Degree = 0** (because there is no variable i.e. it is a constant polynomial)

5. Classify the following as linear, quadratic and cubic polynomials:

(i) $x^2 + x$ (ii) $x - x^3$ (iii) $y + y^2 + 4$ (iv) $1 + x$

(v) $3t$ (vi) $r^2$ (vii) $7x^3$

**Ans** **Linear polynomial:** It has degree of 1.

**Quadratic polynomial:** It has degree of 2.

**Cubic polynomial:** It has degree of 3.

(i) $x^2 + x$

**Quadratic polynomial** (because degree of polynomial is 2)

(ii) $x - x^3$

**Cubic polynomial** (because degree of polynomial is 3)



(iii) $y + y^2 + 4$

**Quadratic polynomial** (because degree of polynomial is 2)

(iv) $1 + x$

**Linear polynomial** (because degree of polynomial is 1)

(v) $3t$

**Linear polynomial** (because degree of polynomial is 1)

(vi) $r^2$

**Quadratic polynomial** (because degree of polynomial is 2)

(vii) $7x^3$

**Cubic polynomial** (because degree of polynomial is 3)

## EXERCISE 2.2

1. Find the value of the polynomial $5x – 4x^2 + 3$ at

(i) $x = 0$ (ii) $x = –1$ (iii) $x = 2$

**Ans** (i) $p(x) = 5x – 4x^2 + 3$

The value of the polynomial at $x = 0$ is

$p(0) = 5 (0) – 4 (0)^2 + 3 =$ **3**

(ii) $p(x) = 5x – 4x^2 + 3$

The value of the polynomial at $x = -1$ is

$p(-1) = 5 (-1) – 4 (-1)^2 + 3 = -5 – 4 + 3 =$ **-6**

(iii) $p(x) = 5x – 4x^2 + 3$

The value of the polynomial at $x = 2$ is

$p(2) = 5 (2) – 4 (2)^2 + 3 = 10 – 16 + 3 =$ **-3**

2. Find p(0), p(1) and p(2) for each of the following polynomials:

(i) $p(y) = y^2 – y + 1$

(ii) $p(t) = 2 + t + 2t^2 – t^3$

(iii) $p(x) = x^3$

(iv) $p(x) = (x – 1) (x + 1)$

**Ans** (i) $p(y) = y^2 – y + 1$

$p(0) = (0)^2 – (0) + 1 =$ **1**

$p(1) = (1)^2 – (1) + 1 =$ **1**

$p(2) = (2)^2 – (2) + 1 =$ **3**

(ii) $p(t) = 2 + t + 2t^2 – t^3$

$p(0) = 2 + (0) + 2 (0)^2 – (0)^3 =$ **2**

$p(1) = 2 + (1) + 2 (1)^2 – (1)^3 = 2 + 1 + 2 – 1 =$ **4**

$p(2) = 2 + (2) + 2 (2)^2 – (2)^3 = 2 + 2 + 8 – 8 =$ **4**

(iii) $p(x) = x^3$

$p(0) = (0)^3 =$ **0**

$p(1) = (1)^3 =$ **1**

$p(2) = (2)^3 =$ **8**

(iv) $p(x) = (x – 1) (x + 1)$

$p(0) = (0 – 1) (0 + 1) = -1 \times 1 =$ **-1**

$p(1) = (1 – 1) (1 + 1) = 0 \times 2 =$ **0**

$p(2) = (2 – 1) (2 + 1) = 1 \times 3 =$ **3**

3. Verify whether the following are zeroes of the polynomial, indicated against them.

(i) $p(x) = 3x + 1, x = – 1/3$ (ii) $p(x) = 5x – \pi, x = 4/5$

(iii) $p(x) = x^2 – 1, x = 1, –1$ (iv) $p(x) = (x + 1) (x – 2), x = – 1, 2$

(v) $p(x) = x^2, x = 0$ (vi) $p(x) = lx + m, x = – m/l$

(vii) $p(x) = 3x^2 – 1, x = -1/\sqrt{3}, 2/\sqrt{3}$ (viii) $p(x) = 2x + 1, x = 1/2$

**Ans** If x = a is a zero of the polynomial p(x), then at x = a the value of polynomial will be zero i.e. p(a) = 0.

(i) $p(x) = 3x + 1, x = – 1/3$

» $p(-1/3) = 3 (-1/3) + 1 = -1 + 1 = 0$

Hence x = -1/3 is a zero of the given polynomial.



(ii) $p(x) = 5x - \pi$, $x = 4/5$

» $p(4/5) = 5\ (4/5) - \pi = 4 - \pi \neq 0$

Hence x = 4/5 is not a zero of the given polynomial.

(iii) $p(x) = x^2 - 1$, $x = 1, -1$

» $p(1) = (1)^2 - 1 = 1 - 1 = 0$

$p(-1) = (-1)^2 - 1 = 1 - 1 = 0$

Hence x = 1, - 1 are zeroes of the given polynomial.

(iv) $p(x) = (x + 1)(x - 2)$, $x = -1, 2$

» $p(-1) = (-1 + 1)(-1 - 2) = 0 \times -3 = 0$

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

Hence x = -1, 2 are zeroes of the given polynomial.

(v) $p(x) = x^2$, $x = 0$

» $p(0) = (0)^2 = 0$

Hence x = 0 is a zero of the given polynomial.

(vi) $p(x) = lx + m$, $x = -m/l$

» $p(-m/l) = l\ (-m/l) + m = -m + m = 0$

Hence x = -m/l is a zero of the given polynomial.

(vii) $p(x) = 3x^2 - 1$, $x = -1/\sqrt{3}, 2/\sqrt{3}$

» $p(-1/\sqrt{3}) = 3\ (-1/\sqrt{3})^2 - 1 = 1 - 1 = 0$

$p(2/\sqrt{3}) = 3\ (2/\sqrt{3})^2 - 1 = 4 - 1 = 3$

Hence $x = -1/\sqrt{3}$ is a zero, but $x = 2/\sqrt{3}$ is not a zero of the given polynomial.

(viii) $p(x) = 2x + 1$, $x = 1/2$

» $p(1/2) = 2\ (1/2) + 1 = 1 + 1 = 2$

Hence x = 1/2 is not a zero of the given polynomial.

4. Find the zero of the polynomial in each of the following cases:

(i) p(x) = x + 5 (ii) p(x) = x – 5 (iii) p(x) = 2x + 5

(iv) p(x) = 3x – 2 (v) p(x) = 3x (vi) p(x) = ax, a ≠ 0

(vii) p(x) = cx + d, c ≠ 0, c, d are real numbers.

**Ans** The zero of any polynomial p(x) can be found by using equation p(x) = 0.

(i) p(x) = x + 5

For finding zero of the polynomial, put p(x) = 0

» x + 5 = 0

**» x = -5**

Thus, x = -5 is the zero of the given polynomial.

(ii) p(x) = x – 5

For finding zero of the polynomial, put p(x) = 0

» x – 5

**» x = 5**

Thus, x = 5 is the zero of the given polynomial.

(iii) p(x) = 2x + 5

For finding zero of the polynomial, put p(x) = 0

» 2x + 5 = 0

**» x = -5/2**

Thus, x = -5/2 is the zero of the given polynomial.

(iv) p(x) = 3x – 2

For finding zero of the polynomial, put p(x) = 0

» 3x – 2 = 0

**» x = 2/3**

Thus, x = 2/3 is the zero of the given polynomial.



(v) p(x) = 3x

For finding zero of the polynomial, put p(x) = 0

» 3x = 0

**» x = 0**

Thus, x = 0 is the zero of the given polynomial.

(vi) p(x) = ax, a ≠ 0

For finding zero of the polynomial, put p(x) = 0

» ax = 0

**» x = 0 (because a ≠ 0)**

Thus, x = 0 is the zero of the given polynomial.

(vii) p(x) = cx + d, c ≠ 0, c, d are real numbers

For finding zero of the polynomial, put p(x) = 0

» cx + d = 0

**» x = -d/c**

Thus, x = -d/c is the zero of the given polynomial.



## EXERCISE 2.3

1. Find the remainder when $x^3 + 3x^2 + 3x + 1$ is divided by

   (i) $x + 1$ (ii) $x - 1/2$ (iii) $x$ (iv) $x + \pi$ (v) $5 + 2x$

**Ans** (i) $x + 1$

By long division,

$$
\begin{array}{r|l}
 & x^2 + 2x + 1 \\
\hline
x + 1 & x^3 + 3x^2 + 3x + 1 \\
 & \underline{-\,x^3 - x^2} \\
 & \quad 2x^2 + 3x + 1 \\
 & \quad \underline{-\,2x^2 - 2x} \\
 & \qquad x + 1 \\
 & \qquad \underline{-\,x - 1} \\
 & \qquad\quad 0
\end{array}
$$

Hence, the remainder = 0.

By remainder theorem,

$p(x) = x^3 + 3x^2 + 3x + 1$ and zero of $x + 1$ is $-1$ (obtained by putting $x + 1 = 0$).

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

Hence, the remainder = 0.



(ii) x – 1/2

By long division,

$$\text{Quotient: } x^2 + \frac{7}{2}x + \frac{19}{4}$$

$$x - \frac{1}{2} \overline{\big) \; x^3 + 3x^2 + 3x + 1}$$

$$\underline{\underset{-}{x^3} \underset{+}{-} \frac{x^2}{2}}$$

$$\frac{7}{2}x^2 + 3x + 1$$

$$\underline{\underset{-}{\frac{7}{2}x^2} \underset{+}{-} \frac{7}{4}x}$$

$$\frac{19}{4}x + 1$$

$$\underline{\underset{-}{\frac{19}{4}x} \underset{+}{-} \frac{19}{8}}$$

$$\frac{27}{8}$$

Hence, the remainder = 27/8.

By remainder theorem,

p(x) = $x^3 + 3x^2 + 3x + 1$ and zero of x – 1/2 is 1/2 (obtained by putting x – 1/2 = 0).

So, p(1/2) = $(1/2)^3 + 3\,(1/2)^2 + 3\,(1/2) + 1 = 1/8 + 3/4 + 3/2 + 1 = 27/8$

Hence, the remainder = 27/8.



(iii) x

By long division,

$$\begin{array}{r|l} & x^2 + 3x + 3 \\ \hline x & x^3 + 3x^2 + 3x + 1 \\ & -\ x^3 \\ \hline & 3x^2 + 3x + 1 \\ & -\ 3x^2 \\ \hline & 3x + 1 \\ & -\ 3x \\ \hline & 1 \end{array}$$

Hence, the remainder = 1.

By remainder theorem,

$p(x) = x^3 + 3x^2 + 3x + 1$ and zero of x is 0 (obtained by putting $x = 0$).

So, $p(0) = (0)^3 + 3\,(0)^2 + 3\,(0) + 1 = 1$

Hence, the remainder = 1.

(iv) $x + \pi$

By long division,

$$\begin{array}{r|l} & x^2 + (3 - \pi)x + (3 - 3\pi + \pi^2) \\ \hline x + \pi & x^3 + 3x^2 + 3x + 1 \\ & -\,x^3 - \pi x^2 \\ \hline & (3 - \pi)x^2 + 3x + 1 \\ & -\,(3 - \pi)x^2 - (3\pi - \pi^2)x \\ \hline & (3 - 3\pi + \pi^2)x + 1 \\ & -\,(3 - 3\pi + \pi^2)x - (3 - 3\pi + \pi^2)\pi \\ \hline & 1 - 3\pi + 3\pi^2 - \pi^3 \end{array}$$

Hence, the remainder = $-\pi^3 + 3\pi^2 - 3\pi + 1$.

By remainder theorem,

$p(x) = x^3 + 3x^2 + 3x + 1$ and zero of $x + \pi$ is $-\pi$ (obtained by putting $x + \pi = 0$).

So, $p(-\pi) = (-\pi)^3 + 3(-\pi)^2 + 3(-\pi) + 1 = -\pi^3 + 3\pi^2 - 3\pi + 1$

Hence, the remainder = $-\pi^3 + 3\pi^2 - 3\pi + 1$.

(v) 5 + 2x

By long division,

$$
\begin{array}{r|l}
 & \frac{x^2}{2} + \frac{x}{4} + \frac{7}{8} \\
\hline
2x + 5 & x^3 + 3x^2 + 3x + 1 \\
 & x^3 + \frac{5}{2}x^2 \\
 & - \quad - \\
\hline
 & \frac{1}{2}x^2 + 3x + 1 \\
 & \frac{1}{2}x^2 + \frac{5}{4}x \\
 & - \quad\quad - \\
\hline
 & \frac{7}{4}x + 1 \\
 & \frac{7}{4}x + \frac{35}{8} \\
 & - \quad\quad - \\
\hline
 & -\frac{27}{8}
\end{array}
$$

Hence, the remainder = -27/8

By remainder theorem,

p(x) = $x^3 + 3x^2 + 3x + 1$ and zero of 2x + 5 is -5/2 (obtained by putting 2x + 5 = 0).

So, p(-5/2) = $(-5/2)^3 + 3\,(-5/2)^2 + 3\,(-5/2) + 1 = -125/8 + 75/4 – 15/2 + 1 = -27/8$

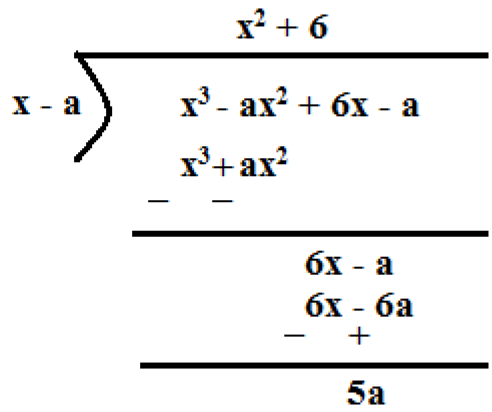
Hence, the remainder = -27/8.



2. Find the remainder when $x^3 - ax^2 + 6x - a$ is divided by $x - a$.

**Ans** **By long division,**




Hence, the remainder = 5a

**By remainder theorem,**

$p(x) = x^3 - ax^2 + 6x - a$ and zero of $x - a$ is a (obtained by putting $x - a = 0$).

So, $p(a) = (a)^3 - a(a)^2 + 6(a) - a = 5a$

Hence, the remainder = 5a.

3. Check whether $7 + 3x$ is a factor of $3x^3 + 7x$.

**Ans** $7 + 3x$ will be a factor of $p(x) = 3x^3 + 7x$, if it divides p(x) leaving remainder zero.

By applying remainder theorem to calculate the remainder, we have

$p(x) = 3x^3 + 7x$ and zero of $7 + 3x$ is $-7/3$ (obtained by putting $7 + 3x = 0$ )

So, $p(-7/3) = 3(-7/3)^3 + 7(-7/3) = -343/9 - 49/3 = -490/9$

Since the remainder is not zero, $7 + 3x$ is not a factor of $3x^3 + 7x$.



## EXERCISE 2.4

1. Determine which of the following polynomials has (x + 1) a factor :

(i) $x^3 + x^2 + x + 1$ (ii) $x^4 + x^3 + x^2 + x + 1$

(iii) $x^4 + 3x^3 + 3x^2 + x + 1$ (iv) $x^3 – x^2 – (2 + \sqrt{2})x + \sqrt{2}$

**Ans** Zero of x + 1 is -1 (obtained by putting x + 1 = 0).

x + 1 will be a factor of any polynomial p(x), only if p(-1) = 0.

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

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

Hence, x + 1 is a factor of the given polynomial.

(ii) $p(x) = x^4 + x^3 + x^2 + x + 1$

» $p(-1) = (-1)^4 + (-1)^3 + (-1)^2 + (-1) + 1 = 1 \neq 0$

Hence, x + 1 is not a factor of the given polynomial.

(iii) $p(x) = x^4 + 3x^3 + 3x^2 + x + 1$

» $p(-1) = (-1)^4 + 3 (-1)^3 + 3 (-1)^2 + (-1) + 1 = 1 \neq 0$

Hence, x + 1 is not a factor of the given polynomial.

(iv) $p(x) = x^3 – x^2 – (2 + \sqrt{2})x + \sqrt{2}$

» $p(-1) = (-1)^3 – (-1)^2 – (2 + \sqrt{2}) (-1) + \sqrt{2} = -1 – 1 + 2 + \sqrt{2} + \sqrt{2} = \sqrt{2} \neq 0$

Hence, x + 1 is not a factor of the given polynomial.

2. Use the Factor Theorem to determine whether g(x) is a factor of p(x) in each of the following cases:

(i) $p(x) = 2x^3 + x^2 – 2x – 1$, $g(x) = x + 1$

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

(iii) $p(x) = x^3 – 4x^2 + x + 6$, $g(x) = x – 3$

**Ans** (i) $p(x) = 2x^3 + x^2 – 2x – 1$, $g(x) = x + 1$

Zero of g(x) = x + 1 is -1 (obtained by putting g(x) = 0)

According to Factor Theorem, if g(x) = x + 1 is a factor of p(x), then p(-1) = 0.

Now, $p(-1) = 2 (-1)^3 + (-1)^2 – 2 (-1) – 1 = 0$

Thus, by the Factor Theorem, g(x) = x + 1 is a factor of p(x) = $2x^3 + x^2 – 2x – 1$.

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

Zero of g(x) = x + 2 is -2 (obtained by putting g(x) = 0)

According to Factor Theorem, if g(x) = x + 2 is a factor of p(x), then p(-2) = 0.

Now, p(-2) = $(-2)^3 + 3\ (-2)^2 + 3\ (-2) + 1 = -8 + 12 – 6 + 1 = -1 \neq 0$

Thus, by the Factor Theorem, g(x) = x + 2 is not a factor of p(x) = $x^3 + 3x^2 + 3x + 1$.

(iii) p(x) = $x^3 – 4x^2 + x + 6$, g(x) = x – 3

Zero of g(x) = x – 3 is 3 (obtained by putting g(x) = 0)

According to Factor Theorem, if g(x) = x – 3 is a factor of p(x), then p(3) = 0.

Now, p(3) = $(3)^3 – 4\ (3)^2 + (3) + 6 = 27 – 36 + 3 + 6 = 0$

Thus, by the Factor Theorem, g(x) = x – 3 is a factor of p(x) = $x^3 – 4x^2 + x + 6$.

3. Find the value of k, if x – 1 is a factor of p(x) in each of the following cases:

(i) p(x) = $x^2 + x + k$ (ii) p(x) = $2x^2 + kx + \sqrt{2}$

(iii) p(x) = $kx^2 – \sqrt{2}x + 1$ (iv) p(x) = $kx^2 – 3x + k$

**Ans** Zero of x – 1 is 1 (obtained by putting x – 1 = 0).

According to Factor Theorem, If x – 1 is a factor of p(x), then p(1) = 0.

(i) p(x) = $x^2 + x + k$

» p(1) = $(1)^2 + (1) + k = 0$ (From Factor Theorem)

**» k = -2**

(ii) p(x) = $2x^2 + kx + \sqrt{2}$

» p(1) = $2\ (1)^2 + k\ (1) + \sqrt{2} = 0$ (From Factor Theorem)

**» k = – (2 + √2)**

(iii) p(x) = $kx^2 – \sqrt{2}x + 1$

» p(1) = $k\ (1)^2 - \sqrt{2}\ (1) + 1 = 0$ (From Factor Theorem)

**» k = √2 – 1**

(iv) $p(x) = kx^2 – 3x + k$

»$p(1) = k (1)^2 – 3 (1) + k = 0$ (From Factor Theorem)

**» k = 3/2**

4. Factorise :

(i) $12x^2 – 7x + 1$ (ii) $2x^2 + 7x + 3$

(iii) $6x^2 + 5x – 6$ (iv) $3x^2 – x – 4$

**Ans** (i) $12x^2 – 7x + 1$

By splitting the middle term method,

p + q = -7 & pq = 12 x 1 = 12

So p = -3 and q = -4

» $12x^2 – 7x + 1 = 12x^2 – 3x – 4x + 1$

= 3x (4x – 1) -1 ( 4x – 1)

**= (3x – 1) (4x – 1)**

(ii) $2x^2 + 7x + 3$

By splitting the middle term method,

p + q = 7 & pq = 2 x 3 = 6

So p = 6 and q = 1

» $2x^2 + 7x + 3 = 2x^2 + 6x + x + 3$

= 2x (x + 3) + 1 (x + 3)

**= (x + 3) (2x + 1)**

(iii) $6x^2 + 5x – 6$

By splitting the middle term method,

p + q = 5 & pq = 6 x -6 = -36

So p = 9 and q = -4

» $6x^2 + 5x – 6 = 6x^2 + 9x – 4x – 6$

= 3x (2x + 3) -2 (2x + 3)

**= (2x + 3) (3x – 2)**



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

By splitting the middle term method,

$p + q = -1$ & $pq = 3 \times -4 = -12$

So $p = -4$ and $q = 3$

» $3x^2 - x - 4 = 3x^2 - 4x + 3x - 4$

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

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

5. Factorise :

(i) $x^3 - 2x^2 - x + 2$ (ii) $x^3 - 3x^2 - 9x - 5$

(iii) $x^3 + 13x^2 + 32x + 20$ (iv) $2y^3 + y^2 - 2y - 1$

**Ans** (i) Let $p(x) = x^3 - 2x^2 - x + 2$

All the factors of 2 must be considered. The factors are ± 1 & ± 2.

By trial, we get $p(1) = (1)^3 - 2(1)^2 - (1) + 2 = 0$.

Thus, $(x - 1)$ is a factor of $p(x)$.

Dividing $p(x)$ by $(x - 1)$, we get

$$
\begin{array}{r|l}
 & x^2 - x - 2 \\
\hline
x - 1 & x^3 - 2x^2 - x + 2 \\
 & x^3 - x^2 \\
 & - \quad + \\
\hline
 & -x^2 - x + 2 \\
 & -x^2 + x \\
 & + \quad - \\
\hline
 & -2x + 2 \\
 & -2x + 2 \\
 & + \quad - \\
\hline
 & 0
\end{array}
$$

Now, we know that

Dividend = Divisor X Quotient + Remainder

» $x^3 - 2x^2 - x + 2 = (x - 1)(x^2 - x - 2) + 0$

$x^2 - x - 2$ can be factorised further using splitting the middle term,

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

Hence, $x^3 – 2x^2 – x + 2 =$ **$(x – 1) (x + 1) (x – 2)$**

(ii) Let $p(x) = x^3 – 3x^2 – 9x – 5$

All the factors of 5 must be considered. The factors are ± 1 & ± 5.

By trial, we get $p(-1) = (-1)^3 – 3 (-1)^2 – 9 (-1) – 5 = -1 – 3 + 9 – 5 = 0$.

Thus, (x + 1) is a factor of p(x).

Dividing p(x) by (x + 1), we get

$$
\begin{array}{r|l}
 & x^2 - 4x - 5 \\
\hline
x + 1 & x^3 - 3x^2 - 9x - 5 \\
 & \underline{x^3 + x^2} \\
 & \;\;- \;\;\; - \\
 & -4x^2 - 9x - 5 \\
 & \underline{-4x^2 - 4x} \\
 & \;\;+ \;\;\; + \\
 & -5x - 5 \\
 & \underline{-5x - 5} \\
 & \;\;+ \;\;\; + \\
 & 0
\end{array}
$$

Now, we know that

Dividend = Divisor X Quotient + Remainder

» $x^3 – 3x^2 – 9x – 5 = (x + 1) (x^2 – 4x – 5) + 0$

$x^2 – 4x – 5$ can be factorised further using splitting the middle term,

$x^2 – 4x – 5 = x^2 – 5x + x – 5 = x (x – 5) + 1 (x – 5) = (x – 5) (x + 1)$

Hence, $x^3 – 3x^2 – 9x – 5 =$ **$(x + 1) (x + 1) (x – 5)$**

(iii) Let $p(x) = x^3 + 13x^2 + 32x + 20$

All the factors of 20 must be considered. The factors are ± 1, ± 2, ±4, ±5, ±10 & ±20 .

By trial, we get $p(-1) = (-1)^3 + 13 (-1)^2 + 32 (-1) + 20 = -1 + 13 – 32 + 20 = 0$.

Thus, (x + 1) is a factor of p(x).

Dividing p(x) by (x + 1), we get

$$\begin{array}{r|l} & x^2 + 12x + 20 \\ \hline x + 1 & x^3 + 13x^2 + 32x + 20 \\ & x^3 + x^2 \\ & - \quad - \\ \hline & 12x^2 + 32x + 20 \\ & 12x^2 + 12x \\ & - \quad - \\ \hline & 20x + 20 \\ & 20x + 20 \\ & - \quad - \\ \hline & 0 \end{array}$$

Now, we know that

Dividend = Divisor X Quotient + Remainder

» $x^3 + 13x^2 + 32x + 20 = (x + 1)(x^2 + 12x + 20) + 0$

$x^2 + 12x + 20$ can be factorised further using splitting the middle term,

$x^2 + 12x + 20 = x^2 + 10x + 2x + 20 = x(x + 10) + 2(x + 10) = (x + 10)(x + 2)$

Hence, $x^3 + 13x^2 + 32x + 20 =$ **$(x + 1)(x + 2)(x + 10)$**

(iv) Let $p(y) = 2y^3 + y^2 - 2y - 1$

By trial, we get $p(1) = 2(1)^3 + (1)^2 - 2(1) - 1 = 2 + 1 - 2 - 1 = 0$.

Thus, (y – 1) is a factor of p(y).

Dividing p(y) by (y – 1), we get

$$
\begin{array}{r|l}
 & 2y^2 + 3y + 1 \\
\hline
y - 1 & 2y^3 + y^2 - 2y - 1 \\
 & 2y^3 - 2y^2 \\
 & - \quad + \\
\hline
 & 3y^2 - 2y - 1 \\
 & 3y^2 - 3y \\
 & - \quad + \\
\hline
 & y - 1 \\
 & y - 1 \\
 & - \quad + \\
\hline
 & 0
\end{array}
$$

Now, we know that

Dividend = Divisor X Quotient + Remainder

» $2y^3 + y^2 – 2y – 1 = (y – 1) (2y^2 + 3y + 1) + 0$

$2y^2 + 3y + 1$ can be factorised further using splitting the middle term,

$2y^2 + 3y + 1 = 2y^2 + 2y + y + 1 = 2y (y + 1) + 1 (y + 1) = (y + 1) (2y + 1)$

Hence, $2y^3 + y^2 – 2y – 1 =$ **$(y – 1) (y + 1) (2y + 1)$**

## EXERCISE 2.5

1. Use suitable identities to find the following products:

(i) $(x + 4) (x + 10)$ (ii) $(x + 8) (x – 10)$ (iii) $(3x + 4) (3x – 5)$

(iv) $(y^2 + 3/2) (y^2 – 3/2)$ (v) $(3 – 2x) (3 + 2x)$

**Ans** (i) $(x + 4) (x + 10)$

Using identity, $(x + a) (x + b) = x^2 + (a + b)x + ab$, we have

$(x + 4) (x + 10) = x^2 + (4 + 10)x + (4) (10) =$ **$x^2 + 14x + 40$**



(ii) (x + 8) (x – 10)

Using identity, $(x + a)(x + b) = x^2 + (a + b)x + ab$, we have

$(x + 8)(x – 10) = x^2 + (8 – 10)x + (8)(-10) =$ $\mathbf{x^2 – 2x – 80}$

(iii) (3x + 4) (3x – 5)

$= 9 (x + 4/3)(x – 5/3)$

Using identity, $(x + a)(x + b) = x^2 + (a + b)x + ab$, we have

$(3x + 4)(3x – 5) = 9 (x + 4/3)(x – 5/3) = 9 [x^2 + (4/3 – 5/3)x + (4/3)(-5/3)] =$ $\mathbf{9x^2 – 3x – 20}$

(iv) $(y^2 + 3/2)(y^2 – 3/2)$

Using identity, $(x – y)(x + y) = x^2 – y^2$, we have

$(y^2 + 3/2)(y^2 – 3/2) = (y^2)^2 – (3/2)^2 =$ $\mathbf{y^4 – 9/4}$

(v) (3 – 2x) (3 + 2x)

Using identity, $(x – y)(x + y) = x^2 – y^2$, we have

$(3 – 2x)(3 + 2x) = (3)^2 – (2x)^2 =$ $\mathbf{9 – 4x^2}$

2. Evaluate the following products without multiplying directly:

(i) 103 × 107 (ii) 95 × 96 (iii) 104 × 96

**Ans** (i) 103 × 107

= (100 + 3) (100 + 7)

Using identity, $(x + a)(x + b) = x^2 + (a + b)x + ab$, we have

$103 × 107 = (100 + 3)(100 + 7) = (100)^2 + (3 + 7)100 + (3)(7)$

= 10000 + 1000 + 21 = **11021**

(ii) 95 × 96

= (100 – 5) (100 – 4)

Using identity, $(x + a)(x + b) = x^2 + (a + b)x + ab$, we have

$95 × 96 = (100 – 5)(100 – 4) = (100)^2 + (-5 – 4)100 + (-5)(-4)$

= 10000 – 900 + 20 = **9120**

(iii) $104 \times 96$

$= (100 + 4)(100 - 4)$

Using identity, $(x + y)(x - y) = x^2 - y^2$, we have

$104 \times 96 = (100 + 4)(100 - 4) = (100)^2 - (4)^2$

$= 10000 - 16 =$ **9984**

3. Factorise the following using appropriate identities:

(i) $9x^2 + 6xy + y^2$ (ii) $4y^2 - 4y + 1$ (iii) $x^2 - y^2/100$

**Ans** (i) $9x^2 + 6xy + y^2$

$= (3x)^2 + 2(3x)(y) + (y)^2$

$= (3x + y)^2 =$ **$(3x + y)(3x + y)$** [ using identity, $x^2 + 2xy + y^2 = (x + y)^2$]

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

$= (2y)^2 - 2(2y)(1) + (1)^2$

$= (2y - 1)^2 =$ **$(2y - 1)(2y - 1)$** [ using identity, $x^2 - 2xy + y^2 = (x - y)^2$]

(iii) $x^2 - y^2/100$

$= (x)^2 - (y/10)^2$

$=$ **$(x + y/10)(x - y/10)$** [ using identity, $x^2 - y^2 = (x + y)(x - y)$]

4. Expand each of the following, using suitable identities:

(i) $(x + 2y + 4z)^2$ (ii) $(2x - y + z)^2$ (iii) $(-2x + 3y + 2z)^2$

(iv) $(3a - 7b - c)^2$ (v) $(-2x + 5y - 3z)^2$ (vi) $[a/4 - b/2 + 1]^2$

**Ans** (i) $(x + 2y + 4z)^2$

Using identity, $(x + y + z)^2 = x^2 + y^2 + z^2 + 2xy + 2yz + 2zx$, we have

$(x + 2y + 4z)^2 = (x)^2 + (2y)^2 + (4z)^2 + 2(x)(2y) + 2(2y)(4z) + 2(4z)(x)$

$= x^2 + 4y^2 + 16z^2 + 4xy + 16yz + 8xz$

(ii) $(2x - y + z)^2$

Using identity, $(x + y + z)^2 = x^2 + y^2 + z^2 + 2xy + 2yz + 2zx$, we have

$(2x - y + z)^2 = (2x)^2 + (-y)^2 + (z)^2 + 2 (2x) (-y) + 2 (-y) (z) + 2 (z) (2x)$

$= 4x^2 + y^2 + z^2 - 4xy - 2yz + 4xz$

(iii) $(-2x + 3y + 2z)^2$

Using identity, $(x + y + z)^2 = x^2 + y^2 + z^2 + 2xy + 2yz + 2zx$, we have

$(-2x + 3y + 2z)^2 = (-2x)^2 + (3y)^2 + (2z)^2 + 2 (-2x) (3y) + 2 (3y) (2z) + 2 (2z) (-2x)$

= **$4x^2 + 9y^2 + 4z^2 - 12xy + 12yz - 8xz$**

(iv) $(3a - 7b - c)^2$

Using identity, $(x + y + z)^2 = x^2 + y^2 + z^2 + 2xy + 2yz + 2zx$, we have

$(3a - 7b - c)^2 = (3a)^2 + (-7b)^2 + (-c)^2 + 2 (3a) (-7b) + 2 (-7b) (-c) + 2 (-c) (3a)$

= **$9a^2 + 49b^2 + c^2 - 42ab + 14bc - 6ac$**

(v) $(-2x + 5y - 3z)^2$

Using identity, $(x + y + z)^2 = x^2 + y^2 + z^2 + 2xy + 2yz + 2zx$, we have

$(-2x + 5y - 3z)^2 = (-2x)^2 + (5y)^2 + (-3z)^2 + 2 (-2x) (5y) + 2 (5y) (-3z) + 2 (-3z) (-2x)$

= **$4x^2 + 25y^2 + 9z^2 - 20xy - 30yz + 12xz$**

(vi) $[a/4 - b/2 + 1]^2$

Using identity, $(x + y + z)^2 = x^2 + y^2 + z^2 + 2xy + 2yz + 2zx$, we have

$[a/4 - b/2 + 1]^2 = (a/4)^2 + (-b/2)^2 + (1)^2 + 2 (a/4) (-b/2) + 2 (-b/2) (1) + 2 (1) (a/4)$

= **$a^2/16 + b^2/4 + 1 - ab/4 - b + a/2$**



5. Factorise:

(i) $4x^2 + 9y^2 + 16z^2 + 12xy – 24yz – 16xz$

(ii) $2x^2 + y^2 + 8z^2 – 2\sqrt{2}xy + 4\sqrt{2}yz – 8xz$

**Ans** (i) $4x^2 + 9y^2 + 16z^2 + 12xy – 24yz – 16xz$

$= (2x)^2 + (3y)^2 + (-4z)^2 + 2 (2x) (3y) + 2 (3y) (-4z) + 2 (2x) (-4z)$

$= (2x + 3y – 4z)^2$ [ using identity $x^2 + y^2 + z^2 + 2xy + 2yz + 2zx = (x + y + z)^2$]

$= \mathbf{(2x + 3y – 4z) (2x + 3y – 4z)}$

(ii) $2x^2 + y^2 + 8z^2 – 2\sqrt{2}xy + 4\sqrt{2}yz – 8xz$

$= (-\sqrt{2}x)^2 + (y)^2 + (2\sqrt{2}z)^2 + 2 (-\sqrt{2}x) (y) + 2 (y) (2\sqrt{2}z) + 2 (-\sqrt{2}x) (2\sqrt{2}z)$

$= (-\sqrt{2}x + y + 2\sqrt{2}z)^2$ [ using identity $x^2 + y^2 + z^2 + 2xy + 2yz + 2zx = (x + y + z)^2$]

$= \mathbf{(-\sqrt{2}x + y + 2\sqrt{2}z) (-\sqrt{2}x + y + 2\sqrt{2}z)}$

6. Write the following cubes in expanded form:

(i) $(2x + 1)^3$ (ii) $(2a – 3b)^3$ (iii) $[3x/2 + 1]^3$ (iv) $[x – 2y/3]^3$

**Ans** (i) $(2x + 1)^3$

Using identity, $(x + y)^3 = x^3 + y^3 + 3xy (x + y)$, we have

$(2x + 1)^3 = (2x)^3 + (1)^3 + 3 (2x) (1) (2x + 1) = 8x^3 + 1 + 12x^2 + 6x$

$= \mathbf{8x^3 + 12x^2 + 6x + 1}$

(ii) $(2a – 3b)^3$

Using identity, $(x – y)^3 = x^3 – y^3 – 3xy (x – y)$, we have

$(2a – 3b)^3 = (2a)^3 – (3b)^3 – 3 (2a) (3b) (2a – 3b)$

$= \mathbf{8a^3 – 27b^3 – 36a^2b + 54ab^2}$

(iii) $[3x/2 + 1]^3$

Using identity, $(x + y)^3 = x^3 + y^3 + 3xy (x + y)$, we have

$[3x/2 + 1]^3 = (3x/2)^3 + (1)^3 + 3 (3x/2) (1) (3x/2 + 1) = 27x^3/8 + 1 + 27x^2/4 + 9x/2$

$= \mathbf{27x^3/8 + 27x^2/4 + 9x/2 + 1}$

(iv) $[x - 2y/3]^3$

Using identity, $(x - y)^3 = x^3 - y^3 - 3xy\,(x - y)$, we have

$[x - 2y/3]^3 = (x)^3 - (2y/3)^3 - 3\,(x)\,(2y/3)\,(x - 2y/3)$

$= \mathbf{x^3 - 8y^3/27 - 2x^2y + 4xy^2/3}$

7. Evaluate the following using suitable identities:

(i) $(99)^3$ (ii) $(102)^3$ (iii) $(998)^3$

**Ans** (i) $(99)^3$

$= (100 - 1)^3$

Using identity, $(x - y)^3 = x^3 - y^3 - 3xy\,(x - y)$, we have

$(99)^3 = (100 - 1)^3 = (100)^3 - (1)^3 - 3\,(100)\,(1)\,(100 - 1)$

$= 1000000 - 1 - 30000 + 300 =$ **970299**

(ii) $(102)^3$

$= (100 + 2)^3$

Using identity, $(x + y)^3 = x^3 + y^3 + 3xy\,(x + y)$, we have

$(102)^3 = (100 + 2)^3 = (100)^3 + (2)^3 + 3\,(100)\,(2)\,(100 + 2)$

$= 1000000 + 8 + 60000 + 1200 =$ **1061208**

(iii) $(998)^3$

$= (1000 - 2)^3$

Using identity, $(x - y)^3 = x^3 - y^3 - 3xy\,(x - y)$, we have

$(998)^3 = (1000 - 2)^3 = (1000)^3 - (2)^3 - 3\,(1000)\,(2)\,(1000 - 2)$

$= 1000000000 - 8 - 6000000 + 12000 =$ **994011992**

8. Factorise each of the following:

(i) $8a^3 + b^3 + 12a^2b + 6ab^2$ (ii) $8a^3 - b^3 - 12a^2b + 6ab^2$

(iii) $27 - 125a^3 - 135a + 225a^2$ (iv) $64a^3 - 27b^3 - 144a^2b + 108ab^2$

(v) $27p^3 - 1/216 - 9p^2/2 + p/4$

**Ans** (i) $8a^3 + b^3 + 12a^2b + 6ab^2$

$= (2a)^3 + (b)^3 + 6ab\,(2a + b)$

$= (2a)^3 + (b)^3 + 3\ (2a)\ (b)\ (2a + b)$

$= (2a + b)^3$ [ Using identity, $x^3 + y^3 + 3xy\ (x + y) = (x + y)^3$]

**$= (2a + b)\ (2a + b)\ (2a + b)$**

(ii) $8a^3 – b^3 – 12a^2b + 6ab^2$

$= (2a)^3 – (b)^3 – 6ab\ (2a – b)$

$= (2a)^3 – (b)^3 – 3\ (2a)\ (b)\ (2a – b)$

$= (2a – b)^3$ [ Using identity, $x^3 – y^3 – 3xy\ (x – y) = (x – y)^3$]

**$= (2a – b)\ (2a – b)\ (2a – b)$**

(iii) $27 – 125a^3 – 135a + 225a^2$

$= (3)^3 – (5a)^3 – 45a\ (3 – 5a)$

$= (3)^3 – (5a)^3 – 3\ (3)\ (5a)\ (3 – 5a)$

$= (3 – 5a)^3$ [ Using identity, $x^3 – y^3 – 3xy\ (x – y) = (x – y)^3$]

**$= (3 – 5a)\ (3 – 5a)\ (3 – 5a)$**

(iv) $64a^3 – 27b^3 – 144a^2b + 108ab^2$

$= (4a)^3 – (3b)^3 – 36ab\ (4a – 3b)$

$= (4a)^3 – (3b)^3 – 3\ (4a)\ (3b)\ (4a – 3b)$

$= (4a – 3b)^3$ [ Using identity, $x^3 – y^3 – 3xy\ (x – y) = (x – y)^3$]

**$= (4a – 3b)\ (4a – 3b)\ (4a – 3b)$**

(v) $27p^3 – 1/216 – 9p^2/2 + p/4$

$= (3p)^3 – (1/6)^3 – 3\ (3p)\ (1/6)\ (3p – 1/6)$

$= (3p – 1/6)^3$ [ Using identity, $x^3 – y^3 – 3xy\ (x – y) = (x – y)^3$]

**$= (3p – 1/6)\ (3p – 1/6)\ (3p – 1/6)$**

9. Verify : (i) $x^3 + y^3 = (x + y)\ (x^2 – xy + y^2)$ (ii) $x^3 – y^3 = (x – y)\ (x^2 + xy + y^2)$

**Ans** (i) $x^3 + y^3 = (x + y)\ (x^2 – xy + y^2)$

We all know that, $x^3 + y^3 + 3xy\ (x + y) = (x + y)^3$

» $x^3 + y^3 = (x + y)^3 – 3xy\ (x + y)$

$= (x + y) [(x + y)^2 – 3xy] = (x + y) (x^2 + y^2 + 2xy – 3xy)$

$= \mathbf{(x + y) (x^2 – xy + y^2)}$

Hence, $x^3 + y^3 = (x + y) (x^2 – xy + y^2)$ is verified.

(ii) $x^3 – y^3 = (x – y) (x^2 + xy + y^2)$

We all know that, $x^3 – y^3 – 3xy (x – y) = (x – y)^3$

» $x^3 – y^3 = (x – y)^3 + 3xy (x – y)$

$= (x – y) [(x – y)^2 + 3xy] = (x – y) (x^2 + y^2 – 2xy + 3xy)$

$= \mathbf{(x – y) (x^2 + xy + y^2)}$

Hence, $x^3 – y^3 = (x – y) (x^2 + xy + y^2)$ is verified.

10. Factorise each of the following:

(i) $27y^3 + 125z^3$ (ii) $64m^3 – 343n^3$

[**Hint :** See Question 9.]

**Ans** (i) $27y^3 + 125z^3$

$= (3y)^3 + (5z)^3$

$= (3y + 5z) [(3y)^2 – (3y) (5z) + (5z)^2]$ {Using identity, $x^3 + y^3 = (x + y) (x^2 – xy + y^2)$}

$= \mathbf{(3y + 5z) (9y^2 + 25z^2 – 15yz)}$

(ii) $64m^3 – 343n^3$

$= (4m)^3 – (7n)^3$

$= (4m – 7n) [(4m)^2 + (4m) (7n) + (7n)^2]$ { Using identity, $x^3 – y^3 = (x – y) (x^2 + xy + y^2)$}

$= \mathbf{(4m – 7n) (16m^2 + 49n^2 + 28mn)}$

11. Factorise : $27x^3 + y^3 + z^3 – 9xyz$

**Ans** $27x^3 + y^3 + z^3 – 9xyz$

$= (3x)^3 + (y)^3 + (z)^3 – 3 (3x) (y) (z)$

$= (3x + y + z) [(3x)^2 + (y)^2 + (z)^2 – (3x) (y) – (y) (z) – (z) (3x)]$ { Using identity, $x^3 + y^3 + z^3 – 3xyz = (x + y + z) (x^2 + y^2 + z^2 – xy – yz – zx)$}

$= \mathbf{(3x + y + z) (9x^2 + y^2 + z^2 – 3xy – yz – 3xz)}$

12. Verify that $x^3 + y^3 + z^3 - 3xyz = \frac{1}{2}(x + y + z)[(x - y)^2 + (y - z)^2 + (z - x)^2]$

**Ans** We know the identity,

$x^3 + y^3 + z^3 - 3xyz = (x + y + z)(x^2 + y^2 + z^2 - xy - yz - zx)$

$= \frac{1}{2}[2(x + y + z)(x^2 + y^2 + z^2 - xy - yz - zx)]$

$= \frac{1}{2}(x + y + z)(2x^2 + 2y^2 + 2z^2 - 2xy - 2yz - 2zx)$

$= \frac{1}{2}(x + y + z)[(x^2 + y^2 - 2xy) + (y^2 + z^2 - 2yz) + (x^2 + z^2 - 2zx)]$

**$= \frac{1}{2}(x + y + z)[(x - y)^2 + (y - z)^2 + (z - x)^2]$ (Hence verified)**

13. If $x + y + z = 0$, show that $x^3 + y^3 + z^3 = 3xyz$.

**Ans** We know the identity,

$x^3 + y^3 + z^3 - 3xyz = (x + y + z)(x^2 + y^2 + z^2 - xy - yz - zx)$

Now, if $x + y + z = 0$, then

$x^3 + y^3 + z^3 - 3xyz = (0)(x^2 + y^2 + z^2 - xy - yz - zx) = 0$

» **$x^3 + y^3 + z^3 = 3xyz$**

14. Without actually calculating the cubes, find the value of each of the following:

(i) $(-12)^3 + (7)^3 + (5)^3$

(ii) $(28)^3 + (-15)^3 + (-13)^3$

**Ans** (i) $(-12)^3 + (7)^3 + (5)^3$

Let $x = -12$, $y = 7$ and $z = 5$

Then, $x + y + z = -12 + 7 + 5 = 0$

As we know that, if $x + y + z = 0$, then

$x^3 + y^3 + z^3 = 3xyz$

» $(-12)^3 + (7)^3 + (5)^3 = 3(-12)(7)(5) =$ **-1260**



(ii) $(28)^3 + (-15)^3 + (-13)^3$

Let x = 28, y = -15 and z = -13

Then, x + y + z = 28 – 15 – 13 = 0

As we know that, if x + y + z = 0, then

$x^3 + y^3 + z^3 = 3xyz$

» $(28)^3 + (-15)^3 + (-13)^3 = 3\ (28)\ (-15)\ (-13) =$ **16380**

15. Give possible expressions for the length and breadth of each of the following rectangles, in which their areas are given:

| (i) | (ii) |
|---|---|
| Area : $25a^2 - 35a + 12$ | Area : $35y^2 + 13y - 12$ |

**Ans** (i) Area = $25a^2 - 35a + 12$

Area = Length x Breadth

Thus length and breadth can be calculated by factorising the given polynomial.

Now we have, Area = $25a^2 - 35a + 12$

By splitting the middle term method,

p + q = -35 & pq = 25 x 12 = 300

So p = -20 and q = -15

» $25a^2 - 35a + 12 = 25a^2 - 20a - 15a + 12$

= 5a (5a – 4) -3 (5a – 4)

= (5a – 3) (5a – 4)

Hence, Length = 5a – 3 and Breadth = 5a – 4.

(ii) Area = $35y^2 + 13y - 12$

Area = Length x Breadth

Thus length and breadth can be calculated by factorising the given polynomial.

Now we have, Area = $35y^2 + 13y - 12$

By splitting the middle term method,

p + q = 13 & pq = 35 x -12 = -420

So p = 28 and q = -15

» $35y^2 + 13y - 12 = 35y^2 + 28y - 15y - 12$

= 7y (5y + 4) -3 (5y + 4)

= (7y – 3) (5y + 4)

Hence, Length = 7y – 3 and Breadth = 5y + 4.

16. What are the possible expressions for the dimensions of the cuboids whose volumes are given below?

| Volume : $3x^2 - 12x$ | Volume : $12ky^2 + 8ky - 20k$ |
|---|---|
| (i) | (ii) |

**Ans** (i) Volume = $3x^2 - 12x$

Volume of cuboid = Length x Breadth x Height

Thus length, breadth and height can be calculated by factorising the given polynomial.

Now we have,

Volume = $3x^2 - 12x$

= **3x (x – 4)**

Hence one of the solution is: Length = 3, Breadth = x and Height = x – 4.

(ii) Volume = $12ky^2 + 8ky - 20k$

Volume of cuboid = Length x Breadth x Height

Thus length, breadth and height can be calculated by factorising the given polynomial.

Now we have,

Volume = $12ky^2 + 8ky - 20k$

= $4k (3y^2 + 2y - 5)$

By splitting the middle term method,

p + q = 2 & pq = 3 x -5 = -15

So p = 5 and q = -3



» $4k(3y^2 + 2y - 5) = 4k(3y^2 + 5y - 3y - 5)$

$= 4k[y(3y + 5) - 1(3y + 5)]$

**$= 4k(3y + 5)(y - 1)$**

Hence one of the solution is: Length = 4k, Breadth = 3y + 5 and Height = y – 1.

