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NCERT Solutions for 9th Class Maths :Chapter 2 Polynomials



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NCERT Solutions for 9th Class Maths :Chapter 2 Polynomials

Class 9: Maths Chapter 2 solutions. Complete Class 9 Maths Chapter 2 Notes.

NCERT Solutions for 9th Class Maths :Chapter 2 Polynomials

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Exercise 2.1

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

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

(ii) $y^2 + \sqrt{2}$

(iii) $3\sqrt{t} + t\sqrt{2}$

(iv) $y + 2/y$

(v) $x^{10} + y^3 + t^{50}$

Answer

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

There is only one variable x with whole number power so this polynomial in one variable.

(ii) $y^2 + \sqrt{2}$

There is only one variable y with whole number power so this polynomial in one variable.

(iii) $3\sqrt{t} + t\sqrt{2}$

There is only one variable t but in $3\sqrt{t}$ power of t is $1/2$ which is not a whole number so $3\sqrt{t} + t\sqrt{2}$ is not a polynomial.

(iv) $y + 2/y$

There is only one variable y but $2/y = 2y^{-1}$ so the power is not a whole number so $y + 2/y$ is not a polynomial.

(v) $x^{10} + y^3 + t^{50}$

There are three variable x , y and t and there powers are whole number so this polynomial in three variable.

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

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

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

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

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

Answer

(i) coefficients of $x^2 = 1$

(ii) coefficients of $x^2 = -1$

(iii) coefficients of $x^2 = \pi/2$

(iv) coefficients of $x^2 = 0$

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

Answer

$3x^{35}+7$ and $4x^{100}$

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

Answer

(i) $5x^3$ has highest power in the given polynomial which power is 3. Therefore, degree of polynomial is 3.

(ii) $-y^2$ has highest power in the given polynomial which power is 2. Therefore, degree of polynomial is 2.

(iii) $5t$ has highest power in the given polynomial which power is 1. Therefore, degree of polynomial is 1.

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(iv) There is no variable in the given polynomial. Therefore, degree of polynomial is 0.

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

(i) $x^2 + x$

▶ Quadratic Polynomial

(ii) $x - x^3$

▶ Cubic Polynomial

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

▶ Quadratic Polynomial

(iv) $1 + x$

▶ Linear Polynomial

(vi) r^2

▶ Quadratic Polynomial

(vii) $7x^3$

▶ Cubic Polynomial

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Exercise 2.2

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

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

Answer

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

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

$$= 3$$

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

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

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

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

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

$$= 10 + 16 + 3 = 29$$

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

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

$$(ii) p(t) = 2 + t + 2t^2 - t^3$$

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

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

Answer

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

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

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

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

$$(ii) p(t) = 2 + t + 2t^2 - t^3$$

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

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

$$= 2 + 1 + 2 - 1 = 4$$

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$$p(2) = 2 + 2 + 2(2)^2 - (2)^3$$
$$= 2 + 2 + 8 - 8 = 4$$

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

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

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

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

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

$$p(0) = (0 - 1)(0 + 1) = (-1)(1) = -1$$

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

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

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

$$(i) p(x) = 3x + 1, x = -1/3$$

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

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

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

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

$$(vi) p(x) = lx + m, x = -\frac{m}{l}$$

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

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

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Answer

(i) If $x = -1/3$ is a zero of polynomial $p(x) = 3x + 1$ then $p(-1/3)$ should be 0.

$$\text{At, } p(-1/3) = 3(-1/3) + 1 = -1 + 1 = 0$$

Therefore, $x = -1/3$ is a zero of polynomial $p(x) = 3x + 1$.

(ii) If $x = 4/5$ is a zero of polynomial $p(x) = 5x - \pi$ then $p(4/5)$ should be 0.

$$\text{At, } p(4/5) = 5(4/5) - \pi = 4 - \pi$$

Therefore, $x = 4/5$ is not a zero of given polynomial $p(x) = 5x - \pi$.

(iii) If $x = 1$ and $x = -1$ are zeroes of polynomial $p(x) = x^2 - 1$, then $p(1)$ and $p(-1)$ should be 0.

$$\text{At, } p(1) = (1)^2 - 1 = 0 \text{ and}$$

$$\text{At, } p(-1) = (-1)^2 - 1 = 0$$

Hence, $x = 1$ and -1 are zeroes of the polynomial $p(x) = x^2 - 1$.

(iv) If $x = -1$ and $x = 2$ are zeroes of polynomial $p(x) = (x + 1)(x - 2)$, then $p(-1)$ and $p(2)$ should be 0.

$$\text{At, } p(-1) = (-1 + 1)(-1 - 2) = 0(-3) = 0, \text{ and}$$

$$\text{At, } p(2) = (2 + 1)(2 - 2) = 3(0) = 0$$

Therefore, $x = -1$ and $x = 2$ are zeroes of the polynomial $p(x) = (x + 1)(x - 2)$.

(v) If $x = 0$ is a zero of polynomial $p(x) = x^2$, then $p(0)$ should be zero.

$$\text{Here, } p(0) = (0)^2 = 0$$

Hence, $x = 0$ is a zero of the polynomial $p(x) = x^2$.

(vi) If $x = \frac{-m}{l}$ is a zero of polynomial $p(x) = lx + m$ then $p\left(\frac{-m}{l}\right)$ should be 0.

$$\text{At, } p\left(\frac{-m}{l}\right) = l\left(\frac{-m}{l}\right) + m = -m + m = 0$$

Therefore, $x = \frac{-m}{l}$ is a zero of the polynomial $(x) = lx + m$

(vii) If $x = \frac{-1}{\sqrt{3}}$ and $x = \frac{2}{\sqrt{3}}$ are zeroes of polynomial $p(x) = 3x^2 + 1$, then

$p\left(\frac{-1}{\sqrt{3}}\right)$ and $p\left(\frac{2}{\sqrt{3}}\right)$ should be 0.

$$\text{At, } p\left(\frac{-1}{\sqrt{3}}\right) = 3\left(\frac{-1}{\sqrt{3}}\right)^2 - 1 = 3\left(\frac{1}{3}\right) - 1 = 1 - 1 = 0 \text{ and}$$

$$\text{At, } p\left(\frac{2}{\sqrt{3}}\right) = 3\left(\frac{2}{\sqrt{3}}\right)^2 - 1 = 3\left(\frac{4}{3}\right) - 1 = 4 - 1 = 3$$

Therefore, $x = \frac{-1}{\sqrt{3}}$ is a zero of polynomial $p(x) = 3x^2 + 1$

but $x = \frac{2}{\sqrt{3}}$ is not a zero of this polynomial.

(viii) If $x = 1/2$ is a zero of polynomial $p(x) = 2x + 1$ then $p(1/2)$ should be 0.

$$\text{At, } p(1/2) = 2(1/2) + 1 = 1 + 1 = 2$$

Therefore, $x = 1/2$ is not a zero of given polynomial $p(x) = 2x + 1$.

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) $p(x) = ax, a \neq 0$

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

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Answer

$$(i) p(x) = x + 5$$

$$p(x) = 0$$

$$x + 5 = 0$$

$$x = -5$$

Therefore, $x = -5$ is a zero of polynomial $p(x) = x + 5$.

$$(ii) p(x) = x - 5$$

$$p(x) = 0$$

$$x - 5 = 0$$

$$x = 5$$

Therefore, $x = 5$ is a zero of polynomial $p(x) = x - 5$.

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

$$p(x) = 0$$

$$2x + 5 = 0$$

$$2x = -5$$

$$x = -5/2$$

Therefore, $x = -5/2$ is a zero of polynomial $p(x) = 2x + 5$.

$$(iv) p(x) = 3x - 2$$

$$p(x) = 0$$

$$3x - 2 = 0$$

$$x = 2/3$$

Therefore, $x = 2/3$ is a zero of polynomial $p(x) = 3x - 2$.

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$$(v) p(x) = 3x$$

$$p(x) = 0$$

$$3x = 0$$

$$x = 0$$

Therefore, $x = 0$ is a zero of polynomial $p(x) = 3x$.

$$(vi) p(x) = ax$$

$$p(x) = 0$$

$$ax = 0$$

$$x = 0$$

Therefore, $x = 0$ is a zero of polynomial $p(x) = ax$.

$$(vii) p(x) = cx + d$$

$$p(x) = 0$$

$$cx + d = 0$$

$$x = -d/c$$

Therefore, $x = -d/c$ is a zero of polynomial $p(x) = cx + d$.

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NCERT 9th Maths Chapter 2, class 9 Maths Chapter 2 solutions

Exercises 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

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(iv) $x + \pi$

(v) $5 + 2x$

Answer

(i) $x + 1$

By long division,

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

Therefore, the remainder is 0.

(ii) $x - 1/2$

By long division,

$$\begin{array}{r}
 x^2 + \frac{7}{2}x + \frac{19}{4} \\
 \hline
 x - \frac{1}{2} \overline{) \begin{array}{l} x^3 + 3x^2 + 3x + 1 \\ x^3 - \frac{x^2}{2} \\ \hline \frac{7}{2}x^2 + 3x + 1 \\ \frac{7}{2}x^2 - \frac{7}{4}x \\ \hline \frac{19}{4}x + 1 \\ \frac{19}{4}x - \frac{19}{8} \\ \hline \frac{27}{8} \end{array} }
 \end{array}$$

Therefore, the remainder is $\frac{27}{8}$.

(iii) x

$$\begin{array}{r}
 x^2 + 3x + 3 \\
 \hline
 x \left(\begin{array}{r}
 x^3 + 3x^2 + 3x + 1 \\
 x^3 \\
 \hline
 3x^2 + 3x + 1 \\
 3x^2 \\
 \hline
 3x + 1 \\
 3x \\
 \hline
 1
 \end{array} \right.
 \end{array}$$

Therefore, the remainder is 1.

(iv) $x + \pi$

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

Therefore, the remainder is $[1 - 3\pi + 3\pi^2 - \pi^3]$.

(v) $5 + 2x$

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$$\begin{array}{r}
 x^2 + (3 - \pi)x + (3 - 3\pi + \pi^2) \\
 \hline
 x + \pi \left\{ \begin{array}{l}
 x^3 + 3x^2 + 3x + 1 \\
 x^3 + \pi x^2 \\
 \hline
 (3 - \pi)x^2 + 3x + 1 \\
 (3 - \pi)x^2 + (3 - \pi)\pi x \\
 \hline
 [3 - 3\pi + \pi^2]x + 1 \\
 [3 - 3\pi + \pi^2]x + (3 - 3\pi + \pi^2)\pi \\
 \hline
 [1 - 3\pi + 3\pi^2 - \pi^3]
 \end{array} \right.
 \end{array}$$

Therefore, the remainder is $-27/8$.

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

Answer

By Long Division,

$$\begin{array}{r}
 x^2 + 6 \\
 \hline
 x - a \left\{ \begin{array}{l}
 x^3 - ax^2 + 6x - a \\
 x^3 - ax^2 \\
 \hline
 6x - a \\
 6x - 6a \\
 \hline
 5a
 \end{array} \right.
 \end{array}$$

Therefore, remainder obtained is $5a$ when $x^3 - ax^2 + 6x - a$ is divided by $x - a$.

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

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Answer

We have to divide $3x^3 + 7x$ by $7 + 3x$. If remainder comes out to be 0 then $7 + 3x$ will be a factor of $3x^3 + 7x$.

By Long Division,

$$\begin{array}{r} x^2 - \frac{7}{3}x + \frac{70}{9} \\ 3x - 7 \overline{) 3x^3 + 0x^2 + 7x} \\ \underline{3x^3 + 7x^2} \\ -7x^2 + 7x \\ \underline{-7x^2 - \frac{49x}{3}} \\ \frac{70x}{3} \\ \underline{\frac{70x}{3} + \frac{490}{9}} \\ \phantom{\frac{70x}{3} +} \frac{-490}{9} \end{array}$$

As remainder is not zero so $7 + 3x$ is not a factor of $3x^3 + 7x$.

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Exercise 2.4

NCERT 9th Maths Chapter 2, class 9 Maths Chapter 2 solutions

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

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

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

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

(iv) $x^3 - x^2 - (2 + \sqrt{2})x + \sqrt{2}$

Answer

(i) If $(x + 1)$ is a factor of $p(x) = x^3 + x^2 + x + 1$, $p(-1)$ must be zero.

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

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

$$= -1 + 1 - 1 + 1 = 0$$

Therefore, $x + 1$ is a factor of this polynomial

(ii) If $(x + 1)$ is a factor of $p(x) = x^4 + x^3 + x^2 + x + 1$, $p(-1)$ must be zero.

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

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

$$= 1 - 1 + 1 - 1 + 1 = 1$$

As, $p(-1) \neq 0$

Therefore, $x + 1$ is not a factor of this polynomial

(iii) If $(x + 1)$ is a factor of polynomial $p(x) = x^4 + 3x^3 + 3x^2 + x + 1$, $p(-1)$ must be 0.

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

$$= 1 - 3 + 3 - 1 + 1 = 1$$

As, $p(-1) \neq 0$

Therefore, $x + 1$ is not a factor of this polynomial.

(iv) If $(x + 1)$ is a factor of polynomial

$$p(x) = x^3 - x^2 - (2 + \sqrt{2})x + \sqrt{2}, p(-1) \text{ must be } 0.$$

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

As, $p(-1) \neq 0$

Therefore, $x + 1$ is not a factor of this 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) $p(x) = x^3 - 4x^2 + x + 6$, $g(x) = x - 3$

Answer

(i) If $g(x) = x + 1$ is a factor of given polynomial $p(x)$, $p(-1)$ must be zero.

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

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

$$= 2(-1) + 1 + 2 - 1 = 0$$

Hence, $g(x) = x + 1$ is a factor of given polynomial.

(ii) If $g(x) = x + 2$ is a factor of given polynomial $p(x)$, $p(-2)$ must be 0.

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

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

$$= -8 + 12 - 6 + 1$$

$$= -1$$

As, $p(-2) \neq 0$

Hence $g(x) = x + 2$ is not a factor of given polynomial.

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(iii) If $g(x) = x - 3$ is a factor of given polynomial $p(x)$, $p(3)$ must be 0.

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

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

$$= 27 - 36 + 9 = 0$$

Therefore,, $g(x) = x - 3$ is a factor of given polynomial.

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

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

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

$$(iii) p(x) = kx^2 - \sqrt{2}x + 1$$

$$(iv) p(x) = kx^2 - 3x + k$$

Answer

(i) If $x - 1$ is a factor of polynomial $p(x) = x^2 + x + k$, then

$$p(1) = 0$$

$$\Rightarrow (1)^2 + 1 + k = 0$$

$$\Rightarrow 2 + k = 0$$

$$\Rightarrow k = -2$$

Therefore, value of k is -2.

(ii) If $x - 1$ is a factor of polynomial $p(x) = 2x^2 + kx + \sqrt{2}$, then

$$p(1) = 0$$

$$\Rightarrow 2(1)^2 + k(1) + \sqrt{2} = 0$$

$$\Rightarrow 2 + k + \sqrt{2} = 0$$

$$\Rightarrow k = -2 - \sqrt{2} = -(2 + \sqrt{2})$$

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Therefore, value of k is $-(2 + \sqrt{2})$.

(iii) If $x - 1$ is a factor of polynomial $p(x) = kx^2 - \sqrt{2}x + 1$, then

$$p(1) = 0$$

$$\Rightarrow k(1)^2 - \sqrt{2}(1) + 1 = 0$$

$$\Rightarrow k - \sqrt{2} + 1 = 0$$

$$\Rightarrow k = \sqrt{2} - 1$$

Therefore, value of k is $\sqrt{2} - 1$.

(iv) If $x - 1$ is a factor of polynomial $p(x) = kx^2 - 3x + k$, then

$$p(1) = 0$$

$$\Rightarrow k(1)^2 + 3(1) + k = 0$$

$$\Rightarrow k - 3 + k = 0$$

$$\Rightarrow 2k - 3 = 0$$

$$\Rightarrow k = 3/2$$

Therefore, value of k is $3/2$.

4. Factorise:

(i) $12x^2 + 7x + 1$

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

(iii) $6x^2 + 5x - 6$

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

Answer

(i) $12x^2 + 7x + 1$

$$= 12x^2 - 4x - 3x + 1$$

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

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

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

$$= 2x^2 + 6x + x + 3$$

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

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

$$(iii) 6x^2 + 5x - 6$$

$$= 6x^2 + 9x - 4x - 6$$

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

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

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

$$= 3x^2 - 4x + 3x - 4$$

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

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

5. Factorise:

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

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

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

$$(iv) 2y^3 + y^2 - 2y - 1$$

Answer

$$(i) \text{ Let } p(x) = x^3 - 2x^2 - x + 2$$

Factors of 2 are ± 1 and ± 2

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By trial method, we find that

$$p(1) = 0$$

So, $(x+1)$ is factor of $p(x)$

Now,

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

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

Therefore, $(x+1)$ is the factor of $p(x)$

$$\begin{array}{r}
 x^2 - \frac{7}{3}x + \frac{70}{9} \\
 \hline
 3x - 7 \overline{) 3x^3 + 0x^2 + 7x} \\
 \underline{3x^3 + 7x^2} \\
 -7x^2 + 7x \\
 \underline{-7x^2 - \frac{49x}{3}} \\
 \frac{70x}{3} \\
 \underline{\frac{70x}{3} + \frac{490}{9}} \\
 \phantom{\frac{70x}{3} +} \frac{-490}{9}
 \end{array}$$

Now, Dividend = Divisor \times Quotient + Remainder

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

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

$$= (x+1)\{x(x-1) - 2(x-1)\}$$

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$$= (x-5)(x+1)(x+1)$$

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

Factors of 20 are $\pm 1, \pm 2, \pm 4, \pm 5, \pm 10$ and ± 20

By trial method, we find that

$$p(-1) = 0$$

So, $(x+1)$ is factor of $p(x)$

Now,

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

$$p(-1) = (-1)^3 + 13(-1)^2 + 32(-1) + 20 = -1 + 13 - 32 + 20 = 0$$

Therefore, $(x+1)$ is the factor of $p(x)$

$$\begin{array}{r} x^2 + 12x + 20 \\ \hline x+1 \overline{) x^3 + 13x^2 + 32x + 20} \\ \underline{x^3 + x^2} \\ 12x^2 + 32x + 20 \\ \underline{12x^2 + 12x} \\ 20x + 20 \\ \underline{20x + 20} \\ 0 \end{array}$$

Now, Dividend = Divisor \times Quotient + Remainder

$$(x+1)(x^2 + 12x + 20)$$

$$= (x+1)(x^2 + 2x + 10x + 20)$$

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$$= (x-5) \{x(x+2) + 10(x+2)\}$$

$$= (x-5) (x+2) (x+10)$$

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

Factors of $ab = 2 \times (-1) = -2$ are ± 1 and ± 2

By trial method, we find that

$$p(1) = 0$$

So, $(y-1)$ is factor of $p(y)$

Now,

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

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

Therefore, $(y-1)$ is the factor of $p(y)$

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

Now, Dividend = Divisor \times Quotient + Remainder

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

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$$\begin{aligned} &= (y-1) (2y^2 + 2y + y + 1) \\ &= (y-1) \{2y(y+1) + 1(y+1)\} \\ &= (y-1) (2y+1) (y+1) \end{aligned}$$

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Exercise 2.5

1. Use suitable identities to find the following products:

$$\begin{array}{lll} \text{(i) } (x + 4) (x + 10) & \text{(ii) } (x + 8) (x - 10) & \text{(iii) } (3x + 4) \\ (3x - 5) & & \\ \text{(iv) } (y^2 + 3/2) (y^2 - 3/2) & \text{(v) } (3 - 2x) (3 + 2x) & \end{array}$$

Answer

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

In $(x + 4) (x + 10)$, $a = 4$ and $b = 10$

Now,

$$\begin{aligned} (x + 4) (x + 10) &= x^2 + (4 + 10)x + (4 \times 10) \\ &= x^2 + 14x + 40 \end{aligned}$$

(ii) $(x + 8) (x - 10)$

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

Here, $a = 8$ and $b = -10$

$$\begin{aligned} (x + 8) (x - 10) &= x^2 + \{8 + (-10)\}x + \{8 \times (-10)\} \\ &= x^2 + (8 - 10)x - 80 \\ &= x^2 - 2x - 80 \end{aligned}$$

(iii) $(3x + 4) (3x - 5)$

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

Here, $x = 3x$, $a = 4$ and $b = -5$

$$\begin{aligned}(3x + 4)(3x - 5) &= (3x)^2 + \{4 + (-5)\}3x + \{4 \times (-5)\} \\ &= 9x^2 + 3x(4 - 5) - 20 \\ &= 9x^2 - 3x - 20\end{aligned}$$

(iv) $(y^2 + 3/2)(y^2 - 3/2)$

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

Here, $x = y^2$ and $y = 3/2$

$$\begin{aligned}(y^2 + 3/2)(y^2 - 3/2) &= (y^2)^2 - (3/2)^2 \\ &= y^4 - 9/4\end{aligned}$$

(v) $(3 - 2x)(3 + 2x)$

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

Here, $x = 3$ and $y = 2x$

$$\begin{aligned}(3 - 2x)(3 + 2x) &= 3^2 - (2x)^2 \\ &= 9 - 4x^2\end{aligned}$$

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2. Evaluate the following products without multiplying directly:

(i) 103×107

(ii) 95×96

(iii) 104×96

Answer

(i) $103 \times 107 = (100 + 3)(100 + 7)$

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

Here, $x = 100$, $a = 3$ and $b = 7$

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$$\begin{aligned}103 \times 107 &= (100 + 3)(100 + 7) = (100)^2 + (3 + 7)10 + (3 \times 7) \\ &= 10000 + 100 + 21 \\ &= 10121\end{aligned}$$

$$(ii) 95 \times 96 = (90 + 5)(90 + 4)$$

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

Here, $x = 90$, $a = 5$ and $b = 4$

$$\begin{aligned}95 \times 96 &= (90 + 5)(90 + 4) = 90^2 + 90(5 + 4) + (5 \times 4) \\ &= 8100 + (11 \times 90) + 20 \\ &= 8100 + 990 + 20 = 9110\end{aligned}$$

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

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

Here, $x = 100$ and $y = 4$

$$104 \times 96 = (100 + 4)(100 - 4) = (100)^2 - (4)^2 = 10000 - 16 = 9984$$

3. Factorise the following using appropriate identities:

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

Answer

$$(i) 9x^2 + 6xy + y^2 = (3x)^2 + (2 \times 3x \times y) + y^2$$

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

Here, $a = 3x$ and $b = y$

$$9x^2 + 6xy + y^2 = (3x)^2 + (2 \times 3x \times y) + y^2 = (3x + y)^2 = (3x + y)(3x + y)$$

$$(ii) 4y^2 - 4y + 1 = (2y)^2 - (2 \times 2y \times 1) + 1^2$$

Using identity, $(a - b)^2 = a^2 - 2ab + b^2$

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Here, $a = 2y$ and $b = 1$

$$4y^2 - 4y + 1 = (2y)^2 - (2 \times 2y \times 1) + 1^2 = (2y - 1)^2 = (2y - 1)(2y - 1)$$

$$(iii) x^2 - y^2/100 = x^2 - (y/10)^2$$

Using identity, $a^2 - b^2 = (a + b)(a - b)$

Here, $a = x$ and $b = (y/10)$

$$x^2 - y^2/100 = x^2 - (y/10)^2 = (x - y/10)(x + y/10)$$

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

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

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

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

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

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

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

Answer

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

Using identity, $(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$

Here, $a = x$, $b = 2y$ and $c = 4z$

$$\begin{aligned} (x + 2y + 4z)^2 &= x^2 + (2y)^2 + (4z)^2 + (2 \times x \times 2y) + (2 \times 2y \times 4z) + (2 \times 4z \times x) \\ &= x^2 + 4y^2 + 16z^2 + 4xy + 16yz + 8xz \end{aligned}$$

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

Using identity, $(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$

Here, $a = 2x$, $b = -y$ and $c = z$

$$\begin{aligned} (2x - y + z)^2 &= (2x)^2 + (-y)^2 + z^2 + (2 \times 2x \times -y) + (2 \times -y \times z) + (2 \times z \times 2x) \\ &= 4x^2 + y^2 + z^2 - 4xy - 2yz + 4xz \end{aligned}$$

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

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Using identity, $(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$

Here, $a = -2x$, $b = 3y$ and $c = 2z$

$$\begin{aligned}(-2x + 3y + 2z)^2 &= (-2x)^2 + (3y)^2 + (2z)^2 + (2 \times -2x \times 3y) + (2 \times 3y \times 2z) + (2 \times 2z \times -2x) \\ &= 4x^2 + 9y^2 + 4z^2 - 12xy + 12yz - 8xz\end{aligned}$$

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

Using identity, $(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$

Here, $a = 3a$, $b = -7b$ and $c = -c$

$$\begin{aligned}(3a - 7b - c)^2 &= (3a)^2 + (-7b)^2 + (-c)^2 + (2 \times 3a \times -7b) + (2 \times -7b \times -c) + (2 \times -c \times 3a) \\ &= 9a^2 + 49b^2 + c^2 - 42ab + 14bc - 6ac\end{aligned}$$

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

Using identity, $(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$

Here, $a = -2x$, $b = 5y$ and $c = -3z$

$$\begin{aligned}(-2x + 5y - 3z)^2 &= (-2x)^2 + (5y)^2 + (-3z)^2 + (2 \times -2x \times 5y) + (2 \times 5y \times -3z) + (2 \times -3z \times -2x) \\ &= 4x^2 + 25y^2 + 9z^2 - 20xy - 30yz + 12xz\end{aligned}$$

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

Using identity, $(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$

Here, $a = 1/4 a$, $b = -1/2 b$ and $c = 1$

$$\begin{aligned}[1/4 a - 1/2 b + 1]^2 &= (1/4 a)^2 + (-1/2 b)^2 + 1^2 + (2 \times 1/4 a \times -1/2 b) + (2 \times -1/2 b \times 1) + (2 \times 1 \times 1/4 a) \\ &= 1/16 a^2 + 1/4 b^2 + 1 - 1/4 ab - b + 1/2 a\end{aligned}$$

5. Factorise:

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

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

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Answer

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

Using identity, $(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$

$$\begin{aligned} &4x^2 + 9y^2 + 16z^2 + 12xy - 24yz - 16xz \\ &= (2x)^2 + (3y)^2 + (-4z)^2 + (2 \times 2x \times 3y) + (2 \times 3y \times -4z) + (2 \times -4z \times 2x) \\ &= (2x + 3y - 4z)^2 \\ &= (2x + 3y - 4z)(2x + 3y - 4z) \end{aligned}$$

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

Using identity, $(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$

$$\begin{aligned} &2x^2 + y^2 + 8z^2 - 2\sqrt{2}xy + 4\sqrt{2}yz - 8xz \\ &= (-\sqrt{2}x)^2 + (y)^2 + (2\sqrt{2}z)^2 + (2 \times -\sqrt{2}x \times y) + (2 \times y \times 2\sqrt{2}z) + (2 \times 2\sqrt{2}z \times -\sqrt{2}x) \\ &= (-\sqrt{2}x + y + 2\sqrt{2}z)^2 \\ &= (-\sqrt{2}x + y + 2\sqrt{2}z)(-\sqrt{2}x + y + 2\sqrt{2}z) \end{aligned}$$

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6. Write the following cubes in expanded form:

(i) $(2x + 1)^3$ (ii) $(2a - 3b)^3$ (iii) $[\frac{3}{2}x + 1]^3$ (iv) $[x - \frac{2}{3}y]^3$

Answer

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

Using identity, $(a + b)^3 = a^3 + b^3 + 3ab(a + b)$

$$\begin{aligned} (2x + 1)^3 &= (2x)^3 + 1^3 + (3 \times 2x \times 1)(2x + 1) \\ &= 8x^3 + 1 + 6x(2x + 1) \\ &= 8x^3 + 12x^2 + 6x + 1 \end{aligned}$$

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$$(ii)(2a - 3b)^3$$

Using identity, $(a - b)^3 = a^3 - b^3 - 3ab(a - b)$

$$(2a - 3b)^3 = (2a)^3 - (3b)^3 - (3 \times 2a \times 3b)(2a - 3b)$$

$$= 8a^3 - 27b^3 - 18ab(2a - 3b)$$

$$= 8a^3 - 27b^3 - 36a^2b + 54ab^2$$

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

Using identity, $(a + b)^3 = a^3 + b^3 + 3ab(a + b)$

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

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

$$= 27/8 x^3 + 1 + 27/4 x^2 + 9/2 x$$

$$= 27/8 x^3 + 27/4 x^2 + 9/2 x + 1$$

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

Using identity, $(a - b)^3 = a^3 - b^3 - 3ab(a - b)$

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

$$= x^3 - 8/27y^3 - 2xy(x - 2/3 y)$$

$$= x^3 - 8/27y^3 - 2x^2y + 4/3xy^2$$

7. Evaluate the following using suitable identities:

$$(i) (99)^3$$

$$(ii) (102)^3$$

$$(iii) (998)^3$$

Answer

$$(i) (99)^3 = (100 - 1)^3$$

Using identity, $(a - b)^3 = a^3 - b^3 - 3ab(a - b)$

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$$(100 - 1)^3 = (100)^3 - 1^3 - (3 \times 100 \times 1)(100 - 1)$$

$$= 1000000 - 1 - 300(100 - 1)$$

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

$$= 970299$$

$$(ii) (102)^3 = (100 + 2)^3$$

Using identity, $(a + b)^3 = a^3 + b^3 + 3ab(a + b)$

$$(100 + 2)^3 = (100)^3 + 2^3 + (3 \times 100 \times 2)(100 + 2)$$

$$= 1000000 + 8 + 600(100 + 2)$$

$$= 1000000 + 8 + 60000 + 1200$$

$$= 1061208$$

$$(iii) (998)^3$$

Using identity, $(a - b)^3 = a^3 - b^3 - 3ab(a - b)$

$$(1000 - 2)^3 = (1000)^3 - 2^3 - (3 \times 1000 \times 2)(1000 - 2)$$

$$= 1000000000 - 8 - 6000(1000 - 2)$$

$$= 1000000000 - 8 - 600000 + 12000$$

$$= 994011992$$

8. Factorise each of the following:

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

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

$$(iii) 27 - 125a^3 - 135a + 225a^2$$

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

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

Answer

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

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Using identity, $(a + b)^3 = a^3 + b^3 + 3a^2b + 3ab^2$

$$\begin{aligned} &8a^3 + b^3 + 12a^2b + 6ab^2 \\ &= (2a)^3 + b^3 + 3(2a)^2b + 3(2a)(b)^2 \\ &= (2a + b)^3 \\ &= (2a + b)(2a + b)(2a + b) \end{aligned}$$

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

Using identity, $(a - b)^3 = a^3 - b^3 - 3a^2b + 3ab^2$

$$\begin{aligned} &8a^3 - b^3 - 12a^2b + 6ab^2 = (2a)^3 - b^3 - 3(2a)^2b + 3(2a)(b)^2 \\ &= (2a - b)^3 \\ &= (2a - b)(2a - b)(2a - b) \end{aligned}$$

(iii) $27 - 125a^3 - 135a + 225a^2$

Using identity, $(a - b)^3 = a^3 - b^3 - 3a^2b + 3ab^2$

$$\begin{aligned} &27 - 125a^3 - 135a + 225a^2 = 3^3 - (5a)^3 - 3(3)^2(5a) + 3(3)(5a)^2 \\ &= (3 - 5a)^3 \\ &= (3 - 5a)(3 - 5a)(3 - 5a) \end{aligned}$$

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

Using identity, $(a - b)^3 = a^3 - b^3 - 3a^2b + 3ab^2$

$$\begin{aligned} &64a^3 - 27b^3 - 144a^2b + 108ab^2 = (4a)^3 - (3b)^3 - 3(4a)^2(3b) + 3(4a)(3b)^2 \\ &= (4a - 3b)^3 \\ &= (4a - 3b)(4a - 3b)(4a - 3b) \end{aligned}$$

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

Using identity, $(a - b)^3 = a^3 - b^3 - 3a^2b + 3ab^2$

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$$\begin{aligned} & 27p^3 - 1/216 - 9/2 p^2 + 1/4 p \\ &= (3p)^3 - (1/6)^3 - 3(3p)^2(1/6) + 3(3p)(1/6)^2 \\ &= (3p - 1/6)^3 \\ &= (3p - 1/6)(3p - 1/6)(3p - 1/6) \end{aligned}$$

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

Answer

(i) $x^3 + y^3 = (x + y)(x^2 - xy + y^2)$

We know that,

$$\begin{aligned} (x + y)^3 &= x^3 + y^3 + 3xy(x + y) \\ \Rightarrow x^3 + y^3 &= (x + y)^3 - 3xy(x + y) \\ \Rightarrow x^3 + y^3 &= (x + y)[(x + y)^2 - 3xy] && \{Taking (x+y) common\} \\ \Rightarrow x^3 + y^3 &= (x + y)[(x^2 + y^2 + 2xy) - 3xy] \\ \Rightarrow x^3 + y^3 &= (x + y)(x^2 + y^2 - xy) \end{aligned}$$

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

We know that,

$$\begin{aligned} (x - y)^3 &= x^3 - y^3 - 3xy(x - y) \\ \Rightarrow x^3 - y^3 &= (x - y)^3 + 3xy(x - y) \\ \Rightarrow x^3 - y^3 &= (x - y)[(x - y)^2 + 3xy] && \{Taking (x-y) common\} \\ \Rightarrow x^3 - y^3 &= (x - y)[(x^2 + y^2 - 2xy) + 3xy] \\ \Rightarrow x^3 - y^3 &= (x - y)(x^2 + y^2 + xy) \end{aligned}$$

10. Factorise each of the following:

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

(ii) $64m^3 - 343n^3$

Answer

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

Using identity, $x^3 + y^3 = (x + y)(x^2 - xy + y^2)$

$$27y^3 + 125z^3 = (3y)^3 + (5z)^3$$

$$= (3y + 5z) \{(3y)^2 - (3y)(5z) + (5z)^2\}$$

$$= (3y + 5z)(9y^2 - 15yz + 25z^2)$$

(ii) $64m^3 - 343n^3$

Using identity, $x^3 - y^3 = (x - y)(x^2 + xy + y^2)$

$$64m^3 - 343n^3 = (4m)^3 - (7n)^3$$

$$= (4m - 7n) \{(4m)^2 + (4m)(7n) + (7n)^2\}$$

$$= (4m - 7n)(16m^2 + 28mn + 49n^2)$$

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

Answer

$$27x^3 + y^3 + z^3 - 9xyz = (3x)^3 + y^3 + z^3 - 3 \times 3xyz$$

Using identity, $x^3 + y^3 + z^3 - 3xyz = (x + y + z)(x^2 + y^2 + z^2 - xy - yz - xz)$

$$27x^3 + y^3 + z^3 - 9xyz$$

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

$$= (3x + y + z)(9x^2 + y^2 + z^2 - 3xy - yz - 3xz)$$

12. Verify that: $x^3 + y^3 + z^3 - 3xyz = 1/2(x + y + z)[(x - y)^2 + (y - z)^2 + (z - x)^2]$

Answer

We know that,

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$$\begin{aligned}x^3 + y^3 + z^3 - 3xyz &= (x + y + z)(x^2 + y^2 + z^2 - xy - yz - xz) \\ \Rightarrow x^3 + y^3 + z^3 - 3xyz &= 1/2 \times (x + y + z) 2(x^2 + y^2 + z^2 - xy - yz - xz) \\ &= 1/2(x + y + z) (2x^2 + 2y^2 + 2z^2 - 2xy - 2yz - 2xz) \\ &= 1/2(x + y + z) [(x^2 + y^2 - 2xy) + (y^2 + z^2 - 2yz) + (x^2 + z^2 - 2xz)] \\ &= 1/2(x + y + z) [(x - y)^2 + (y - z)^2 + (z - x)^2]\end{aligned}$$

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

Answer

We know that,

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

Now put $(x + y + z) = 0$,

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

$$\Rightarrow x^3 + y^3 + z^3 - 3xyz = 0$$

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

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

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

Answer

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

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

We observed that, $x + y + z = -12 + 7 + 5 = 0$

We know that if,

$$x + y + z = 0, \text{ then } x^3 + y^3 + z^3 = 3xyz$$

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

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

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

We observed that, $x + y + z = 28 - 15 - 13 = 0$

We know that if,

$$x + y + z = 0, \text{ then } x^3 + y^3 + z^3 = 3xyz$$

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

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

(i) Area : $25a^2 - 35a + 12$

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

Answer

(i) Area : $25a^2 - 35a + 12$

Since, area is product of length and breadth therefore by factorizing the given area, we can know the length and breadth of rectangle.

$$25a^2 - 35a + 12$$

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

$$= 5a(5a - 3) - 4(5a - 3)$$

$$= (5a - 4)(5a - 3)$$

Possible expression for length = $5a - 4$

Possible expression for breadth = $5a - 3$

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

$$35y^2 + 13y - 12$$

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

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

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

Possible expression for length = $(5y + 4)$

Possible expression for breadth = $(7y - 3)$

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16. What are the possible expressions for the dimensions of the cuboids whose volumes are given below?(i) Volume : $3x^2 - 12x$

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

Answer

(i) Volume : $3x^2 - 12x$

Since, volume is product of length, breadth and height therefore by factorizing the given volume, we can know the length, breadth and height of the cuboid.

$$3x^2 - 12x$$

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

Possible expression for length = 3

Possible expression for breadth = x

Possible expression for height = $(x - 4)$

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

Since, volume is product of length, breadth and height therefore by factorizing the given volume, we can know the length, breadth and height of the cuboid.

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

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

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

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

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

Possible expression for length = $4k$

Possible expression for breadth = $(3y + 5)$

Possible expression for height = $(y - 1)$

We have already understood about algebraic expressions in previous class and in this chapter we will be studying about a particular algebraic expression, Polynomial. What is Polynomial? An algebraic expression containing one or more than one terms is called Polynomial. We will study the Remainder Theorem, Factor Theorem and algebraic identities and their use in factorisation of polynomials.

- Polynomials in one Variable: We will discuss linear, quadratic and cubic polynomial in this section briefly.
- Zeroes of a Polynomial: You will know how to find the zero of the polynomial in given cases.
- Remainder Theorem: Let $p(x)$ be any polynomial of degree greater than or equal to one and let a be any real number. If $p(x)$ is divided by the linear polynomial $x - a$, then the remainder is $p(a)$.
- Factorisation of Polynomials: If $p(x)$ is a polynomial of degree $n > 1$ and a is any real number, then (i) $x - a$ is a factor of $p(x)$, if $p(a) = 0$, and (ii) $p(a) = 0$, if $x - a$ is a factor of $p(x)$.
- Algebraic Identities: We will be solving questions of the exercise based on the given four identities:

$$\text{Identity I: } (x + y)^2 = x^2 + 2xy + y^2$$

$$\text{Identity II: } (x - y)^2 = x^2 - 2xy + y^2$$

$$\text{Identity III: } x^2 - y^2 = (x + y)(x - y)$$

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Identity IV : $(x + a) (x + b) = x^2 + (a + b)x + ab$

You will find total 5 exercises in the whole chapter that are very helpful in building your basic concepts. Indcareer Schools experts have prepared exercisewise answers of every question for **Chapter 2 Polynomials NCERT Solutions Class 9** which you can find below.

These NCERT Solutions for Class 9 Maths prepared by Indcareer Schools will help you in revising whole topics in less time and improving skills.

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FAQ on Chapter 2 Polynomials

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Chapter 2 Polynomials Class 9 Maths NCERT Solutions PDF download is very useful in understanding the basic concepts embedded in the chapter. It is very essential to solve every question before moving further to any other supplementary books.

What do you mean by Algebraic Expressions?

A combination of constants and variables, connected by some or all the basic operations +, −, ×, ÷ is called an algebraic expression.

What is the coefficient of a zero polynomial?

The coefficient of a zero polynomial is 1.

What is Biquadratic Polynomial?

A polynomial of degree 4 is called a biquadratic polynomial.

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- Chapter 5 Introduction to Euclid's Geometry
- Chapter 6 Lines and Angles
- Chapter 7 Triangles
- Chapter 8 Quadrilaterals
- Chapter 9 Areas of Parallelograms and Triangles
- Chapter 10 Circles
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