

NTSE

NCERT Solutions for Class 9
MATHS – Polynomials



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1. 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

Sol. (i) The degree of $5x^3 + 4x^2 + 7x$ is 3.

(ii) The degree of $4 - y^2$ is 2.

(iii) The degree of $5t - \sqrt{7} = 5t^1 - \sqrt{7}$ is 1.

(iv) The degree of $3 = 3x^0$ is 0.

2. 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) $7x^3$

Sol.

(i) $x^2 + x$ Quadratic polynomial.

(ii) $x - x^3$ Cubic polynomial.

(iii) $y + y^2 + 4$ Quadratic polynomial.

(iv) $1 + x$ Linear polynomial.

(v) $3t$ Linear polynomial.

(vi) r^2 Quadratic polynomial.

(vii) $7x^3$ Cubic polynomial.

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

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

Sol. (i) Putting $x = 0$, we get

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

(ii) Putting $x = -1$, we get

$$p(-1) = 5 \times (-1) - 4(-1)^2 + 3 = -5 - 4 + 3 = -6$$

(iii) Putting $x = 2$, we get

$$p(2) = 5 \times 2 - 4(2)^2 + 3 = 10 - 16 + 3 = -3$$

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4. Find the remainder when $x^3 + 3x^2 + 3x + 1$ is divided by
- (i) $x + 1$ (ii) $x - \frac{1}{2}$ (iii) x (iv) $x + \pi$
- (v) $5 + 2x$

Sol. Let $p(x) = x^3 + 3x^2 + 3x + 1$

(i) $x + 1$

Putting $x + 1 = 0$, we get $x = -1$

Using remainder theorem, when $p(x) = x^3 + 3x^2 + 3x + 1$ is divided by $x + 1$, remainder is given by $p(-1)$

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

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

$$= 0$$

(ii) $x - \frac{1}{2}$

Putting $x - \frac{1}{2} = 0$, we get, $x = \frac{1}{2}$

Using remainder theorem, when $p(x) = x^3 + 3x^2 + 3x + 1$ divided by $x - \frac{1}{2}$, remainder is given by $p\left(\frac{1}{2}\right)$

$$= \left(\frac{1}{2}\right)^3 + 3\left(\frac{1}{2}\right)^2 + 3\left(\frac{1}{2}\right) + 1$$

$$= \frac{1}{8} + 3 \times \frac{1}{4} + 3 \times \frac{1}{2} + 1$$

$$= \frac{1 + 6 + 12 + 8}{8}$$

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

(iii) x

Putting $x = 0$, we get

Using remainder theorem, when $p(x) = x^3 + 3x^2 + 3x + 1$ is divided by x , remainder is given by $p(0)$

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

$$= 0 + 1$$

$$= 1$$

(iv) $x + \pi$

Putting $x + \pi = 0$, we get, $x = -\pi$

Using remainder theorem, when $p(x) = x^3 + 3x^2 + 3x + 1$ is divided by $x + \pi$, remainder is given by $p(-\pi)$

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

$$= -\pi^3 + 3\pi^2 - 3\pi + 1$$



**Success
STORY**

I still wonder how one man has such a deep understanding of an examination. It becomes the truth what ever Vipin Sir says about NTSE.

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(v) $5 + 2x$

Putting $5 + 2x = 0$, we get $x = -\frac{5}{2}$

Using remainder theorem, when $p(x) = x^3 + 3x^2 + 3x + 1$ is divided by $5 + 2x$, remainder is given by $p\left(-\frac{5}{2}\right)$

$$\begin{aligned} &= \left(-\frac{5}{2}\right)^3 + 3\left(-\frac{5}{2}\right)^2 + 3\left(-\frac{5}{2}\right) + 1 \\ &= -\frac{125}{8} + 3 \times \frac{25}{4} - 3 \times \frac{5}{2} + 1 \\ &= \frac{-125 + 150 - 60 + 8}{8} \\ &= -\frac{27}{8} \end{aligned}$$

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

Sol. Let $p(x) = x^3 - ax^2 + 6x - a$

Putting $x - a = 0$, we get $x = a$

Using remainder theorem, when $p(x) = x^3 - ax^2 + 6x - a$ is divided by $x - a$, remainder is given by $p(a)$

$$\begin{aligned} &= (a)^3 - a(a)^2 + 6(a) - a \\ &= a^3 - a^3 + 6a - a \\ &= 5a \end{aligned}$$

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

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

$$p(1) = 0$$

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

$$\Rightarrow 1 + 1 + k = 0 \qquad \Rightarrow k = -2$$

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

$$p(1) = 0$$

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

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

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

$$p(1) = 0$$

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

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

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

$$p(1) = 0$$

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

$$2k = 3 \Rightarrow k = \frac{3}{2}$$

7. Factorise the following using appropriate identities:

(i) $9x^2 + 6xy + y^2$ (ii) $4y^2 - 4y + 1$ (iii) $x^2 - \frac{y^2}{100}$

Sol. (i) $9x^2 + 6xy + y^2 = (3x)^2 + 2(3x)(y) + (y)^2$
 $= (3x + y)^2 = (3x + y)(3x + y)$

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

(iii) $x^2 - \frac{y^2}{100} = (x)^2 - \left(\frac{y}{10}\right)^2$
 $= \left(x - \frac{y}{10}\right)\left(x + \frac{y}{10}\right)$

8. Factorise each of the following:

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

Sol. (i) $27y^3 + 125z^3 = (3y)^3 + (5z)^3$
 $= (3y + 5z)[(3y)^2 - (3y)(5z) + (5z)^2]$
 $= (3y + 5z)(9y^2 - 15yz + 25z^2)$

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

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$$\begin{aligned} &= (4m - 7n)[(4m)^2 + (4m)(7n) + (7n)^2] \\ &= (4m - 7n)[16m^2 + 28mn + 49n^2] \end{aligned}$$

9. Factorise:

(i) $27x^3 + y^3 + z^3 - 9xyz$

Sol. $27x^3 + y^3 + z^3 - 9xyz = (3x)^3 + y^3 + z^3 - 3(3x)(y)(z)$
 $= (3x + y + z)[(3x)^2 + y^2 + z^2 - (3x)y - yz - z(3x)]$
 $= (3x + y + z)(9x^2 + y^2 + z^2 - 3xy - yz - 3zx)$

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

Sol. We know that,

$$\begin{aligned} x^3 + y^3 + z^3 - 3xyz &= (x + y + z)(x^2 + y^2 + z^2 - xy - yz - zx) \\ &= 0(x^2 + y^2 + z^2 - xy - yz - zx) \quad (\because x + y + z = 0 \text{ given}) \\ &= 0 \\ \Rightarrow x^3 + y^3 + z^3 &= 3xyz \end{aligned}$$

Hence proved.

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