



# MATHS

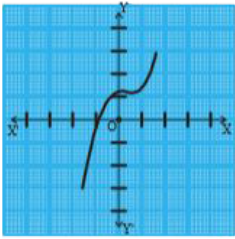
## NCERT - NCERT MATHS (GUJARATI ENGLISH)

### POLYNOMIALS

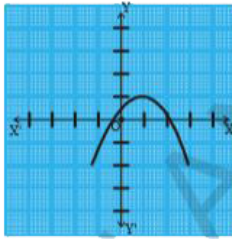
#### Examples

1. Look at graphs in the figures below. Each is the graph of  $y = p(x)$ , where  $p(x)$  is a

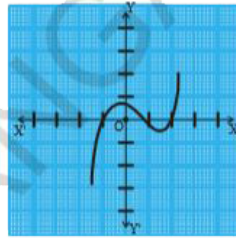
polynomial. In each of the graphs, find the number of zeroes of  $p(x)$  in the given range of  $x$ .



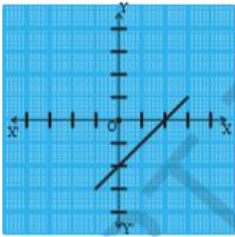
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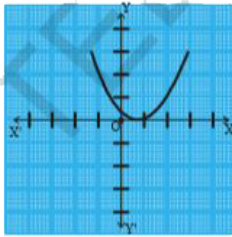
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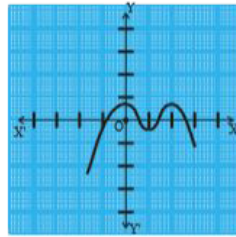
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2. Find the number zeroes of the given polynomials. And also find their values.

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



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3. Find the number zeroes of the given polynomials. And also find their values.

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



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4. Find the number zeroes of the given polynomials. And also find their values.

$$r(z) = z^3$$



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5. Find the zeroes of the quadratic polynomial  $x^2 + 7x + 10$ , and verify the relationship between the zeroes and the coefficients.



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6. Find the zeroes of the polynomial  $x^2 - 3$  and verify the relationship between the zeroes and the coefficients.



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7. Find the quadratic polynomial, whose sum and product of the zeroes are  $-3$  and  $2$ , respectively.



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8. Find the quadratic polynomial whose zeroes are 2 and  $\frac{-1}{3}$



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9. Verify whether 3,  $-1$  and  $-\frac{1}{3}$  are the zeroes of the cubic polynomial

$p(x) = 3x^3 - 5x^2 - 11x - 3$ , and then verify the relationship between the zeroes and the coefficients.



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10. Divide  $2x^2 + 3x + 1$  by  $x + 2$ .



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11. Divide  $3x^3 + x^2 + 2x + 5$  by  $1 + 2x + x^2$ .



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12. Divide  $3x^2 - x^3 - 3x + 5$  by  $x - 1 - x^2$ ,

and verify the division algorithm.





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13. Find all the zeroes of  $2x^4 - 3x^3 - 3x^2 + 6x - 2$ , if you know that two of its zeroes are  $\sqrt{2}$  and  $-\sqrt{2}$ .



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Do This

1. State which of the following are polynomials and which are not ? Give reasons.



$$2x^3$$



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2. State which of the following are polynomials and which are not ? Give reasons.

$$\frac{1}{x} - 1(x \neq 0)$$



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3. State which of the following are polynomials and which are not ? Give reasons.

$$4z^2 + \frac{1}{7}$$



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4. State which of the following are polynomials and which are not ? Give reasons.

$$m^2 - \sqrt{2}m + 2$$



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5. State which of the following are polynomials and which are not ? Give reasons.

$$p^{-2} + 1$$



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**6.** If  $p(x) = x^2 - 5x - 6$ , then find the values of

$p(1), p(2), p(3), p(0), p(-1), p(-2), p(-3)$

.



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7. If  $p(m) = m^2 - 3m + 1$ , then find the value of  $p(1)$  and  $p(-1)$ .



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8. Let  $p(x) = x^2 - 4x + 3$ . Find the value of  $p(0)$ ,  $p(1)$ ,  $p(2)$ ,  $p(3)$  and obtain zeroes of the polynomial  $p(x)$ .



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9. Check whether  $-3$  and  $3$  are the zeroes of the polynomial  $x^2 - 9$ .



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10. Draw the graph of (i)  $y = 2x + 5$ , (ii)  $y = 2x - 5$ , (iii)  $y = 2x$  and find the point of intersection on X - axis Is the x-coordinate of these points also the zeroes of the polynomial ?



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**11.** Find the zeroes of the quadratic polynomials given below. Find the sum and product of the zeroes and verify relationship to the coefficients of terms of terms in the polynomial.

$$p(x) = x^2 - x - 6$$



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**12.** Find the zeroes of the quadratic polynomials given below. Find the sum and

product of the zeroes and verify relationship to the coefficients of terms of terms in the polynomial.

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



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**13.** Find the zeroes of the quadratic polynomials given below. Find the sum and product of the zeroes and verify relationship to the coefficients of terms of terms in the

polynomial.

$$p(x) = x^2 - 4$$



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**14.** Find the zeroes of the quadratic polynomials given below. Find the sum and product of the zeroes and verify relationship to the coefficients of terms of terms in the polynomial.

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



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15. If  $\alpha, \beta, \gamma$  are the zeroes of the given cubic polynomials, find the values of the expressions given in the table.

S.No.	Cubic Polynomial	$\alpha + \beta + \gamma$	$\alpha\beta + \beta\gamma + \gamma\alpha$	$\alpha\beta\gamma$
1	$x^3 + 3x^2 - x - 2$			
2	$4x^3 + 8x^2 - 6x - 2$			
3	$x^3 + 4x^2 - 5x - 2$			
4	$x^3 + 5x^2 + 4$			

Let us consider an example.



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Try This

1. Write 3 different quadratic, cubic and 2 linear polynomials with different number of terms.



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2. Write the general form of a quadratic polynomial and cubic polynomial in variable  $x$ .



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3. Write a general polynomial  $q(z)$  of degree  $n$  with coefficients that are  $b_0, b_1, b_2, \dots, b_n$ ,

What are the conditions on  $b_0, b_1, b_2, \dots, b_n$

?



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4. Write three quadratic polynomials that have 2 zeroes each.



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5. Write one quadratic polynomial that has one zero.



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6. How will you verify if a quadratic polynomial has only zero ?



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7. Write three quadratic polynomials that have no zeroes for  $x$  they are real.



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8. Find the zeroes of cubic polynomials (i)  $-x^3$   
(ii)  $x^2 - x^3$  (iii)  $x^3 - 5x^2 + 6x$  without drawing the graph of the polynomial.



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9. Find a quadratic polynomial with zeroes  $-2$  and  $\frac{1}{3}$ .



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10. What is the quadratic polynomial the sum of whose zeroes is  $\frac{-3}{2}$  and the product of the zeroes is  $-1$



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1. In  $p(x) = 5x^7 - 6x^5 + 7x + 6$ , what is the  
(i) coefficient of  $x^5$  (ii) degree of  $p(x)$  (iii)  
constant term.



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2. State which of the following statements are true and which are false ? Give reasons for your choice.

The degree of the polynomial  $\sqrt{2}x^2 - 3x + 1$  is  $\sqrt{2}$ .



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3. State which of the following statements are true and which are false ? Give reasons for your choice.

The coefficient of  $x^2$  in the polynomial

$$p(x) = 3x^3 - 4x^2 + 5x + 7 \text{ is } 2$$



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4. State which of the following statements are true and which are false ? Give reasons for your choice.

the degree of a constant term is zero.



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5. State which of the following statements are true and which are false ? Give reasons for your choice.

$\frac{1}{x^2 - 5x + 6}$  is a quadratic polynomial.





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6. State which of the following statements are true and which are false ? Give reasons for your choice.

The degree of a polynomial is one more than the number of term in it.



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7. If  $p(t) = t^3 - 1$ , find the values of  $p(1)$ ,  $p(-1)$ ,  $p(0)$ ,  $p(2)$ ,  $p(-2)$ .



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8. Check whether  $-2$  and  $2$  are the zeroes of the polynomial  $x^4 - 16$ .



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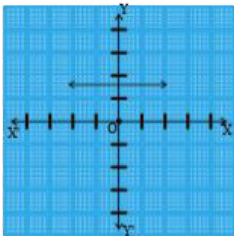
9. Check whether  $3$  and  $-2$  are the zeroes of the polynomial  $p(x)$  when  $p(x) = x^2 - x - 6$ .



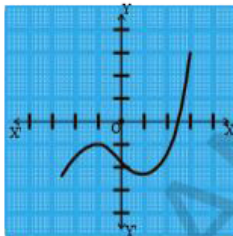
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## Exercise 3 2

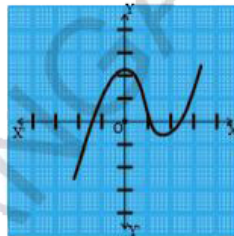
1. The graphs  $y = p(x)$  are given in the figure below, for some polynomials  $p(x)$ . In each case, find the number of zeroes of  $p(x)$ .



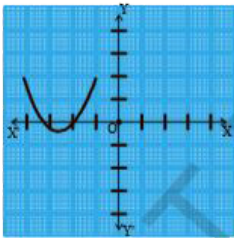
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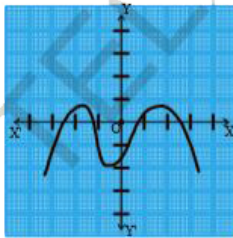
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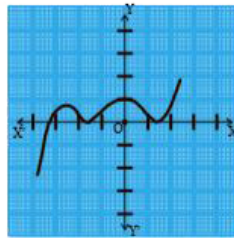
(iii)



(iv)



(v)



(vi)



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2. Find the zeroes of the given polynomials.

$$p(x) = 3x$$



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3. Find the zeroes of the given polynomials.

$$p(x) = x^2 + 5x + 6$$



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4. Find the zeroes of the given polynomials.

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



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5. Find the zeroes of the given polynomials.

$$p(x) = x^4 - 16$$



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6. Draw the graphs of the given polynomial and find the zeroes. Justify the answers.

$$p(x) = x^2 - x - 12$$



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7. Draw the graphs of the given polynomial and find the zeroes. Justify the answers.

$$p(x) = x^2 - 6x + 9$$



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8. Draw the graphs of the given polynomial and find the zeroes. Justify the answers.

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



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9. Draw the graphs of the given polynomial and find the zeroes. Justify the answers.

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



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**10.** Draw the graphs of the given polynomial and find the zeroes. Justify the answers.

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



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**11.** Why are  $\frac{1}{4}$  and  $-1$  zeroes of the polynomials  $p(x) = 4x^2 + 3x - 1$ ?



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

$$x^2 - 2x - 8$$



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

$$4s^2 - 4s + 1$$



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

$$6x^2 - 3 - 7x$$



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**4.** Find the zeroes of the following quadratic polynomials and verify relationship between

the zeroes and the coefficients.

$$4u^2 + 8u$$



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

$$t^2 - 15$$



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

$$3x^2 - x - 4$$



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7. Find the quadratic polynomial in each case, with the given numbers as the sum and product of its zeroes respectively.

$$\frac{1}{4}, -1$$





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8. Find the quadratic polynomial in each case, with the given numbers as the sum and product of its zeroes respectively.

$$\sqrt{2}, \frac{1}{3}$$



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9. Find the quadratic polynomial in each case, with the given numbers as the sum and

product of its zeroes respectively.

$0, \sqrt{5}$



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**10.** Find the quadratic polynomial in each case, with the given numbers as the sum and product of its zeroes respectively.

1,1



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**11.** Find the quadratic polynomial in each case, with the given numbers as the sum and product of its zeroes respectively.

$$-\frac{1}{4}, \frac{1}{4}$$



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**12.** Find the quadratic polynomial in each case, with the given numbers as the sum and product of its zeroes respectively.

4,1







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**13.** Find the quadratic polynomial, for the zeroes  $\alpha, \beta$  given in each case.

2, - 1



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**14.** Find the quadratic polynomial, for the zeroes  $\alpha, \beta$  given in each case.

$\sqrt{3} - \sqrt{3}$



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**15.** Find the quadratic polynomial, for the zeroes  $\alpha, \beta$  given in each case.

$$\frac{1}{4}, -1$$



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**16.** Find the quadratic polynomial, for the zeroes  $\alpha, \beta$  given in each case.

$$\frac{1}{2}, \frac{3}{2}$$



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17. Verify that 1,  $-1$  and  $+3$  are the zeroes of the cubic polynomial  $x^3 - 3x^2 - x + 3$  and check the relationship between zeroes and the coefficients.



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### Exercise 3 4

1. Divide the polynomial  $p(x)$  by the polynomial  $g(x)$  and find the quotient and

remainder in each of the following :

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



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

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



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

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



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4. Check whether the first polynomial is a factor of the second polynomial by dividing the second polynomial by the first polynomial :

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





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5. Check whether the first polynomial is a factor of the second polynomial by dividing the second polynomial by the first polynomial :

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



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6. Check whether the first polynomial is a factor of the second polynomial by dividing

the second polynomial by the first polynomial :

$$x^3 - 3x + 1, x^5 - 4x^3 + x^2 + 3x + 1$$



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7. Obtain all other zeroes of

$3x^4 + 6x^3 - 2x^2 - 10x - 5$ , if two of its

zeroes are  $\sqrt{\frac{5}{3}}$  and  $-\sqrt{\frac{5}{3}}$ .



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8. 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  $g(x)$ .



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

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







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

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



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**11.** Give examples of polynomials  $p(x)$ ,  $g(x)$ ,  $q(x)$  and  $r(x)$ , which satisfy the

division algorithm and

$$\text{degr}(x) = 0.$$



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## Optional Exercise For Extensive Learning

1. Verify that the number gives alongside the cubic polynomials below are their zeroes Also verify relationship between the zeroes and coefficients in each case.

$$2x^3 + x^2 - 5x + 2, \left( \frac{1}{2}, 1, -2 \right)$$



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2. Verify that the number gives alongside the cubic polynomials below are their zeroes Also verify relationship between the zeroes and coefficients in each case.

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



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3. Find a cubic polynomial with sum , the sum of the product of zeroes taken two at a time, and the product of its zeroes as 2,  $-7$ ,  $-14$  respectively.



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



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



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6. If the polynomial  $x^4 - 6x^3 + 16x^2 - 25x + 10$  is divided by another polynomial  $x^2 - 2x + k$ , the remainder comes out to be  $x + a$ , find  $k$  and  $a$ .



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