

Real Numbers

Important Definitions/Formulae - A Flow Chart

Real Numbers

Rationals and Irrationals together made up the real numbers.

A number 'r' is called rational, if it can be written in the form $\frac{p}{q}$, where p and q are integers and $q \neq 0$.

A number 's' is called irrational, if it cannot be written in the form $\frac{p}{q}$, where p and q are integers and $q \neq 0$.

Fundamental Theorem of Arithmetic

Every composite number can be expressed or factorised as a product of primes, and this factorisation is unique, apart from the order in which the prime factors occur.

If p is a prime and p divides a^2 , then p divides a also, where a is positive integer.

H.C.F. is the product of the smallest power of each common prime factor in the numbers.
L.C.M. is the product of the greatest power of each prime factor involved in the numbers.

For any two positive integers a and b

H.C.F. $(a, b) \times$ L.C.M. $[a, b] =$ Product of a and b

H.C.F. $(a, b) = \frac{a \times b}{\text{L.C.M. } [a, b]}$ and L.C.M. $[a, b] = \frac{a \times b}{\text{H.C.F. } (a, b)}$

Important Definitions/Formulae - A Flow Chart

Polynomial

An algebraic expression $p(x) = a_0 x^n + a_1 x^{n-1} + a_2 x^{n-2} + \dots + a_{n-1} x + a_n$, where $a_0, a_1, a_2, \dots, a_n$ are real numbers and n is non-negative integer and $a_0 \neq 0$, is called a polynomial of degree n .

Degree : The highest power of x in a polynomial $p(x)$ is called the degree of the polynomial.

Types of polynomial

A polynomial $p(x)$ of degree zero, is called a zero polynomial or a constant polynomial

$$p(x) = k$$

A polynomial $p(x)$ of degree one, is called a linear polynomial.

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

A polynomial $p(x)$ of degree two, is called a quadratic polynomial.

$$p(x) = ax^2 + bx + c, a \neq 0$$

Value of a polynomial at a point : If $p(x)$ is a polynomial in x and α is a real number, then the value obtained by putting $x = \alpha$ in $p(x)$ is called the value of $p(x)$ at $x = \alpha$.

Zeroes of a polynomial : A real number k is said to be a zero of the polynomial $p(x)$, if $p(k) = 0$. Geometrically, the zeroes of a polynomial $p(x)$ are precisely the x -coordinates of the points where the graph of $y = p(x)$ intersect the x -axis.

- A linear polynomial has at most one zero.
- A quadratic polynomial has at most two zeroes.
- In general, a polynomial of degree n has at most n zeroes.

If α and β are the two zeroes of a quadratic polynomial $p(x)$, then

$$p(x) = x^2 - (\text{sum of zeroes})x + \text{product of zeroes}$$

$$= x^2 - (\alpha + \beta)x + \alpha\beta.$$

Relationship between the zeroes and the coefficients of a polynomial

- For a linear polynomial if k is a zero of $p(x) = ax + b$, $a \neq 0$ then $p(k) = ak + b = 0$

$$k = -\frac{b}{a}$$

$$= -\frac{\text{constant term}}{\text{coefficient of } x}$$

- For a quadratic polynomial, if α and β are the zeroes of $p(x) = ax^2 + bx + c$, then

$$\text{Sum of zeroes} = \alpha + \beta = -\frac{b}{a}$$

$$= -\frac{(\text{coefficient of } x)}{\text{coefficient of } x^2}$$

$$\text{Product of zeroes} = \alpha\beta = \frac{c}{a}$$

$$= \frac{\text{constant term}}{\text{coefficient of } x^2}$$

A polynomial $p(x)$ of degree three, is called a cubic polynomial.

$$p(x) = ax^3 + bx^2 + cx + d, \quad a \neq 0$$

A polynomial $p(x)$ of degree four is called a biquadratic polynomial.

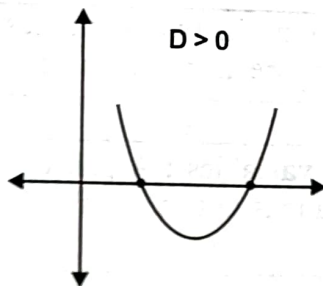
$$p(x) = ax^4 + bx^3 + cx^2 + dx + e, \quad a \neq 0$$

Discriminant of a quadratic polynomial $p(x) = ax^2 + bx + c, a \neq 0$

$$\text{Discriminant (D)} = b^2 - 4ac$$

- If $D > 0$, then

graph of $p(x)$ will intersect the x -axis at two distinct points.



- For a cubic polynomial $p(x) = ax^3 + bx^2 + cx + d$,

$$\text{Sum of zeroes} = \alpha + \beta + \gamma = \frac{-b}{a}$$

$$= \frac{-(\text{coefficient of } x^2)}{\text{coefficient of } x^3}$$

Sum of the products of zeroes taken two at a time

$$= \alpha\beta + \beta\gamma + \gamma\alpha = \frac{c}{a}$$

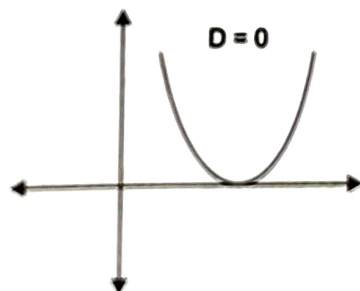
$$= \frac{\text{coefficient of } x}{\text{coefficient of } x^3}$$

$$\text{Product of zeroes} = \alpha\beta\gamma = \frac{-d}{a}$$

$$= \frac{-(\text{constant term})}{\text{coefficient of } x^3}$$

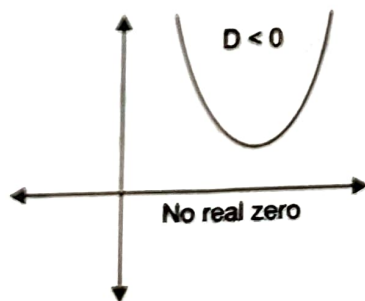
- If $D = 0$, then

graph of $p(x)$ will touch the x -axis at one point only.



- If $D < 0$, then

graph of $p(x)$ will neither touch nor intersect the x -axis i.e., $p(x)$ will not have any real zeroes.



• Useful relations involving α and β :

$$\bullet \alpha^2 + \beta^2 = (\alpha + \beta)^2 - 2\alpha\beta$$

$$\bullet (\alpha - \beta)^2 = (\alpha + \beta)^2 - 4\alpha\beta$$

$$\bullet \alpha^2 - \beta^2 = (\alpha + \beta)(\alpha - \beta) = (\alpha + \beta)\sqrt{(\alpha + \beta)^2 - 4\alpha\beta}$$

$$\bullet \alpha^3 + \beta^3 = (\alpha + \beta)^3 - 3\alpha\beta(\alpha + \beta)$$

Multiple Choice Questions

Choose and write the correct option in the following questions.

1. $n^2 - 1$ is divisible by 8 if n is [NCERT Exemplar]
(a) an integer (b) a natural number (c) an odd integer (d) an even integer
2. The product of three consecutive integers is divisible by 3
(a) 5 (b) 6 (c) 7 (d) none of these
3. The largest number which divides 615 and 963 leaving remainder 6 in each case is
(a) 82 (b) 95 (c) 87 (d) 93
4. The largest number which divides 70 and 125 leaving remainders 5 and 8 respectively is [NCERT Exemplar]
(a) 13 (b) 65 (c) 875 (d) 1750
-
5. If two positive integers a and b are written as $a = x^3y^2$ and $b = xy^3$; x, y are prime numbers, then LCM (a, b) is [NCERT Exemplar]
(a) xy (b) xy^2 (c) x^3y^3 (d) x^2y^2
6. If HCF (26, 169) = 13 then LCM (26, 169) is
(a) 26 (b) 52 (c) 338 (d) 13
7. The HCF and the LCM of 12, 21, 15 respectively are [CBSE 2020 (30/1/1)]
(a) 3, 140 (b) 12, 420 (c) 3, 420 (d) 420, 3
8. The product of two irrational numbers is
(a) always irrational (b) always rational
(c) rational or irrational (d) one
9. $3.\overline{27}$ is
(a) an integer (b) a rational number (c) a natural number (d) an irrational number
10. If 3 is the least prime factor of number a and 7 is the least prime factor of number b , then the least prime factor of $(a + b)$ is [Competency Based Question]
(a) 2 (b) 3 (c) 5 (d) 10
11. Which of these is a RATIONAL number? [CBSE Question Bank]
(a) 3π (b) $5\sqrt{5}$ (c) 0.346666... (d) 0.345210651372849...
12. Which of these numbers can be expressed as a product of two or more prime numbers?
(i) 15 (ii) 34568 (iii) (15×13) [CBSE Question Bank]
(a) only (ii) (b) only (iii) (c) only (i) and (ii) (d) all-(i), (ii) and (iii)
13. A number of the form 8^n , where n is a natural number greater than 1, cannot be divisible by [CBSE Question Bank]
(a) 1 (b) 40 (c) 64 (d) 2^{2n}
14. 1245 is a factor of the numbers p and q .
Which of the following will always have 1245 as a factor? [Competency Based Question]
(i) $p + q$ (ii) $p \times q$ (iii) $p \div q$
(a) only (ii) (b) only (i) and (ii) (c) only (ii) and (iii) (d) all-(i), (ii) and (iii)

Case Study-based Questions

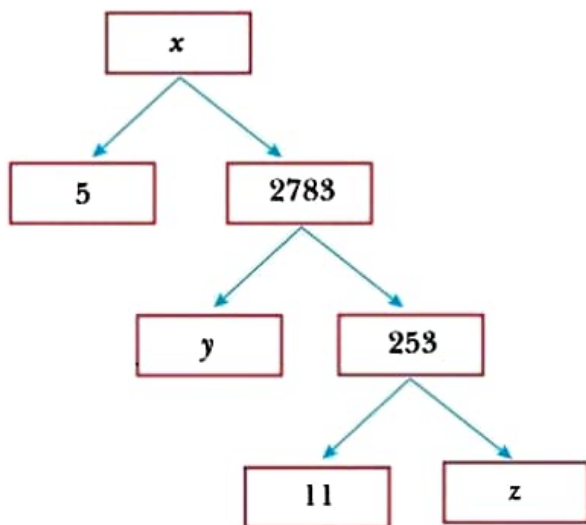
Each of the following questions are of 4 marks.

1. Read the following and answer any four questions from (i) to (v).

A Mathematics Exhibition is being conducted in your School and one of your friends is making a model of a factor tree. He has some difficulty and asks for your help in completing a quiz for the audience.

[CBSE Question Bank]

Observe the following factor tree and answer the following:



- (i) What will be the value of x ?

(a) 15005 (b) 13915 (c) 56920 (d) 17429

- (ii) What will be the value of y ?

(a) 23 (b) 22 (c) 11 (d) 19

- (iii) What will be the value of z ?

(a) 22 (b) 23 (c) 17 (d) 19

- (iv) According to Fundamental Theorem of Arithmetic 13915 is a

(a) Composite number (b) Prime number
(c) Neither prime nor composite (d) Even number

- (v) The prime factorisation of 13915 is

(a) $5 \times 11^3 \times 13^2$ (b) $5 \times 11^3 \times 23^2$ (c) $5 \times 11^2 \times 23$ (d) $5 \times 11^2 \times 13^2$

2. Read the following and answer any four questions from (i) to (v).

To enhance the reading skills of grade X students, the school nominates you and two of your friends to set up a class library. There are two sections- section A and section B of grade X. There are 32 students in section A and 36 students in section B. [CBSE Question Bank]



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- (i) What is the minimum number of books you will require for the class library, so that they can be distributed equally among students of Section A or Section B?
(a) 144 (b) 128 (c) 288 (d) 272
- (ii) If the product of two positive integers is equal to the product of their HCF and LCM is true then, the HCF (32, 36) is
(a) 2 (b) 4 (c) 6 (d) 8
- (iii) 36 can be expressed as a product of its primes as
(a) $2^2 \times 3^2$ (b) $2^1 \times 3^3$ (c) $2^3 \times 3^1$ (d) $2^0 \times 3^0$
- (iv) $7 \times 11 \times 13 \times 15 + 15$ is a
(a) Prime number (b) Composite number
(c) Neither prime nor composite (d) None of the above
- (v) If p and q are positive integers such that $p = ab^2$ and $q = a^2b$, where a, b are prime numbers, then the LCM (p, q) is
(a) ab (b) a^2b^2 (c) a^3b^2 (d) a^3b^3

3. Read the following and answer any four questions from (i) to (v).

A seminar is being conducted by an Educational Organisation, where the participants will be educators of different subjects. The number of participants in Hindi, English and Mathematics are 60, 84 and 108 respectively.

[CBSE Question Bank]



- (i) In each room the same number of participants are to be seated and all of them being in the same subject, hence maximum number of participants that can accommodated in each room are
- (a) 14 (b) 12 (c) 16 (d) 18
- (ii) What is the minimum number of rooms required during the event?
- (a) 11 (b) 31 (c) 41 (d) 21
- (iii) The LCM of 60, 84 and 108 is
- (a) 3780 (b) 3680 (c) 4780 (d) 4680
- (iv) The product of HCF and LCM of 60,84 and 108 is
- (a) 55360 (b) 35360 (c) 45500 (d) 45360
- (v) 108 can be expressed as a product of its primes as
- (a) $2^3 \times 3^2$ (b) $2^3 \times 3^3$ (c) $2^2 \times 3^2$ (d) $2^2 \times 3^3$

Objective Type Questions:**[1 mark each]****1. Choose and write the correct option in each of the following questions.**

(i) For some integer a , every odd integer is of the form

(a) $2a + 1$

(b) $2a$

(c) $a + 1$

(d) a

(ii) If the LCM of p and 18 is 36 and the HCF of p and 18 is 2 then p is equal to

(a) 2

(b) 3

(c) 4

(d) 1

(iii) Which of the following is an irrational number?

(a) $\frac{\sqrt{2}}{\sqrt{8}}$

(b) $\frac{\sqrt{63}}{\sqrt{7}}$

(c) $\frac{\sqrt{5}}{\sqrt{20}}$

(d) $\frac{\sqrt{3}}{3\sqrt{5}}$

(iv) Is $9 + \sqrt{2}$ an irrational number?

(a) Yes, because if $9 + \sqrt{2} = \frac{a}{b}$, where a and b are integers and $b \neq 0$, then $\sqrt{2} = \frac{a - 9b}{b}$, but $\sqrt{2}$ is an irrational number. So, $9 + \sqrt{2} \neq \frac{a}{b}$.

(b) Yes, because if $9 + \sqrt{2} = \frac{a}{b}$, where a and b are integers and $b \neq 0$, then $\sqrt{2} = \frac{9b + a}{b}$, but $\sqrt{2}$ is an irrational number. So, $9 + \sqrt{2} \neq \frac{a}{b}$.

(c) No, because if $9 + \sqrt{2} = \frac{a}{b}$, where a and b are integers and $b \neq 0$, then $\sqrt{2} = \frac{9b - a}{b}$, but $\sqrt{2}$ is an irrational number. So, $9 + \sqrt{2} \neq \frac{a}{b}$.

(d) No, because if $9 + \sqrt{2} = \frac{a}{b}$, where a and b are integers and $b \neq 0$, then $\sqrt{2} = \frac{9b + a}{b}$, but $\sqrt{2}$ is an irrational number. So, $9 + \sqrt{2} \neq \frac{a}{b}$.

(v) The LCM of smallest two digit composite number and smallest composite number is

[CBSE Sample Question Paper 2020]

(a) 12

(b) 4

(c) 20

(d) 44

■ **Short Answer Questions-II:**

[3 marks each]

11. If the HCF (210, 55) is expressible in the form $210 \times 5 - 55y$, find y .
12. Three bulbs red, green and yellow flash at intervals of 80 seconds, 90 seconds and 110 seconds. All three flash together at 8:00 am. At what time will the three bulbs flash altogether again?
13. Find the greatest number that will divide 445, 572 and 699 leaving remainders 4, 5 and 6 respectively.
14. Show that 9^n cannot end with digit 0 for any $n \in N$.
15. Prove that $\sqrt{2}$ is an irrational number.
16. Prove that $2 + 5\sqrt{3}$ is an irrational number, given that $\sqrt{3}$ is an irrational number.

[CBSE 2019(30/2/1)]

SECTION A

1. Choose and write the correct option in the following questions. (3 × 1 = 3)
- (i) The sum of exponents of prime factors in the prime factorisation of 196 is
 (a) 3 (b) 4 (c) 5 (d) 2
- (ii) The LCM and HCF of two rational numbers are equal then the numbers must be
 (a) prime (b) composite (c) not equal (d) equal
- (iii) The product of a non zero rational and an irrational number is [NCERT Exemplar]
 (a) always irrational (b) always rational
 (c) rational or irrational (d) one
2. Solve the following questions. (2 × 1 = 2)
- (i) If two positive integers p and q are written as $p = a^2b^3$ and $q = a^3b$; a, b are prime numbers then find HCF (p, q).
- (ii) Given that $\text{HCF}(135, 225) = 45$, find the LCM (135, 225). [CBSE 2020(30/4/1)]

SECTION B

- Solve the following questions. (4 × 2 = 8)
3. What is the least number that is divisible by all the numbers from 1 to 10?
4. Find the sum of $0.\overline{68} + 0.\overline{73}$.
5. Show that $5 + 2\sqrt{7}$ is an irrational number, where $\sqrt{7}$ is given to be an irrational number. [CBSE 2020(30/5/1)]
6. Given that $\sqrt{2}$ is irrational, prove that $(5 + 3\sqrt{2})$ is an irrational number. [CBSE 2018]
- Solve the following questions. (4 × 3 = 12)
7. Given that $\sqrt{5}$ is irrational, prove that $2\sqrt{5} - 3$ is an irrational number. [CBSE Sample Question Paper 2021]
8. Find the LCM and HCF of 12, 15 and 21 by applying the prime factorisation method.
9. Find the LCM of $x^2 - 4$ and $x^4 - 16$.
10. Show that $3\sqrt{2}$ is an irrational number.
- Solve the following questions. (3 × 5 = 15)
11. 144 cartons of coke cans and 90 cartons of pepsi cans are to be stacked in a canteen. If each stack is of the same height and is to contain carton of same drink. What would be the greatest number of cartons in each stack?
12. 105 donkeys, 140 cows and 175 goats have to be taken across a river. There is only one boat which will have to make many trips in order to do so. The lazy boatman has his own conditions for transporting them. He insists that he will take the same number of animals in every trip and they have to be of the same kind. He will naturally like to take the largest possible number each times, find how many animals went in each trip?
13. Prove that $\sqrt{7}$ is an irrational number.

Answers

1. (i) (b) (ii) (d) (iii) (a) 2. (i) a^2b (ii) 675 3. 2520
 4. $1.\overline{42}$ 8. LCM = 420; HCF = 3 9. $(x^2 + 4)(x^2 - 4)$ 11. 18 12. 35

■ Objective Type Questions:

[1 mark each]

1. Choose and write the correct option in each of the following questions.

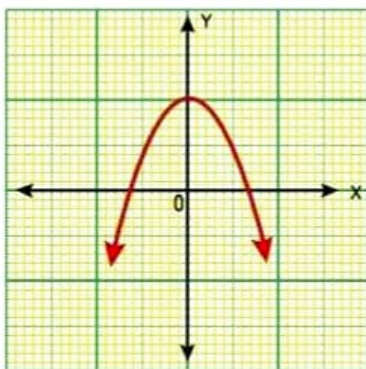
- (i) If 5 is a zero of the quadratic polynomial, $x^2 - kx - 15$ then the value of k is
(a) 2 (b) -2 (c) 4 (d) -4
- (ii) The number of polynomials having zeros 1 and -2 is
(a) 1 (b) 2 (c) 3 (d) more than 3
- (iii) A quadratic polynomial, whose zeros are -3 and 4, is
(a) $x^2 - x + 12$ (b) $x^2 + x + 12$
(c) $\frac{x^2}{2} - \frac{x}{2} - 6$ (d) $2x^2 + 2x - 24$
- (iv) The zeros of the quadratic polynomial $x^2 + kx + k, k \neq 0$
(a) cannot be positive (b) cannot be negative
(c) are always equal (d) are always unequal

- (v) If the graph of a polynomial intersects the x-axis at exactly two points, then it
- cannot be a linear or a cubic polynomial
 - can be a quadratic polynomial only
 - can be a cubic or a quadratic polynomial
 - can be a linear or a quadratic polynomial

■ **Very Short Answer Questions:**

[1 mark each]

- If 1 is a zero of the polynomial $p(x) = ax^2 - 3(a-1)x - 1$, then find the value of a .
- If one root of the polynomial $p(y) = 7y^2 + 14y + m$ is reciprocal of other, then find the value of m .
- Find the other zero of the quadratic polynomial $y^2 + 7y - 60$ if one zero is -12 .
- Find the quadratic polynomial whose zeros are -3 and -5 .
- What number should be added to the polynomial $x^2 + 7x - 35$ so that 3 is the zero of the polynomial?
- The graph of $y = p(x)$ where $p(x)$ is a polynomial in variable x , is as follows:



Write the number of zeros of $p(x)$.

- If one zero of the quadratic polynomial $p(x) = x^2 + 4kx - 25$ is negative of the other, find the value of k .

■ **Short Answer Questions-I:**

[2 marks each]

- If m and n are the zeros of the polynomial $3x^2 + 11x - 4$, find the value of $\frac{m}{n} + \frac{n}{m}$.
[Competency Based Question]
- Find the zeros of the polynomial $5y^2 - 11y + 2$.
- If one of the zeros of the quadratic polynomial $(k-2)x^2 - 2x - (k+5)$ is 4 , find the value of k .
- If α, β are the zeros of the polynomial $x^2 + x - 6$, find the value of $\frac{1}{\alpha^2} + \frac{1}{\beta^2}$.
- If α, β are the two zeros of the polynomial $f(y) = y^2 - 8y + a$ and $\alpha^2 + \beta^2 = 40$, find the value of a .
- If the sum of the zeros of the quadratic polynomial $f(x) = kx^2 + 2x + 3k$ is equal to their product, find the value of k .

■ **Short Answer Questions-II:**

[3 marks each]

- Find the zeros of the following polynomials and verify the relationship between the zeros and the coefficients of the polynomials.

(i) $x^2 + \frac{1}{6}x - 2$

(ii) $\sqrt{3}x^2 - 11x + 6\sqrt{3}$

(iii) $a(x^2 + 1) - x(a^2 + 1)$

■ Long Answer Questions:

[5 marks each]

18. If α and β are zeros of polynomial $f(x) = 2x^2 + 11x + 5$, then find

(i) $\alpha^4 + \beta^4$

(ii) $\frac{1}{\alpha} + \frac{1}{\beta} - 2\alpha\beta$

19. Verify that the numbers given alongside the cubic polynomials below are their zeros. Also verify the relationship between the zeros and the coefficients.

(i) $x^3 - 2x^2 - 5x + 6$; $-2, 1, 3$

(ii) $2x^3 + 7x^2 + 2x - 3$; $-3, -1, \frac{1}{2}$

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

[Competency Based Question]

Answers

1. (i) (a) (ii) (d) (iii) (c) (iv) (a) (v) (c)
 2. $a = 1$ 3. $m = 7$ 4. 5 5. $x^2 + 8x + 15$ 6. 5 7. 2 8. $k = 0$
 9. $\frac{-145}{12}$ 10. $\frac{1}{5}, 2$ 11. $k = 3$ 12. $\frac{13}{36}$ 13. $a = 12$ 14. $k = \frac{-2}{3}$
 15. (i) $(\frac{4}{3}, \frac{-3}{2})$ (ii) $\frac{2}{\sqrt{3}}, 3\sqrt{3}$ (iii) $a, \frac{1}{a}$ 17. $a = -2, b = -8$ 18. (i) $\frac{10001}{16}$ (ii) $\frac{-36}{5}$
 20. $a = 1, b = \pm\sqrt{2}$

Self-Assessment

Time allowed: 1 hour

Max. marks: 40

SECTION A

1. Choose and write the correct option in the following questions.

(3 × 1 = 3)

(i) A quadratic polynomial with 3 and 2 as the sum and product of its zeros respectively is

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

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

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

(d) $x^2 - 2x - 3$

(ii) The zeros of the quadratic polynomial $x^2 + 99x + 127$ are

(a) both positive

(b) both negative

(c) one positive and one negative

(d) both equal

(iii) If the product of the zeros of the polynomial $p(x) = ax^3 - 6x^2 + 11x - 6$ is 4, then a equals

(a) $-\frac{2}{3}$

(b) $\frac{2}{3}$

(c) $-\frac{3}{2}$

(d) $\frac{3}{2}$

2. Solve the following questions.

(2 × 1 = 2)

(i) If α and β are zeros of a polynomial $x^2 - 4\sqrt{3}x + 3$, then find the value of $\alpha + \beta - \alpha\beta$.

(ii) If the square of difference of the zeros of the quadratic polynomial $x^2 + px + 45$ is equal to 144. Find out the value of p .
 [Competency Based Question]

SECTION B

■ Solve the following questions.

(4 × 2 = 8)

3. If p and q are the zeros of the polynomial $f(x) = 2x^2 - 7x + 3$, find the value of $p^2 + q^2$.
4. If α and β are the zeros of the quadratic polynomial $f(x) = 3x^2 - 5x - 2$, then evaluate $\frac{\alpha^2}{\beta} + \frac{\beta^2}{\alpha}$.
5. If α, β are the zeros of the quadratic polynomial $p(y) = y^2 - 4y + 3$, find the value of $\alpha^4\beta^3 + \alpha^3\beta^4$.
6. Find the cubic polynomial with the sum, sum of the products of its zeros taken two at a time, and the products of its zeros as $-3, -8$ and 2 respectively.

■ Solve the following questions.

(4 × 3 = 12)

7. If $\frac{2}{3}$ and -3 are the zeros of the polynomial $ax^2 + 7x + b$, then find the values of a and b .
 8. If $(x + a)$ is a factor of two polynomials $x^2 + px + q$ and $x^2 + mx + n$ then prove that $a = \frac{n - q}{m - p}$.
- [Competency Based Question]**
9. If α and β are the zeros of the polynomial $2x^2 - 3x + 1$, then find the value of (i) $\alpha^2\beta + \alpha\beta^2$
(ii) $\alpha^2 + \beta^2$.

10. Find a quadratic polynomial whose zeros are

$$\frac{5 + \sqrt{2}}{5 - \sqrt{2}}, \frac{5 - \sqrt{2}}{5 + \sqrt{2}}$$

■ Solve the following questions.

(3 × 5 = 15)

11. If the sum of squares of the zeroes of the quadratic polynomial $x^2 - 8x + k$ be 40 , find k .
12. If α and β are the zeros of the quadratic polynomial $f(x) = 3x^2 - 7x - 6$, find a polynomial whose zeros are (i) α^2 and β^2 (ii) $2\alpha + 3\beta$ and $3\alpha + 2\beta$.
13. Find the zeroes of the following quadratic polynomials and verify the relationship between the zeroes and the coefficients:

$$x^2 - (2a + b)x + 2ab$$

Answers

- | | | | | |
|---|--|-------------------------------------|--------------------------------------|--------------------|
| 1. (i) (b) | (ii) (b) | (iii) (d) | 2. (i) $4\sqrt{3} - 3$ (ii) ± 18 | 3. $\frac{37}{4}$ |
| 4. $\frac{-215}{18}$ | 5. 108 | 6. $x^3 + 3x^2 - 8x - 2$ | | 7. $a = 3, b = -6$ |
| 9. (i) $\frac{3}{4}$ (ii) $\frac{5}{4}$ | | 10. $23x^2 - 54x + 23$ | | |
| 11. 12 | 12. (i) $\frac{1}{9}(9x^2 - 85x + 36)$ | (ii) $\frac{1}{3}(3x^2 - 35x + 92)$ | | 13. $2a, b$ |