PART-I

1. For what values of a does the equation $9x^2 - 2x + a = 6 - ax$ posses equal roots ?

2. Find the values of a for which the roots of the equation $(2a - 5)x^2 - 2(a - 1)x + 3 = 0$ are equal.

3. For what values of m does the equation $x^2 - x + m = 0$ possess no real roots ?

4. For what values of m does the equation $mx^2 - (m + 1)x + 2m - 1 = 0$ possess no real roots ?

5. Find integral values of k for which the equation $(k - 12)x^2 + 2(k - 12)x + 2 = 0$ possess no real roots ?

6. For what values of 'a' does the equation $x^2 + 2a\sqrt{a^2 - 3}\,x + 4 = 0$ possess equal roots ?

7. Form a quadratic equation whose roots are the numbers $\frac{1}{10 - \sqrt{72}}$ and $\frac{1}{10 + 6\sqrt{2}}$.

8. Find the least integral value of k for which the equation $x^2 - 2(k + 2)x + 12 + k^2 = 0$ has two different real roots.

9. For what values of a is the sum of the roots of the equation $x^2 + (2 - a - a^2)x - a^2 = 0$ equal to zero ?

10. For what values of a do the graphs of the functions $y = 2ax + 1$ and $y = (a - 6)x^2 - 2$ not intersect?

11. For what values of a is the ratio of the roots of the equation $x^2 + ax + a + 2 = 0$ equal to 2 ?

12. For what values of a do the roots x_1 and x_2 of the equation $x^2 - (3a + 2)x + a^2 = 0$ satisfy the relation $x_1 = 9x_2$?

13. Find a such that one of the roots of the equation $x^2 - \frac{15}{4}x + a = 0$ is the square of the other.

14. The roots x_1 and x_2 of the equation $x^2 + px + 12 = 0$ are such that $x_2 - x_1 = 1$. Find p.

15. Find k in the equation $5x^2 - kx + 1 = 0$ such that the difference between the roots of the equation is unity.

16. For what value of a is the difference between the roots of the equation $(a - 2)x^2 - (a - 4)x - 2 = 0$ equal to 3 ?

17. Find b in the equation $5x^2 + bx - 28 = 0$ if the roots x_1 and x_2 of the equation are related as $5x_1 + 2x_2 = 1$ and b is an integer.

18. Find p in the equation $x^2 - 4x + p = 0$ if it is know that the sum of the squares of its roots is equal to 16.

19. For what values of a is the difference between the roots of the equation $2x^2 - (a + 1)x + (a - 1) = 0$ equal to their product ?

20. Find all the values of a for which the sum of the roots of the equation $x^2 - 2a(x - 1) - 1 = 0$ is equal to the sum of the squares of its roots.

PART-II

1. Find the coefficients of the equation $x^2 + px + q = 0$ such that its roots are equal to p and q.

2. Given two quadratic equations $x^2 - x + m = 0$ and $x^2 - x + 3m = 0$, $m \neq 0$. Find the value of m for which one of the roots of the second equation is equal to double the root of the first equation.

3. Express $x_1^3 + x_2^3$ in terms of the coefficients of the equation $x^2 + px + q = 0$, where x_1 and x_2 are the roots of the equation.

4. Assume that x_1 and x_2 are roots of the equation $3x^2 - ax + 2a - 1 = 0$. Calculate $x_1^3 + x_2^3$.

5. Without solving the equation $3x^2 - 5x - 2 = 0$, find the sum of the cubes of its roots.

6. Calculate $\frac{1}{x_1^3} + \frac{1}{x_2^3}$, where x_1 and x_2 are roots of the equation $2x^2 - 3ax - 2 = 0$.

7. For what values of a does the equation $(2 - x)(x + 1) = a$ posses real and positive roots ?

8. Find all values of p for which the roots of the equation $(p - 3)x^2 - 2px + 5p = 0$ are real and positive.

9. If the equation $x^2 - 15 - m(2x - 8) = 0$ has equal roots, find the values of m.

10. For what values of m will the equation $x^2 - 2x(1+3m) + 7(3+2m) = 0$ have equal roots ?

11. For what value of m will the equation $\frac{x^2 - bx}{ax - c} = \frac{m-1}{m+1}$ have roots equal in magnitude but opposite in sign ?

12. Prove that the roots of the following equations are rational, where a, b, c $\in$ Q :

(1) $(a + c - b)x^2 + 2cx + (b + c - a) = 0$,

(2) $abc^2x^2 + 3a^2cx + b^2cx - 6a^2 - ab + 2b^2 = 0$.

13. If α, β are the roots of the equation $ax^2 + bx + c = 0$, find the values of

(i) $\frac{1}{\alpha^2} + \frac{1}{\beta^2}$

(ii) $\alpha^4\beta^7 + \alpha^7\beta^4$

14. Find the value of $x^3 + x^2 - x + 22$ when x = 1 + 2i.

15. If α and β are the roots of $x^2 + px + q = 0$, form the equation whose roots are $(\alpha - \beta)^2$ and $(\alpha + \beta)^2$.

16. Prove that the roots of $(x - a)(x - b) = h^2$ are always real.

17. If α, β are the roots of $ax^2 + bx + c = 0$, form the equation whose roots are $\alpha^2 + \beta^2$ and $\alpha^{-2} + \beta^{-2}$.

18. Form the equation whose roots are the squares of the sum and of the difference of the roots of $2x^2 + 2(m + n)x + m^2 + n^2 = 0$.

19. Solve the following for x :

(i) $12x^4 - 56x^3 + 89x^2 - 56x + 12 = 0$

(ii) $2\sqrt{x} + 2x^{-\frac{1}{2}} = 5$

(iii) $\sqrt{\frac{x}{1-x}} + \sqrt{\frac{1-x}{x}} = 2\frac{1}{6}$

(iv) $2^{2x+3} - 57 = 65(2^x - 1)$

(v) $x(2x + 1)(x - 2)(2x - 3) = 63$

RACE # 20 QUADRATIC EQUATION MATHEMATICS

STRAIGHT OBJECTIVE TYPE

1. Let p, q $\in$ {1, 2, 3, 4}. The number of equation of the form $px^2 + qx + 1 = 0$ having real roots is
(A) 15 (B) 9 (C) 7 (D) 8

2. If $b \in R^+$ then roots of the equation $(2+b)x^2 + (3+b)x + (4+b) = 0$ is
(A) Real and distinct (B) Real and equal
(C) Imaginary (D) Cannot be predicted

3. Suppose a, b, c > 0, then the number of real roots of the equation $ax^2 + b|x| + c = 0$ is
(A) 1 (B) 4 (C) 2 (D) None of these

4. If $x = \sqrt{3+2\sqrt{2}}$, then $x^2 + \frac{1}{x^2}$ is equal to
(A) $2\sqrt{2}$ (B) 8 (C) 6 (D) 1

5. If $x = 3 - \sqrt{8}$, then $x^3 + \frac{1}{x^3}$ is equal to
(A) 6 (B) 198 (C) $6\sqrt{2}$ (D) 102

6. If $\frac{3+2\sqrt{2}}{3-\sqrt{2}} = a + b\sqrt{2}$, then a and b (a, b $\in$ Q) are respectively equal to
(A) $\frac{13}{7}, \frac{9}{7}$ (B) $\frac{9}{7}, \frac{13}{7}$ (C) $\frac{13}{7}, \frac{7}{9}$ (D) $\frac{7}{9}, \frac{7}{13}$

7. The number of solution of the equation, $\log(-2x) = 2\log(x + 1)$ is
(A) zero (B) 1 (C) 2 (D) none

8. The solution set of the equation $e^{4x} - 5e^{2x} + 4 = 0$ over R is
(A) {1, 4} (B) {–4, –1} (C) $\{-\log_e 2, 0, \log_e 2\}$ (D) $\{0, \log_e 2\}$

9. The sum of the solutions of the equation $9^x - 6 \cdot 3^x + 8 = 0$ is
(A) $\log_3 2$ (B) $\log_3 6$ (C) $\log_3 8$ (D) $\log_3 4$

10. If sin θ and cos θ are the roots of the equation $ax^2 - bx + c = 0$, then
(A) $a^2 - b^2 = 2ac$ (B) $a^2 + b^2 = 2ac$ (C) $a^2 + b^2 + 2ac = 0$ (D) $b^2 - a^2 = 2ac$

11. The roots of the equation $x^2 - 2\sqrt{2}x + 1 = 0$ are
(A) real and different (B) imaginary and different
(C) real and equal (D) rational and different

12. The roots of the equation $(b + c)x^2 - (a + b + c)x + a = 0$ (a, b, c $\in$ Q, b + c $\neq$ a) are
(A) irrational and different (B) rational and different
(C) imaginary and different (D) real and equal

13. If the roots of the equation $ax^2 + x + b = 0$ be real and different, then the roots of the equation $x^2 - 4\sqrt{ab}\,x + 1 = 0$ will be
(A) rational (B) irrational (C) real (D) imaginary

14. If a < c < b then the roots of the equation $(a - b)^2 x^2 + 2(a + b - 2c)x + 1 = 0$ are
(A) imaginary (B) real
(C) one real & imaginary (D) equal & imaginary

15. The number of real solutions of $x - \frac{1}{x^2-4} = 2 - \frac{1}{x^2-4}$ is

(A) 0 (B) 1 (C) 2 (D) infinite

16. Sum of roots of the equation $(x + 3)^2 - 4|x + 3| + 3 = 0$ is

(A) 4 (B) 12 (C) – 12 (D) – 4

17. If α, β are roots of the equation $x^2 + px - q = 0$ & γ, δ are roots of $x^2 + px + r = 0$, then the value of $(\alpha-\gamma)(\alpha-\delta)$ is

(A) p + r (B) p – r (C) q – r (D) q + r

18. If α, β are roots of $Ax^2 + Bx + C = 0$ and α^2, β^2 are roots of $x^2 + px + q = 0$ then p is equal to

(A) $\frac{B^2-4AC}{A^2}$ (B) $\frac{2AC-B^2}{A^2}$ (C) $\frac{B^2-2AC}{A^2}$ (D) $\frac{4AC-B^2}{A^2}$

19. If α, β are roots of the equation $x^2 - 5x + 6 = 0$ then the equation whose roots are $\alpha + 3$ and $\beta + 3$ is

(A) $x^2 - 11x + 30 = 0$ (B) $(x - 3)^2 - 5(x - 3) + 6 = 0$

(C) Both (A) and (B) (D) None of these

20. If α, β are the root of a quadratic equation $x^2 - 3x + 5 = 0$ then the equation whose roots are $(\alpha^2 - 3\alpha + 7)$ and $(\beta^2 - 3\beta + 7)$ is

(A) $x^2 + 4x + 1 = 0$ (B) $x^2 - 4x + 4 = 0$ (C) $x^2 - 4x - 1 = 0$ (D) $x^2 + 2x + 3 = 0$

21. The number of values of a for which $(a^2 - 3a + 2)x^2 + (a^2 - 5a + 6)x + a^2 - 4 = 0$ is an identity in x is

(A) 0 (B) 2 (C) 1 (D) 3

22. If $x = \sqrt{110 + \sqrt{110 + \sqrt{110 + \sqrt{110 + ...\text{to } \infty}}}}$, then

(A) $-11 < x < -10$ (B) $10 < x < 11$ (C) $x = 11$ (D) $x = 10$

23. If $(2x + 1)^2 - |2x + 1| - 6 < 0$, then

(A) $-1 < x < 2$ (B) $-2 < x < 1$ (C) $-2 < x < -1$ (D) $1 < x < 2$

24. $\frac{x+3}{x^2-x-2} \geq \frac{1}{x-4}$ for all x satisfying

(A) $-2 < x < 1$ or $x > 4$ (B) $-1 < x < 2$ or $x > 4$ (C) $x < -1$ or $2 < x < 4$ (D) None of these

25. If $(3-4\sin^2 1)(3-4\sin^2 3)(3-4\sin^2 3^2).....(3 - 4\sin^2(3^{n-1})) = \sin a/\sin b$, where $n \in N$ and $n>1$ & a, b are integers in radian, then the digit at the unit place of (a + b) cannot be-

(A) 4 (B) 1 (C) 8 (D) 2

[SINGLE CORRECT CHOICE TYPE]

Q.1 to Q. 15 has four choices (A), (B), (C), (D) out of which **ONLY ONE** is correct.

1. The values of the parameter 'a' for which the quadratic equations $(1-2a)x^2-6ax-1=0$ and $ax^2-x+1=0$ have at least one root common, are

(A) 0, 1/2 (B) 1/2, 2/9 (C) 2/9 (D) 1/3, 1/2, 2/9

2. If $\alpha+\beta=3$ and $\alpha^3+\beta^3=7$, then α and β are the roots of the equation

(A) $3x^2+9x+7=0$ (B) $9x^2-27x+20=0$ (C) $2x^2-6x+15=0$ (D) none of these

3. If α, β are roots of the equation $ax^2+bx+c=0$, then the equation whose roots are $2\alpha+3\beta$ and $3\alpha+2\beta$ is

(A) $abx^2-(a+b)cx+(a+b)^2=0$ (B) $acx^2-(a+c)bx+(a+c)^2=0$

(C) $acx^2+(a+c)bx-(a+c)^2=0$ (D) None of these

4. The equations $ax^2+bx+a=0\,(a,b\in R)$ and $x^3-2x^2+2x-1=0$ have 2 roots common. Then a + b must be equal to

(A) 1 (B) -1 (C) 0 (D) None of these

5. The value of m for which the equation $\frac{a}{x+a+m}+\frac{b}{x+b+m}=1$ has roots equal in magnitude and opposite in signs is

(A) $\frac{a-b}{a+b}$ (B) –1 (C) 0 (D) $\frac{a+b}{a-b}$

6. If the product of 2 positive numbers is 9, then the possible value of the sum of their reciprocals lies in the interval

(A) $\left[\frac{1}{3},\infty\right)$ (B) $[1,\infty)$ (C) $\left[\frac{4}{9},\infty\right)$ (D) $\left[\frac{2}{3},\infty\right)$

7. If $(49)^{3\log_{\sqrt{343}}\sqrt{x}}-2x-3=0$, then x is equal to

(A) –1 (B) 3 (C) –1, 3 (D) 2, 3

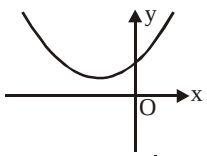
8. The curve of the quadratic expression $y = ax^2 + bx + c$ is shown in the figure and α,β be the roots of the equation $ax^2 + bx + c = 0$ then correct option is [D is the discriminant]

(A) $a > 0, b > 0, c > 0, D > 0, \alpha+\beta > 0, \alpha\beta > 0$

(B) $a > 0, b > 0, c > 0, D < 0, \alpha+\beta < 0, \alpha\beta < 0$

(C) $a > 0, b > 0, c > 0, D < 0, \alpha+\beta < 0, \alpha\beta > 0$

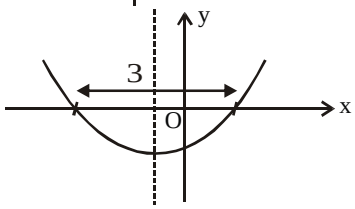
(D) $a > 0, b < 0, c > 0, D < 0, \alpha+\beta > 0, \alpha\beta > 0$



9. If graph of $f(x) = x^2 + bx + c$ is drawn in adjacent diagram, where b, c $\in$ I, then number of such quadratic equation $f(x) = 0$ is

(A) 1 (B) 2

(C) 3 (D) 4



10. The value of 'a' for which the equation $x^7 + ax^2 + 3 = 0$ and $x^8 + ax^3 + 3 = 0$ have a common root, can be

(A) 1 (B) –2 (C) –3 (D) –4

11. If $x^2 + 3x + 3 = 0$ and $ax^2 + bx + 1 = 0$, $a, b \in Q$ have a common root, then value of $(3a + b)$ is equal to

(A) 1/3 (B) 1 (C) 2 (D) 4

12. The number of integral values of k for which the curve $y = x^2 + kx + 4$ touches the x axis is

(A) 0 (B) 1 (C) 2 (D) 4

13. If α, β are the roots of $x^2 - px + r = 0$ and $\alpha + 1, \beta - 1$ are the roots of $x^2 - qx + r = 0$, then r is

(A) $\frac{p-1}{4}$ (B) $\frac{q+1}{4}$ (C) $\frac{p^2-1}{4}$ (D) $\frac{q^2+1}{4}$

14. If the roots of the equation $x^2 - bx + c = 0$ are two consecutive integers, then $b^2 - 4c$ equals.

(A) –2 (B) 3 (C) 2 (D) 1

15. The sum of all values of p for which the vertex of the parabola $y = x^2 + 2px + 13$ lie at a distance of 5 from the origin, is

(A) 0 (B) 6 (C) 7 (D) 8

[MULTIPLE CORRECT CHOICE TYPE]

Q.16 to Q.17 has four choices (A), (B), (C), (D) out of which **ONE OR MORE** may be correct

16. If equations $ax^2 - (a + b)x + b = 0$ & $bx^2 + (b - c)x - c = 0$ has exactly one root in common $\{a, b, c \neq 0\}$, then which of the following can be correct

(A) $b^2 = ac$ (B) $-a = b \neq c$ (C) $b = a \neq c$ (D) $-a \neq b = c$

17. If one of the roots of $x^2 - bx + c = 0$, $b\ c \in Q$ is $\sqrt{7-4\sqrt{3}}$ then

(A) $\log_b c = 0$ (B) $b + c = 5$ (C) $\log_c b = 0$ (D) $bc = -4$

[COMPREHENSION TYPE]

Paragraph for Question 18 to 20

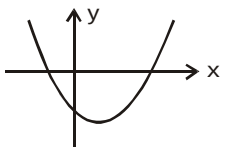
Consider the quadratic expression $y = x^2 - px + q$ where $p, q \in R$.

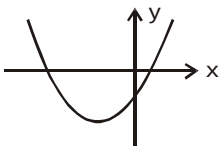
On the basis of above information, answer the following questions :

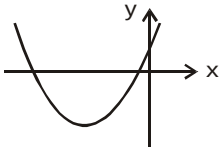
18. If $p = 4$ and $q = 9$, then minimum value of the expression is

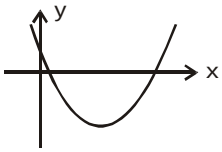
(A) 3 (B) 4 (C) 5 (D) 6

19. If $p < 0$ & $q < 0$, then the possible graph of $y = x^2 - px + q$ is

(A) 

(B) 

(C) 

(D) 

20. If p is positive odd integer and roots of equation $y = 0$ are prime numbers and $p + q = 23$, then absolute value of difference of roots is

(A) 1 (B) 2 (C) 3 (D) 5

1. Let $x^2-(m-3)x+m=0$ $(m\in R)$ be a quadratic equation. Find the value of m for which the roots of the equation are

(a) Positive

(b) Negative

(c) Such that at least one is positive

(d) One root is smaller than 2 and other root is greater than 2

(e) Both the roots are greater than 2(f) Both the roots are smaller than 2

(g) Exactly one root lies in the interval (1, 2)

(h) Both the roots lie in the interval (1, 2)

(i) Such that at least one root lie in the interval (1, 2)

(j) One root is greater than 2 and the other root is smaller than 1

2. If α, β are the roots of $x^2 - p(x+1) - c = 0, c \neq 1$ then show that

(i) $(\alpha+1)(\beta+1)=1-c$ (ii) $\dfrac{\alpha^2+2\alpha+1}{\alpha^2+2\alpha+c}+\dfrac{\beta^2+2\beta+1}{\beta^2+2\beta+c}=1$

3. Find the value of k for which $\left|\dfrac{x^2+kx+1}{x^2+x+1}\right|<2 \quad \forall\, x\in R$

4. If x and y are two real numbers connected by the equation $9x^2+2xy+y^2-92x-20y+244=0$, then find range of x and y.

5. If x is real, then find the range of the expression $\dfrac{x^2+14x+9}{x^2+2x+3}$.

6. Find the smallest and greatest value of $\dfrac{x^2+x+1}{x^2+1}$ $\forall\, x\in R$.

COMPREHENSION TYPE

Paragraph for Q. No. 7 to 9

Let $f(x)\equiv ax^2+bx+c,\ a\neq 0$. Let α and β be roots of f(x) = 0. Then the following hold good.

(a) $\alpha+h$ and $\beta+h$ are roots of $f(x-h)=0$ for all h.

(b) $\lambda\alpha+h$ and $\lambda\beta+h$ are roots of $f[(x-h)/\lambda]=0$ for all h and for all $\lambda\neq 0$.

7. If α and β are the roots of $ax^2+bx+c=0$, then the equation whose roots are $\dfrac{\alpha+1}{\alpha-2}$ and $\dfrac{\beta+1}{\beta-2}$ is

(A) $a(x+1)^2+b(x+1)(x-2)+c(x-2)^2=0$ (B) $a(x-2)^2+b(x+1)(x-2)+c(x+1)^2=0$

(C) $a(2x+3)^2+b(x+1)(x+2)+c(x+2)^2=0$ (D) $a(2x+1)^2+b(2x+1)(x-1)+c(x-1)^2=0$

8. If α and β are roots of the equation $2x^2+4x-5=0$, then the equation whose roots are $2\alpha-3$ and $2\beta-3$ is

(A) $x^2+10x-11=0$ (B) $11x^2+10x-1=0$ (C) $x^2+10x+11=0$ (D) $11x^2-10x+1=0$

9. If α and β are roots of $ax^2+bx+c=0$, then the equation whose roots are $\alpha+(c/a)$ and $\beta+(c/a)$ is

(A) $a^2x^2-2(ac+b)x+c(a+b)=0$ (B) $a^2x^2-(ca+b)x+c(a+b)=0$

(C) $a^2x^2+2(ac+b)x-c(a+b+c)=0$ (D) $a^2x^2-a(-b+2c)x+c(a-b+c)=0$

Paragraph for Q. No. 10 to 12

Let a, b and c be real numbers, $a\neq0$ and $f(x)\equiv ax^2+bx+c$. If $\alpha<\beta$ are roots of f(x) = 0, then it is known that

(A) $f(x)\cdot a<0$ for all x in the open interval (α, β).

(B) $f(x)\cdot a>0$ for all x such that either $x<\alpha$ or $x>\beta$.

10. If the equation $(a^2+1)x^2-(a+1)x+(a^2-a-2)=0$ has one positive and one negative root, then which one of the following is possible ?

(A) $a\leq-1$ (B) $-1<a<2$ (C) $2\leq a\leq5$ (D) $a>5$

11. If $mx^2-(m+1)x+3=0$ has roots belonging to (1, 2), then

(A) $0<m<1$ (B) $1\leq m\leq2$ (C) $m<0$ (D) no real value for m exists

12. If $x^2-(m+1)x+m^2+m-8=0$ has one root in $(-\infty,1)$ and the other root in $(1,\infty)$, then

(A) $m<-2\sqrt{2}$ (B) $m>2\sqrt{2}$ (C) $-2\sqrt{2}<m<2\sqrt{2}$ (D) no real value for m exists

Paragraph for Q. No. 13 to 15

Let $f(x)\equiv ax^2+bx+c$, where a, b and c are real and $a\neq0$. Then f(x) = 0 has real roots or imaginary roots according as $b^2-4ac\geq0$ or $b^2-4ac<0$.

13. If the function $y=\dfrac{x^2-x}{1-mx}$ takes all real values for real values of x, then

(A) $m<0$ (B) $0<m<1$ (C) $m>0$ (D) $m>1$

14. If $y=\dfrac{x^2+2x+c}{x^2+4x+3c}$ takes all real values, then

(A) $0<c<1$ (B) $c<-1$ (C) $c>1$ (D) $c>0$

15. If $\dfrac{x^2+ax+1}{x^2+x+1}<3$ for all real x, then

(A) $a<0$ (B) $a<-1$ (C) $-1<a<7$ (D) $a>7$

ANSWER KEY

RACE-19

PART-I

1. $a = 20 \pm 6\sqrt{5}$ **2.** $a = 4$ **3.** $m \in \left(\frac{1}{4}, \infty\right)$ **4.** $m \in \left(-\infty, -\frac{1}{7}\right) \cup (1, \infty)$

5. $k = 13$ **6.** $a = \pm 2$ **7.** $28x^2 - 20x + 1 = 0$ **8.** $k = 3$

9. $a_1 = -2,\ a_2 = 1$ **10.** $a \in (-6, 3)$ **11.** $a_1 = -\frac{3}{2},\ a_2 = 6.$ **12.** $a = 6,\ -\frac{6}{19}$

13. $a_1 = -\frac{125}{8},\ a_2 = \frac{27}{8}$ **14.** $p = \pm 7$ **15.** $k = \pm 3\sqrt{5}$ **16.** $a_1 = 3/2,\ a_2 = 3$

17. $b = -13$ **18.** $p = 0$ **19.** $a = 2$ **20.** $a_1 = 1/2,\ a_2 = 1$

PART-II

1. $p_1 = 0,\ q_1 = 0,\ p_2 = 1,\ q_2 = -2$ **2.** $m = -2$ **3.** $3pq - p^3$ **4.** $\frac{a(a^2 - 18a + 9)}{27}$

5. $\frac{215}{27}$ **6.** $-\left(\frac{27a^3 + 36a}{8}\right)$ **7.** $a \in \left(2, \frac{9}{4}\right]$ **8.** $p \in \left[3, \frac{15}{4}\right]$

9. 3, 5 **10.** $2, -\frac{10}{9}$ **11.** $\frac{a-b}{a+b}$ **13.** (i) $\frac{b^2 - 2ac}{c^2}$ (ii) $\frac{bc^4(3ac - b^2)}{a^7}$

14. 7 **15.** $x^2 - 2(p^2 - 2q)x + p^2(p^2 - 4q) = 0$

17. $a^2c^2x^2 - (b^2 - 2ac)(a^2 + c^2)x + (b^2 - 2ac)^2 = 0$ **18.** $x^2 - 4mnx - (m^2 - n^2)^2 = 0$

19. (i) $2, \frac{1}{2}, \frac{3}{2}, \frac{2}{3}$ (ii) $4, \frac{1}{4}$ (iii) $\frac{9}{13}, \frac{4}{13}$ (iv) $-3, 3$ (v) $3, -\frac{3}{2}$

RACE-20

1.	(C)	**2.**	(C)	**3.**	(D)	**4.**	(C)	**5.**	(B)	**6.**	(A)	**7.**	(B)	**8.**	(D)	**9.**	(C)
10.	(D)	**11.**	(A)	**12.**	(B)	**13.**	(D)	**14.**	(A)	**15.**	(A)	**16.**	(C)	**17.**	(D)	**18.**	(B)
19.	(C)	**20**	(B)	**21.**	(C)	**22.**	(C)	**23.**	(B)	**24.**	(C)	**25.**	(B)				

RACE-21

1.	(C)	**2.**	(B)	**3.**	(D)	**4.**	(C)	**5.**	(C)	**6.**	(D)	**7.**	(B)	**8.**	(C)	**9.**	(A)
10.	(D)	**11.**	(C)	**12.**	(C)	**13.**	(C)	**14.**	(D)	**15.**	(A)	**16.**	(ABD)			**17.**	(A,B)
18.	(C)	**19.**	(B)	**20.**	(D)												

RACE-22

1. (a) $m \in [9, \infty)$ (b) $m \in (0, 1]$ (c) $m \in (-\infty, 0) \cup [9, \infty)$ (d) $m \in (10, \infty)$

(e) $m \in [9, 10)$ (f) $m \in (-\infty, 1]$ (g) $m \in (10, \infty)$ (h) $m \in \phi$

(i) $m \in (10, \infty)$ (j) $m \in \phi$

3. $0 < k < 4$ **4.** $x \in [3, 6]$ and $y \in [1, 10]$ **5.** $[-5, 4]$ **6.** $\frac{1}{2}$ and $\frac{3}{2}$ **7.** (D)

8. (C) **9.** (D) **10.** (B) **11.** (D) **12.** (C) **13.** (D) **14.** (A) **15.** (C)