4. QUADRATIC EXPRESSIONS ①
Class: IX . MATHEMATICS – II
FOUNDATION. SOLUTIONS

TEACHING TASK 2025-26
JEE MAINS

01. Given $f(x) = \sqrt{x^2+4x+5}$

We have $x^2+4x+5 \geq 0, \forall x \in R$

Since $\Delta < 0$, Domain of $f = R$.

Now, $f(x) = \sqrt{x^2+4x+5}$

$= \sqrt{(x+2)^2+1}$

Clearly, $\forall x \in R$, $(x+2)^2+1 \geq 1$

$\Rightarrow \sqrt{(x+2)^2+1} \geq 1$

$\therefore$ Range of $f(x) = [1, \infty)$

Ans: B

02. $f(x) = (x-2)^2+1 \geq 0, \forall x \in R$

$\therefore$ Range of $f(x) = [1, \infty)$ Ans: A

03 $f(x) = \dfrac{1}{x^2-5x+6}$

f is defined only when, $x^2-5x+6 \neq 0$.

$\Rightarrow (x-2)(x-3) \neq 0 \Rightarrow x \neq 2$ and $x \neq 3$

$\therefore$ Domain $= R - \{2, 3\}$ Ans: A

04 $x^2 - 2x + 1 \le 0$

$\Rightarrow (x-1)^2 \le 0$

$\Rightarrow x = 1$

Ans: B

05 $f(x) = x^2 + Kx + 4.$

Minimum value $= \frac{4ac - b^2}{4a} = 0$

$\Rightarrow 4ac - b^2 = 0$

$\Rightarrow 16 - K^2 = 0$

$\Rightarrow K = \pm 4$

Ans: D

06 $y = x^2 + 2x + 3$

$y = ax^2 + bx + c$

Max. Value occurs at $x = \frac{-b}{2a} = \frac{-2}{2 \cdot 1} = -1$

Ans: B

07. a, b are the roots of $x^2 + ax + b$

$\therefore a + b = -a$ | $a \cdot b = b$

$\Rightarrow 1 + b = -1$ | $\Rightarrow a = 1$

$\Rightarrow b = -2$

min. value of $x^2 + ax + b = \frac{4 \cdot 1 \cdot b - a^2}{4 \cdot 1}$

$= \frac{4(-2) - 1^2}{4} = \frac{-9}{4}$

Ans: B

08 $\alpha^2 + \beta^2 = (\alpha + \beta)^2 - 2\alpha\beta$

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

$= a^2 - 2a + 6$

$= (a-1)^2 + 5$

We know, $(a-1)^2 \ge 0$

$\Rightarrow (a-1)^2 + 5 \ge 5$

$\therefore$ Least value $= 5$

Ans: C

09. $\dfrac{14x}{x+1} - \dfrac{9x-30}{x-4} < 0$

$$\Rightarrow \frac{(x-1)(x-6)}{(x+1)(x-4)} < 0$$

$\therefore\ x \in (-1,1) \cup (4,6)$ Ans. D

10. $\min\{f(x)\} > \max.\{g(x)\}$

$$\frac{4.1.2c^2 - 4b^2}{4.1} > \frac{4(-1).b^2 - 4c^2}{4(-1)}$$

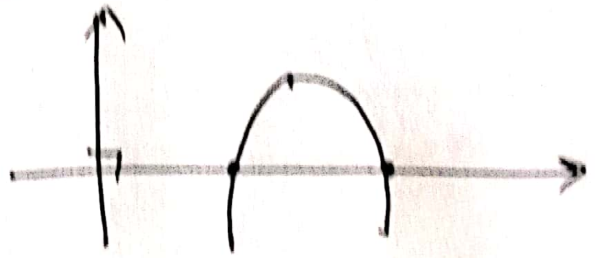
$\Rightarrow\ 2c^2 - b^2 > b^2 + c^2$

$\Rightarrow\ c^2 > 2b^2$

$\Rightarrow\ |c| > |b|\sqrt{2}$ Ans. B

JEE ADVANCED LEVEL

01. Conceptual



A) $a < 0$ (true)

B) $b^2 - 4ac > 0$ (true)

D) Range $= (-\infty, \text{max. value})$ Ans. A,B,D

02 $(3+2\sqrt{2})^{x^2-4} + (3-2\sqrt{2})^{x^2-4} = 6$

clearly, $(3+2\sqrt{2}) + (3-2\sqrt{2}) = 6$

and $(3+2\sqrt{2})(3-2\sqrt{2}) = 9-8 = 1$

$\therefore\ x^2-4 = \pm 1$

$\Rightarrow x^2-4 = 1$ or $x^2-4 = -1$

$\Rightarrow x = \pm\sqrt{5}$ or $x = \pm\sqrt{3}$ Ans: A, B, C, D

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03 Statement I: $f(x) = x^2+6x+13$

Min. value $= \dfrac{4ac-b^2}{4a}$

$= \dfrac{4\cdot 1\cdot 13 - 6^2}{4\cdot 1} = 4$ (True)

Statement II: $f(x) = x^2+6x+13$

Min. value occurs at $x = \dfrac{-b}{2a}$

$= \dfrac{-6}{2\cdot 1} = -3$ (True)

Ans: A

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04. Statement I: $(\log_5 x)^2 + (\log_5 x) < 2$

let $\log_5 x = a$

$\therefore\ a^2+a-2 < 0$

$\Rightarrow (a+2)(a-1) < 0$

$\Rightarrow -2 < a < 1$

$\Rightarrow -2 < \log_5 x < 1$

$\Rightarrow 5^{-2} < x < 5^1$

$\Rightarrow \frac{1}{25} < x < 5$

$\therefore x \in \left(\frac{1}{25}, 5\right)$

(True)

Statement II: Conceptual (true) Ans. A

05 Assertion:

Given $\sqrt{x^2-5x+7} < 0$

here x^2-5x+7

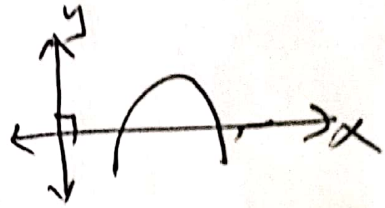
$\Delta = -3 < 0$

i.e x^2-5x+7 does not have real roots

Hence $\sqrt{x^2-5x+7} < 0$ is meaningless (True)

Reason: Conceptual (true) Ans. A

06. Assertion: $y = -2x^2+3x-1$



here $a = -2 < 0$

Ans: A

Reason: Conceptual (true)

07. $f(x) = \sqrt{x^2-4x+3}$

$\therefore \quad x^2-4x+3 \geq 0$

$\Rightarrow (x-1)(x-3) \geq 0$

Domain $= (-\infty, 1] \cup [3, \infty)$ Ans: B

08 $f(x) = \sqrt{x^2-4x+3}$

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

Minimum value possible $= 0$ Ans: A

09 $2^{x^2-5x+8}+3^{x^2-5x+8}=13$

clearly, $2^2+3^2=13$

$\Rightarrow x^2-5x+8=2$

$\Rightarrow x^2-5x+6=0$

$\Rightarrow (x-2)(x-3)=0$

$\Rightarrow x=2,3$

Ans: A

10 $(2\sqrt{2})^{x^2-4x+6}+(3\sqrt{2})^{x^2-4x+6}=26$

clearly, $(2\sqrt{2})^2+(3\sqrt{2})^2=26$

$\therefore x^2-4x+6=2$

$\Rightarrow x^2-4x+4=0$

$\Rightarrow x=2,2$

Ans: D

11. $y=x^2-4x+5$

$\therefore x^2-4x+5=0$

$\Delta = 16-20=-4<0$

$\therefore$ The graph never touches the X-axis

Ans: D

12. $x=\dfrac{\sqrt{7}+\sqrt{3}}{\sqrt{7}-\sqrt{3}} * \dfrac{\sqrt{7}+\sqrt{3}}{\sqrt{7}+\sqrt{3}} = \dfrac{7+3+2\sqrt{21}}{7-3}=\dfrac{5+\sqrt{21}}{2}$

Similarly, $y=\dfrac{5-\sqrt{21}}{2}$

$x^4+y^4+(x+y)^4=\left(\dfrac{5+\sqrt{21}}{2}\right)^4+\left(\dfrac{5-\sqrt{21}}{2}\right)^2+\left(\dfrac{5+\sqrt{21}}{2}+\dfrac{5-\sqrt{21}}{2}\right)$

$=1152$

Ans: 1152

13 NOTE! Please note, we have to find the "RANGE" of the functions given in column I.

a) $y = x^2+1 \Rightarrow$ Range $= [1, \infty)$

b) $y = (x-2)^2-5 \Rightarrow$ Range $= [-5, \infty)$

Since $(x-2)^2 \geq 0$

$\Rightarrow (x-2)^2-5 \geq -5$

c) $y = -x^2+4$

We have, $x^2 \geq 0$

$\Rightarrow -x^2 \leq 0$

$\Rightarrow -x^2+4 \leq 4$

$\therefore$ Range $= (-\infty, 4]$

d) $y = (x+1)^2$

We have $(x+1)^2 \geq 0$

$\therefore$ Range $= [0, \infty)$ Ans: p, q, r, s

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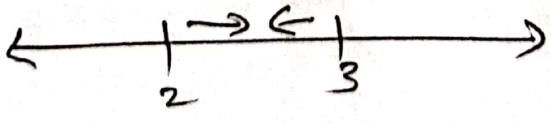
14. a) $x^2-5x+6<0$

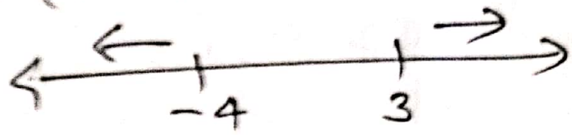
$\Rightarrow (x-2)(x-3)<0$



$\therefore 2<x<3$

b) $x^2+x-12>0$

$\Rightarrow (x+4)(x-3)>0$

$\Rightarrow$ 

$x<-4$ or $x>3$

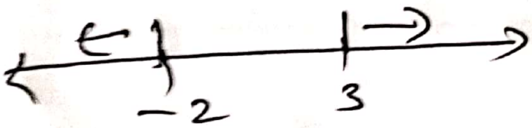
c) $x^2+9x+18<0$

$\Rightarrow (x+6)(x+3)<0$

$\Rightarrow -6<x<-3$

d) $x^2-x-6>0$

$\Rightarrow (x-3)(x+2)>0$



$x<-2$ or $x>3$

Ans: p, r, t, q

LEARNERS TASK (CUQ's)

01. $\alpha\beta = 6, \quad \alpha+\beta = 5$

$\Rightarrow x^2-(\alpha+\beta)x+\alpha\beta=0$

$\Rightarrow x^2-5x+6=0$

Ans: A

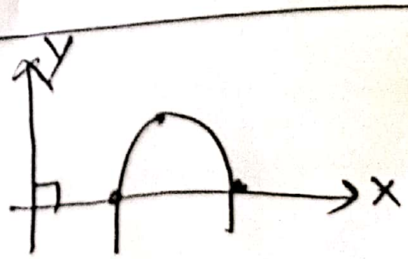
02. Roots Equal $\Rightarrow b^2-4ac=0$

$\Rightarrow b^2=4ac$

Ans: A

03. $y=ax^2+bx+c$

$\Rightarrow a<0$ and $\Delta>0$



Ans: C

04. $y = ax^2 + 6x + 9$

$\Delta < 0$

$\Rightarrow 6^2 - 4.a.9 < 0$

$\Rightarrow 1 - a < 0$

$\Rightarrow a > 1$

Ans: B

05 $y = x^2 + bx + 4$

$\Delta = 0$

$\Rightarrow b^2 - 4.1.4 = 0$

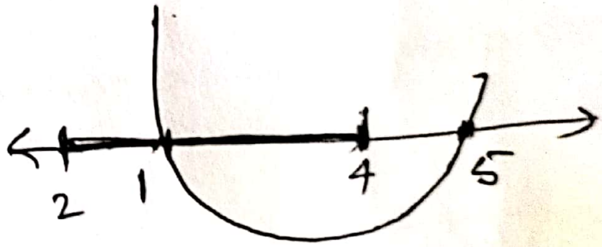
$\Rightarrow b = \pm 4$

Ans: C

06. Conceptual — Ans: C

07. $y = x^2 - 6x + 5$

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



$\text{min. value} = \dfrac{4ac - b^2}{4a}$

$= -4$

Ans: A

08. Conceptual — Ans: C

09. Conceptual — Ans: D

10. Conceptual — Ans: A

JEE MAINS LEVEL

01. $x^2 - (\alpha + \beta)x + \alpha\beta = 0$

$\Rightarrow x^2 - 6x + 5 = 0$

Ans: A

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02. $x^2-3x-10=0$ NOTE: Change the question "Solve $x^2-3x-10=0$"

$\Rightarrow (x-5)(x+2)=0$

$\Rightarrow x=-2$ ~~and~~ or 5

Ans: B

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03 $f(x)=\sqrt{5-x^2}$

$\Rightarrow 5-x^2\geq 0$

$\Rightarrow x^2-5\leq 0$

$\Rightarrow (x+\sqrt{5})(x-\sqrt{5})\leq 0$

$\Rightarrow -\sqrt{5}\leq x\leq\sqrt{5}$

$\therefore$ Domain $=[-\sqrt{5},\sqrt{5}]$

Ans. A

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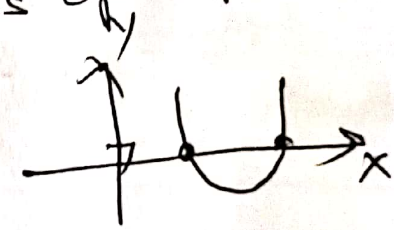
04 $y=x^2-4x+3$

$a=1>0$, The parabola is open upward



Also, $\Delta=4>0$

The parabola intersects the x-axis at two distinct points

Ans: B

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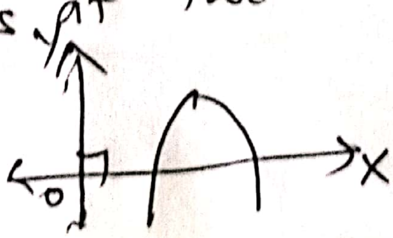
05 $y=-x^2+3x+4$

$a=-1<0$, The parabola is open downward.

$\Delta=25>0$, the parabola intersects the x-axis at two distinct points



Ans. A

06 $x^2 - 3x + 2 \geq 0$

$\Rightarrow (x-1)(x-2) \geq 0$

$\Rightarrow x \in (-\infty, 1] \cup [2, \infty)$

Ans. B

07. $f(x) = -2x^2 + 8x + c$

$\Rightarrow \dfrac{4(-2).c - 8^2}{4.(-2)} = 10$

$\Rightarrow c = 2$

Ans. B

08 $-x^2 + x + 6 > 0$

$\Rightarrow x^2 - x - 6 < 0$

$\Rightarrow (x-3)(x+2) < 0$

$\Rightarrow -2 < x < 3$

Ans. D

09. $2^{x^2-3} = 2 \Rightarrow x^2 - 3 = 1 \Rightarrow x = \pm 2$

Ans. A

10 $(x-2)^2 - 2|x-2| - 15 = 0$

$\Rightarrow |x-2|^2 - 2|x-2| - 15 = 0$

let $|x-2| = a$

$\Rightarrow a^2 - 2a - 15 = 0$

$\Rightarrow (a+3)(a-5) = 0$

$\Rightarrow a+3 = 0$ or $a - 5 = 0$

$\Rightarrow a = -3$

$\Rightarrow |x-2| = -3$

Not possible

$\Rightarrow a = 5$

$\Rightarrow |x-2| = 5$

$\Rightarrow x - 2 = \pm 5$

$\Rightarrow x = -3$ & 7

Sum $= -3 + 7$
$= 4$

Ans: A

01. $f(x) = 3x^2 - 6x + 7$

$a = 3 > 0$, f has minimum value

Minimum value occurs at $x = \frac{-b}{2a}$

$= \frac{-(-6)}{2.3} = 1.$

Minimum value $= \frac{4ac - b^2}{4a}$

$= \frac{4.3.7 - (-6)^2}{4.3} = 4$

$\therefore$ Vertex $= (1, 4)$

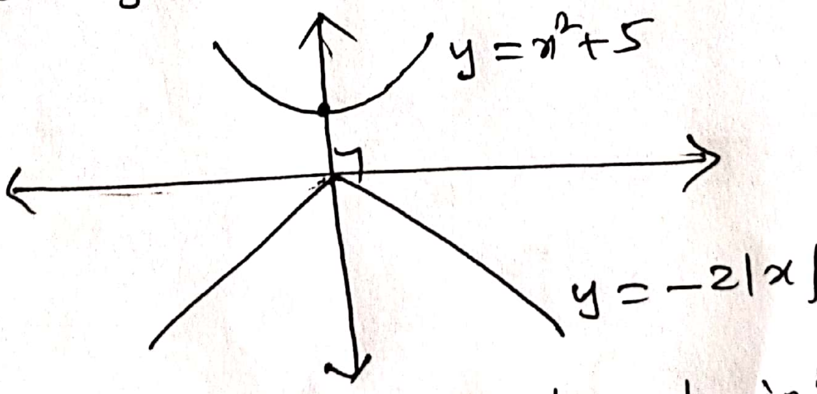
Range $= [4, \infty)$

Ans. A, C, D

02. $x^2 + 2|x| + 5 = 0$

$\Rightarrow x^2 + 5 = -2|x|$

let $y = x^2 + 5$ and $y = -2|x|$



Both the graphs do not intersects.

$\therefore$ The given eqn does not real Roots

Ans. A, B

03 **Statement I:**

$$x^2 - 5x + 6 < 0$$
$$\Rightarrow (x-2)(x-3) < 0$$
$$\Rightarrow 2 < x < 3$$
$$\Rightarrow x \in (2,3) \quad \text{(True)}$$

Statement II: Conceptual (True)

Ans: A

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04 **Statement I:**

$$(\cos p - 1)x^2 + \cos p\, x + \sin p = 0$$
$$\therefore \Delta \geq 0$$
$$\Rightarrow \cos^2 p - 4(\cos p - 1)(\sin p) \geq 0$$

clearly, $\cos^2 p \geq 0$, $-1 \leq \cos p \leq 1$
$\Rightarrow \cos p - 1 \leq 0$

i.e. $\cos^2 p$ is positive, $\cos p - 1$ is negative

$$\Rightarrow \underbrace{\cos^2 p}_{\text{positive}} - 4\underbrace{(\cos p - 1)}_{\text{Negative}}\sin p \geq 0$$

$\Rightarrow$ positie Negative

$\Rightarrow \sin p \geq 0$

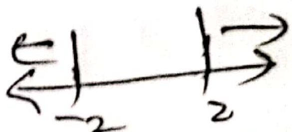
$\Rightarrow$ p lies in Either I or II quadrants

$\Rightarrow p \in [0, \pi]$

$\Rightarrow p \in (0, \frac{\pi}{2})$ (True)

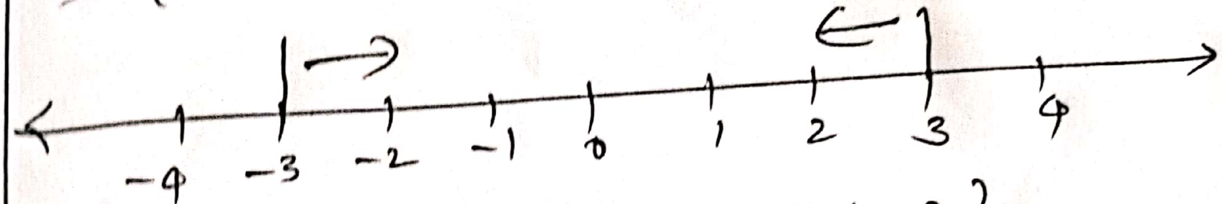
Statement II: Conceptual (False)

Ans: C

05.	**Assertion:** $y = x^2 + 4x + 7$ $a = 1 > 0$ $\therefore$ y has minimum value (True) **Reason:** Conceptual (True)	Ans: A
06	**Assertion:** $x^2 - 6x + 9 = 0$ (True) **Reason:** Conceptual (True)	Ans: A
07.	$y = -2x^2 + 8x - 5$ x-Coordinate $= x = \frac{-b}{2a} = \frac{-8}{2(-2)} = 2$	Ans: A
$\boxed{08}$.	Max. value $= \frac{4ac - b^2}{4a}$ $= \frac{4 \cdot (-2)(-5) - 8^2}{4(-2)} = 3$	$\boxed{\text{Ans: B}}$
09	$-x^2 + 5x + 24 > 0$ $\Rightarrow x^2 - 5x - 24 < 0$ $\Rightarrow (x-8)(x+3) < 0$ $\Rightarrow -3 < x < 8$	Ans: C
10.	$x \leq -2$ or $x \geq 2$ $\Rightarrow x + 2 \leq 0$ or $x - 2 \geq 0$ $\Rightarrow x^2 - 4 \geq 0$ 	Ans. B

11. $x^2 - 9 < 0$

$\Rightarrow (x+3)(x-3) < 0$



Integer value $= \{-2, -1, 0, 1, 2\}$

No. of integer value $= 5$ Ans: 5

12. $(x+2)(x-3) = 0$

$\Rightarrow x^2 - x - 6 = 0$

min. value $= \dfrac{4(1)(-6) - (-1)^2}{4.1}$

$\therefore \alpha = \dfrac{-25}{4}$ Ans: 0

$\Rightarrow 4\alpha + 25 = 0$

13 a) $y = -x^2 + 6x - 5$

max. value $= \dfrac{4(-1)(-5) - 6^2}{4(-1)} = 4$ (p)

b) $y = x^2 - 2x + 3$

min value $= \dfrac{4.1.3 - (-2)^2}{4.1} = 2$ (q)

c) Vertex $\left(\dfrac{-b}{2a}, \dfrac{4ac - b^2}{4a}\right) = (-4, -4)$

d) Max. Value $= 2$ Ans: p, q, r, s

14 a) $-3 < x < 4$

$\Rightarrow (x+3)(x-4) < 0$

$\Rightarrow x^2 - x - 12 < 0$ (P)

b) $x < -3$, $x > 4$

$\Rightarrow (x+3)(x-4) > 0$

$\Rightarrow x^2 - x - 12 > 0$

c) $-4 < x < -3$

$\Rightarrow (x+4)(x+3) < 0$

$\Rightarrow x^2 + 7x + 12 < 0$

d) $x < -4$ or $x > -3$

$\Rightarrow (x+4)(x+3) > 0$

$\Rightarrow x^2 + 7x + 12 > 0$

Ans: P, Q, R, S

$\Longrightarrow$ THE END $\Longleftarrow$