JEE MAIN ANSWER KEY & SOLUTIONS

SUBJECT :- MATHEMATICS
CLASS :- 11th **PAPER CODE :- CWT-2**
CHAPTER :- BASIC MATHS

ANSWER KEY

1.	(A)	**2.**	(D)	**3.**	(D)	**4.**	(B)	**5.**	(D)	**6.**	(A)	**7.**	(B)
8.	(C)	**9.**	(D)	**10.**	(D)	**11.**	(C)	**12.**	(B)	**13.**	(B)	**14.**	(D)
15.	(A)	**16.**	(A)	**17.**	(A)	**18.**	(C)	**19.**	(B)	**20.**	(A)	**21.**	890
22.	25	**23.**	5	**24.**	1	**25.**	9	**26.**	1	**27.**	1	**28.**	4
29.	1	**30.**	7										

SOLUTIONS

1. (A)

Sol. Let |x| = y

$\left|\frac{3y-2}{y-1}\right| \geq 2 \Rightarrow (3y - 2)^2 \geq 4(y - 1)^2$ &

$y \neq 1$

$\Rightarrow 5y^2 - 4y \geq 0 \;\; \Rightarrow y \in (-\infty, 0] \cup \left[\frac{4}{5}, \infty\right)$

Hence $|x| \in \{0\} \;\cup \left[\frac{4}{5}, 1\right) \cup (1, \infty)$

Sox $\neq \pm 1$ if $x \in z \;\; \Rightarrow$ Product = –1

2. (D)

Sol. f(x) = |x – 2|, g(x) = |x – 3|

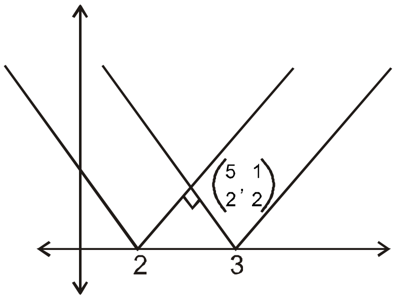
$f(x) = g(x) \quad \Rightarrow \quad |x-2|^2 = |x-3|^2$

$\Rightarrow \quad x^2 - 4x + 4 = x^2 - 6x + 9$

$\Rightarrow \quad x = \frac{5}{2}$

Hence A = 1

$h(x) = |x-2| + |x-3| \geq |(x-2) - (x-3)| = 1 \Rightarrow B = 1$



hence $C = \frac{1}{4}$

$|x-2| = 4 \quad \Rightarrow \quad x = 2 \pm 4$

$\Rightarrow \quad \alpha = -2$ and $\beta = 6$

$|x-3| = 4 \quad \Rightarrow \quad x = 3 \pm 4$

$\Rightarrow \quad \gamma = -1$ and $\delta = 7$

$\frac{\alpha^2+\beta^2+\gamma^2+\delta^2}{ABC} = 4(4 + 36 + 1 + 49) = 360$

Sum of digits = 9

3. (D)

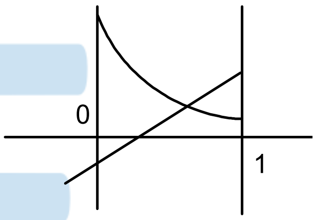
Sol. Let |x–1| = t

then $\log_3 t \log_4 t \;\; \log_5 t = \log_5 t + (\log_3 t \log_4 t)$

$\Rightarrow \frac{1}{\log_t 3 \log_t 5} = \frac{1}{\log_t 5} + \frac{1}{\log_t 3 \log_t 4}$

$\Rightarrow \log_t 5 + \log_t 3 \log_t 4 = 1$

$\Rightarrow 4\log_t 3 = \frac{t}{5} \;\; \Rightarrow 4^{\frac{\ell n^3}{\ell nt}} = \frac{t}{5} \qquad t \in (0,1)$



one solution between (0,1)

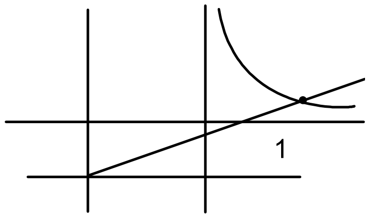
one solution is 1

t > 1

one solution is greater than 1

$\Rightarrow$ |x–1| has 3 positive sol.

$\Rightarrow$ x has 6 solution



4. (B)

Sol. $x^2 - 16 \geq 0$

$\therefore \quad (x-4)(x+4) \geq 0$

$\therefore \quad x \in (-\infty, -4] \cup [4, \infty)$ ....(1)

Now $\frac{(x^2+2)(\sqrt{x^2-16})}{(x^4+2)(x-3)(x+3)} \leq 0$

$x \in (-3, 3)$ ....(2)

By (1) and (2) $\quad x \in \{-4, 4\}$

5. (D)

Sol. For domain $21 - 4x - x^2 \geq 0$

$\Rightarrow x^2 + 4x - 21 \leq 0 \Rightarrow (x + 7)(x - 3) \leq 0$

$\Rightarrow \quad x \in [-7, 3]$

case-I : $-7 \leq x < -1$ then $1 - \sqrt{21 - 4x - x^2} - \leq 0$

$\Rightarrow 1 \leq \sqrt{21 - 4x - x^2} \Rightarrow x^2 + 4x - 20 \leq 0$

$\Rightarrow \quad (x + 2)^2 - 24 \leq 0$

$\Rightarrow \quad (x + 2 + 2\sqrt{6})(x + 2 - 2\sqrt{6}) \leq 0$

$\Rightarrow \quad x \in [-2 - 2\sqrt{6}, 2\sqrt{6} - 2]$

$\therefore \quad x \in [-2 - 2\sqrt{6}, -1)$

case-II : $-1 < x \leq 3$ then $1 \geq 21 - 4x - x^2$

$\Rightarrow \quad x^2 + 4x - 20 \geq 0$

$\Rightarrow \quad x \in (-\infty, -2 - 2\sqrt{6}] \cup [2\sqrt{6} - 2, \infty)$

$\therefore \quad x \in \left[2\sqrt{6} - 2, \ 3\right]$

$x \in \left[-2 \ -2\sqrt{6}, \ -1\right) \cup \left[2\sqrt{6} - 2, \ 3\right]$

6. (A)

Sol. $\frac{|x+2| - |x|}{\sqrt{4 - x^3}} \geq 0 \Rightarrow 4 - x^3 > 0 \Rightarrow x^3 - 4 < 0$

$\Rightarrow x < 4^{1/3}$ ...(i)

$\therefore \ |x + 2| - |x| \geq 0$

case-I : $x \leq -2$ then $-x - 2 + x \geq 0 \Rightarrow -2 \geq 0$ no solution

case-II: $-2 < x \leq 0$ then $x + 2 + x \geq 0$

$\Rightarrow \quad x + 1 \geq 0 \Rightarrow x \geq -1$

$\therefore \ x \in [-1, 0]$ ...(ii)

case-III : $x > 0$ then

$x + 2 - x \geq 0 \Rightarrow 2 \geq 0 \quad \therefore \ x \in R^+$ ...(iii)

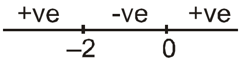
$\therefore$ (i) $\cap$ (ii) $\cap$ (iii) is $x \in [-1, 4^{1/3})$.

7. (B)

Sol. Domain $x > 0$

$\log^2{}_2x + 2\log_2x \geq 0$

$\log_2x(\log_2x + 2) \geq 0$



$\log_2x \leq -2$ or या $\log_2x \geq 0$

$0 < x \leq \frac{1}{4}$ or या $x \geq 1$

$x \in \left(0, \frac{1}{4}\right] \cup [1, \infty)$ ....(i)

Case-I $4 - \log_2x < 0$

positive <negative (false)

Case-II $4 - \log_2x \geq 0 \quad \Rightarrow \quad \log_2x \leq 4$

$\Rightarrow \quad \log_2{}^2x \ 2\log_2x < 2(4 - \log_2x)^2$

Let $\log_2x = t$

$t^2 + 2t < 2(4 - t)^2$

$t^2 - 18t + 32 > 0$

$(t - 16)(t - 2) > 0$

$\Rightarrow \quad t < 2 \cup t > 16$

$\log_2x < 2 \cup \log_2x > 16$ (Rejected)

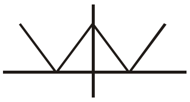
$\log_2x < 2 \qquad x < 4$ ....(ii)

by (i) and (ii)

$x \in \left(0, \frac{1}{4}\right] \cup [1, 4)$

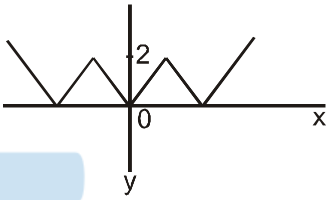
8. (C)

Sol. $f_1(x) = ||x| - 2|$



$f_1(x) = 2 \rightarrow 3$ solution हल

$f_2(x) = |||x| - 2| - 2|$



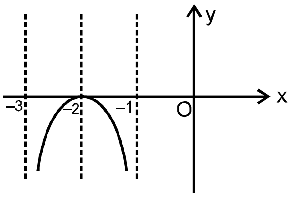
$f_2(x) = 2 \rightarrow 4$ solution

$f_n(x) = |f_{n-1}(x) - 2|$ have n + 2 solution हल

$f_{2015}(x) = 2$ have 2017 solutions हल

9. (D)

Sol. $g(x) = \ell n(f(x))$ domain is $(-3, -1)$ range is $(-\infty, 0]$ graph of $y = g(x)$ is



$\therefore$ graph of $y = g(-|x|)$ is as shown in option (D)

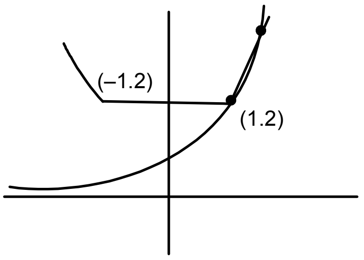
10. (D)

Sol. $||x - a| - b| = c \Rightarrow |x - a| = b + c, b - c$

for four solutions $b > c > 0$.

11. (C)

Sol.



$\Rightarrow$ Two solutions

12. (B)

Sol. $3^{|x+1|} - 2.3^x = 2.|3^x - 1| + 1$

critical points are x = –1, $3^x - 1 = 0$

⇒ x = 0

Case-I : x < –1

$3^{-(x+1)} - 2.3^x = -2(3^x - 1) + 1$

⇒ $\frac{3^{-x}}{3} - 2.3^x = -2.3^x + 2 + 1$

$3^{-x} = 9 \Rightarrow x = -2$

Case-II $-1 \le x < 0$

$3^{(x+1)} - 2.3^x = -2(3^x - 1) + 1$

⇒ $3^x = 1 \Rightarrow x = 0$

Not in solution.

Case-III : $x \ge 0$

$3^{x+1} - 2.3^x = 2.3^x - 2 + 1 \Rightarrow x = 0$

so x = 0, 2 satisfy the equation.

$3^{|x+1|} - 2.3^x = 2.|3^x - 1| + 1$

Not in solution

13. (B)

Sol. $|f(x)| = f(x)\ \forall x \Rightarrow f(x) \ge 0 \Rightarrow x^2 + 6x + p \ge 0\ \forall x \in p \Rightarrow D \le 0$

⇒ $4(9 - p) \le 0$

Hence $p \ge 9 \Rightarrow p_{min} = 11$ (as p is prime)

14. (D)

Sol. Let $|\log_{10}x| = y$

$y^2 - 4y + 3 = 0 \Rightarrow y = 1, 3 \Rightarrow \log_{10}x = \pm1, \pm3 \Rightarrow x = 10, \frac{1}{10}, 10^3, \frac{1}{10^3}$ Hence product = 1

15. (A)

Sol. $||x - 1| + a| = 4$

$|x - 1| = -a + 4, -a - 4$

For this equation to have solutions $-a + 4 \ge 0 \Rightarrow a \le 4$

16. (A)

Sol. $|2x + 3| + |2x - 3| = 4x + 6$

Case-I : $x \ge \frac{3}{2} \Rightarrow 2x + 3 + 2x - 3 = 4x + 6 \Rightarrow$ No solution

Case-II : $-\frac{3}{2} \le x \le \frac{3}{2} \Rightarrow 2x + 3 + 3 - 2x = 4x + 6 \Rightarrow x = 0$

Case-III : $x \le -\frac{3}{2} \Rightarrow -2x - 3 - 2x + 3 = 4x + 6 \Rightarrow$ No solution

17. (A)

Sol. $\log_3 \frac{|x^2 - 4x| + 3}{x^2 + |x - 5|} \ge 0$

⇒ $|x^2 - 4x| + 3 \ge x^2 + |x - 5|$

Case-I $x \ge 5$ $x^2 - 4x + 3 \ge x^2 + x - 5$

⇒ $-5x + 8 \ge 0$

⇒ $x \le \frac{8}{5}$ (No solution)

Case-II $x \in (-\infty, 0] \cup [4, 5]$

$x^2 - 4x + 3 \ge x^2 + x - 5$

⇒ $-3x \ge 2$

⇒ $x \le \frac{-2}{3}$

Case-III $x \in [0, 4]$

$4x - x^2 + 3 \ge x^2 - x + 5$

⇒ $2x^2 - 5x + 2 \le 0 \Rightarrow x \in \left[\frac{1}{2}, 2\right]$

18. (C)

Sol. $|x + 2| + y = 5$ for $x < -2$

we get $-x + y = 7$ ...(1)

& for $x \ge -2$

we get $x + y = 3$ ...(2)

$x - |y| = 1$ for $y < 0$

we get $x + y = 1$ ...(3)

& for $y \ge 0$

we get $x - y = 1$ ...(4)

solving (2) & (4)

x = 2 & y = 1

19. (B)

Sol. $|x - 1|^A = (x - 1)^7$

case (i) $x - 1 = 1 \Rightarrow x = 2$

case (ii) $\log_3 x^2 - 2\log_x 9 = 7$

⇒ $2\log_3 x - 4\log_x 3 = 7$

let $\log_3 x = y$

∴ $2y - \frac{4}{y} = 7$

⇒ $2y^2 - 7y - 4 = 0 \Rightarrow (2y + 1)(y - 4) = 0$

⇒ $y = -\frac{1}{2}$ & $y = 4$

⇒ $\log_3 x = -\frac{1}{2}$ ⇒ $\log_3 x = 4$

$x = 3^{-1/2}$ ⇒ $x = 81$

$\frac{1}{\sqrt{3}} =$ for $x = \frac{1}{\sqrt{3}}$ $x - 1 < 0$

∴ not acceptable

∴ x = 2 or 81.

20. (A)

Sol. $\left|\log_{\sqrt{3}} x - 2\right| - \left|\log_3 x - 2\right| = 2$

$\Rightarrow$ $|2\log_3 x - 2| - |\log_3 x - 2| = 2$

case I If $\log_3 x - 2 \ge 0$ $\Rightarrow$ $\log_3 x \ge 2$

Then $2\log_3 x - 2 - \log_3 x + 2 = 2$

$\Rightarrow$ $\log_3 x = 2$

$\therefore$ $\log_3 x = 2$

$\Rightarrow$ $x = 3^2 = 9$ $\Rightarrow$ $x = 9$

case II $1 \le \log_3 x < 2$

$\therefore$ $2\log_3 x - 2 + \log_3 x - 2 = 2$

$\Rightarrow$ $3\log_3 x = 6$ $\Rightarrow$ $\log_3 x = 2$

which is not possible

case III If $\log_3 x < 1$ the $-2\log_3 x + 2 + \log_3 x - 2 = 2$

$-\log_3 x = 2$ $\Rightarrow$ $\log_3 x = -2$

$\therefore$ $x = 3^{-2} = \dfrac{1}{9}$ $\Rightarrow$ $x = 9, \dfrac{1}{9}$

21. 890

Sol. $81^{(1/\log_5 3)} + 27^{\log_9 36} + 3^{4/\log_7 9}$

$= 3^{4\log_3 5} + 3^{3.\frac{1}{2}\log_3 36} + 3^{4\log_9 7}$

$= 3^{\log_3 5^4} + 3^{\log_3 36^{3/2}} + 3^{\log_3 7^{4/2}}$

$= 5^4 + 36^{3/2} + 7^2 = 890$.

22. 25

Sol. $\log_5 a.\log_a x = 2 \Rightarrow \log_5 x = 2 \Rightarrow x = 5^2 = 25$

23. 5

Sol. $A = \log_2 \log_2 \log_4 256 + 2\log_{2^{1/2}} 2$

$= \log_2 \log_2 \log_4 4^4 + 2 \times \dfrac{1}{(1/2)} \log_2 2$

$= \log_2 \log_2 4 + 4 = \log_2 \log_2 2^2 + 4$

$= \log_2 2 + 4 = 1 + 4 = 5$.

24. 1

Sol. $a^x = b \Rightarrow x\log a = \log b$

$\Rightarrow x = \dfrac{\log b}{\log a} = \log_a b$

Similarly $y = \log_b c, z = \log_c a$

$\therefore xyz = \log_a b.\log_b c.\log_c a = 1$

25. 9

Sol. $y = 3^{12} \times 2^8 \Rightarrow \log_{10} y = 12\log_{10} 3 + 8\log_{10} 2$

$= 12 \times 0.47712 + 8 \times 0.30103$

$= 5.72544 + 2.40824 = 8.13368$

$\therefore$ Number of digits in y = 8 + 1 = 9.

26. 1

Sol. $[\log_b a.\log_c a - \log_a a] + [\log_a b.\log_c b - \log_b b]$

$+[\log_a c\log_b c - \log_c c] = 0$

$\Rightarrow [(\ln a)^3 + (\ln b)^3 + (\ln c)^3]\dfrac{1}{\ln a.\ln b.\ln c} - 3 = 0$

$\Rightarrow \dfrac{1}{\ln a.\ln b.\ln c}[(\ln a)^3 + (\ln b)^3 + (\ln c)^3 - 3\ln a.\ln b.\ln c] = 0$

$\Rightarrow (\ln a)^3 + (\ln b)^3 + (\ln c)^3 - 3\ln a.\ln b.\ln c = 0$

$\Rightarrow \ln a + \ln b + \ln c = 0$

$\Rightarrow \ln(abc)$ = ln 1, $[a^3 + b^3 + c^3 - 3abc = 0$

$\Rightarrow a + b + c = 0]$, $\therefore abc = 1$.

27. 1

Sol. Let $\log_{16} x = y \Rightarrow y^2 - y + \log_{16} k = 0$

This quadratic equation will have exactly one solution if its discriminant vanishes.

$\therefore (-1)^2 - 4.1.\log_{16} k = 0 \Rightarrow 1 = \log_{16} k^4$

$\Rightarrow k^4 = 16 \Rightarrow k^2 = 4 \Rightarrow k = \pm 2$.

But $\log_{16} k$ is not defined $k < 0$, $\therefore k = 2$.

$\therefore$ Number of real values of $k = 1$.

28. 4

Sol. $\left(\dfrac{2}{3}\right)^{x+2} = \left(\dfrac{3}{2}\right)^{2-2x} \Rightarrow \left(\dfrac{2}{3}\right)^{x+2} = \left(\dfrac{2}{3}\right)^{2x-2}$.

Clearly $x + 2 = 2x - 2 \Rightarrow x = 4$

29. 1

Sol. $x^y = y^x \Rightarrow (x^y)^{1/x} = y$

Now, $\left(\dfrac{x}{y}\right)^{x/y} = \left(\dfrac{x}{x^{y/x}}\right)^{x/y} = \left(x^{1-\frac{y}{x}}\right)^{x/y}$

$= x^{(x/y)-1} = x^{(x/y)-k} \Rightarrow k = 1$.

30. 7

Sol. Putting $x = 1$, remainder = 7