PPSC / FPSC MATHEMATICS

50 SOLVED MCQs - Toughest Level - Fully Explained

Algebra | Calculus | Geometry | Trigonometry | Statistics | Matrices | Sequences

Instructions:

(1) Each question carries equal marks. No negative marking.
(2) Correct answers are highlighted in GREEN with a tick mark.
(3) Step-by-step explanation is given below each question.

ALGEBRA

1. If $\log_2(x) + \log_2(x - 2) = 3$, then x equals:

[CORRECT] A) 4
[ ] B) 6
[ ] C) 3 + sqrt(17)
[ ] D) 2 + sqrt(6)

Explanation: *Product rule: $\log_2[x(x-2)] = 3 \Rightarrow x(x-2) = 8 \Rightarrow x^2 - 2x - 8 = 0 \Rightarrow (x-4)(x+2) = 0$. Since $x > 2$, $x = 4$.*

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2. Sum of roots of $2x^2 - 5x + 3 = 0$ is:

[CORRECT] A) 5/2
[ ] B) 3/2
[ ] C) -5/2
[ ] D) 5/3

Explanation: *Vieta's formula: sum of roots = -b/a = -(-5)/2 = 5/2.*

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3. If A = {1,2,3,4} and B = {3,4,5,6}, then |A union B| equals:

[ ] A) 4
[CORRECT] B) 6
[ ] C) 8
[ ] D) 2

Explanation: *A union B = {1, 2, 3, 4, 5, 6} => |A union B| = 6.*

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4. The value of i^{47} (where i = sqrt(-1)) is:

[ ] A) i
[CORRECT] B) -i
[ ] C) 1
[ ] D) -1

Explanation: *47 = 4x11 + 3, so $i^{47} = i^3 = -i$. (Powers of i cycle every 4.)*

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5. If $f(x) = 3x^2 - 2x + 1$, then f(-1) equals:

[CORRECT] A) 6
[ ] B) 4
[ ] C) 2
[ ] D) 0

Explanation: *f(-1) = 3(1) - 2(-1) + 1 = 3 + 2 + 1 = 6.*

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6. The number of terms in the expansion of $(a + b)^{10}$ is:

[ ] A) 10
[CORRECT] B) 11
[ ] C) 9
[ ] D) 12

Explanation: *Number of terms = n + 1 = 10 + 1 = 11.*

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7. If $3^x = 81$, then x is:

[ ] A) 2
[ ] B) 3
[CORRECT] C) 4
[ ] D) 5

Explanation: *$81 = 3^4$, so $3^x = 3^4 \Rightarrow x = 4$.*

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8. Remainder when $x^3 - 3x^2 + 3x - 1$ is divided by (x - 1) is:

[ ] A) 1
[CORRECT] B) 0
[ ] C) -1
[ ] D) 2

Explanation: *Remainder theorem: f(1) = 1 - 3 + 3 - 1 = 0.*

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9. Arithmetic mean of 5, 8, 11, 14, 17 is:

[ ] A) 10
[CORRECT] B) 11
[ ] C) 12
[ ] D) 13

Explanation: *Sum = 55, n = 5. Mean = 55 / 5 = 11.*

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10. The H.C.F. of 36, 48, and 60 is:

[ ] A) 6
[CORRECT] B) 12
[ ] C) 18
[ ] D) 24

Explanation: *36 = $2^2 \times 3^2$, 48 = $2^4 \times 3$, 60 = $2^2 \times 3 \times 5$. HCF = $2^2 \times 3 = 12$.*

CALCULUS

11. Derivative of $\sin(x^2)$ with respect to x is:

[ ] A) $\cos(x^2)$
[CORRECT] B) $2x \cos(x^2)$
[ ] C) $2 \cos(x^2)$
[ ] D) $x \cos(x^2)$

Explanation: *Chain rule: $d/dx [\sin(x^2)] = \cos(x^2) \times 2x = 2x \cos(x^2)$.*

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12. Integral of $(3x^2 + 2x - 1)\, dx$ equals:

[CORRECT] A) $x^3 + x^2 - x + C$
[ ] B) $6x + 2 + C$
[ ] C) $3x^3 + x^2 + C$
[ ] D) $x^3 + x + C$

Explanation: *Integrate term by term: $x^3 + x^2 - x + C$.*

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13. lim (x->0) [sin(x) / x] equals:

[ ] A) 0
[ ] B) Infinity
[CORRECT] C) 1
[ ] D) -1

Explanation: *Standard limit result: lim(x->0) sin(x)/x = 1.*

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14. Maximum value of f(x) = $-x^2 + 4x - 3$ is:

[CORRECT] A) 1

[ ] B) 2

[ ] C) 3

[ ] D) 4

Explanation: *f'(x) = -2x + 4 = 0 => x = 2. f(2) = -4 + 8 - 3 = 1. f''(2) < 0 (maximum confirmed).*

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15. Definite integral of x^2 from 0 to 1 equals:

[ ] A) 1/4

[CORRECT] B) 1/3

[ ] C) 1/2

[ ] D) 1

Explanation: *[$x^3/3$] from 0 to 1 = 1/3 - 0 = 1/3.*

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16. Gradient of curve $y = x^3 - 3x$ at x = 2 is:

[ ] A) 6

[CORRECT] B) 9

[ ] C) 12

[ ] D) 3

Explanation: *dy/dx = $3x^2$ - 3. At x = 2: 3(4) - 3 = 12 - 3 = 9.*

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17. Second derivative of $y = e^{2x}$ is:

[ ] A) $2e^{2x}$

[CORRECT] B) $4e^{2x}$

[ ] C) e^{2x}

[ ] D) $2x\ e^{2x}$

Explanation: *y' = $2e^{2x}$, y'' = $4e^{2x}$.*

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18. lim (x->infinity) [$(3x^2 + 2) / (x^2 - 5)$] equals:

[ ] A) 0

[ ] B) Infinity

[CORRECT] C) 3

[ ] D) -3

Explanation: *Divide by x^2: $(3 + 2/x^2) / (1 - 5/x^2)$ -> 3/1 = 3 as x -> infinity.*

GEOMETRY & TRIGONOMETRY

19. Area of a circle with diameter 14 cm (pi = 22/7) is:

[CORRECT] A) 154 cm^2
[ ] B) 44 cm^2
[ ] C) 308 cm^2
[ ] D) 616 cm^2

Explanation: *r = 7. Area = pi x r^2 = (22/7) x 49 = 154 cm^2.*

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20. In a right triangle, if one acute angle is 30 degrees, the ratio opposite/hypotenuse is:

[ ] A) sqrt(3)/2
[CORRECT] B) 1/2
[ ] C) 1/sqrt(2)
[ ] D) sqrt(3)

Explanation: *sin(30 deg) = opposite / hypotenuse = 1/2.*

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21. $\cos^2$(45 deg) + $\sin^2$(45 deg) equals:

[ ] A) 0
[ ] B) 1/2
[ ] C) sqrt(2)
[CORRECT] D) 1

Explanation: *Pythagorean identity: $\sin^2$(theta) + $\cos^2$(theta) = 1 for all values of theta.*

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22. Circumference of a circle whose area is 25 pi is:

[ ] A) 5 pi
[CORRECT] B) 10 pi
[ ] C) 25 pi
[ ] D) 50 pi

Explanation: *pi x r^2 = 25 pi => r = 5. Circumference = 2 pi r = 10 pi.*

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23. tan(60 deg) equals:

[ ] A) 1/sqrt(3)
[ ] B) sqrt(3)/2
[CORRECT] C) sqrt(3)
[ ] D) 1

Explanation: *tan(60) = sin(60)/cos(60) = (sqrt(3)/2) / (1/2) = sqrt(3).*

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24. Slope of a line perpendicular to y = 3x - 5 is:

[ ] A) 3
[CORRECT] B) -1/3
[ ] C) 1/3
[ ] D) -3

Explanation: *Slope of given line = 3. Perpendicular slope = -1/m = -1/3.*

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25. Diagonal of a square with side 6 cm is:

[CORRECT] A) 6 sqrt(2) cm
[ ] B) 12 cm
[ ] C) 6 cm
[ ] D) 3 sqrt(2) cm

Explanation: *Diagonal = a x sqrt(2) = 6 sqrt(2) cm. (By Pythagoras on half the square.)*

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26. A triangle has sides 5, 12, and 13. The triangle is:

[ ] A) Acute
[ ] B) Obtuse
[CORRECT] C) Right-angled
[ ] D) Equilateral

Explanation: *$5^2 + 12^2 = 25 + 144 = 169 = 13^2$. Satisfies Pythagoras => Right-angled.*

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27. $\sec^2(\theta) - \tan^2(\theta)$ equals:

[ ] A) 0
[ ] B) 2
[ ] C) $\sin^2(\theta)$
[CORRECT] D) 1

Explanation: *Trigonometric identity: $1 + \tan^2(\theta) = \sec^2(\theta) \Rightarrow \sec^2(\theta) - \tan^2(\theta) = 1$.*

NUMBER THEORY & ARITHMETIC

28. The L.C.M. of 12 and 18 is:

[ ] A) 6
[CORRECT] B) 36
[ ] C) 54
[ ] D) 72

Explanation: *$12 = 2^2 \times 3$, $18 = 2 \times 3^2$. LCM = $2^2 \times 3^2 = 36$.*

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29. What is 15% of 240?

[ ] A) 30
[CORRECT] B) 36
[ ] C) 40
[ ] D) 24

Explanation: *15/100 x 240 = 0.15 x 240 = 36.*

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30. If a : b = 3 : 4 and b : c = 8 : 9, then a : c equals:

[CORRECT] A) 2:3
[ ] B) 3:9
[ ] C) 1:3
[ ] D) 2:5

Explanation: *Make b common. a:b = 6:8, b:c = 8:9. So a:b:c = 6:8:9. a:c = 6:9 = 2:3.*

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31. A shopkeeper sells for Rs. 480 at 20% profit. Cost price is:

[CORRECT] A) Rs. 400
[ ] B) Rs. 380
[ ] C) Rs. 420
[ ] D) Rs. 360

Explanation: *CP = SP x 100/(100 + profit%) = 480 x 100/120 = Rs. 400.*

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32. Simple Interest on Rs. 5000 at 8% per annum for 3 years is:

[ ] A) Rs. 1000
[CORRECT] B) Rs. 1200
[ ] C) Rs. 1500
[ ] D) Rs. 2400

Explanation: *SI = P x R x T / 100 = 5000 x 8 x 3 / 100 = Rs. 1200.*

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33. If average of 6 numbers is 42, their sum is:

[ ] A) 240
[CORRECT] B) 252
[ ] C) 262
[ ] D) 246

Explanation: *Sum = Average x n = 42 x 6 = 252.*

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34. Square root of 0.0016 is:

[ ] A) 0.4
[CORRECT] B) 0.04
[ ] C) 0.004
[ ] D) 0.16

Explanation: *sqrt(0.0016) = sqrt(16/10000) = 4/100 = 0.04.*

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35. Two pipes fill a tank in 10 and 15 hours. Together they fill it in:

[ ] A) 5 hrs
[CORRECT] B) 6 hrs
[ ] C) 8 hrs
[ ] D) 12 hrs

Explanation: *Combined rate = 1/10 + 1/15 = 3/30 + 2/30 = 5/30 = 1/6. Time = 6 hrs.*

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36. A train travels 360 km in 4 hours. Its speed in m/s is:

[ ] A) 90 m/s
[ ] B) 100 m/s
[CORRECT] C) 25 m/s
[ ] D) 40 m/s

Explanation: *Speed = 360/4 = 90 km/h. Convert: 90 x 1000/3600 = 25 m/s.*

MATRICES & DETERMINANTS

37. Determinant of [[3, 2], [1, 4]] is:

[CORRECT] A) 10
[ ] B) 14
[ ] C) 12
[ ] D) 8

Explanation: *det = (3 x 4) - (2 x 1) = 12 - 2 = 10.*

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38. If A is 3x4 and B is 4x2, then AB has dimensions:

[ ] A) 4x3
[CORRECT] B) 3x2
[ ] C) 4x2
[ ] D) 3x4

Explanation: *(3x4) x (4x2) = 3x2. Inner dimensions (4,4) must match; result uses outer (3,2).*

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39. A square matrix A is called singular if:

[ ] A) det(A) is not equal to 0
[CORRECT] B) det(A) = 0
[ ] C) A = A-transpose
[ ] D) A = A-inverse

Explanation: *A matrix is singular when its determinant equals zero (no inverse exists).*

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40. Trace of matrix [[5, 3], [2, 7]] is:

[ ] A) 10
[CORRECT] B) 12
[ ] C) 14
[ ] D) 8

Explanation: *Trace = sum of main diagonal elements = 5 + 7 = 12.*

STATISTICS & PROBABILITY

41. Median of {3, 5, 7, 9, 11, 13, 15} is:

[ ] A) 7
[CORRECT] B) 9
[ ] C) 11
[ ] D) 8

Explanation: *7 values in ascending order. Middle (4th) value = 9.*

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42. Probability of getting a head on tossing a fair coin is:

[ ] A) 0
[ ] B) 1/4
[ ] C) 1/3
[CORRECT] D) 1/2

Explanation: *P(Head) = favourable outcomes / total outcomes = 1/2.*

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43. Standard deviation is the square root of:

[ ] A) Mean
[CORRECT] B) Variance
[ ] C) Median
[ ] D) Range

Explanation: *By definition, Standard Deviation (sigma) = sqrt(Variance).*

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44. Two dice are rolled. Probability that sum is 7 is:

[CORRECT] A) 1/6
[ ] B) 7/36
[ ] C) 1/12
[ ] D) 5/36

Explanation: *Favourable pairs: (1,6),(2,5),(3,4),(4,3),(5,2),(6,1) = 6. P = 6/36 = 1/6.*

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45. Mode of {2, 3, 3, 5, 6, 6, 6, 8} is:

[ ] A) 3
[ ] B) 5
[CORRECT] C) 6
[ ] D) 8

Explanation: *6 appears 3 times (most frequent). Mode = 6.*

SEQUENCES & SERIES

46. 10th term of A.P. 3, 7, 11, 15, ... is:

[CORRECT] A) 39
[ ] B) 41
[ ] C) 43
[ ] D) 45

Explanation: *a = 3, d = 4. T(10) = a + (n-1)d = 3 + 9 x 4 = 3 + 36 = 39.*

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47. Sum of first 20 natural numbers is:

[ ] A) 190
[ ] B) 200
[CORRECT] C) 210
[ ] D) 220

Explanation: *S = n(n+1)/2 = 20 x 21 / 2 = 210.*

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48. In a G.P., first term = 2, common ratio = 3. The 4th term is:

[CORRECT] A) 54
[ ] B) 18
[ ] C) 27
[ ] D) 81

Explanation: *$T(4) = a \times r^3 = 2 \times 3^3 = 2 \times 27 = 54$.*

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49. Sum of infinite G.P. with first term 1 and common ratio 1/3 is:

[ ] A) 2/3
[CORRECT] B) 3/2
[ ] C) 3
[ ] D) 4/3

Explanation: *S(inf) = a / (1 - r) = 1 / (1 - 1/3) = 1 / (2/3) = 3/2.*

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50. 5th term of an A.P. is 17 and 9th term is 33. Common difference is:

[ ] A) 2
[ ] B) 3
[CORRECT] C) 4
[ ] D) 5

Explanation: *T(9) - T(5) = 4d => 33 - 17 = 4d => 16 = 4d => d = 4.*

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