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SET 02

# MATHS MASTERY

## 100 Solved MCQs

- ✔ Correct answer ticked & highlighted
- ✔ Clear step-by-step solutions
- ✔ 10 fresh topics, 10 MCQs each

# Hello, Mathlete!

Here are **100 brand-new Mathematics MCQs**, one per page, each with a full solution.

## How to use this set

**1.** Read the question and pick your answer.
**2.** The **green pill with ✓** shows the right option.
**3.** Study the orange **Solution** box to learn the method.
**4.** Check the answer key at the end.

## Topics inside


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# 01 Word Problems & Number Theory

Questions 1 – 10

## Focus areas

Profit, work, ages, mixtures, remainders, unit digits and compound interest.

## 1 Question

Word Problems

**A shopkeeper buys an item for Rs. 400 and sells it for Rs. 500. What is his profit percentage?**

A 20%

B 15%

C 30%

D **25%** ✔

## Solution

**✔ Correct Answer: D) 25%**

Profit = SP − CP = 500 − 400 = Rs. 100. Profit % = (Profit ÷ CP) × 100 = (100 ÷ 400) × 100 = 25%. Always divide by the cost price, not the selling price.

## 2 Question

Word Problems

**A can finish a job in 12 days and B can finish it in 6 days. In how many days will they finish it together?**

A 3 days

B 6 days

C 9 days

D **4 days** ✔

## Solution

**✔ Correct Answer: D) 4 days**

A does 1/12 of the job per day and B does 1/6 = 2/12. Together they do 1/12 + 2/12 = 3/12 = 1/4 of the job per day, so the whole job takes 4 days.

## 3 Question

Word Problems

**A father is 3 times as old as his son. After 12 years he will be twice as old as his son. What is the son's present age?**

A 10 years

B 14 years

C 16 years

D **12 years** ✔

## Solution

**✔ Correct Answer: D) 12 years**

Let the son be s, so the father is 3s. After 12 years: 3s + 12 = 2(s + 12) = 2s + 24, giving s = 12. Check: now 36 and 12; later 48 and 24, and 48 = 2 × 24 ✔.

## 4 Question

Word Problems

**What is the remainder when $2^{10}$ is divided by 7?**

- **A** 2 ✔
- **B** 1
- **C** 4
- **D** 3

## Solution

**✔ Correct Answer: A) 2**

Powers of 2 leave remainders 2, 4, 1, 2, 4, 1 ... when divided by 7 (period 3). Since $10 = 3 \times 3 + 1$, the remainder equals that of $2^1$, which is 2. Check: $1024 = 7 \times 146 + 2$.

## 5 Question

Word Problems

**What is the unit digit of $7^{23}$?**

A 1

B 7

C 9

D 3 ✔

## Solution

**✔ Correct Answer: D) 3**

Unit digits of powers of 7 repeat every 4 steps: 7, 9, 3, 1. Since $23 = 4 \times 5 + 3$, the unit digit of $7^{23}$ matches that of $7^3 = 343$, which is 3.

## 6 Question

Word Problems

**A 40 litre mixture has milk and water in the ratio 3 : 1. How much water must be added to make the ratio 1 : 1?**

A 10 litres

B 15 litres

C 25 litres

D **20 litres** ✔

## Solution

✔ **Correct Answer: D) 20 litres**

In 40 L, milk = 30 L and water = 10 L. For a 1 : 1 ratio the water must also be 30 L. Water to add = 30 − 10 = 20 litres.

## 7 Question

Word Problems

**Which of the following numbers is divisible by 9?**

- **A** 4527 ✔
- **B** 4532
- **C** 4521
- **D** 4538

## Solution

**✔ Correct Answer: A) 4527**

A number is divisible by 9 when its digit sum is a multiple of 9. For 4527: 4 + 5 + 2 + 7 = 18 ✔. The digit sums of the others are 12, 14 and 20, so they fail.

## 8 Question

Word Problems

**Find the compound interest on Rs. 10,000 at 10% per annum for 2 years.**

A Rs. 2000

B Rs. 1900

C Rs. 2200

D **Rs. 2100** ✔

## Solution

**✔ Correct Answer: D) Rs. 2100**

Amount = $10000 \times (1.1)^2 = 10000 \times 1.21 = Rs.\ 12,100$. Compound interest = 12,100 − 10,000 = Rs. 2100. (Rs. 2000 would be the simple interest.)

## 9 Question

Word Problems

**A car travels to a city at 60 km/h and returns along the same road at 40 km/h. What is its average speed for the whole trip?**

A 50 km/h

B 52 km/h

C 45 km/h

D **48 km/h** ✔

## Solution

**✔ Correct Answer: D) 48 km/h**

For equal distances, average speed = 2ab/(a + b) = 2 × 60 × 40 / 100 = 48 km/h. It is not 50 because more time is spent travelling at the slower speed.

## 10 Question

Word Problems

**How many zeros are at the end of 25! ?**

- **A** 6 ✔
- **B** 5
- **C** 7
- **D** 4

## Solution

**✔ Correct Answer: A) 6**

Trailing zeros come from pairs of factors 2 and 5, and 5s are scarcer. Count them: ⌊25/5⌋ + ⌊25/25⌋ = 5 + 1 = 6 zeros.

# 02 Functions & Relations

Questions 11 – 20

## Focus areas

Evaluating, composing and inverting functions; domain, range and symmetry.

## 11 Question

Functions

**If f(x) = 2x + 3, find f(4).**

A 8

B 9

C 14

D **11** ✔

## Solution

✔ **Correct Answer: D) 11**

Replace x by 4: f(4) = 2(4) + 3 = 8 + 3 = 11.

## 12 Question

Functions

**If $f(x) = x^2 - 1$, find $f(-3)$.**

- **A** 8 ✔
- **B** 10
- **C** −10
- **D** −8

## Solution

**✔ Correct Answer: A) 8**

$f(-3) = (-3)^2 - 1 = 9 - 1 = 8$. A negative number squared is positive, so the answer cannot be −10 or −8.

## 13 Question

Functions

**What is the domain of f(x) = √(x − 5)?**

A $x \leq 5$

B All real numbers

C $x > 0$

D **$x \geq 5$** ✔

## Solution

**✔ Correct Answer: D) $x \geq 5$**

A square root is real only if the quantity inside is non-negative: $x - 5 \geq 0$, so $x \geq 5$. For instance $x = 4$ would give $\sqrt{(-1)}$, which is not real.

## 14 Question

Functions

**What is the range of $f(x) = x^2$ for real x?**

- **A** $y \geq 0$ ✔
- **B** $y \leq 0$
- **C** All real numbers
- **D** $y > 1$

## Solution

**✔ Correct Answer: A) $y \geq 0$**

A square is never negative and f(0) = 0. Larger inputs give arbitrarily large outputs, so every value $y \geq 0$ is produced.

## 15 Question

Functions

If f(x) = 3x − 2 and g(x) = x + 1, find (f∘g)(2).

A 9

B 4

C 5

D 7 ✔

## Solution

✔ **Correct Answer: D) 7**

(f∘g)(2) means f(g(2)). First g(2) = 2 + 1 = 3. Then f(3) = 3(3) − 2 = 7.

## 16 Question

Functions

**Find the inverse of f(x) = 2x + 6.**

- **A** **(x − 6)/2** ✔
- **B** (x + 6)/2
- **C** 2x − 6
- **D** x/2 + 6

## Solution

**✔ Correct Answer: A) (x − 6)/2**

Write y = 2x + 6 and swap the letters: x = 2y + 6. Solving for y gives y = (x − 6)/2. Check: f((x − 6)/2) = (x − 6) + 6 = x ✔.

## 17 Question

Functions

**If f(x) = |x|, what is f(−7) + f(7)?**

A 0

B 7

C −14

D **14** ✔

## Solution

✔ **Correct Answer: D) 14**

|−7| = 7 and |7| = 7. The absolute value never gives a negative result, so the sum is 7 + 7 = 14.

## 18 Question

Functions

**Which of the following is an even function?**

A $x^3$

B $\sin x$

C $x^3 + x$

D $x^4$ ✔

## Solution

**✔ Correct Answer: D) $x^4$**

A function is even when $f(-x) = f(x)$. For $x^4$: $(-x)^4 = x^4$ ✔. The functions $x^3$, $\sin x$ and $x^3 + x$ are odd, since $f(-x) = -f(x)$.

## 19 Question

Functions

**Simplify $(x^2 - 4)/(x - 2)$ for $x \neq 2$.**

**A** $x + 2$ ✔

B $x - 2$

C $x^2 - 2$

D $x + 4$

## Solution

**✔ Correct Answer: A) x + 2**

Factorise the numerator: $x^2 - 4 = (x - 2)(x + 2)$. Cancelling the common factor $(x - 2)$, which is allowed because $x \neq 2$, leaves $x + 2$.

## 20 Question

Functions

**If $f(x) = x^2 + 2x$, find $f(x + 1) - f(x)$.**

A $2x + 1$

B $x + 3$

C $2x + 2$

D **$2x + 3$** ✔

## Solution

**✔ Correct Answer: D) $2x + 3$**

$f(x + 1) = (x + 1)^2 + 2(x + 1) = x^2 + 4x + 3$.

Subtracting $f(x) = x^2 + 2x$ leaves $2x + 3$.

# 03 Matrices & Determinants

Questions 21 – 30

## Focus areas

Order, addition, transpose, trace, determinant and inverse.

## 21 Question

Matrices

**A matrix has 3 rows and 4 columns. What is its order?**

- **A** **3 × 4** ✔
- **B** 4 × 3
- **C** 12
- **D** 7

## Solution

**✔ Correct Answer: A) 3 × 4**

Order is written as rows × columns, so this matrix is 3 × 4. It contains 3 × 4 = 12 elements.

## 22 Question

Matrices

**Find the determinant of the matrix [[2, 3], [1, 4]].**

- **A** 5 ✔
- **B** 11
- **C** 8
- **D** −5

## Solution

**✔ Correct Answer: A) 5**

For [[a, b], [c, d]] the determinant is ad − bc = (2)(4) − (3)(1) = 8 − 3 = 5.

## 23 Question

Matrices

**What is the transpose of [[1, 2], [3, 4]]?**

A [[1, 2], [3, 4]]

B [[4, 3], [2, 1]]

C [[2, 1], [4, 3]]

D **[[1, 3], [2, 4]]** ✔

## Solution

**✔ Correct Answer: D) [[1, 3], [2, 4]]**

The transpose swaps rows and columns. Row 1 (1, 2) becomes column 1 and row 2 (3, 4) becomes column 2, giving [[1, 3], [2, 4]].

## 24 Question

Matrices

**If A = [[1, 2], [3, 4]] and B = [[0, 1], [1, 0]], find A + B.**

- **A** [[1, 3], [4, 4]] ✔
- **B** [[1, 2], [4, 4]]
- **C** [[1, 3], [3, 4]]
- **D** [[0, 2], [3, 0]]

## Solution

**✔ Correct Answer: A) [[1, 3], [4, 4]]**

Add the matching elements: row 1 gives (1 + 0, 2 + 1) = (1, 3) and row 2 gives (3 + 1, 4 + 0) = (4, 4). So A + B = [[1, 3], [4, 4]].

## 25 Question

Matrices

**What is the trace of the matrix [[5, 1], [2, 7]]?**

- **A** 12 ✔
- **B** 14
- **C** 8
- **D** 35

## Solution

**✔ Correct Answer: A) 12**

The trace is the sum of the main-diagonal elements: 5 + 7 = 12. The off-diagonal elements 1 and 2 are not included.

## 26 Question

Matrices

**For a square matrix A and the identity matrix I of the same order, A × I equals:**

A The zero matrix

B **A** ✔

C I

D $A^T$

## Solution

**✔ Correct Answer: B) A**

The identity matrix acts like the number 1: A × I = I × A = A.

## 27 Question

Matrices

**Find the determinant of [[3, 0], [0, 5]].**

A 8

B 15 ✔

C 0

D 2

## Solution

**✔ Correct Answer: B) 15**

Using ad − bc: (3)(5) − (0)(0) = 15. For a diagonal matrix, the determinant is simply the product of the diagonal entries.

## 28 Question

Matrices

**A square matrix whose determinant is 0 is called:**

A Identity matrix

B Symmetric matrix

C Orthogonal matrix

D **Singular matrix** ✔

## Solution

**✔ Correct Answer: D) Singular matrix**

A matrix with determinant 0 is singular. The inverse formula divides by the determinant, so a singular matrix has no inverse.

## 29 Question

Matrices

**Find the product [1 2] × [[3], [4]].**

A [7]

B [14]

C [[3, 8]]

D **[11]** ✔

## Solution

**✔ Correct Answer: D) [11]**

A 1×2 matrix times a 2×1 matrix gives a 1×1 matrix: (1)(3) + (2)(4) = 3 + 8 = 11, so the result is [11].

## 30 Question

Matrices

**What is the inverse of [[2, 0], [0, 4]]?**

A [[2, 0], [0, 4]]

B **[[1/2, 0], [0, 1/4]]** ✔

C [[−2, 0], [0, −4]]

D [[4, 0], [0, 2]]

## Solution

**✔ Correct Answer: B) [[1/2, 0], [0, 1/4]]**

The inverse of a diagonal matrix has the reciprocals on the diagonal. Check: [[2, 0], [0, 4]] × [[1/2, 0], [0, 1/4]] = [[1, 0], [0, 1]].

# 04 Complex Numbers & Vectors

Questions 31 – 40

## Focus areas

Operations on complex numbers, modulus, conjugates, dot products and magnitudes.

## 31 Question

Complex & Vectors

**Find (3 + 4i) + (2 − i).**

A 5 + 3i ✔

B 5 + 5i

C 1 + 5i

D 6 + 3i

## Solution

**✔ Correct Answer: A) 5 + 3i**

Add the real parts and the imaginary parts separately: (3 + 2) + (4 − 1)i = 5 + 3i.

## 32 Question

Complex & Vectors

**What is the modulus of the complex number 6 + 8i?**

A 14

B 2

C **10** ✔

D 48

## Solution

✔ **Correct Answer: C) 10**

|a + bi| = √(a² + b²) = √(36 + 64) = √100 = 10.

## 33 Question

Complex & Vectors

**Simplify $(1 + i)^2$.**

A 2

B **2i** ✔

C $1 + 2i$

D $-2i$

## Solution

✔ **Correct Answer: B) 2i**

$(1 + i)^2 = 1 + 2i + i^2$. Since $i^2 = -1$, this becomes $1 + 2i - 1 = 2i$.

## 34 Question

Complex & Vectors

**What is the conjugate of 5 − 7i?**

A −5 + 7i

B 5 − 7i

C −5 − 7i

D **5 + 7i** ✔

## Solution

**✔ Correct Answer: D) 5 + 7i**

The conjugate changes only the sign of the imaginary part: 5 − 7i becomes 5 + 7i.

## 35 Question

Complex & Vectors

**Find the value of $i^7$.**

A i

B 1

C −1

D −i ✔

## Solution

✔ **Correct Answer: D) −i**

Powers of i repeat every four steps: i, −1, −i, 1.

Since $7 = 4 + 3$, $i^7 = i^3 = -i$.

## 36 Question

Complex & Vectors

If a = (2, 3) and b = (1, −1), find a + b.

A (3, 2) ✔

B (1, 4)

C (3, 4)

D (2, 3)

## Solution

✔ **Correct Answer: A) (3, 2)**

Add the vectors component by component: (2 + 1, 3 + (−1)) = (3, 2).

## 37 Question

Complex & Vectors

**Find the dot product of (1, 2, 3) and (4, 5, 6).**

A 15

B 32 ✔

C 21

D 28

## Solution

✔ **Correct Answer: B) 32**

Multiply matching components and add: (1)(4) + (2)(5) + (3)(6) = 4 + 10 + 18 = 32.

## 38 Question

Complex & Vectors

**Find the magnitude of the vector (2, −3, 6).**

A 5

B 11

C 7 ✔

D √13

## Solution

✔ **Correct Answer: C) 7**

$|v| = \sqrt{(2^2 + (-3)^2 + 6^2)} = \sqrt{(4 + 9 + 36)} = \sqrt{49} = 7.$

## 39 Question

Complex & Vectors

**The vectors (1, 2) and (2, −1) are:**

A Parallel

B **Perpendicular** ✔

C Equal

D Opposite in direction

## Solution

**✔ Correct Answer: B) Perpendicular**

Their dot product is (1)(2) + (2)(−1) = 2 − 2 = 0. A zero dot product means the vectors are perpendicular.

## 40 Question

Complex & Vectors

**What is the unit vector in the direction of (3, 4)?**

A (3, 4)

B (1/3, 1/4)

C (4/5, 3/5)

D **(3/5, 4/5)** ✔

## Solution

**✔ Correct Answer: D) (3/5, 4/5)**

The magnitude is √(9 + 16) = 5. A unit vector is the vector divided by its magnitude: (3/5, 4/5).

# 05 Logarithms & Exponents

Questions 41 – 50

## Focus areas

Log laws, fractional and negative powers and exponential equations.

## 41 Question

Logs & Exponents

**Find the value of $\log_2 32$.**

A 4

B 5 ✔

C 6

D 16

## Solution

**✔ Correct Answer: B) 5**

$\log_2 32$ asks: to what power must 2 be raised to give 32? Since $2^5 = 32$, the answer is 5.

## 42 Question

Logs & Exponents

**Find the value of $\log_3 81$.**

- **A** 4 ✔
- **B** 3
- **C** 27
- **D** 5

## Solution

**✔ Correct Answer: A) 4**

$3^4 = 3 \times 3 \times 3 \times 3 = 81$, so $\log_3 81 = 4$.

## 43 Question

Logs & Exponents

**Find the value of $\log_{10} 50 + \log_{10} 2$.**

A 1

B 3

C 2 ✔

D 52

## Solution

✔ **Correct Answer: C) 2**

Product rule: $\log 50 + \log 2 = \log (50 \times 2) = \log 100 = 2$, because $10^2 = 100$.

## 44 Question

Logs & Exponents

**Evaluate 8^(2/3).**

A 2

B 16

C 4 ✔

D 6

## Solution

✔ **Correct Answer: C) 4**

8^(2/3) = $(\sqrt[3]{8})^2$ = $2^2$ = 4. Taking the root first keeps the numbers small.

## 45 Question

Logs & Exponents

**Evaluate 27^(−1/3).**

A −3

B 1/9

C 3

D **1/3** ✔

## Solution

✔ **Correct Answer: D) 1/3**

A negative exponent means reciprocal: 27^(−1/3) = 1 / 27^(1/3) = 1 / $\sqrt[3]{27}$ = 1/3.

## 46 Question

Logs & Exponents

**Find the value of $\log_5 125 - \log_5 5$.**

A 3

B 2 ✔

C 25

D 1

## Solution

✔ **Correct Answer: B) 2**

$\log_5 125 = 3$ and $\log_5 5 = 1$, so the difference is 2.

Quotient rule check: $\log_5 (125/5) = \log_5 25 = 2$.

## 47 Question

Logs & Exponents

**Solve $2^x = 1/8$.**

A 3

B −3 ✔

C 1/3

D −8

## Solution

**✔ Correct Answer: B) −3**

Write 1/8 as a power of 2: $1/8 = 2^{-3}$. So $2^x = 2^{-3}$ and $x = -3$.

## 48 Question

Logs & Exponents

**If $\log_2 x = 4$, find x.**

A 8

B 6

C **16** ✔

D 32

## Solution

**✔ Correct Answer: C) 16**

By the definition of a logarithm, $\log_2 x = 4$ means $x = 2^4 = 16$.

## 49 Question

Logs & Exponents

**Solve $4^x = 2^{(x+3)}$.**

A 1

B 2

C 6

D 3 ✔

## Solution

✔ **Correct Answer: D) 3**

Write $4^x = (2^2)^x = 2^{2x}$. Then $2^{2x} = 2^{x+3}$, so $2x = x + 3$ and $x = 3$.

## 50 Question

Logs & Exponents

**Simplify $(2^3)^2 \div 2^4$.**

A 4 ✔

B 2

C 8

D 16

## Solution

**✔ Correct Answer: A) 4**

$(2^3)^2 = 2^6$. Dividing powers with the same base subtracts the exponents: $2^6 \div 2^4 = 2^2 = 4$.

# 06 Permutations & Combinations

Questions 51 – 60

## Focus areas

Factorials, arrangements, selections and counting principles.

## 51 Question

Perm & Comb

**What is the value of 6! ?**

A 120

B **720** ✔

C 360

D 5040

## Solution

✔ **Correct Answer: B) 720**

6! = 6 × 5 × 4 × 3 × 2 × 1 = 720.

## 52 Question

Perm & Comb

**In how many ways can 3 students be chosen from 8?**

A 24

B 336

C **56** ✔

D 112

## Solution

✔ **Correct Answer: C) 56**

${}^{8}C_{3} = 8! / (3! \times 5!) = (8 \times 7 \times 6) / (3 \times 2 \times 1) = 336 / 6 = 56.$

## 53 Question

Perm & Comb

**How many different arrangements can be made from the letters of the word LEVEL?**

- **A** 30 ✔
- **B** 60
- **C** 120
- **D** 15

## Solution

**✔ Correct Answer: A) 30**

LEVEL has 5 letters, with L repeated twice and E repeated twice. Arrangements = 5! / (2! × 2!) = 120 / 4 = 30.

## 54 Question

Perm & Comb

**From 4 boys and 3 girls, a committee of 2 boys and 1 girl is formed. How many committees are possible?**

A 12

B 24

C **18** ✔

D 21

## Solution

**✔ Correct Answer: C) 18**

Choose 2 boys from 4: ${}^{4}C_{2} = 6$. Choose 1 girl from 3: ${}^{3}C_{1} = 3$. By the multiplication principle: $6 \times 3 = 18$.

## 55 Question

Perm & Comb

**Find the value of $^{7}P_{3}$.**

A 35

B **210** ✔

C 343

D 840

## Solution

✔ **Correct Answer: B) 210**

$^{n}P_{r} = n! / (n - r)!$, so $^{7}P_{3} = 7 \times 6 \times 5 = 210$. Order matters in a permutation; compare $^{7}C_{3} = 35$.

## 56 Question

Perm & Comb

**In how many ways can 5 people sit around a circular table?**

A 120

B 12

C **24** ✔

D 60

## Solution

**✔ Correct Answer: C) 24**

For n distinct people around a circle, the number of arrangements is (n − 1)!. For n = 5: 4! = 24.

## 57 Question

Perm & Comb

**How many 3-digit numbers can be formed from the digits 1, 2, 3, 4, 5 if no digit repeats?**

- **A** 60 ✔
- **B** 125
- **C** 120
- **D** 30

## Solution

**✔ Correct Answer: A) 60**

Hundreds place: 5 choices; tens place: 4 remaining; units place: 3 remaining. Total = 5 × 4 × 3 = 60.

## 58 Question

Perm & Comb

**10 people each shake hands once with every other person. How many handshakes occur?**

A 90

B **45** ✔

C 100

D 50

## Solution

**✔ Correct Answer: B) 45**

Each handshake is a pair of people, so the count is ${}^{10}C_2 = (10 \times 9) / 2 = 45$.

## 59 Question

Perm & Comb

**How many distinct arrangements are there of the letters of the word APPLE?**

A 120

B 30

C 60 ✔

D 24

## Solution

**✔ Correct Answer: C) 60**

APPLE has 5 letters with P repeated twice.

Arrangements = 5! / 2! = 120 / 2 = 60.

## 60 Question

Perm & Comb

**What is the value of ${}^5C_0 + {}^5C_1 + {}^5C_2 + {}^5C_3 + {}^5C_4 + {}^5C_5$?**

A 16

B 25

C 10

D 32 ✔

## Solution

**✔ Correct Answer: D) 32**

The sum of all binomial coefficients for n is $2^n$. Here $1 + 5 + 10 + 10 + 5 + 1 = 32 = 2^5$.

# 07 Circles, Triangles & Polygons

Questions 61 – 70

## Focus areas

Tangents, chords, similarity, centroid, inradius and cyclic figures.

## 61 Question

Circles & Triangles

**A point is 13 cm from the centre of a circle of radius 5 cm. What is the length of the tangent from the point to the circle?**

A 8 cm

B **12 cm** ✔

C √194 cm

D 18 cm

## Solution

**✔ Correct Answer: B) 12 cm**

The tangent is perpendicular to the radius at the point of contact, so $t^2 = 13^2 - 5^2 = 169 - 25 = 144$. Therefore $t = 12$ cm.

## 62 Question

Circles & Triangles

**Two similar triangles have corresponding sides in the ratio 2 : 3. What is the ratio of their areas?**

A 2 : 3

B 8 : 27

C **4 : 9** ✔

D 1 : 3

## Solution

**✔ Correct Answer: C) 4 : 9**

Areas of similar figures are in the ratio of the squares of corresponding sides: $(2/3)^2 = 4/9$. (8 : 27 would be the ratio of volumes.)

## 63 Question

Circles & Triangles

**A chord is 3 cm from the centre of a circle of radius 5 cm. What is the length of the chord?**

A 4 cm

B 6 cm

C 10 cm

D **8 cm** ✔

## Solution

**✔ Correct Answer: D) 8 cm**

The perpendicular from the centre bisects the chord. Half-chord = $\sqrt{(5^2 - 3^2)} = \sqrt{16} = 4$ cm, so the chord $= 2 \times 4 = 8$ cm.

## 64 Question

Circles & Triangles

**An arc subtends an angle of 80° at the centre of a circle. What angle does it subtend at the circumference?**

A 160°

B **40°** ✔

C 80°

D 20°

## Solution

**✔ Correct Answer: B) 40°**

The angle at the centre is twice the angle at the circumference on the same arc. So the angle = 80° ÷ 2 = 40°.

## 65 Question

Circles & Triangles

**The centroid of a triangle divides each median in the ratio:**

A 1 : 1

B 1 : 2

C **2 : 1** ✔

D 3 : 1

## Solution

**✔ Correct Answer: C) 2 : 1**

The three medians meet at the centroid, which divides each median in the ratio 2 : 1, measured from the vertex.

## 66 Question

Circles & Triangles

**Find the area of an equilateral triangle of side 6 cm.**

- **A** **9√3 cm²** ✔
- **B** 18√3 cm²
- **C** 36√3 cm²
- **D** 6√3 cm²

## Solution

**✔ Correct Answer: A) 9√3 cm²**

Area = (√3/4) × side² = (√3/4) × 36 = 9√3 cm², which is about 15.59 cm².

## 67 Question

Circles & Triangles

**Find the inradius of a right-angled triangle with sides 3, 4 and 5.**

A 2

B 1 ✔

C 1.5

D 0.5

## Solution

**✔ Correct Answer: B) 1**

For a right triangle, r = (a + b − c)/2 = (3 + 4 − 5)/2 = 1. Cross-check: r = Area / s = 6 / 6 = 1.

## 68 Question

Circles & Triangles

**One angle of a cyclic quadrilateral is 70°. What is the opposite angle?**

- **A** 110° ✔
- **B** 70°
- **C** 90°
- **D** 290°

## Solution

**✔ Correct Answer: A) 110°**

Opposite angles of a cyclic quadrilateral add up to 180°. So the opposite angle is 180° − 70° = 110°.

## 69 Question

Circles & Triangles

**Find the area of a triangle with sides 7, 8 and 9 using Heron's formula.**

A 24

B 20√2

C **12√5** ✔

D 30

## Solution

✔ **Correct Answer: C) 12√5**

s = (7 + 8 + 9)/2 = 12. Area = √[s(s − a)(s − b)(s − c)] = √(12 × 5 × 4 × 3) = √720 = 12√5 ≈ 26.8 square units.

## 70 Question

Circles & Triangles

**The diagonals of a rhombus are 6 cm and 8 cm. What is the length of its side?**

- **A** **5 cm** ✔
- **B** 7 cm
- **C** 10 cm
- **D** 14 cm

## Solution

**✔ Correct Answer: A) 5 cm**

The diagonals of a rhombus bisect each other at right angles, forming right triangles with legs 3 and 4. Side = $\sqrt{(3^2 + 4^2)} = 5$ cm.

# 08 Applied Trigonometry

Questions 71 – 80

## Focus areas

Heights and distances, double-angle and addition formulas, radians and ranges.

## 71 Question

Applied Trig

**The sun's elevation is 45°. How long is the shadow of a 10 m pole?**

A 5 m

B 10√2 m

C **10 m** ✔

D 20 m

## Solution

**✔ Correct Answer: C) 10 m**

tan 45° = height / shadow = 1, so the shadow is equal to the height: 10 m.

## 72 Question

Applied Trig

**From a point 20√3 m from the foot of a tower, the angle of elevation of the top is 30°. Find the height of the tower.**

A 20√3 m

B **20 m** ✔

C 60 m

D 10 m

## Solution

✔ **Correct Answer: B) 20 m**

tan 30° = h / (20√3). Therefore h = 20√3 × (1/√3) = 20 m.

## 73 Question

Applied Trig

**If sin θ = 3/5 and θ is acute, find sin 2θ.**

- **A** 24/25 ✔
- **B** 6/5
- **C** 12/25
- **D** 7/25

## Solution

**✔ Correct Answer: A) 24/25**

First cos θ = 4/5. Then sin 2θ = 2 sin θ cos θ = 2 × (3/5) × (4/5) = 24/25.

## 74 Question

Applied Trig

**If sin θ = 1/2, find cos 2θ.**

A 1/4

B √3/2

C **1/2** ✔

D 0

## Solution

✔ **Correct Answer: C) 1/2**

Use cos 2θ = 1 − 2 sin²θ = 1 − 2 × (1/4) = 1 − 1/2 = 1/2.

## 75 Question

Applied Trig

**What is the period of the function y = sin x?**

A π

B 2π ✔

C π/2

D 4π

## Solution

**✔ Correct Answer: B) 2π**

The sine curve completes one full cycle every 2π radians (360°), after which its values repeat.

## 76 Question

Applied Trig

**What is the maximum value of 3 sin x + 4 cos x?**

A 7

B 12

C 1

D 5 ✔

## Solution

**✔ Correct Answer: D) 5**

The maximum of a sin x + b cos x is √(a² + b²) = √(9 + 16) = 5. The value 7 is not reachable, because sin x and cos x cannot both equal 1 together.

## 77 Question

Applied Trig

**Find the value of sin 120°.**

A √3/2 ✔

B −√3/2

C 1/2

D −1/2

## Solution

**✔ Correct Answer: A) √3/2**

sin 120° = sin (180° − 60°) = sin 60° = √3/2. In the second quadrant the sine remains positive.

## 78 Question

Applied Trig

**Convert 60° into radians.**

A π/6

B π/2

C **π/3** ✔

D 2π/3

## Solution

✔ **Correct Answer: C) π/3**

Radians = degrees × π/180 = 60π/180 = π/3.

## 79 Question

Applied Trig

**Which expression is equal to cos (A + B)?**

A cos A cos B + sin A sin B

B sin A cos B + cos A sin B

C **cos A cos B − sin A sin B** ✔

D sin A sin B − cos A cos B

## Solution

**✔ Correct Answer: C) cos A cos B − sin A sin B**

The addition formula is cos (A + B) = cos A cos B − sin A sin B. Test with A = B = 45°: cos 90° = 0 and (1/2) − (1/2) = 0 ✔.

## 80 Question

Applied Trig

**Find the value of sin 90° + cos 0° + tan 0°.**

A 1

B 2 ✔

C 3

D 0

## Solution

✔ **Correct Answer: B) 2**

sin 90° = 1, cos 0° = 1 and tan 0° = 0. The sum is 1 + 1 + 0 = 2.

# 09 Calculus in Action

Questions 81 – 90

## Focus areas

Tangent slopes, product and chain rules, definite integrals, turning points and velocity.

## 81 Question

Calculus in Action

**Find the slope of the tangent to $y = x^2$ at $x = 3$.**

A 3

B 9

C 6 ✔

D 2

## Solution

**✔ Correct Answer: C) 6**

The slope of the tangent equals the derivative: dy/dx = 2x. At x = 3 the slope is 2(3) = 6.

## 82 Question

Calculus in Action

**Differentiate x sin x with respect to x.**

A cos x

B **sin x + x cos x** ✔

C x cos x

D sin x − x cos x

## Solution

**✔ Correct Answer: B) sin x + x cos x**

Use the product rule (uv)′ = u′v + uv′ with u = x and v = sin x. The result is (1)(sin x) + x cos x = sin x + x cos x.

## 83 Question

Calculus in Action

**Evaluate the integral of $3x^2$ from $x = 0$ to $x = 2$.**

- **A** 8 ✔
- **B** 6
- **C** 12
- **D** 4

## Solution

**✔ Correct Answer: A) 8**

An antiderivative of $3x^2$ is $x^3$. Applying the limits: $2^3 - 0^3 = 8$.

## 84 Question

Calculus in Action

**Find the area under the line y = x from x = 0 to x = 4.**

A 16

B 4

C 12

D 8 ✔

## Solution

**✔ Correct Answer: D) 8**

Area = ∫ from 0 to 4 of x dx = [x²/2] = 16/2 = 8. This agrees with the triangle: ½ × 4 × 4 = 8.

## 85 Question

Calculus in Action

**What is d/dx (1/x)?**

A $1/x^2$

B $-1/x^2$ ✔

C ln x

D $-1/x$

## Solution

✔ **Correct Answer: B) $-1/x^2$**

Write $1/x = x^{-1}$. By the power rule, $d/dx\ (x^{-1}) = -x^{-2} = -1/x^2$.

## 86 Question

Calculus in Action

**Differentiate $(2x + 1)^3$.**

A $3(2x + 1)^2$

B **$6(2x + 1)^2$** ✔

C $2(2x + 1)^3$

D $6x + 3$

## Solution

**✔ Correct Answer: B) $6(2x + 1)^2$**

Use the chain rule: the derivative of the outer power is $3(2x + 1)^2$, multiplied by the derivative of the inside, which is 2. Result: $6(2x + 1)^2$.

## 87 Question

Calculus in Action

**Find the limit of $(x^2 - 4)/(x - 2)$ as $x \to 2$.**

A 0

B 2

C 4 ✔

D Does not exist

## Solution

**✔ Correct Answer: C) 4**

Direct substitution gives 0/0, so factorise: $(x - 2)(x + 2)/(x - 2) = x + 2$. As $x \to 2$ this approaches 4.

## 88 Question

Calculus in Action

**Evaluate the integral of 1/x dx.**

A $-1/x^2 + C$

B $1/x^2 + C$

C **$\ln |x| + C$** ✔

D $e^x + C$

## Solution

**✔ Correct Answer: C) $\ln |x| + C$**

The antiderivative of 1/x is the natural logarithm: $\ln |x| + C$. The usual power rule fails here because it would divide by $n + 1 = 0$.

## 89 Question

Calculus in Action

**Find the critical points of $f(x) = x^3 - 3x$.**

A $x = 0$ only

B $x = \pm 3$

C **$x = \pm 1$** ✔

D $x = 1$ only

## Solution

**✔ Correct Answer: C) $x = \pm 1$**

Set $f'(x) = 3x^2 - 3 = 0$, so $x^2 = 1$ and $x = 1$ or $x = -1$. These are the turning points of the curve.

## 90 Question

Calculus in Action

**The position of a particle is $s = t^3 - 2t$. Find its velocity at $t = 2$.**

A 6

B **10** ✔

C 8

D 12

## Solution

✔ **Correct Answer: B) 10**

Velocity is the derivative of position: $v = ds/dt = 3t^2 - 2$. At $t = 2$: $v = 3(4) - 2 = 10$.

# 10 Statistics & Probability

Questions 91 – 100

## Focus areas

Standard deviation, independent events, conditional counting and expected value.

## 91 Question

Stats & Probability

**Find the standard deviation of 2, 4, 4, 4, 5, 5, 7, 9.**

A 1

B 4

C 2 ✔

D √5

## Solution

**✔ Correct Answer: C) 2**

Mean = 40/8 = 5. Squared deviations: 9, 1, 1, 1, 0, 0, 4, 16, which add up to 32. Variance = 32/8 = 4, so the standard deviation is √4 = 2.

## 92 Question

Stats & Probability

**A and B are independent events with P(A) = 0.5 and P(B) = 0.4. Find P(A ∩ B).**

A 0.9

B **0.2** ✔

C 0.1

D 0.45

## Solution

✔ **Correct Answer: B) 0.2**

For independent events, P(A ∩ B) = P(A) × P(B) = 0.5 × 0.4 = 0.2.

## 93 Question

Stats & Probability

**A bag has 5 red and 3 blue balls. One ball is drawn at random. What is the probability that it is blue?**

A 3/5

B 5/8

C **3/8** ✔

D 1/3

## Solution

**✔ Correct Answer: C) 3/8**

The total number of balls is 5 + 3 = 8, of which 3 are blue. So P(blue) = 3/8.

## 94 Question

Stats & Probability

**Two cards are drawn without replacement from a standard deck. What is the probability that both are aces?**

A 1/169

B **1/221** ✔

C 1/26

D 2/13

## Solution

**✔ Correct Answer: B) 1/221**

P = (4/52) × (3/51) = 12/2652 = 1/221. The second draw has only 3 aces left among 51 cards.

## 95 Question

Stats & Probability

**The mean of five numbers is 20. If the number 30 is removed, what is the mean of the remaining four?**

- **A** 17.5 ✔
- **B** 20
- **C** 15
- **D** 16

## Solution

**✔ Correct Answer: A) 17.5**

Total of the five numbers = 5 × 20 = 100. After removing 30, the total is 70 for 4 numbers. New mean = 70/4 = 17.5.

## 96 Question

Stats & Probability

**A fair coin is tossed twice. What is the probability of getting at least one head?**

A 1/2

B 1/4

C **3/4** ✔

D 1

## Solution

✔ **Correct Answer: C) 3/4**

P(no head) = P(TT) = 1/4. So P(at least one head) = 1 − 1/4 = 3/4.

## 97 Question

Stats & Probability

**Find the median of 2, 5, 8, 11.**

- **A** 6.5 ✔
- **B** 5
- **C** 8
- **D** 6

## Solution

**✔ Correct Answer: A) 6.5**

With an even number of values, the median is the mean of the two middle values: (5 + 8)/2 = 6.5.

## 98 Question

Stats & Probability

**A fair coin is tossed 3 times. What is the probability of getting exactly 2 heads?**

A 1/8

B 1/2

C **3/8** ✔

D 3/4

## Solution

**✔ Correct Answer: C) 3/8**

Favourable outcomes: HHT, HTH and THH, which is 3 out of 8. So P = 3/8. (Binomial check: ${}^3C_2 \times (1/2)^3 = 3/8$.)

## 99 Question

Stats & Probability

**Events A and B are mutually exclusive with P(A) = 0.3 and P(B) = 0.5. Find P(A or B).**

A 0.15

B 0.2

C **0.8** ✔

D 1.5

## Solution

**✔ Correct Answer: C) 0.8**

For mutually exclusive events, P(A or B) = P(A) + P(B) = 0.3 + 0.5 = 0.8. No overlap needs to be subtracted.

## 100 Question

Stats & Probability

**What is the expected value of the score when a fair six-sided die is rolled once?**

A 3

B **3.5** ✔

C 4

D 6

## Solution

✔ **Correct Answer: B) 3.5**

E(X) = (1 + 2 + 3 + 4 + 5 + 6)/6 = 21/6 = 3.5. The expected value need not be a possible outcome.

# Answer Key

| Topic | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Word Problems** Q1–10 | D | D | D | A | D | D | A | D | D | A |
| **Functions** Q11–20 | D | A | D | A | D | A | D | D | A | D |
| **Matrices** Q21–30 | A | A | D | A | A | B | B | D | D | B |
| **Complex & Vectors** Q31–40 | A | C | B | D | D | A | B | C | B | D |
| **Logs & Exponents** Q41–50 | B | A | C | C | D | B | B | C | D | A |
| **Perm & Comb** Q51–60 | B | C | A | C | B | C | A | B | C | D |
| **Circles & Triangles** Q61–70 | B | C | D | B | C | A | B | A | C | A |
| **Applied Trig** Q71–80 | C | B | A | C | B | D | A | C | C | B |
| **Calculus in Action** Q81–90 | C | B | A | D | B | B | C | C | C | B |
| **Stats & Probability** Q91–100 | C | B | C | B | A | C | A | C | C | B |

# That's a Wrap!

## Great work, scholar!

You have finished all 100 questions.
Revisit the ones you missed and
try them again after a day.

**My Score**

_____ / 100

Date: _____

**scholareye.xyz**