Infinity Masterclasses
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MTSE 2026 | CLASS 9–10

Detailed Solutions

Step-by-step solutions



Answer Key

Q1 B	Q2 A	Q3 D	Q4 C	Q5 B
Q6 D	Q7 C	Q8 D	Q9 B	Q10 B
Q11 C	Q12 A	Q13 B	Q14 D	Q15 A
Q16 D	Q17 C	Q18 A	Q19 D	Q20 C
Q21 D	Q22 B	Q23 A	Q24 A	Q25 C

Colours follow the sections: A Valuation · B Triangle and Circles · C Algebra · D Counting, Patterns & Structure · E Geometry · F Number Theory

How to use this booklet. Each solution restates the question in brief, works through numbered steps, and ends with the answer in a coloured box that shows the correct option exactly as printed in the paper.

Scoring. 25 questions × 4 marks = 100 marks. There is no negative marking. Correct options: A × 6, B × 6, C × 6, D × 7.

SECTION A · CASE STUDY

The Valuation Story



QUESTIONS
1 – 5
5 × 4 = 20 marks

1 Buying an Existing Stake

Bhushan pays ₹500 crore to Amit personally. Company value stays ₹1,000 crore.

Step 1. The ₹500 crore goes to Mr. Amit, not to the company, so the company's value stays ₹1,000 crore.

Step 2. Mr. Bhushan now owns shares worth ₹500 crore out of ₹1,000 crore.

$$\text{Bhushan's share} = 500 \div 1{,}000 = 50\%$$

Step 3. Mr. Amit sold ₹500 crore of his ₹1,000 crore stake, so he keeps ₹500 crore: 500 ÷ 1,000 = 50%.

ANSWER B **Mr. Amit – 50%, Mr. Bhushan – 50%**

2 Fresh Investment into the Company

Bhushan invests ₹500 crore directly into Inspire Pvt. Ltd.

Step 1. The company receives fresh money, so its value rises: 1,000 + 500 = ₹1,500 crore.

Step 2. Mr. Amit's stake is still worth ₹1,000 crore. Mr. Bhushan's stake is worth ₹500 crore.

$$\text{Amit} = 1{,}000 \div 1{,}500 = 66.67\% \mid \text{Bhushan} = 500 \div 1{,}500 = 33.33\%$$

Step 3. Compare with Q1: the same ₹500 crore buys 50% from Mr. Amit but only 33.33% when invested in the company, because fresh money also raises the company's value.

ANSWER A **Valuation = ₹1,500 crore; Amit = 66.67%, Bhushan = 33.33%**

3 Becoming a 20% Owner Through Fresh Investment

Fresh money into a ₹1,000 crore company. How much for a 20% stake?

Step 1. Let Mr. Bhushan invest ₹x crore. The new company value is $(1{,}000 + x)$ crore.

Step 2. His share must be 20% = 1/5, so:

$$x \div (1{,}000 + x) = 1/5$$

Step 3. Cross-multiply: $5x = 1{,}000 + x$, so $4x = 1{,}000$ and $x = 250$.

Step 4. Check: 250 ÷ (1,000 + 250) = 250 ÷ 1,250 = 20%. ✓ (The tempting answer ₹200 crore is 20% of the *old* value; it ignores that the new money increases the total.)

ANSWER D **₹250 crore**

4 Buying a 20% Stake from Mr. Amit

The company's value stays ₹1,000 crore.

Step 1. Nothing is added to the company, so its value stays ₹1,000 crore.

Step 2. A 20% stake is worth 20% of ₹1,000 crore:

$$20 \div 100 \times 1{,}000 = ₹200 \text{ crore}$$

Step 3. Buying from Mr. Amit costs ₹200 crore, which is less than the ₹250 crore needed in Q3.

ANSWER C **₹200 crore**

5 Question 5

Bhushan has ₹300 crore: pay Mr. Amit (Option 1) or invest in the company (Option 2). Which gives the larger percentage?

Step 1. **Option 1** (pay Mr. Amit): the company value stays ₹1,000 crore.

$$\text{Share} = 300 \div 1{,}000 = 30\%$$

Step 2. **Option 2** (invest in the company): the company value becomes 1,000 + 300 = ₹1,300 crore.

$$\text{Share} = 300 \div 1{,}300 \approx 23.08\%$$

Step 3. 30% > 23.08%, so paying Mr. Amit gives the larger percentage. Fresh money increases the total value, which dilutes everyone's share; buying existing shares does not.

ANSWER B **Paying Mr. Amit personally**

SECTION B · CASE STUDY

A Triangle Locked Between Two Circles



QUESTIONS **6 – 9**
4 × 4 = 16 marks

6 A Triangle with Two Known Sides

Sides x and y are opposite angles 40° and 80°. Find the area.

Step 1. The angles of a triangle add up to 180°, so the third angle is 180° − 40° − 80° = 60°.

Step 2. The third angle (60°) is opposite the third side, so it sits **between** the sides *x* and *y*.

Step 3. Take *x* as the base. The side *y* makes a 60° angle with it, so the height is *y* sin 60° (right-triangle rule from the case study).

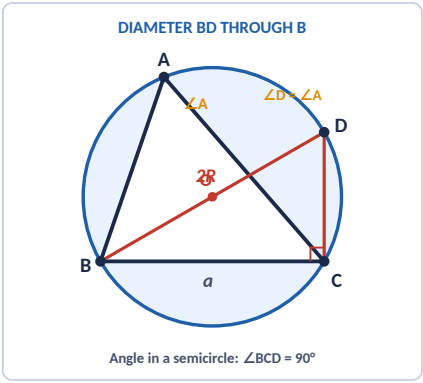
$$\text{Area} = \tfrac{1}{2} \times \text{base} \times \text{height} = \tfrac{1}{2}\, x \cdot y \sin 60°$$

Step 4. Trap: 40° and 80° are the angles *opposite* the sides, not the angle between them, so options with sin 40° or sin 80° are wrong.

ANSWER D **½xy sin 60°**

7 The Mystery of the Circumcircle

What is the common value of a / sin A = b / sin B = c / sin C?



Step 1. Draw the diameter *BD* through *B* and the centre *O*, so *BD* = 2*R*. Join *CD*.

Step 2. Angle *BCD* is in a semicircle, so ∠BCD = 90°.

Step 3. Angles *BAC* and *BDC* stand on the same arc *BC*, so ∠BDC = ∠A.

Step 4. In right triangle *BCD* the hypotenuse is 2*R*, and the side opposite angle *D* (= ∠A) is *BC* = *a*. By the case-study rule (opposite side = hypotenuse × sin):

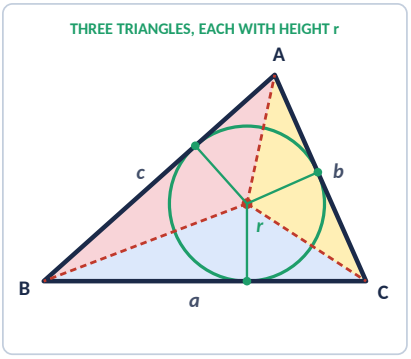
$$a = 2R \sin A \Rightarrow a / \sin A = 2R$$

Step 5. The same argument works from the other corners, so *b* / sin B = *c* / sin C = 2*R* as well. The constant is 2*R*.

ANSWER C **2*R***

8 The Circle Inside the Triangle

Area of the triangle in terms of a, b, c and r.



Step 1. Let I be the incentre. Join I to the three vertices. This splits the triangle into three smaller triangles.

Step 2. Each radius to a side is perpendicular to that side, so each small triangle has height r on bases a, b and c.

$$\text{Area} = \tfrac{1}{2}ar + \tfrac{1}{2}br + \tfrac{1}{2}cr = r(a + b + c) / 2$$

ANSWER D $r(a + b + c) / 2$

9 Two Circles Meet

Find $(R + r)^2 - (R - r)^2$ in terms of a, b, c.

Step 1. Expand the difference of squares: $(R + r)^2 - (R - r)^2 = 4Rr$.

Step 2. Let K be the area of the triangle. As in Q6, $K = \tfrac{1}{2}\, bc \sin A$. From Q7, $\sin A = a / (2R)$, so

$$K = \tfrac{1}{2}\, bc \cdot a / (2R) = abc / (4R) \Rightarrow R = abc / (4K)$$

Step 3. From Q8, $K = r(a + b + c) / 2$, so $r = 2K / (a + b + c)$.

Step 4. Multiply: $Rr = [abc / (4K)] \times [2K / (a + b + c)] = abc / [2(a + b + c)]$. The area K cancels.

$$4Rr = 4 \times abc / [2(a + b + c)] = 2abc / (a + b + c)$$

ANSWER B $2abc / (a + b + c)$

SECTION C

Algebra



QUESTIONS

10 – 13

4 × 4 = 16 marks

10 Question 10

Which is greatest, with x = 0.000...01 (2019 zeroes)?

Step 1. With 2019 zeroes after the decimal point, the 1 is in the 2020th place, so $x = 10^{-2020}$.

Step 2. $\mathbf{10000 + x}$ is just over 10^4. $\mathbf{10000 \cdot x} = 10^4 \times 10^{-2020} = 10^{-2016}$, which is tiny.

Step 3. $\mathbf{10000 / x} = 10^4 \div 10^{-2020} = 10^{2024}$.

Step 4. $\mathbf{1 / x^2} = 1 \div 10^{-4040} = 10^{4040}$.

Step 5. 10^{4040} is far larger than the others, so $1 / x^2$ is the greatest.

ANSWER B $\mathbf{1 / x^2}$

11 Question 11

How many perfect cubes lie between $2^9 + 1$ and $2^{18} + 1$?

Step 1. $2^9 + 1 = 513$. Since $8^3 = 512$ is below 513, the first cube in range is $9^3 = 729$.

Step 2. $2^{18} = (2^6)^3 = 64^3 = 262{,}144$. The upper limit is 262,145, so 64^3 is inside the range, and 65^3 is too big.

Step 3. The cubes are 9^3, 10^3, ..., 64^3. Their number is:

$$64 - 9 + 1 = 56$$

ANSWER C 56

12 Question 12

Remainder of $f(x) = x^{100} + x^{50} + x^{10} + x^2 - 6$ divided by $x^2 - 1$.

Step 1. The divisor has degree 2, so the remainder has the form $ax + b$. Also $x^2 - 1 = (x - 1)(x + 1)$.

Step 2. Put $x = 1$: $f(1) = 1 + 1 + 1 + 1 - 6 = -2$, so $a + b = -2$.

Step 3. Put $x = -1$: every power is even, so $f(-1) = 1 + 1 + 1 + 1 - 6 = -2$, so $-a + b = -2$.

Step 4. Adding: $2b = -4$, so $b = -2$ and $a = 0$. The remainder is -2.

Step 5. Shortcut: since $x^2 \equiv 1$ here, every power x^{100}, x^{50}, x^{10}, x^2 is 1, so the remainder is $4 - 6 = -2$.

ANSWER A **−2**

13 Question 13

Coefficient of x^{90} in $(1 + x + \ldots + x^{60})(1 + x + \ldots + x^{120})$.

Step 1. A term x^{90} arises by choosing x^i from the first bracket and x^j from the second with $i + j = 90$, where $0 \le i \le 60$ and $0 \le j \le 120$.

Step 2. For each i from 0 to 60, $j = 90 - i$ runs from 90 down to 30, and always lies between 0 and 120. So every i works.

Step 3. The number of choices is $60 - 0 + 1 = 61$, and each contributes 1 to the coefficient.

ANSWER B **61**

SECTION D

Counting, Patterns & Structure



QUESTIONS
14 – 17
4 × 4 = 16 marks

14 Question 14

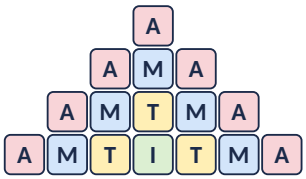
Number of ways to spell AMTI in the letter pyramid (moves: down, left, right).

Step 1. The pyramid has only one I, in the centre of the bottom row. Count the T–I moves first: I touches three T's (the one above it, and one on each side).

Step 2. For each such T, count the M's next to it, and for each M count the A's next to it.

Step 3. **T above I** (centre of row 3): its M neighbours are the M above (3 A-neighbours) and the two M's beside it (2 A-neighbours each): $3 + 2 + 2 = 7$ ways.

Step 4. **T left of I** (bottom row): its M neighbours are the M on its left (2 A's) and the M above (2 A's): $2 + 2 = 4$ ways. The right T gives 4 ways by symmetry.



Total = $7 + 4 + 4 = 15$

ANSWER D **15**

15 Question 15

Which score is impossible? (Maximum possible: $15 \times 5 + 10 \times 6 = 135$.)

Step 1. Work with the marks **lost** from the maximum of 135. A question that does not earn full marks costs:

Q1–15 wrong or blank: 5 | Q16–25 blank: 6 | Q16–20 wrong: 7 | Q21–25 wrong: 8

Step 2. So every question that loses marks loses at least 5 and at most 8.

Step 3. **127** (lose 8): one wrong answer in Q21–25. ✓ | **128** (lose 7): one wrong answer in Q16–20. ✓ | **129** (lose 6): leave one of Q16–25 blank. ✓

Step 4. **126** (lose 9): one question loses at most 8, and two questions lose at least $5 + 5 = 10$. No combination gives exactly 9. ✗

ANSWER A **126**

16 Question 16

John climbs at 1 step/s (20 s) and at 2 steps/s (16 s). How many steps are in the escalator?

Step 1. Let the escalator carry people up e steps per second, and let N be the number of steps.

Step 2. **Day 1:** John walks $1 \times 20 = 20$ steps and the escalator carries him $20e$ steps, so $N = 20 + 20e$.

Step 3. **Day 2:** John walks $2 \times 16 = 32$ steps and the escalator carries him $16e$ steps, so $N = 32 + 16e$.

$$20 + 20e = 32 + 16e \Rightarrow 4e = 12 \Rightarrow e = 3$$

Step 4. Then $N = 20 + 20 \times 3 = 80$. Check with day 2: $32 + 16 \times 3 = 80$. ✓

ANSWER D 80

17 Question 17

Tallest tower with 2015 coins (each row has one coin less than the row below).

Step 1. Suppose the tower has k rows and the bottom row has a coins. The total is $a + (a - 1) + \ldots + (a - k + 1) = k(2a - k + 1) / 2$.

Step 2. So $k \times (2a - k + 1) = 2 \times 2015 = 4030 = 2 \times 5 \times 13 \times 31$.

Step 3. The top row has at least 1 coin, so $a \geq k$, which makes the second factor larger than k. So k must be the **smaller** factor in a pair whose product is 4030:

$$1 \times 4030,\ 2 \times 2015,\ 5 \times 806,\ 10 \times 403,\ 13 \times 310,\ 26 \times 155,\ 31 \times 130,\ 62 \times 65$$

Step 4. The largest possible k is 62, with $2a - 62 + 1 = 65$, so $a = 63$. The tower runs 63, 62, ..., 2 and its total is $(63 + 2) \times 62 / 2 = 2015$. ✓

Step 5. Check the nine-coin example: $18 = 2 \times 9 = 3 \times 6$ gives towers of 2 rows $(5 + 4)$ and 3 rows $(4 + 3 + 2)$, the two towers in the picture.

ANSWER C 62

SECTION E

Euclidean Geometry

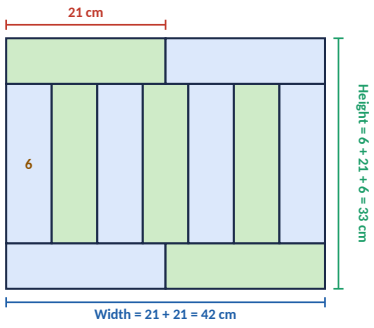


QUESTIONS **18 – 20**

3 × 4 = 12 marks

18 Question 18

Eleven identical rectangles, longer side 21 cm. Find the perimeter of the large rectangle.



Step 1. Let the shorter side of each small rectangle be s cm. The picture has 2 flat rectangles at the top, 7 standing rectangles in the middle and 2 flat ones at the bottom: $2 + 7 + 2 = 11$. ✓

Step 2. **Width:** two flat rectangles side by side give $21 + 21 = 42$ cm.

Step 3. The 7 standing rectangles also fill this width: $7s = 42$, so $s = 6$ cm.

Step 4. **Height:** bottom flat row (6) + standing rectangles (21) + top flat row (6) = 33 cm.

$$\text{Perimeter} = 2 \times (42 + 33) = 150 \text{ cm}$$

ANSWER A 150

19 Question 19

Which figure is possible to construct?

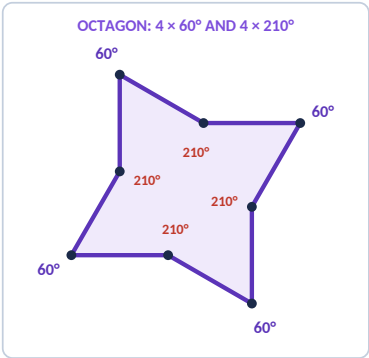
Step 1. **Pentagon with 4 right angles.** A pentagon's angles add up to 540°. Four right angles use 360°, leaving 180° for the fifth angle. A 180° "corner" is a straight line, so it is not a real vertex. Impossible.

Step 2. **Parallelogram with 3 obtuse angles.** Opposite angles are equal, and angles next to each other add up to 180°. Two obtuse angles are always accompanied by two acute ones. Impossible.

Step 3. **Hexagon with 4 reflex angles.** A hexagon's angles add up to 720°. Four reflex angles (each more than 180°) already exceed 4 × 180° = 720°. Impossible.

Step 4. **Octagon with 4 × 60° and 4 × 210° (all sides equal).** The angle sum for an octagon is 6 × 180° = 1080°, and 4 × 60° + 4 × 210° = 1080°. ✓

Step 5. It can be drawn: going round the shape, the turns alternate +120° and −30°, so every pair of sides turns by 90°. Four equal pairs close up into a symmetric four-pointed star with all 8 sides equal.



ANSWER D **An octagon with all 8 sides equal and 4 angles each of measure 60° and the other four angles of measure 210°.**

20 Question 20

Rhombus, side 5. One diagonal ≥ 6, the other ≤ 6. Maximum sum of the diagonals?

Step 1. The diagonals of a rhombus cross at right angles and bisect each other. With half-diagonals p and q, Pythagoras gives:

$$p^2 + q^2 = 25$$

Step 2. Say the shorter diagonal is $2q \le 6$, so $q \le 3$. Then $p = \sqrt{(25 - q^2)} \ge 4$, so the longer diagonal is at least 8, which satisfies "at least 6".

Step 3. The sum of the diagonals is $2(p + q)$, and $(p + q)^2 = 25 + 2pq$. For q between 0 and 3, $pq = q\sqrt{(25 - q^2)}$ keeps increasing, so the maximum is at $q = 3$, $p = 4$.

$$\text{Sum} = 2 \times (4 + 3) = 14$$

Step 4. Why not $10\sqrt{2} \approx 14.14$? That is the sum for a square ($p = q$), but a square's diagonals are both about 7.07, which breaks the "at most 6" condition.

ANSWER C **14**

SECTION F

Number Theory



QUESTIONS
21 – 25
5 × 4 = 20 marks

21 Question 21

A number leaves remainder 2 when divided by 6. Possible remainders when divided by 9?

Step 1. Write the number as $n = 6k + 2$, where $k = 0, 1, 2, 3, \ldots$

Step 2. Divide the first few numbers by 9:

$k = 0$: 2 → remainder 2 | $k = 1$: 8 → remainder 8 | $k = 2$: 14 → remainder 5 | $k = 3$: 20 → remainder 2

Step 3. From $k = 3$ the remainders repeat (because $6 \times 3 = 18$ is a multiple of 9). So the possible remainders are 2, 5 and 8.

ANSWER D **{2, 5, 8}**

22 Question 22

Number of 5-digit multiples of 13.

Step 1. 5-digit numbers run from 10,000 to 99,999.

Step 2. The smallest multiple of 13 that is at least 10,000: 13 × 769 = 9,997 is too small, so it is 13 × 770 = 10,010.

Step 3. The largest multiple of 13 that is at most 99,999: 13 × 7,692 = 99,996 (13 × 7,693 = 100,009 is too big).

Step 4. The multiples are 13 × 770, 13 × 771, ..., 13 × 7,692. Their number is:

$$7{,}692 - 770 + 1 = 6{,}923$$

ANSWER B **6923**

23 Question 23

The teacher's age, from the 10 guesses and the three clues.

Step 1. "Two of you are off by one" means *both* age − 1 and age + 1 are in the list. Look for guesses that differ by 2: (38, 40), (40, 42), (46, 48) and (57, 59). The ages in between are 39, 41, 47 and 58.

Step 2. Prime numbers among these: 41 and 47. (39 = 3 × 13 and 58 = 2 × 29 are not prime.)

Step 3. "At least half guessed too low": at least 5 of the 10 guesses must be below the age.

Step 4. Age 41: only 34, 38, 40 are below it, which is 3 guesses. ✗ Age 47: 34, 38, 40, 42, 46 are below it, which is 5 guesses. ✓

Step 5. The teacher's age is 47.

ANSWER A **47**

24 Question 24

6-digit numbers ABCABC divisible by 13, with distinct digits and A, C even.

Step 1. ABCABC = ABC × 1000 + ABC = **1001 × ABC**, and 1001 = 7 × 11 × 13. So every number of this form is divisible by 13, and that condition does not remove anything. We only count digit choices.

Step 2. **A:** even and not 0 (a 6-digit number cannot start with 0): 2, 4, 6, 8, so 4 choices.

Step 3. **C:** even and different from A: the even digits are 0, 2, 4, 6, 8, minus A, so 4 choices.

Step 4. **B:** any digit except A and C: 10 − 2 = 8 choices.

$$\text{Total} = 4 \times 4 \times 8 = 128$$

ANSWER A **128**

25 Question 25

Sum of the odd numbers from 1 to 2019: divisible by 100, by 101, both or neither?

Step 1. The sum of the first n odd numbers is n^2. The n-th odd number is $2n - 1$, so $2n - 1 = 2019$ gives $n = 1010$.

$$\text{Sum} = 1010^2 = (10 \times 101)^2 = 100 \times 101^2$$

Step 2. This has both 100 and 101 as factors, so the sum is divisible by both. (Numerically, $1010^2 = 1{,}020{,}100 = 100 \times 10{,}201 = 101 \times 10{,}100$.)

ANSWER C **both 100 and 101**