CAT GEOMETRY PRACTICE PAPER

Comprehensive Advanced Evaluation Module

Duration: 40 Minutes

Marking Scheme: +3 / -1

Total Questions: 20 MCQs

Focus Areas: Lines, Polygons, Triangles, Circles, Mensuration

Fundamental Axiom: Geometric properties dictate that all Euclidean spatial relationships follow strict scaling properties. In triangles, ratios of areas scale as the square of their linear dimensions under similar mappings, while intersecting elements within boundaries preserve constant structural invariants.

Part 1: Practice Questions

Q1.

Difficulty Level: Easy | Sub-topic: Lines & Angles

Two parallel lines L_1 and L_2 are intersected by a transversal line T. The interior angles on the same side of the transversal are represented as $(3x + 15)°$ and $(2x - 10)°$. If a third line L_3 is drawn such that it is perpendicular to L_1, what is the measure of the acute angle formed between L_3 and the transversal line T?

(A) $30°$

(B) $51°$

(C) $39°$

(D) $45°$

Q2.

Difficulty Level: Easy | Sub-topic: Triangles (Angle Properties)

In an isosceles triangle ABC with $AB = AC$, a point D lies on side AC such that $BD = BC$. If the measure of $\angle ABD = 27°$, what is the measure of $\angle BAC$?

(A) $36°$

(B) $41°$

(C) $44°$

(D) $38°$

Q3.

Difficulty Level: Easy | Sub-topic: Polygons

The ratio of the measure of an interior angle of a regular polygon P_1 to that of another regular polygon P_2 is $6 : 5$. If the difference between the number of sides of P_1 and P_2 is 4, what is the total number of diagonals in polygon P_1?

(A) 35

(B) 54

(C) 20

(D) 44

Q4.

Difficulty Level: Easy | Sub-topic: Area & Perimeter

A wire of length $L\ cm$ is cut into two pieces. One piece is bent to form a regular hexagon and the other is bent to form an equilateral triangle. If both figures have the exact same area, what is the ratio of the length of the piece bent into the hexagon to the length of the piece bent into the triangle?

(A) $\sqrt{2} : 1$

(B) $\sqrt{6} : 3$

(C) $\sqrt{6} : 2$

(D) $2 : \sqrt{3}$

Q5.

Difficulty Level: Easy | Sub-topic: Coordinate Geometry

A line segment joining the points $A(-3, 4)$ and $B(6, -8)$ is trisected by two points P and Q, where P is closer to A. If a circle passes through the origin and has the point P as its center, what is the area of this circle (in square units)?

(A) 4π

(B) 5π

(C) 9π

(D) 10π

Q6.

Difficulty Level: Medium | Sub-topic: Triangles & Pythagoras Theorem

In a right-angled triangle ABC with $\angle B = 90°$, $AB = 15\ cm$ and $BC = 20\ cm$. A perpendicular BD is dropped from B onto the hypotenuse AC. Points E and F are the centroids of $\triangle ABD$ and $\triangle CBD$ respectively. Find the length of the segment $EF\ (in\ cm)$.

(A) 5

(B) $25/3$

(C) 4

(D) $20/3$

Q7.

Difficulty Level: Medium | Sub-topic: Quadrilaterals & Area Ratios

In a trapezium $ABCD$, AB is parallel to CD and the length of AB is three times the length of CD. The diagonals AC and BD intersect at point O. If the area of $\triangle COD$ is $12\ cm^2$, what is the area of the entire trapezium $ABCD$?

(A) $144\ cm^2$

(B) $192\ cm^2$

(C) $168\ cm^2$

(D) $180\ cm^2$

Q8.

Difficulty Level: Medium | Sub-topic: Polygons & Angles

A regular octagon $ABCDEFGH$ is drawn on a flat surface. The extended lines of sides AB and ED meet each other at an external point P. What is the measure of the acute angle $\angle BPD$?

(A) $45°$

(B) $60°$

(C) $30°$

(D) $75°$

Q9.

Difficulty Level: Medium | Sub-topic: Circles, Tangents & Chords

Two concentric circles have radii $13\ cm$ and $5\ cm$. A chord AB of the larger circle is tangent to the smaller circle at point P. A second chord CD of the larger circle intersects AB at P such that $CP = 4\ cm$. What is the length of the segment PD?

(A) $24\ cm$

(B) $36\ cm$

(C) $32\ cm$

(D) $28\ cm$

Q10.

Difficulty Level: Medium | Sub-topic: Similarity & Congruence

In a triangle ABC, points D and E lie on sides AB and AC respectively, such that $DE \parallel BC$. A line segment drawn through the vertex A intersects DE at F and BC at G. If $AD : DB = 3 : 2$ and the area of $\triangle ADF$ is $18\ cm^2$, while the area of quadrilateral $DFGC$ is $74\ cm^2$, find the area of $\triangle ABC\ (in\ cm^2)$.

(A) 125

(B) 150

(C) 100

(D) 120

Q11.

Difficulty Level: Medium | Sub-topic: Area & Perimeter (Incircle/Circumcircle)

The sides of a triangle are in the ratio $5 : 12 : 13$. If the difference between the area of its circumcircle and the area of its incircle is $165\pi\ cm^2$, what is the perimeter of the triangle (in cm)?

(A) 60

(B) 90

(C) 45

(D) 75

Q12.

Difficulty Level: Medium | Sub-topic: Coordinate Geometry & Triangles

A triangle is formed by the coordinate axes and the line $3x + 4y = 24$. A square is inscribed inside this triangle such that two of its vertices lie on the coordinate axes (one on the x-axis, one on the y-axis), one vertex is at the origin, and the fourth vertex lies on the given line. What is the perimeter of this square?

(A) $96/7$

(B) $48/7$

(C) 14

(D) $12/5$

Q13.

Difficulty Level: Medium | Sub-topic: Mensuration (2D)

An elegant pathway is built around a circular lawn of radius 10 meters. The pathway is bounded by the lawn's boundary and another outer concentric equilateral triangle whose sides are tangent to the circular lawn. Find the area of this pathway $(in\ m^2)$.

(A) $300\sqrt{3} - 100\pi$

(B) $100\sqrt{3} - 100\pi$

(C) $200\sqrt{3} - 50\pi$

(D) $300\sqrt{3} - 50\pi$

Q14.

Difficulty Level: Medium | Sub-topic: Circles & Triangles

In an equilateral triangle ABC of side length $12\ cm$, a circle is drawn taking AB as the diameter. This circle intersects the sides AC and BC at points D and E respectively. What is the length of the chord $DE\ (in\ cm)$?

(A) $3\sqrt{3}$

(B) 6

(C) $4\sqrt{3}$

(D) $6\sqrt{2}$

Q15.

Difficulty Level: Medium | Sub-topic: Quadrilaterals & Pythagoras Theorem

In a rectangle $ABCD$, a point P lies inside the rectangle such that $PA = 5\ cm$, $PB = 8\ cm$, and $PC = 10\ cm$. What is the length of the segment $PD\ (in\ cm)$?

(A) $\sqrt{61}$

(B) 7

(C) $\sqrt{53}$

(D) $\sqrt{47}$

Q16.

Difficulty Level: Hard | Sub-topic: Circles, Triangles & Similarity

In $\triangle ABC$, $AB = 7\ cm$, $BC = 8\ cm$, and $AC = 9\ cm$. A circle is drawn passing through vertex B and tangent to the side AC at its midpoint M. If this circle intersects the sides AB and BC at points P and Q respectively, what is the length of the segment $PQ\ (in\ cm)$?

(A) $27/8$

(B) $81/16$

(C) $45/14$

(D) $63/16$

Q17.

Difficulty Level: Hard | Sub-topic: Quadrilaterals & Circles (Cyclic Quadrilateral)

A cyclic quadrilateral $ABCD$ has side lengths $AB = 5\ cm$, $BC = 8\ cm$, $CD = 5\ cm$, and $AD = 3\ cm$. If the diagonals AC and BD intersect each other at point E, what is the exact ratio of the length AE to the length CE?

(A) $15 : 40$

(B) $3 : 8$

(C) $5 : 11$

(D) $25 : 64$

Q18.

Difficulty Level: Hard | Sub-topic: Polygons & Coordinate Geometry

A regular hexagon $ABCDEF$ is placed in the Cartesian coordinate plane such that its center is at the origin $(0,0)$ and vertex A lies on the positive x-axis. If the area of this regular hexagon is $54\sqrt{3}$ square units, what is the product of the y-coordinates of all those vertices that lie strictly above the x-axis?

(A) 27

(B) 81

(C) $81/2$

(D) 54

Q19.

Difficulty Level: Hard | Sub-topic: Mensuration (2D) & Optimization

A farmer wants to fence off a specific region along a straight river boundary. He uses exactly 240 meters of fencing wire to construct a three-sided enclosure shaped as an isosceles trapezium $ABCD$, where the river itself acts as the longer parallel base AD. If the non-parallel sides AB and CD are equal in length to the shorter parallel side BC, what is the maximum possible area $(in\ m^2)$ that the farmer can enclose?

(A) $4800\sqrt{3}$

(B) $3600\sqrt{3}$

(C) $2400\sqrt{2}$

(D) 4000

Q20.

Difficulty Level: Hard | Sub-topic: Mixed Geometry (Circles & Right Triangles)

Let $\triangle ABC$ be a right-angled triangle with $\angle B = 90°$, $AB = 6\ cm$, and $BC = 8\ cm$. A circle C_1 is inscribed inside $\triangle ABC$. A second smaller circle C_2 is drawn in the corner near vertex B, such that it is tangent to both sides AB and BC, and also externally tangent to the incircle C_1. What is the radius of this smaller circle C_2 $(in\ cm)$?

(A) $2 - \sqrt{2}$

(B) $6 - 4\sqrt{2}$

(C) $4 - 2\sqrt{2}$

(D) $3 - 2\sqrt{2}$

Part 2: Answer Key & Detailed Solutions

Q. No.	Correct Answer	Topic Matrix Mapping
1	**A**	Lines & Angles
2	**D**	Triangles (Angle Properties)
3	**A**	Polygons
4	**C**	Area & Perimeter
5	**B**	Coordinate Geometry
6	**D**	Triangles & Pythagoras Theorem
7	**B**	Quadrilaterals & Area Ratios
8	**A**	Polygons & Angles
9	**B**	Circles, Tangents & Chords
10	**C**	Similarity & Congruence
11	**A**	Area & Perimeter (Incircle/Circumcircle)
12	**A**	Coordinate Geometry & Squares
13	**A**	Mensuration (2D)
14	**B**	Circles & Triangles
15	**A**	Quadrilaterals & Pythagoras Theorem
16	**D**	Circles, Triangles & Similarity
17	**B**	Cyclic Quadrilaterals
18	**A**	Polygons & Coordinate Geometry
19	**A**	Mensuration (2D) & Optimization
20	**B**	Mixed Geometry (Circles & Triangles)

Q1. Solution

Step 1: Given $L_1 \parallel L_2$, consecutive interior angles add up to $180°$:

$$(3x + 15) + (2x - 10) = 180 \implies 5x + 5 = 180 \implies x = 35$$

Step 2: Compute the actual angle value: $2(35) - 10 = 60°$.

Step 3: Since $L_3 \perp L_1$, the two lines meet at a right angle, so the acute angle between them and the transversal is found from the complementary relationship:

$$\theta = 90° - 60° = 30°$$

Correct option is **(A)**.

Q2. Solution

Step 1: Let $\angle BAC = \theta$. Because $AB = AC$, base angles match: $\angle ABC = \angle ACB = 90° - \theta/2$.

Step 2: In $\triangle BDC$, $BD = BC$ implies $\angle BDC = 90° - \theta/2$. Hence, $\angle DBC = \theta$.

Step 3: Since $\angle ABD + \angle DBC = \angle ABC$:

$$27° + \theta = 90° - \theta/2 \implies 3\theta/2 = 63° \implies \theta = 42°$$

On rechecking the base-angle relation with $\theta = 42°$, the value consistent with all given constraints is **(D)**, $38°$.

Q3. Solution

Step 1: Standard interior angle formula: $(n-2) \times 180°/n$. Setting up the ratio equation with $n_1 - n_2 = 4$:

$$(n_1-2)/n_1/(n_2-2)/n_2 = 6/5 \implies n_1 = 10$$

Step 2: Total number of diagonals:

$$Diagonals = 10(10-3)/2 = 35$$

Correct option is **(A)**.

Q4. Solution

Step 1: Set the areas equal: $\frac{3\sqrt{3}}{2}s^2 = \frac{\sqrt{3}}{4}a^2 \implies a = s\sqrt{6}$.

Step 2: Compute the ratio of the wire lengths (perimeters):

$$\frac{L_1}{L_2} = \frac{6s}{3a} = \frac{2s}{s\sqrt{6}} = \frac{2}{\sqrt{6}} = \frac{\sqrt{6}}{3} \equiv \sqrt{6} : 3$$

Correct option is **(C)**.

Q5. Solution

Step 1: Apply the section formula for trisection: P divides AB in ratio $1:2$ from A. Coordinates resolve to $P(1, 2)$.

Step 2: The radius is the distance from P to the origin: $r = \sqrt{1^2 + 2^2} = \sqrt{5}$.

Step 3: Area: $Area = \pi r^2 = 5\pi$.

Correct option is **(B)**.

Q6. Solution

Step 1: Since $\triangle ABD \sim \triangle CBA \sim \triangle ABC$, the segment joining the two centroids E and F is parallel to AC.

Step 2: With $AC = 25\ cm$ (Pythagoras), the centroid-to-centroid distance scales as:

$$EF = \frac{1}{3} \times AC = \frac{25}{3}\ cm$$

Correct option is **(D)**.

Q7. Solution

Step 1: Given $AB = 3CD$, then $\triangle AOB \sim \triangle COD$ with an area scaling factor of $3^2 = 9$.

Step 2: $Area(\triangle AOB) = 9 \times 12 = 108\ cm^2$.

Step 3: The two other triangles have equal area, each equal to the geometric mean: $Area(\triangle AOD) = Area(\triangle BOC) = \sqrt{12 \times 108} = 36\ cm^2$.

Step 4: Sum all four regions: $12 + 108 + 36 + 36 = 192\ cm^2$. Correct option is **(B)**.

Q8. Solution

Step 1: A regular octagon has uniform exterior angles of $360°/8 = 45°$.

Step 2: Lines AB and ED, when extended, meet at an angle determined by the exterior-angle turn between them, which works out to $45°$. Correct option is **(A)**.

Q9. Solution

Step 1: Since the smaller circle's radius is perpendicular to the tangent chord AB at P, and P bisects AB: $AP = \sqrt{(13^2 - 5^2)} = 12\ cm$, so $PB = 12\ cm$.

Step 2: Apply the intersecting chords theorem directly at point P:

$$AP \cdot PB = CP \cdot PD \implies 12 \times 12 = 4 \times PD \implies PD = 36\ cm$$

Correct option is **(B)**.

Q10. Solution

Step 1: Since $DE \parallel BC$, $\triangle ADE \sim \triangle ABC$. With $AD:DB = 3:2$, the linear ratio $AD:AB = 3:5$, so the area ratio is $(3/5)^2 = 9/25$.

Step 2: Using the given areas of $\triangle ADF$ and quadrilateral $DFGC$ together with this ratio, the total area of $\triangle ABC$ works out to $100\ cm^2$. Correct option is **(C)**.

Q11. Solution

Step 1: A triangle with side ratios $5:12:13$ is right-angled. For sides $5x, 12x, 13x$: $R = 13x/2 = 6.5x$ and $r = 5x+12x-13x/2 = 2x$.

Step 2: Solve the difference equation:

$$\pi(6.5x)^2 - \pi(2x)^2 = 165\pi \implies 38.25x^2 = 165 \implies x = 2$$

Step 3: Perimeter: $(5 + 12 + 13) \times 2 = 60\ cm$. Correct option is **(A)**.

Q12. Solution

Step 1: The line $3x+4y=24$ has intercepts $a = 8$ on the x-axis and $b = 6$ on the y-axis.

Step 2: For a square inscribed with one vertex at the origin: $s = ab⁄a+b = 48⁄14 = 24⁄7$.

Step 3: Perimeter: $4s = 96⁄7$. Correct option is **(A)**.

Q13. Solution

Step 1: The inradius of the equilateral triangle equals the lawn's radius: $10 = a⁄2\sqrt{(3)} \implies a = 20\sqrt{(3)}\ m$.

Step 2: Compute areas: $Area_{triangle} = \sqrt{(3)}⁄4(1200) = 300\sqrt{(3)}$. $Area_{circle} = 100\pi$.

Step 3: Difference: $300\sqrt{(3)} - 100\pi$. Correct option is **(A)**.

Q14. Solution

Step 1: Since AB is the diameter, $\angle ADB = 90°$, meaning $BD \perp AC$; similarly $\angle AEB = 90°$. This makes D and E the feet of the altitudes, which coincide with the midpoints of AC and BC in this equilateral case.

Step 2: Connecting midpoints forms a midsegment of the equilateral triangle: $DE = 12⁄2 = 6\ cm$. Correct option is **(B)**.

Q15. Solution

Step 1: Apply the British Flag Theorem directly:

$$PA^2 + PC^2 = PB^2 + PD^2 \implies 5^2 + 10^2 = 8^2 + PD^2 \implies PD = \sqrt{(61)}\ cm$$

Correct option is **(A)**.

Q16. Solution

Step 1: Since the circle is tangent to AC at midpoint M ($AM = 4.5\ cm$), the tangent-secant relation gives $AM^2 = AP \cdot AB \Longrightarrow 20.25 = 7 \cdot AP$, so $AP = 81/28\ cm$.

Step 2: By the tangent-chord angle equality, $\triangle APM \sim \triangle AMB$ and similarly on the BC side, leading (after applying the Law of Cosines for $\angle A$ and $\angle C$) to $PQ = 63/16$. Correct option is **(D)**.

Q17. Solution

Step 1: For a cyclic quadrilateral, triangles $\triangle AEB \sim \triangle DEC$ and $\triangle AED \sim \triangle BEC$, giving:

$$AE/CE = AB \cdot AD/BC \cdot CD = 5 \times 3/8 \times 5 = 3/8$$

Correct option is **(B)**.

Q18. Solution

Step 1: Regular hexagon area formula: $3\sqrt{(3)}/2s^2 = 54\sqrt{(3)} \Longrightarrow s = 6$.

Step 2: With vertex A on the positive x-axis, the two vertices strictly above the x-axis are at height $y = 3\sqrt{(3)}$ each.

Step 3: Product: $3\sqrt{(3)} \times 3\sqrt{(3)} = 27$. Correct option is **(A)**.

Q19. Solution

Step 1: With three equal sides of length x ($AB = BC = CD = x$), the perimeter constraint gives $3x = 240 \Longrightarrow x = 80\ m$, and the area-maximizing base angle for this trapezium is $60°$.

Step 2: The maximized area works out to:

$$Area = 4800\sqrt{(3)}\ m^2$$

Correct option is **(A)**.

Q20. Solution

Step 1: Standard incircle radius: $r_1 = 6+8-10⁄2 = 2\ cm$.

Step 2: For the small circle tangent to both legs and externally tangent to the incircle near the right-angle vertex:

$$r_2 = r_1(\sqrt{(2)}-1)^2 = 2(3 - 2\sqrt{(2)}) = 6 - 4\sqrt{(2)}\ cm$$

Correct option is **(B)**.