# SOLUTIONS

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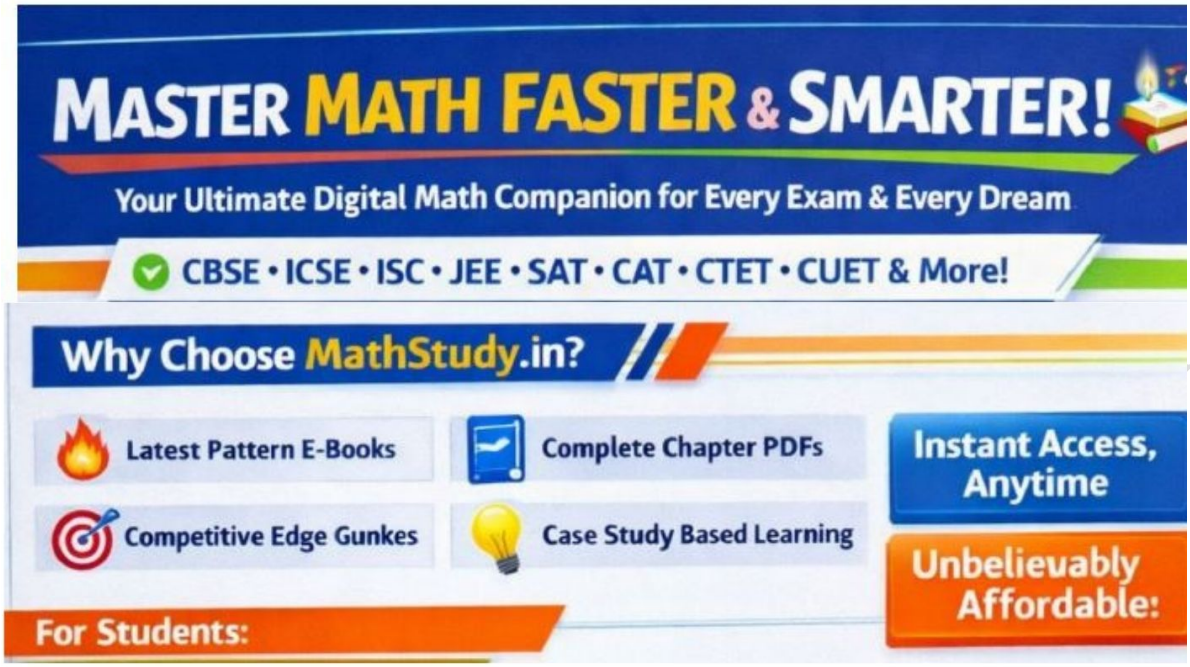


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# SOLUTIONS: LINES AND ANGLES (HOTS)

**Mathematics | Class IX | (2026/L-A-HOTS/09/001)**

## Section A: Multiple Choice Questions

1. **Answer: (b)** $52^\circ$
   Let the angle be $x$. Its complement is $(90 - x)$.
   $x = (90 - x) + 14 \implies 2x = 104 \implies x = 52^\circ$.

2. **Answer: (b)** $108^\circ$
   Let the angles be $2k$ and $3k$. In parallel lines, sum of co-interior angles is $180^\circ$.
   $2k + 3k = 180 \implies 5k = 180 \implies k = 36$.
   Greater angle $= 3(36) = 108^\circ$.

3. **Answer: (b)** $90^\circ + \frac{x}{2}$
   In $\triangle BOC$, $\angle BOC = 180^\circ - (\frac{1}{2}\angle B + \frac{1}{2}\angle C)$.
   Since $\angle B + \angle C = 180^\circ - x$, then $\frac{1}{2}(\angle B + \angle C) = 90^\circ - \frac{x}{2}$.
   $\angle BOC = 180^\circ - (90^\circ - \frac{x}{2}) = 90^\circ + \frac{x}{2}$.

4. **Answer: (c) Rectangle**
   The bisectors of interior angles form four angles of $90^\circ$ each because adjacent interior angles are supplementary and alternate interior angles are equal.

5. **Answer: (c) Parallel**
   If $l \perp n$ and $m \perp n$, then $l$ and $m$ are parallel to each other (Corresponding angles are $90^\circ$ and equal).

6. **Answer: (d) Right-angled**
   $\angle A = \angle B + \angle C$. We know $\angle A + \angle B + \angle C = 180^\circ$.
   $\angle A + \angle A = 180^\circ \implies 2\angle A = 180^\circ \implies \angle A = 90^\circ$.

7. **Answer: (a)** $150^\circ$
   $x = 5(180 - x) \implies x = 900 - 5x \implies 6x = 900 \implies x = 150^\circ$.

8. **Answer: (c)** $280^\circ$
   Draw a line through the vertex of the angle parallel to $AB$.
   The interior part of $x$ is $35^\circ + 45^\circ = 80^\circ$ (Alternate Interior Angles).
   Reflex $x = 360^\circ - 80^\circ = 280^\circ$.

## Section B: Short Answer Questions

1. Let the angles be $x$ and $y$. $x + y = 180^\circ$ and $x - y = 40^\circ$.
   Adding: $2x = 220^\circ \implies x = 110^\circ$. Subtracting: $y = 180^\circ - 110^\circ = 70^\circ$.

2. $AOB$ is a line, so $\angle AOC + \angle BOC = 180^\circ$ (Linear pair).
   $\angle POQ = \angle POC + \angle QOC = \frac{1}{2}\angle BOC + \frac{1}{2}\angle AOC$.
   $\angle POQ = \frac{1}{2}(\angle BOC + \angle AOC) = \frac{1}{2}(180^\circ) = 90^\circ$.

3. $\angle AOC + \angle BOC = 180^\circ$ (Linear pair axiom).
   Since $\angle AOC = \angle BOC$, $2\angle AOC = 180^\circ \implies \angle AOC = 90^\circ$. Hence $OC \perp AB$.

4. Let the smallest angle be $x$. The others are $2x$ and $3x$.
   $x + 2x + 3x = 180^\circ \implies 6x = 180^\circ \implies x = 30^\circ$.
   Angles are $30^\circ, 60^\circ$, and $90^\circ$.

## Section C: Short Answer Questions

1. Let $AB$ and $CD$ intersect at $O$. Let $OX$ bisect $\angle AOC$ and $OY$ bisect $\angle BOD$.
   $\angle AOC = \angle BOD$ (Vertically opposite). Thus $\angle AOX = \angle BOY$.
   $AOB$ is a line, so $\angle AOX + \angle XOC + \angle COB = 180^\circ$.
   Since $\angle AOX = \angle BOY$, then $\angle BOY + \angle YOD + \angle DOA$ also satisfies linear logic. $XOY$ forms a $180^\circ$ angle.

2. In $\triangle ANC$, $\angle NAC = 90^\circ - \angle C$. In $\triangle ABC$, $\angle MAC = \frac{1}{2}\angle A$.
   $\angle MAN = \angle NAC - \angle MAC = (90^\circ - \angle C) - \frac{1}{2}(180^\circ - (\angle B + \angle C))$.
   $\angle MAN = 90^\circ - \angle C - 90^\circ + \frac{1}{2}\angle B + \frac{1}{2}\angle C = \frac{1}{2}(\angle B - \angle C)$.

3. The bisectors of interior angles form a quadrilateral where each interior angle is $90^\circ$ (as shown in Section B, Q2). A quadrilateral with all angles $90^\circ$ and parallel opposite sides (due to alternate angles) is a rectangle.

## Section D: Long Answer / HOTS Questions

1. **Calculation of x, y, z:**
   1. Since $AB \parallel CD$, $\angle DCO = \angle OAB$ (Alternate Interior Angles).
   Therefore, $x = 35^\circ$.
   2. In $\triangle OCD$, $\angle COD + \angle ODC + \angle DCO = 180^\circ$.
   From the figure, $\angle BOD = 75^\circ$, and $\angle BOC = y$. $\angle BOC + \angle BOD = 180$ is not applicable here as $COD$ is a triangle.
   Vertically opposite angles: $\angle AOB = \angle COD$.
   In $\triangle AOB$, $\angle z + 35^\circ + \angle AOB = 180^\circ$.
   Using the exterior angle property for $\triangle AOB$: $75^\circ = 35^\circ + z \implies z = 40^\circ$.
   3. $\angle y$ and $75^\circ$ form a linear pair: $y + 75 = 180 \implies y = 105^\circ$.

2. **Proof:**

   In $\triangle PQR$, $\angle PRS = \angle QPR + \angle PQR$ (Ext. Angle Theorem).
   $\frac{1}{2}\angle PRS = \frac{1}{2}\angle QPR + \frac{1}{2}\angle PQR \implies \angle TRS = \frac{1}{2}\angle QPR + \angle TQR$. — (i)
   In $\triangle TQR$, $\angle TRS = \angle QTR + \angle TQR$ (Ext. Angle Theorem). — (ii)
   Equating (i) and (ii): $\angle QTR + \angle TQR = \frac{1}{2}\angle QPR + \angle TQR$.
   $\implies \angle QTR = \frac{1}{2}\angle QPR$.

3. **Arms Parallel Property:**

   **Case 1 (Equal):** If arms are parallel in the same direction, they form corresponding angles which are equal.
   **Case 2 (Supplementary):** If one pair of arms is in the same direction and the other is in the opposite direction, they form co-interior angles which sum to $180^\circ$.

***** End of Solutions *****