

Case Study Based Questions

Class – VI

Subject – Mathematics

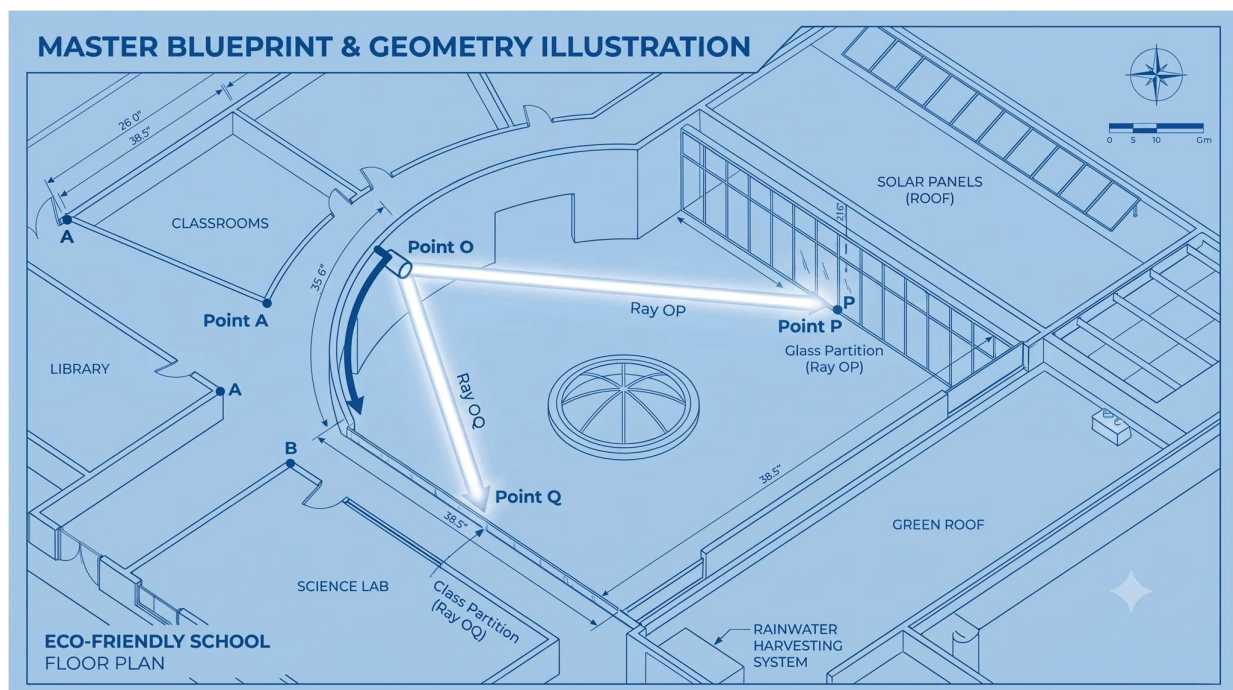
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Chapter 2: Lines and Angles

Case Study 1: Architectural Floor Plan & Highway Design

Context Paragraph:

An architectural firm is designing a new eco-friendly school building. On the master blueprint, the main hallway represents a straight line path passing through reference markers A and B. An emergency spotlight placed at central point O on the wall projects a beam of light towards point P across the courtyard. Two glass partitions branch off from point O along rays OP and OQ to divide the main atrium into study zones. The engineers need to analyse the geometry of these structural lines, rays, and boundary angles to ensure optimal lighting and safety.



Multiple Choice Questions:

- The straight hallway model extends endlessly in both directions across the blueprint. How is this geometric structure correctly denoted?
A) Line segment AB B) Line AB C) Ray AB D) Point AB
- The spotlight beam originates at fixture O and passes endlessly through courtyard marker P. Which geometric figure and symbol represent this beam?
A) Line segment OP B) Line OP C) Ray OP D) Point O
- [HOTS] A junior draftsman labelled the spotlight beam starting at O as PO instead of OP. Why is this labelling incorrect?
A) PO and OP represent line segments of different lengths.
B) The first letter of a ray denotes its starting point; PO starts at P, whereas the beam originates at O.
C) Rays must always be named in alphabetical order regardless of their starting point.
D) PO represents a full line while OP represents a line segment.
- The wall corner where two perpendicular atrium walls meet forms an angle of 90° . What type of angle is formed at this intersection?
A) Acute angle B) Straight angle C) Right angle D) Reflex angle

5. [HOTS] A straight corridor line (180°) at vertex O is divided by partition ray OR into two adjacent angles, $\angle AOR$ and $\angle ROB$. If $\angle AOR$ is exactly twice the size of $\angle ROB$, what is the measure and classification of $\angle AOR$?

- A) 60° , Acute angle
C) 90° , Right angle

- B) 120° , Obtuse angle
D) 135° , Obtuse angle

Answer Key & Explanations (Case Study 1):

Question 1: B) Line AB — A line extends endlessly in both directions.

Question 2: C) Ray OP — A ray starts at one initial point (O) and extends endlessly in one direction.

Question 3: B) — The first letter of a ray denotes its starting point; PO starts at P, whereas the beam originates at O.

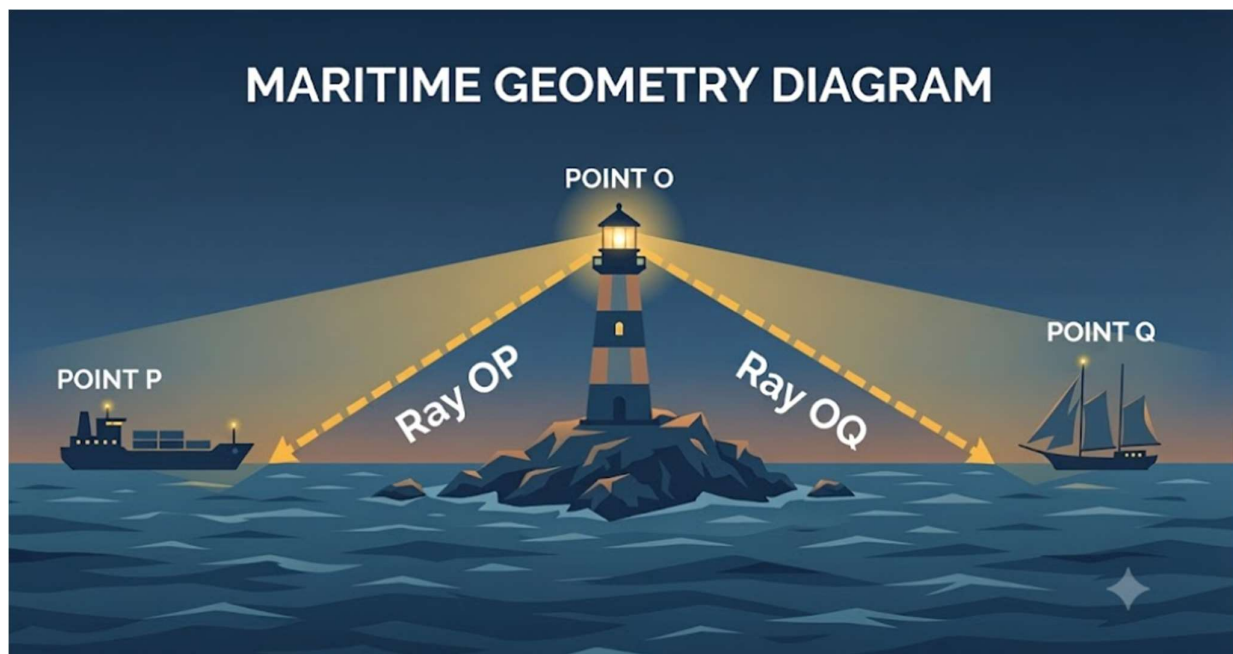
Question 4: C) Right angle — An angle measuring exactly 90° is a right angle.

Question 5: B) 120° , Obtuse angle — Let $\angle ROB = x$. Then $\angle AOR = 2x$. Since they lie on a straight line (180°), $x + 2x = 180^\circ \Rightarrow 3x = 180^\circ \Rightarrow x = 60^\circ$. Thus $\angle AOR = 120^\circ$, which is greater than 90° and less than 180° (Obtuse).

Case Study 2: Navigation and Lighthouse Beacon at Sea

Context Paragraph:

A harbour lighthouse situated at point O on a rocky island uses a rotating beacon to guide ships at night. Two vessel positions in the harbour are marked as Point P and Point Q. The lighthouse keeper tracks the searchlight beam as it sweeps across the water from ray OP to ray OQ. To avoid collisions, maritime navigators calculate the amount of turn (angle) between different ship positions relative to the lighthouse vertex O.



Multiple Choice Questions:

1. What is the vertex of the angle formed by searchlight rays OP and OQ?

- A) Point P B) Point Q C) Point O D) Ray PQ

2. What determines the size of the angle $\angle POQ$ formed by the lighthouse beam?

- A) The distance of ship P from the lighthouse
B) The length of the light rays shining into the ocean

- C) The amount of rotation or turn needed to move from ray OP to ray OQ
- D) The brightness of the lighthouse bulb

3. The beacon turns from directly North to directly East. What fraction of a full turn is this rotation?

- A) $\frac{1}{2}$ turn (180°)
- B) $\frac{1}{4}$ turn (90°)
- C) $\frac{1}{8}$ turn (45°)
- D) 1 full turn (360°)

4. [HOTS] Ship P is located at a bearing of 20° East of North, and Ship Q is located at 110° East of North from lighthouse O. What is the measure of $\angle POQ$ and how is it classified?

- A) 90° , Right angle
- B) 130° , Obtuse angle
- C) 70° , Acute angle
- D) 110° , Obtuse angle

5. [HOTS] Ship P sails further out to sea along the same line, doubling its distance from lighthouse O to point P'. How does the measure of angle $\angle P'OQ$ compare to the original angle $\angle POQ$?

- A) $\angle P'OQ$ becomes twice as large as $\angle POQ$.
- B) $\angle P'OQ$ becomes half as large as $\angle POQ$.
- C) $\angle P'OQ$ remains exactly equal to $\angle POQ$ because arm length does not affect angle size.
- D) $\angle P'OQ$ becomes a straight angle.

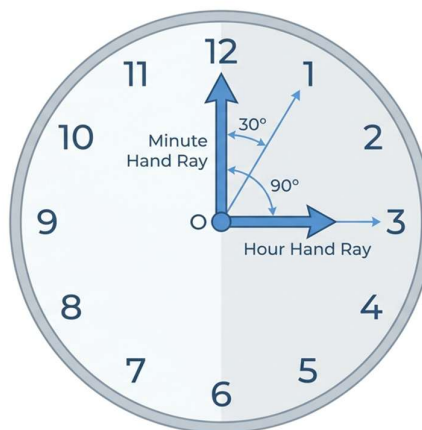
Answer Key & Explanations (Case Study 2):

- Question 1: C) Point O — The common initial starting point of rays OP and OQ is the vertex O.
 Question 2: C) — The size of an angle is defined purely as the amount of rotation about the vertex.
 Question 3: B) $\frac{1}{4}$ turn (90°) — Moving from North to East is a quarter turn (90° , right angle).
 Question 4: A) 90° , Right angle — Measure = $110^\circ - 20^\circ = 90^\circ$, which is a right angle.
 Question 5: C) — The length of the rays/arms does not change the amount of rotation between them.

Case Study 3: Clock Face & Timekeeping Geometry

Context Paragraph:

During a mathematics lab activity, Grade 6 students analyse the movement of hands on an analog clock face. The centre of the clock represents the vertex O, while the hour hand and minute hand act as two rotating arms/rays. The clock dial is divided into 12 equal hour sectors, completing a full circle of 360° . Students record the types of angles formed at various times throughout the school day.



Multiple Choice Questions:

1. What type of angle is formed between the hour hand and minute hand at exactly 3:00 PM?

- A) Acute angle (45°)
- B) Right angle (90°)
- C) Obtuse angle (120°)
- D) Straight angle (180°)

2. At 2:00 PM, what is the degree measure of the angle between the clock hands?
 A) 30° B) 60° C) 90° D) 120°
3. How is the angle formed by the clock hands at 5:00 PM classified?
 A) Acute angle B) Right angle C) Obtuse angle D) Reflex angle
4. [HOTS] Between 12:00 PM and 12:45 PM, the minute hand rotates from the 12 marker to the 9 marker. What is the degree measure of this rotation, and what is its major reflex angle counterpart on the clock face?
 A) Rotation = 270° ; Reflex angle = 90°
 B) Rotation = 180° ; Reflex angle = 180°
 C) Rotation = 270° (Reflex angle); interior acute/right counterpart = 90°
 D) Rotation = 135° ; Reflex angle = 225°
5. [HOTS] Each hour mark on a 12-hour clock represents a sector of 30° ($360^\circ/12$). At what integer hour mark past 12:00 (between 1:00 and 5:00) do the hands form an angle that is equal to exactly $2/3$ of a straight angle (180°)?
 A) 2:00 (60°) B) 3:00 (90°) C) 4:00 (120°) D) 5:00 (150°)

Answer Key & Explanations (Case Study 3):

Question 1: B) Right angle (90°) — At 3:00, the hands span 3 hour sectors ($3 \times 30^\circ = 90^\circ$).

Question 2: B) 60° — At 2:00, the hands span 2 hour sectors ($2 \times 30^\circ = 60^\circ$).

Question 3: C) Obtuse angle — At 5:00, the angle is $5 \times 30^\circ = 150^\circ$, which is between 90° and 180° (Obtuse).

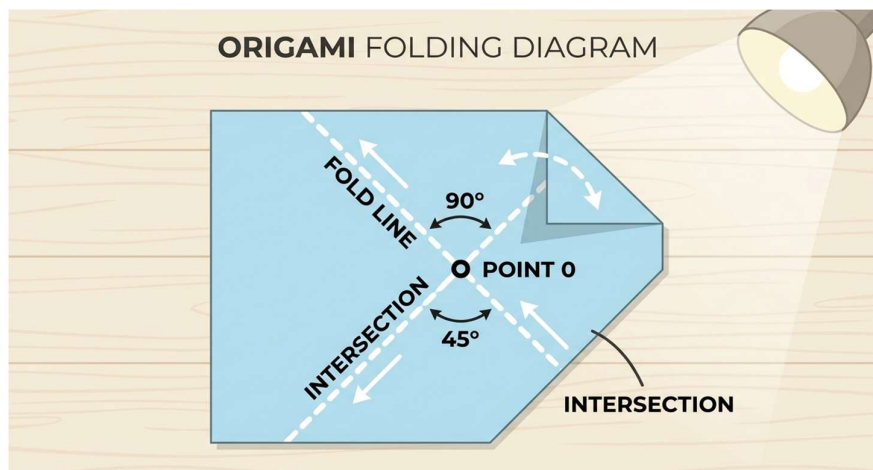
Question 4: C) — Minute hand rotates through 9 sectors = $9 \times 30^\circ = 270^\circ$, which is a reflex angle ($>180^\circ$).

Question 5: C) 4:00 (120°) — $2/3$ of $180^\circ = 120^\circ$. Since each hour sector is 30° , $120^\circ/30^\circ = 4$ hours, which corresponds to 4:00.

Case Study 4: Origami & Paper Folding Exploration

Context Paragraph:

In geometry class, Vidya performs paper-folding experiments with a rectangular sheet of paper. When she folds the paper in half and unfolds it, the crease represents a line segment. By making subsequent intersecting folds, she creates various angles along the edges. Vidya uses these folded paper models to explore straight angles, right angles, and angle comparison techniques such as superimposition.



Multiple Choice Questions:

1. When Vidya unfolds a paper that was folded flat along a single straight crease, what geometric figure does the crease line represent between its two border endpoints?
A) Ray B) Line segment C) Point D) Full turn
2. Vidya opens a folded book cover flat onto her desk in a single straight line. What type of angle is formed by the front and back covers?
A) Right angle (90°) B) Acute angle (45°)
C) Straight angle (180°) D) Reflex angle (270°)
3. If Vidya folds a straight angle crease (180°) exactly in half, what angle measure is formed by the new crease line?
A) 45° B) 90° C) 135° D) 60°
4. [HOTS] Vidya folds a paper sheet so that a straight edge (180°) at vertex O is divided by three crease rays into four equal adjacent angles. What is the measure and classification of each small angle?
A) 45° , Acute angle B) 90° , Right angle C) 30° , Acute angle D) 60° , Acute angle
5. [HOTS] Vidya wants to compare Angle A on a small paper cutout with Angle B drawn in her notebook without using a protractor. What method should she use, and what is the key rule for accuracy?
A) Measure the lengths of the paper edges; the longer edge forms the larger angle.
B) Use superimposition by placing the cutout over the notebook drawing so that their vertices overlap and one arm coincides.
C) Count the number of points on both paper cutouts.
D) Multiply the length of the arms by 2.

Answer Key & Explanations (Case Study 4):

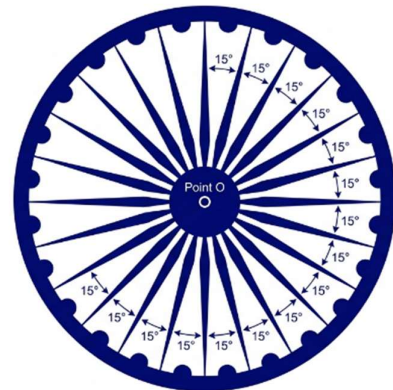
- Question 1: B) Line segment — A crease bounded by two edges of a paper has two endpoints, forming a line segment.
- Question 2: C) Straight angle (180°) — Arms lying in a straight line form a straight angle.
- Question 3: B) 90° — Half of a straight angle ($180^\circ / 2$) forms a right angle (90°).
- Question 4: A) 45° , Acute angle — $180^\circ / 4 = 45^\circ$, which is less than 90° (Acute).
- Question 5: B) — Superimposition requires aligning the vertices and at least one arm to visually compare rotation.

Case Study 5: National Flag & The Ashoka Chakra

Context Paragraph:

During a national festival celebration, students examine the Ashoka Chakra printed on the central white band of the Indian National Flag.

The Ashoka Chakra is a wheel containing 24 equally spaced spokes radiating from the central hub to the outer circular rim. The math teacher asks the students to calculate the geometric angle properties formed by adjacent and distant spokes radiating from the central vertex O.



Multiple Choice Questions:

1. What is the total degree measure of one full circular turn around the center of the Ashoka Chakra?

- A) 180° B) 90° C) 360° D) 270°

2. What is the degree measure of the angle formed between two spokes next to each other in the Ashoka Chakra?

- A) 10° B) 15° C) 24° D) 30°

3. How is the angle between two adjacent spokes classified?

- A) Right angle B) Obtuse angle C) Acute angle D) Straight angle

4. [HOTS] What is the measure of the largest possible acute angle that can be formed between any two spokes of the Ashoka Chakra?

- A) 90° B) 75° C) 85° D) 60°

5. [HOTS] How many spoke gaps are required between two selected spokes to form an angle that is exactly equal to half of a right angle (45°)?

- A) 2 gaps B) 3 gaps C) 4 gaps D) 5 gaps

Answer Key & Explanations (Case Study 5):

Question 1: C) 360° — A complete circular turn measures 360° .

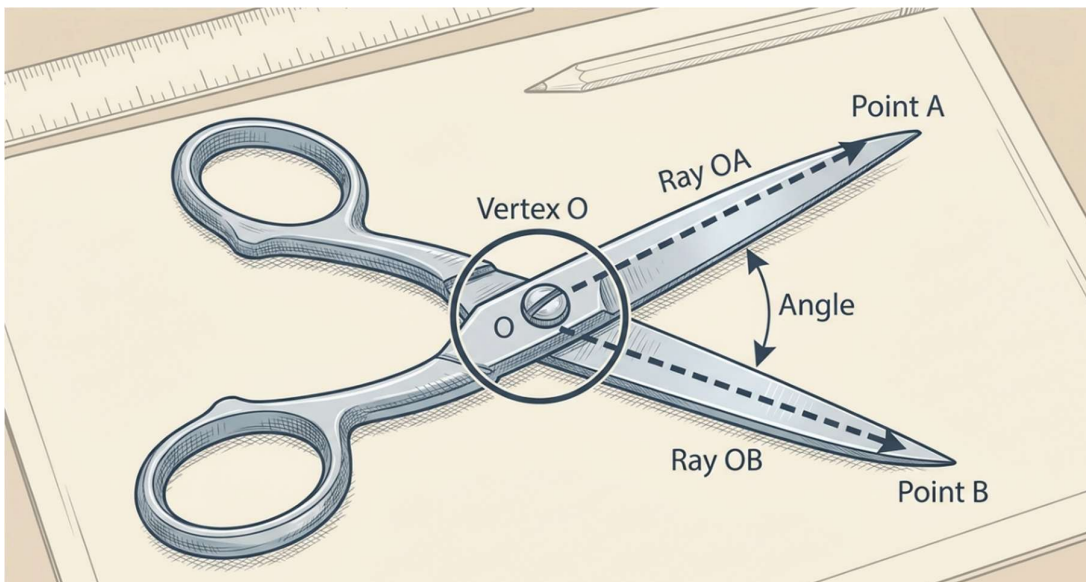
Question 2: B) 15° — Angle between adjacent spokes = $360^\circ / 24 = 15^\circ$.

Question 3: C) Acute angle — 15° is greater than 0° and less than 90° .

Question 4: B) 75° — Multiples of 15° are $15^\circ, 30^\circ, 45^\circ, 60^\circ, 75^\circ, 90^\circ$. The largest multiple strictly less than 90° is 75° (5 spoke gaps).

Question 5: B) 3 gaps — Half of a right angle = 45° . Number of gaps = $45^\circ / 15^\circ = 3$ gaps.

Case Study 6: Carpentry Tools & Adjustable Scissors Shears



Context Paragraph:

In a manual arts workshop, students use tools such as scissors, compasses, dividers, and adjustable ladders. A student named Rihan opens a pair of heavy-duty craft scissors to cut cardboard. The pivot screw joining the two metal blades acts as the common vertex O, while the cutting edges of the blades form two radiating rays. Rihan observes how the angle changes as he opens and closes the handles.

Multiple Choice Questions:

1. In a pair of open scissors, what geometric element is represented by the pivot screw joining the blades?

- A) Line B) Vertex C) Arm D) Ray

2. What geometric structures act as the arms of the angle formed by the open scissors?

- A) The circular finger holes B) The two cutting blade edges radiating from the pivot screw
C) The cardboard being cut D) The length of the table

3. If Rihan opens the scissor blades wider, what happens to the size of the angle?

- A) The angle size decreases because the blades get shorter.
B) The angle size increases because the amount of rotation between the blades increases.
C) The angle size remains unchanged.
D) The angle automatically becomes a straight angle.

4. [HOTS] Rihan opens a small pair of embroidery scissors to an angle of 50° . He then opens a large garden shear with long blades to an angle of 50° . A classmate claims the garden shear forms a larger angle because its arms are longer. Is this claim correct?

- A) Yes, longer arms always create a larger angle.
B) No, because angle size depends entirely on the amount of turn/rotation between the arms, regardless of arm length.
C) Yes, because garden shears have wider metal edges.
D) No, because small scissors always have larger angles.

5. [HOTS] An adjustable drafting compass arm is rotated from closed position (0°) to an angle of 135° . What type of angle is formed inside the compass, and what is its reflex angle on the outer side?

- A) Inside = Obtuse (135°); Outer Reflex = 225°
B) Inside = Acute (135°); Outer Reflex = 180°
C) Inside = Right (90°); Outer Reflex = 270°
D) Inside = Obtuse (135°); Outer Reflex = 360°

Answer Key & Explanations (Case Study 6):

Question 1: B) Vertex — The central pivot point where the two arms meet is the vertex.

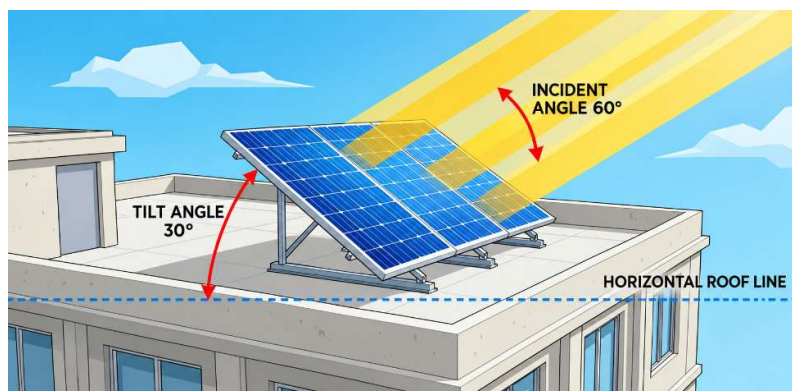
Question 2: B) — The blade edges radiating from the pivot point form the two rays/arms.

Question 3: B) — Opening the blades wider increases the rotation between them, increasing angle size.

Question 4: B) — The size of an angle depends purely on rotation and is independent of arm length.

Question 5: A) Inside = Obtuse (135°); Outer Reflex = 225° — 135° is between 90° and 180° (Obtuse). The reflex angle = $360^\circ - 135^\circ = 225^\circ$.

Case Study 7: Solar Panel Engineering & Installation Slopes



SOLAR ROOFTOP ENGINEERING

Multiple Choice Questions:

1. What geometric term describes the inclination of the solar panel relative to the flat roof?

- A) Line segment length
- B) Slope or angle of rotation
- C) Perimeter
- D) Point location

2. In spring, the panel is tilted at an angle of 35° relative to the flat roof. How is this angle classified?

- A) Acute angle
- B) Right angle
- C) Obtuse angle
- D) Straight angle

3. During maintenance, a panel is lifted until it stands perfectly upright, forming a 90° angle with the roof. What term describes the position of the panel relative to the roof line?

- A) Parallel lines
- B) Perpendicular lines
- C) Straight line
- D) Collinear rays

4. [HOTS] In winter, engineers increase the panel tilt angle from 40° by rotating it upward by an additional 65° . What is the new tilt angle, how is it classified, and how much further rotation would make it a straight angle (180°)?

- A) New angle = 105° (Obtuse); Remaining rotation to straight angle = 75°
- B) New angle = 90° (Right); Remaining rotation to straight angle = 90°
- C) New angle = 105° (Acute); Remaining rotation to straight angle = 85°
- D) New angle = 115° (Obtuse); Remaining rotation to straight angle = 65°

5. [HOTS] A sunbeam strikes the solar panel at an angle of 60° to the panel surface. A sensor normal line is drawn perpendicular (90°) to the panel surface. What is the angle formed between the incoming sunbeam ray and the sensor normal line?

- A) 150°
- B) 30°
- C) 60°
- D) 90°

Answer Key & Explanations (Case Study 7):

Question 1: B) Slope or angle of rotation — Slanted surfaces/ramps form angles with the horizontal base.

Question 2: A) Acute angle — 35° is between 0° and 90° .

Question 3: B) Perpendicular lines — Two lines or surfaces meeting at 90° (right angles) are perpendicular.

Question 4: A) — New angle = $40^\circ + 65^\circ = 105^\circ$ (Obtuse, $>90^\circ$ and $<180^\circ$). Remaining rotation = $180^\circ - 105^\circ = 75^\circ$.

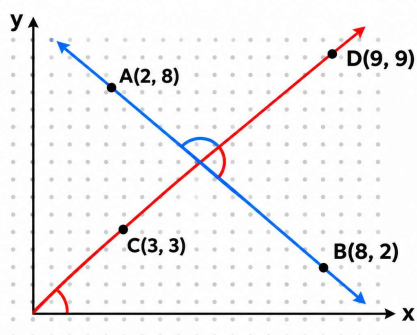
Question 5: B) 30° — Since the normal line forms 90° with the surface, the angle between the ray and the normal = $90^\circ - 60^\circ = 30^\circ$ (Acute).

Case Study 8: Grid Mapping & Geometric Number Puzzles

Context Paragraph:

During a mathematics competition, students are given a square dot-grid paper. Rihaan and Sheetal plot points and draw connecting lines to test various theoretical rules of plane geometry. They also tackle algebraic number puzzles involving acute, right, and obtuse angles based on the properties outlined in their geometry chapter.

GEOMETRIC ANGLES & INTERSECTING LINES



Multiple Choice Questions:

1. Rihaan marks a single Point P on his grid paper. How many distinct straight lines can he draw that pass through Point P?

- A) Exactly 1 line
B) Exactly 2 lines
C) Uncountable / infinite number of lines
D) Zero lines

2. Sheetal marks two distinct points, A and B, on her paper. How many different straight lines can she draw that pass through both points A and B?

- A) Uncountable / infinite number of lines
B) Exactly one unique line
C) Exactly two lines
D) Four lines

3. Sheetal marks 3 points A, B, C on her paper such that they do not lie on a single line (non-collinear). How many distinct lines can be drawn passing through pairs of these points?

- A) 1 line
B) 2 lines
C) 3 lines (AB, BC, CA)
D) 6 lines

4. [HOTS] Rihaan marks 4 points A, B, C, D on grid paper such that no three points lie on the same line. He draws all possible lines connecting pairs of these points. How many lines does he get, and how many interior angles can be named using these points as vertices?

- A) 4 lines and 6 angles
B) 6 lines and 12 angles
C) 6 lines and 4 angles
D) 8 lines and 16 angles

5. [HOTS] Sheetal solves an angle puzzle: 'I am an acute angle measured in whole degrees. If you double my measure, I remain acute. If you triple my measure, I am still acute. If you quadruple (4×) my measure, I am still acute. But if you multiply my measure by 5, I become an obtuse angle.' What are all the possible whole-number degree measures for this angle?

- A) 15° , 16° , 17° , 18°
B) 19° , 20° , 21° , 22°
C) 22.5° , 23° , 24° , 25°
D) 10° , 20° , 30° , 40°

Answer Key & Explanations (Case Study 8):

Question 1: C) Uncountable / infinite number of lines — An infinite number of lines can pass through a single point.

Question 2: B) Exactly one unique line — Two distinct points determine a unique line.

Question 3: C) 3 lines — Connecting 3 non-collinear points pairwise gives 3 unique lines (AB, BC, CA).

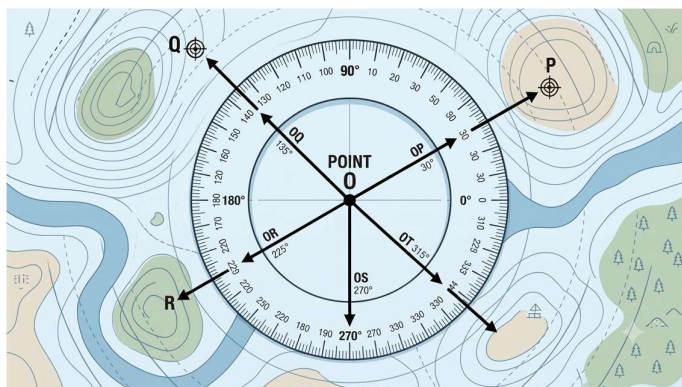
Question 4: B) 6 lines and 12 angles — Pairwise lines = $(4 \times 3) / 2 = 6$ lines (AB, BC, CD, DA, AC, BD). The number of named angles formed at vertices is 12.

Question 5: B) 19° , 20° , 21° , 22° — Let angle be x . $4x < 90^\circ \Rightarrow x < 22.5^\circ$. $5x > 90^\circ \Rightarrow x > 18^\circ$. Integer range: 19° , 20° , 21° , 22° .

Case Study 9: Land Surveying & Angle Measurement Instruments

Context Paragraph:

A land surveyor uses a circular protractor disk to record boundary lines radiating from a central survey benchmark O. Rays OP, OQ, OR, OS, and OT are marked along the protractor scale. The surveyor measures the angles between boundary fences to record land plots in the official registry.



Multiple Choice Questions:

1. What specialized instrument is standard for measuring the degree size of angles in geometry and surveying?
A) Meter scale B) Protractor C) Pair of compasses D) Set square
2. What is the degree measure corresponding to $\frac{1}{4}$ of a full circular turn on a protractor scale?
A) 45° B) 90° C) 180° D) 360°
3. An angle between two boundary property lines measures 145° . How is this angle classified?
A) Acute angle B) Right angle C) Obtuse angle D) Reflex angle
4. [HOTS] On the outer scale of a circular protractor centered at O, ray OT passes through the 20° mark and ray OS passes through the 75° mark. What is the degree measure of angle $\angle TOS$ and how is it classified?
A) 95° , Obtuse angle B) 55° , Acute angle C) 75° , Acute angle D) 20° , Acute angle
5. [HOTS] Two survey angles, $\angle AOB$ and $\angle CDE$, are drawn on separate opaque maps without degree markings. What practical method allows the surveyor to determine which angle is larger without using a protractor?
A) Measure the length of the map paper edges.
B) Trace one angle onto transparent tracing paper and superimpose it over the second angle with matching vertices and overlapping arms.
C) Extend the lines on map A by 10 cm.
D) Count the capital letters in the labels.

Answer Key & Explanations (Case Study 9):

Question 1: B) Protractor — Protractors are used to measure degree sizes of angles.

Question 2: B) 90° — $\frac{1}{4}$ of $360^\circ = 90^\circ$.

Question 3: C) Obtuse angle — 145° is between 90° and 180° (Obtuse).

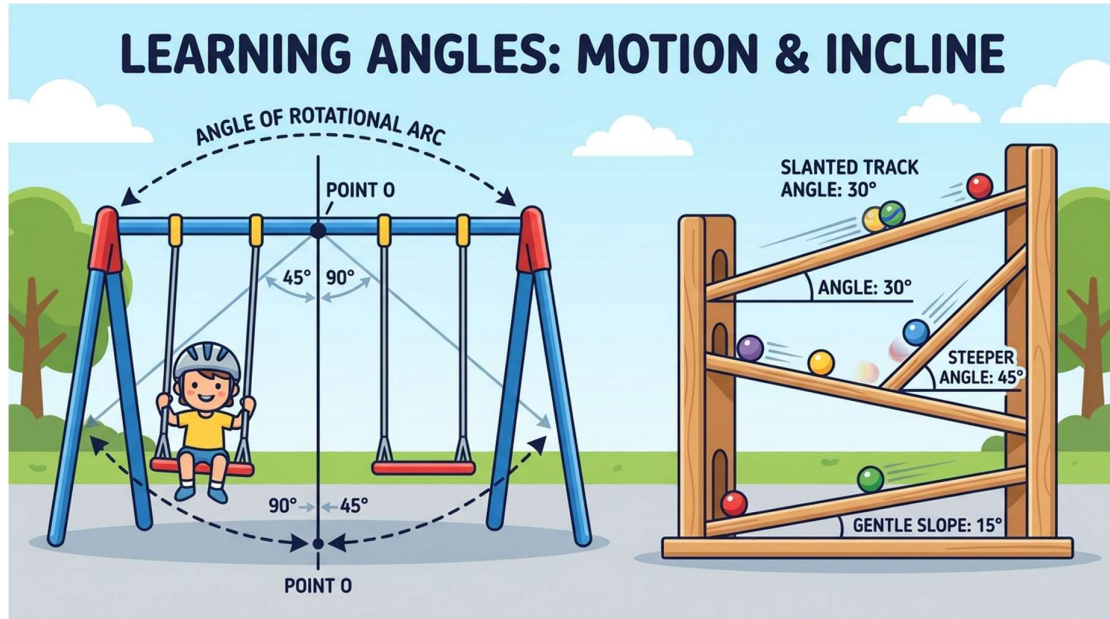
Question 4: B) 55° , Acute angle — Measure = $75^\circ - 20^\circ = 55^\circ$, which is less than 90° (Acute).

Question 5: B) — Superimposition via tracing paper allows direct comparison when figures cannot be moved.

Case Study 10: Playground Equipment, Swings & Marble Motion

Context Paragraph:

During physical education class, students observe geometric principles in action across playground equipment. Vidya swings on a swing set and notices that starting her swing from a higher position increases her speed. Meanwhile, Rihan plays with a wooden toy ramp featuring slanting marble tracks. The physics teacher explains that the motion in both cases can be described using angles of rotation and surface slopes.



Multiple Choice Questions:

1. When a classroom door opens relative to its fixed frame, what acts as the vertex of the opening angle?

- A) The door handle
- B) The vertical door hinge line attached to the wall frame
- C) The bottom edge of the door
- D) The keyhole

2. In a marble ramp toy with slanted track slabs, what forms the two arms of the slope angle for each track?

- A) The marble and the floor
- B) The slanted track slab line and the vertical/horizontal reference frame line
- C) The height of the child and the length of the marble
- D) The two ends of the marble

3. What is the relationship between the slope angle of a marble ramp and the speed of the rolling marble?

- A) Larger slope angles result in slower marble rolling.
- B) Larger slope angles (greater incline) result in faster marble rolling.
- C) Angle size has no effect on rolling speed.
- D) Smaller angles create infinite speed.

4. [HOTS] A heavy gym door opens from its closed position (0°) to a fully open position flat against the wall (180°). If the door is currently opened to $\frac{2}{3}$ of a straight angle turn, what is its degree measure and classification?

- A) 120° , Obtuse angle
- B) 60° , Acute angle
- C) 90° , Right angle
- D) 150° , Obtuse angle

5. [HOTS] A playground swing hangs vertically at rest (0°). When pulled back, it rotates 35° to the left of the vertical rest line. It then swings to the extreme right position, 35° to the right of the vertical rest line. What is the total angle of arc turn from extreme left to extreme right, and how is it classified?

- A) 35° , Acute angle
- B) 70° , Acute angle
- C) 110° , Obtuse angle
- D) 140° , Obtuse angle

Answer Key & Explanations (Case Study 10):

Question 1: B) The vertical door hinge line — The hinge axis serves as the fixed vertex where the door edge and wall meet.

Question 2: B) — One arm is the slanted slab surface and the other arm is the horizontal/vertical support line.

Question 3: B) — Greater slope angles (steeper incline) cause marbles to roll faster.

Question 4: A) 120° , Obtuse angle — $\frac{2}{3}$ of $180^\circ = 120^\circ$, which is between 90° and 180° (Obtuse).

Question 5: B) 70° , Acute angle — Total rotation = 35° (left) + 35° (right) = 70° . 70° is less than 90° (Acute).