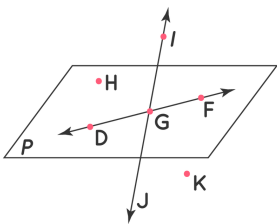
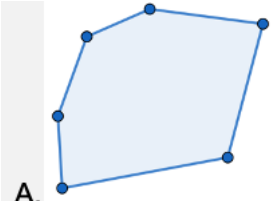
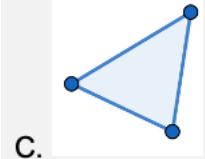
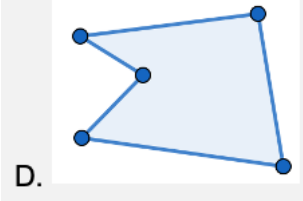


Check Your Understanding 1.3

Show all work. Use correct notation throughout.

Basic	Intermediate	Advanced
Row 1 Spiral — What Makes a Good Definition → Classification and differentiation (final appearance)		
<i>Basic — Spiral</i> 1. A student defines a 'polygon' as: 'A shape made of lines.' What is missing? Write a better definition that correctly includes all polygons and excludes non-polygons such as a circle and a figure-eight.	<i>Intermediate — Spiral</i> 2. Write a definition for 'perpendicular lines' using classification and differentiation. Then test your definition against two examples and two non-examples to verify it includes all perpendicular lines and excludes all non-perpendicular lines.	<i>Advanced — Spiral</i> 3. A student argues: 'Every definition needs undefined terms at its base, so all definitions are ultimately useless.' Evaluate this argument. What is right about it, and what is the student missing about the role of undefined terms in a logical system?
Row 2 Spiral — The Foundational Objects → Naming what we reason about		
<i>Basic — Spiral</i> 4. In the diagram below, identify each object using correct notation.  (a) Name the line. (b) Name the ray. (c) Name the segment.	<i>Intermediate — Spiral</i> 5. Determine whether each set of points is collinear. Show your work. (a) $P(-2, 1)$, $Q(0, 4)$, $R(2, 7)$. (b) $J(1, 5)$, $K(3, 2)$, $L(5, 0)$.	<i>Advanced — Spiral</i> 6. A geometry student says: 'I can define a line as the shortest path between two points.' Explain two problems with this definition — one involving undefined terms and one involving completeness.
Row 3 Spiral — Distance and Midpoint in the Plane → Measuring what we reason about		
<i>Basic — Spiral</i> 7. Find the distance and midpoint for each pair of points. (a) $A(1, 1)$ and $B(7, 9)$. (b) $C(-5, 2)$ and $D(1, -6)$. 8. The midpoint of segment EF is $M(3, 5)$. Point E is at $(1, 2)$. Find F .	<i>Intermediate — Spiral</i> 9. The midpoint of GH is $M(-1, 4)$ and H is at $(3, 6)$. Find G . 10. A segment has endpoints $K(-3, 7)$ and $L(5, 1)$. (a) Find the midpoint M . (b) Find the distance KL . (c) Find the distance from K to M . What fraction of KL is this?	<i>Advanced — Spiral</i> 11. Points $A(2, 1)$, $B(8, 3)$, and $C(5, 7)$ form a triangle. (a) Find all three side lengths exactly. (b) Find the midpoints of all three sides. (c) Is this triangle scalene, isosceles, or equilateral?

Basic	Intermediate	Advanced
Polygons and Area in the Plane → Applying measurement to figures		
<i>Basic</i> 13. Name each polygon by its number of sides and classify it as concave or convex. A.  B.  C.  D.  14. A quadrilateral has vertices $A(0,0)$, $B(4,0)$, $C(4,3)$, $D(0,3)$. Find its area.	<i>Intermediate</i> 15. A polygon has vertices at $A(0,2)$, $B(3,6)$, $C(7,4)$, $D(5,0)$. Find the perimeter. Show your distance formula work for each side. 16. A quadrilateral has vertices $E(0,0)$, $F(6,0)$, $G(6,4)$, $H(0,4)$. Inside it is a triangle with vertices $P(1,1)$, $Q(5,1)$, $R(3,3)$. Find the area of the remaining shape.	<i>Advanced</i> 17. A triangle has vertices $A(0,0)$, $B(6,0)$, $C(2,5)$. Find the area two different ways: (1) $\frac{1}{2} \times \text{base} \times \text{height}$, and (2) bounding rectangle minus extra triangles. Confirm both give the same answer. 18. Explain why you cannot find the length of a slanted side by counting grid squares. What does counting squares actually measure, and why is that different from the slanted distance?
Algebra Spiral Solve equations	<i>Algebra Spiral</i> Solve each equation. Show all steps. (a) $5x + 8 = 2x - 7$ (b) $2(3y - 4) = 4y + 10$ (c) $(1/2)m + 6 = (3/4)m - 2$	

Answers — CYU 1.3**Row 1 Spiral (final appearance)**

1. 'Made of lines' is too vague — lines extend infinitely. Better: a closed, non-self-intersecting figure formed by three or more line segments. This excludes circles (curved sides), figure-eights (self-intersecting), and open paths.
2. Perpendicular lines: two lines (category) that intersect at a right angle (differentiation). Examples: the x-axis and y-axis; a wall meeting a floor. Non-examples: parallel lines (no intersection); two lines crossing at 60° (wrong angle).
3. The student is right that undefined terms exist, but wrong that this makes definitions useless. Undefined terms give the system a firm foundation — they are accepted by agreement, not left unexplained. Definitions built on top of them are precise and usable. The system is not useless; it is grounded.

Row 2 Spiral

4. Answers will vary.
- 5a. Slope PQ = $(4-1)/(0-(-2)) = 3/2$. Slope QR = $(7-4)/(2-0) = 3/2$. Equal $\rightarrow$ collinear.
- 5b. Slope JK = $(2-5)/(3-1) = -3/2$. Slope KL = $(0-2)/(5-3) = -1$. Not equal $\rightarrow$ not collinear.
6. Problem 1 (undefined terms): 'shortest path' uses 'path,' which is equally undefined. Problem 2 (completeness): this definition describes only a segment (between two specific points), not a line, which has no endpoints and extends infinitely.

Row 3 Spiral — Distance & Midpoint

- 7a. Distance = $\sqrt{(36+64)} = 10$. Midpoint = (4, 5).
- 7b. Distance = $\sqrt{(36+64)} = 10$. Midpoint = (-2, -2).
8. $(1+x)/2 = 3 \rightarrow x = 5$. $(2+y)/2 = 5 \rightarrow y = 8$. F = (5, 8).
9. $(x+3)/2 = -1 \rightarrow x = -5$. $(y+6)/2 = 4 \rightarrow y = 2$. G = (-5, 2).
- 10a. M = (1, 4).
- 10b. KL = $\sqrt{(64+36)} = 10$.
- 10c. KM = $\sqrt{(16+9)} = 5$. This is exactly $\frac{1}{2}$ of KL — the midpoint divides the segment in half.
- 11a. AB = $\sqrt{(36+4)} = \sqrt{40} = 2\sqrt{10}$. BC = $\sqrt{(9+16)} = 5$. AC = $\sqrt{(9+36)} = \sqrt{45} = 3\sqrt{5}$.
- 11b. Midpoint AB = (5, 2). Midpoint BC = (6.5, 5). Midpoint AC = (3.5, 4).
- 11c. All three sides are different lengths $\rightarrow$ scalene.

Polygons and Area

13. Accept diagram-specific answers. (a) convex hexagon (b) concave quadrilateral (c) convex triangle (d) concave pentagon.
14. $4 \times 3 = 12$ square units.
15. AB = $\sqrt{(9+16)} = 5$. BC = $\sqrt{(16+4)} = \sqrt{20}$. CD = $\sqrt{(4+16)} = \sqrt{20}$. DA = $\sqrt{(25+4)} = \sqrt{29}$. Perimeter = $5 + 2\sqrt{20} + \sqrt{29} \approx 19.33$.
16. Rectangle = 24. Triangle = $\frac{1}{2} \times 4 \times 2 = 4$. Remaining = 20 square units.
17. Method 1: base = 6, height = 5. Area = 15. Method 2: bounding rect 30, minus left Δ (5) and right Δ (10). Area = 15. $\checkmark$
18. Counting grid squares gives the taxicab distance — the sum of horizontal and vertical steps. A slanted segment's actual length is the hypotenuse of the hidden right triangle, always greater than the sum of its legs.

Algebra Spiral

- (a) $x = -5$
- (b) $y = 9$
- (c) $m = 32$