

Points, Lines, Planes, and Angle Relationships: practice solutions, Grade 10 – download the PDF

Written solutions to the chapter problems. Check each step, then correct yourself.

1 Point, line, or plane?



- a. Point: it marks a location and has no size.
- b. Line: straight and extending in both directions.
- c. Plane: flat and extending in all directions.
- d. Point: a single location.
- e. Plane: a flat surface without edges.

2 Adding two segments



By the Segment Addition Postulate, $PR = PQ + QR = 14.5 + 9.3 = 23.8$.

Answer: $PR = 23.8$ cm.

3 Midpoint on a number line



Length: $|10 - (-6)| = 16$. Midpoint: $\frac{-6 + 10}{2} = 2$.

Answer: the length is 16 units and the midpoint is at **2**. Check: **2** is 8 units from each endpoint.

4 Complement and supplement



Complement: $90^\circ - 37^\circ = 53^\circ$. Supplement: $180^\circ - 37^\circ = 143^\circ$.

5 Vertical angles



The vertical angle is congruent, so it measures 48° . The two other angles each form a linear pair with it: $180^\circ - 48^\circ = 132^\circ$.

Answer: $48^\circ, 132^\circ, 132^\circ$.

6 A linear pair



A linear pair is supplementary: $x + (x + 30) = 180$, so $2x = 150$ and $x = 75$.

Answer: the angles measure 75° and 105° . Check: $75 + 105 = 180$.

7 Angle addition



A right angle measures 90° . By the Angle Addition Postulate, $28 + m\angle BOC = 90$, so $m\angle BOC = 62^\circ$.

8 Segment addition with algebra



$LM + MN = LN$, so $(3x + 2) + (2x + 7) = 44$. That gives $5x + 9 = 44$, $5x = 35$, $x = 7$.

$LM = 3(7) + 2 = 23$ and $MN = 2(7) + 7 = 21$. Check: $23 + 21 = 44$.

Answer: $x = 7$, $LM = 23$ cm, $MN = 21$ cm.

9 Midpoint and distance



Midpoint: $\left(\frac{-3 + 9}{2}, \frac{8 + (-2)}{2} \right) = (3, 3)$.

Distance:

$$AB = \sqrt{(9 - (-3))^2 + (-2 - 8)^2} = \sqrt{12^2 + (-10)^2} = \sqrt{244} = 2\sqrt{61} \approx 15.62.$$

Answer: $M(3, 3)$ and $AB \approx 15.62$ units.

10 Find the other endpoint



Let $B(x, y)$. Then $\frac{7 + x}{2} = 4$, so $x = 1$, and $\frac{2 + y}{2} = -1$, so $y = -4$.

Answer: $B(1, -4)$. Check: the midpoint of $(7, 2)$ and $(1, -4)$ is $(4, -1)$.

11 Bisector equation



A bisector makes congruent angles: $4x + 3 = 6x - 17$, so $20 = 2x$ and $x = 10$.

Each half measures $4(10) + 3 = 43^\circ$, so $m\angle ABC = 2 \times 43 = 86^\circ$.

12 Supplement equals three complements



Let the angle be x . Then $180 - x = 3(90 - x)$, so $180 - x = 270 - 3x$, $2x = 90$, $x = 45$.

Check: the supplement is 135° , the complement is 45° , and $3 \times 45 = 135$.

Answer: 45° .

13 Vertical angles with variables



Vertical angles are congruent: $5x - 12 = 3x + 20$, so $2x = 32$ and $x = 16$.

Each equals $5(16) - 12 = 68^\circ$. The other two angles form linear pairs with them:
 $180 - 68 = 112^\circ$.

14 True or false?



- a. False. Angles of 100° and 80° far apart on a page are supplementary but are not adjacent, so they are not a linear pair.
- b. True. This is the Vertical Angles Theorem: both angles are supplementary to the same neighboring angle.
- c. True. Only one point splits a segment into two equal parts.

15 Intersecting lines



A linear pair adds up to 180° : $(2x + 10) + (3x - 5) = 180$, so $5x + 5 = 180$ and $x = 35$.

$m\angle 1 = 2(35) + 10 = 80^\circ$ and $m\angle 2 = 3(35) - 5 = 100^\circ$. Vertical angles are congruent, so $m\angle 3 = 80^\circ$ and $m\angle 4 = 100^\circ$.

Check: $80 + 100 + 80 + 100 = 360$.

16 A hiking map

a. $\left(\frac{2+14}{2}, \frac{3+12}{2}\right) = (8, 7.5)$.

b. $TC = \sqrt{(14-2)^2 + (12-3)^2} = \sqrt{144 + 81} = \sqrt{225} = 15$ miles. In kilometers:
 $15 \times 1.609 \approx 24.1$ km.

Answer: the rest stop is at $(8, 7.5)$ and the cabin is 15 miles (about 24.1 km) away.

17 Four points on a fence

a. $AB + BC + CD = AD$: $2x + (x + 3) + (3x - 1) = 50$, so $6x + 2 = 50$ and $x = 8$. Then $AB = 16$, $BC = 11$, $CD = 23$. Check: $16 + 11 + 23 = 50$.

b. The midpoint is 25 feet from A . B is 16 ft from A and C is $16 + 11 = 27$ ft from A , and $16 < 25 < 27$, so it lies on $\overline{BC}$, $25 - 16 = 9$ feet from B .

18 Three adjacent angles

a. By angle addition, $x + (2x + 10) + (3x - 4) = 150$, so $6x + 6 = 150$ and $x = 24$. The angles are 24° , 58° , and 68° . Check: $24 + 58 + 68 = 150$.

b. The bisector makes 75° with OA . $m\angle AOB = 24^\circ$ and $m\angle AOC = 24 + 58 = 82^\circ$. Since $24 < 75 < 82$, the bisector lies between OB and OC , 51° from OB .

19 Proof: vertical angles

- $\angle 1$ and $\angle 2$ form a linear pair, so $m\angle 1 + m\angle 2 = 180^\circ$ (Linear Pair Postulate).
- $\angle 2$ and $\angle 3$ form a linear pair, so $m\angle 2 + m\angle 3 = 180^\circ$ (Linear Pair Postulate).
- $m\angle 1 + m\angle 2 = m\angle 2 + m\angle 3$ (substitution, both sums equal 180°).
- $m\angle 1 = m\angle 3$ (subtraction property of equality).

20 Bisectors of a linear pair

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Let the angles be a and b with $a + b = 180$. The bisectors make angles $\frac{a}{2}$ and $\frac{b}{2}$, which are adjacent, so the angle between the bisectors is $\frac{a}{2} + \frac{b}{2} = \frac{180}{2} = 90^\circ$. So they are perpendicular.

Check: $\frac{50}{2} + \frac{130}{2} = 25 + 65 = 90$.

21 Endpoint and length

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$x_Q = 2(-1.5) - (-5) = 2$ and $y_Q = 2(4) - 7 = 1$, so $Q(2, 1)$.

$PQ = \sqrt{(2 - (-5))^2 + (1 - 7)^2} = \sqrt{49 + 36} = \sqrt{85} \approx 9.22$.

22 Why does the construction work?

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1. Draw an arc centered at B crossing the two sides at P and Q , so $BP = BQ$.
2. With the same opening, more than half of PQ , draw arcs centered at P and at Q .
They meet at R , so $PR = QR$.
3. Draw ray BR .

Justification: triangles BPR and BQR have $BP = BQ$, $PR = QR$, and the shared side BR . They are congruent by SSS, so the corresponding angles $\angle PBR$ and $\angle QBR$ are equal.



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