

Quadrilaterals and Polygons: practice solutions, Grade 10 – download the PDF

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

1 Interior angle sums



The formula is $S = (n - 2) \cdot 180^\circ$.

a. $n = 6$: $4 \cdot 180^\circ = 720^\circ$.

b. $n = 8$: $6 \cdot 180^\circ = 1080^\circ$.

c. $n = 15$: $13 \cdot 180^\circ = 2340^\circ$.

2 A regular nonagon



Each exterior angle is $360^\circ \div 9 = 40^\circ$. Each interior angle is $180^\circ - 40^\circ = 140^\circ$. Check:
 $(9 - 2) \cdot 180^\circ \div 9 = 1260^\circ \div 9 = 140^\circ$.

3 Angles of a parallelogram



$\angle R = \angle P = 68^\circ$ because opposite angles are congruent. $\angle Q$ and $\angle P$ are consecutive, so they are supplementary: $\angle Q = 180^\circ - 68^\circ = 112^\circ$. Then $\angle S = \angle Q = 112^\circ$. Check:
 $68 + 112 + 68 + 112 = 360$.

4 Opposite sides



Opposite sides of a parallelogram are congruent, so $3x + 2 = 5x - 6$. Then $8 = 2x$ and $x = 4$. $AB = 3 \cdot 4 + 2 = 14$ cm, and $CD = 5 \cdot 4 - 6 = 14$ cm, which matches.

5 True or false?



- a. True. A square has four right angles, which is the definition of a rectangle.
- b. False. A **3 cm** by **5 cm** rectangle has sides that are not all congruent.
- c. False. In a non-rectangular parallelogram, such as one with sides **5** and **8** and a **60°** angle, the two diagonals have different lengths. Only rectangles have congruent diagonals.

6 Diagonals that bisect



The diagonals bisect each other, so $JN = NL$: $2x + 3 = 4x - 7$, giving $10 = 2x$ and $x = 5$. Then $JN = 2 \cdot 5 + 3 = 13$ and $NL = 4 \cdot 5 - 7 = 13$. The diagonal $JL = 13 + 13 = 26$.

7 A garden bed



The fence is the midsegment: $m = \frac{12 + 20}{2} = 16$ ft (about **4.9 m**).

8 Angles in a pentagon



The sum is $(5 - 2) \cdot 180^\circ = 540^\circ$. So $5x + 100 = 540$, $5x = 440$, $x = 88$. The angles are 88° , 98° , 108° , 118° , 128° . Check: $88 + 98 + 108 + 118 + 128 = 540$.

9 How many sides?



Each exterior angle is $180^\circ - 156^\circ = 24^\circ$. Since the exterior angles add up to 360° , $n = 360 \div 24 = 15$. The polygon is a regular 15-gon. Check: $13 \cdot 180^\circ \div 15 = 156^\circ$.

10 A rhombus from its diagonals



The diagonals are perpendicular and bisect each other, so a side is the hypotenuse of a right triangle with legs 5 and 12: $\sqrt{25 + 144} = 13$ cm. The perimeter is $4 \cdot 13 = 52$ cm. The area is $\frac{10 \cdot 24}{2} = 120$ cm².

11 A rectangular screen



a. The diagonals of a rectangle are congruent: $7x - 5 = 4x + 10$, so $3x = 15$ and $x = 5$. The diagonal is $7 \cdot 5 - 5 = 30$ cm.

b. By the Pythagorean theorem, $\ell = \sqrt{30^2 - 18^2} = \sqrt{900 - 324} = \sqrt{576} = 24$ cm.

12 Angles of a kite



The angles between unequal sides are congruent, so $\angle D = \angle B = 112^\circ$. The sum is 360° , so $\angle C = 360^\circ - 48^\circ - 112^\circ - 112^\circ = 88^\circ$. Diagonal $\overline{AC}$ bisects $\angle A$, so it makes an angle of $48^\circ \div 2 = 24^\circ$ with $\overline{AB}$.

13 Isosceles trapezoid angles



$\overline{AB} \parallel \overline{DC}$, so $\angle D$ and $\angle A$ are supplementary (same-side interior angles):

$\angle D = 180^\circ - 65^\circ = 115^\circ$. Base angles are congruent, so $\angle C = \angle D = 115^\circ$. Check:

$65 + 65 + 115 + 115 = 360$.

14 Which condition is enough?



- a. Yes: one pair of opposite sides is parallel and congruent.
- b. Yes: both pairs of opposite sides are congruent.
- c. No: here the congruent sides are adjacent, which describes a kite and does not force opposite sides to be parallel.
- d. No: a trapezoid has one parallel pair and is not a parallelogram.

15 Coordinate proof: parallelogram



- a. Midpoint of $\overline{AC}$: $\left(\frac{-2+6}{2}, \frac{-1+6}{2}\right) = (2, 2.5)$. Midpoint of $\overline{BD}$: $\left(\frac{4+0}{2}, \frac{1+4}{2}\right) = (2, 2.5)$. The diagonals bisect each other, so $ABCD$ is a parallelogram.
- b. Slope of $\overline{AB}$: $\frac{1-(-1)}{4-(-2)} = \frac{1}{3}$. Slope of $\overline{BC}$: $\frac{6-1}{6-4} = \frac{5}{2}$. The product is $\frac{5}{6} \neq -1$, so $\overline{AB}$ and $\overline{BC}$ are not perpendicular. It is not a rectangle.

16 Coordinate proof: rectangle



Slopes: $PQ = \frac{2}{4} = \frac{1}{2}$; $QR = \frac{4-2}{3-4} = -2$; $RS = \frac{2-4}{-1-3} = \frac{1}{2}$;
 $SP = \frac{0-2}{0-(-1)} = -2$. So $\overline{PQ} \parallel \overline{RS}$ and $\overline{QR} \parallel \overline{SP}$: a parallelogram. Since
 $\frac{1}{2} \cdot (-2) = -1$, adjacent sides are perpendicular, so it is a rectangle. Dimensions:
 $PQ = \sqrt{16+4} = \sqrt{20}$ and $QR = \sqrt{1+4} = \sqrt{5}$. Area = $\sqrt{20} \cdot \sqrt{5} = \sqrt{100} = 10$
 square units. (The diagonals agree: $PR = \sqrt{9+16} = 5$ and $QS = 5$.)

17 Coordinate proof: rhombus



- a. $AB = \sqrt{9 + 16} = 5$, $BC = \sqrt{9 + 16} = 5$, $CD = \sqrt{9 + 16} = 5$,
 $DA = \sqrt{9 + 16} = 5$. Four congruent sides: a rhombus.
- b. The diagonals are $AC = 6$ (horizontal) and $BD = 8$ (vertical), so the area is
 $\frac{6 \cdot 8}{2} = 24$ square units.
- c. In a square the diagonals are congruent, but $AC = 6 \neq BD = 8$.

18 Coordinate proof: trapezoid



- a. Slopes: AB and DC are both 0 , so they are parallel. AD has slope $\frac{4}{2} = 2$ and BC has slope $\frac{4}{-2} = -2$, so the legs are not parallel: exactly one pair. Legs:
 $AD = \sqrt{4 + 16} = \sqrt{20}$ and $BC = \sqrt{4 + 16} = \sqrt{20}$, so it is isosceles.
- b. Bases: $AB = 8$, $DC = 4$. Midsegment = $\frac{8 + 4}{2} = 6$. (Check: the midpoints of the legs are $(1, 2)$ and $(7, 2)$, which are 6 apart.) Height = 4 , so the area is $6 \cdot 4 = 24$ square units.

19 Algebra with a parallelogram



- a. Opposite angles are congruent: $3x + 15 = 5x - 25$, so $40 = 2x$ and $x = 20$. Then
 $\angle A = \angle C = 75^\circ$, and $\angle B = \angle D = 180^\circ - 75^\circ = 105^\circ$.
- b. Let the short side be s . Then $2(s + s + 6) = 76$, $2s + 6 = 38$, $s = 16$. The sides are
16 in and **22 in** (about **40.6 cm** and **55.9 cm**). Check: $2 \cdot 16 + 2 \cdot 22 = 76$.

20 A mystery polygon



- a. $(n - 2) \cdot 180 = 1980$ gives $n - 2 = 11$, so $n = 13$.
- b. From one vertex you cannot reach itself or its two neighbors: $13 - 3 = 10$ diagonals.
- c. Each of the 13 vertices has 10, and each diagonal is counted twice: $\frac{13 \cdot 10}{2} = 65$ diagonals.

21 Joining the midpoints



- a. $M(4, 1)$, $N(9, 5)$, $P(6, 7)$, $Q(1, 3)$.
- b. Move from M to N : $(+5, +4)$. Move from Q to P : $(+5, +4)$. Move from N to P : $(-3, +2)$. Move from M to Q : $(-3, +2)$. Opposite sides are parallel and congruent, so $MNPQ$ is a parallelogram.
- c. In triangle ABC , $\overline{MN}$ joins two midpoints, so it is parallel to $\overline{AC}$ and half as long. In triangle ADC , $\overline{QP}$ is also parallel to $\overline{AC}$ and half as long. So $\overline{MN}$ and $\overline{QP}$ are parallel and congruent, which proves a parallelogram.



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