Parallelograms: properties, criteria and midsegments — Teacher answers

Year 8, lower volume • text pp. 27–36 • textbook lessons 14–18

Use the two prerequisite checks to choose support. Project the worked and guided tasks, then collect the eight paper core questions. Follow-ups and extensions are optional; accept other complete valid methods. This page does not save learners' paper answers.

Ordinary route: prerequisites 4, short inquiry 5, worked/guided 8, independent 15, correction 5, exit 3 minutes. Advanced route: inquiry 18, organise 4, selected practice 13, exit 5 minutes.

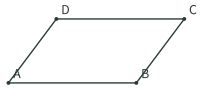
Prerequisites: Parallel lines, triangle congruence and midpoints.

Ordinary route: use the first fixed case for the five-minute demonstration. Advanced route: complete the full investigation.

1. 3′ Predict which of the four half-diagonals in a parallelogram must be equal. Must all four be equal?
2. 8′ Draw A(0,0), B(4,0), C(6,2), D(2,2); join the diagonals and find their common midpoint. Compare a trapezium with vertices (0,0),(4,0),(3,2),(1,2), whose diagonals are equal but do not bisect each other. In a separate triangle, join two side midpoints and predict the new segment's direction and length.
3. 5′ Separate "each diagonal is bisected" from "the diagonals are equal". Use stated parallelism and triangle congruence or an established criterion to justify the claim; measurement alone is not proof.
4. 2′ Individually state the two conditions and length relation for a triangle midsegment.

Worked example 1

ABCD is a parallelogram and AB=8 cm. Find CD and name the property.



Geometry diagram; not drawn to scale except for construction tasks.

Reference answer

$CD = 8$ cm.

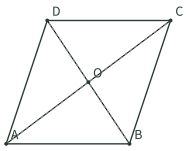
1. Opposite sides of a parallelogram are equal.
2. CD=AB=8 cm.

- Use the stated conditions and justify the relation before calculating.
- Give an exact answer where possible, with units and any domain restrictions.

Guided attempt 2

ABCD is a parallelogram. Its diagonals meet at O and AO=5 cm. Find OC.

1. The diagonals of a parallelogram ____ each other.
2. $AO = OC$, so $OC =$ □ cm.
3. Check the whole diagonal: $AC = AO + OC =$ □ cm.



Geometry diagram; not drawn to scale except for construction tasks.

Reference answer

$OC = 5$ cm.

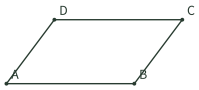
$$OC = 5$$

1. The diagonals bisect each other, so AO=OC.
2. Thus OC=5 cm.

- Use the stated conditions and justify the relation before calculating.
- Give an exact answer where possible, with units and any domain restrictions.

Prerequisite 3

AB ∥ CD and AD ∥ BC. Which quadrilateral family follows directly from the definition?



Geometry diagram; not drawn to scale except for construction tasks.

Reference answer

A parallelogram.

1. Both pairs of opposite sides are parallel.

- Use the stated conditions and justify the relation before calculating.
- Give an exact answer where possible, with units and any domain restrictions.

Prerequisite 4

D is the midpoint of AB and AB=10 cm. Find AD.

Reference answer

5 cm.

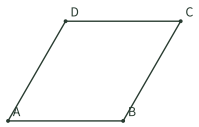
$$5$$

1. A midpoint divides the whole into two equal parts: 10/2=5.

- Use the stated conditions and justify the relation before calculating.
- Give an exact answer where possible, with units and any domain restrictions.

Independent practice 5

ABCD is a parallelogram with ∠A=60°. Find ∠B and explain the angle relation.



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Reference answer

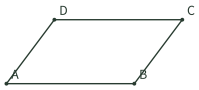
120°; adjacent angles between parallel sides are supplementary.

1. ∠A+∠B=180°.
2. ∠B=180°−60°=120°.

- Use the stated conditions and justify the relation before calculating.
- Give an exact answer where possible, with units and any domain restrictions.

Independent practice 6

Both pairs of opposite sides of ABCD are equal. State the criterion and conclusion.



Geometry diagram; not drawn to scale except for construction tasks.

Reference answer

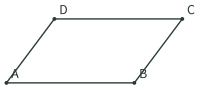
ABCD is a parallelogram by the two-pairs-of-equal-opposite-sides criterion.

1. Use both equal-side pairs; neither pair is omitted.

- Use the stated conditions and justify the relation before calculating.
- Give an exact answer where possible, with units and any domain restrictions.

Independent practice 7

AB ∥ CD and AB=CD. Is ABCD a parallelogram? Identify why the same pair matters.



Geometry diagram; not drawn to scale except for construction tasks.

Reference answer

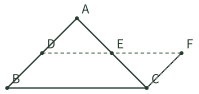
Yes. One pair of opposite sides is both parallel and equal.

1. The parallel and equality conditions concern AB and CD together.

- Use the stated conditions and justify the relation before calculating.
- Give an exact answer where possible, with units and any domain restrictions.

Independent practice 8

D and E are midpoints of AB and AC. Extend DE to F so DE=EF. Prove DE ∥ BC and DE=BC/2 using congruence and a parallelogram criterion.



Geometry diagram; not drawn to scale except for construction tasks.

Reference answer

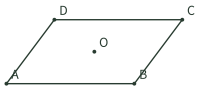
△ADE≅△CFE by SAS. Thus AD=CF and AD ∥ CF; DB=AD gives DB=CF. Hence DBCF is a parallelogram, so DF ∥ BC and DF=BC. Since DF=2DE, the claims follow.

1. AE=EC, DE=EF, and ∠AED=∠CEF are vertical angles; apply SAS.
2. Corresponding sides and angles give AD=CF and AD ∥ CF. Since DB=AD, DB and CF are parallel and equal.
3. Use the parallelogram DBCF to obtain DF ∥ BC and DF=BC; DE=EF then gives DE=BC/2.

- Use the stated conditions and justify the relation before calculating.
- Give an exact answer where possible, with units and any domain restrictions.

Exit question 9

The diagonals of ABCD bisect each other at O. What follows?



Geometry diagram; not drawn to scale except for construction tasks.

Reference answer

ABCD is a parallelogram.

1. Use the criterion involving both diagonal midpoint conditions.

- Use the stated conditions and justify the relation before calculating.
- Give an exact answer where possible, with units and any domain restrictions.

Exit question 10

Only AD=BC is given. Must ABCD be a parallelogram? Use the shown isosceles trapezium as a counterexample.



Geometry diagram; not drawn to scale except for construction tasks.

Reference answer

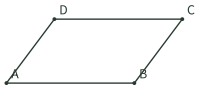
No. One equal opposite-side pair does not ensure both opposite-side pairs are parallel.

1. The legs AD and BC are equal, but AB and CD have different lengths.

- Use the stated conditions and justify the relation before calculating.
- Give an exact answer where possible, with units and any domain restrictions.

Further practice 11

ABCD is a parallelogram with AD=5 cm. Find BC.



Geometry diagram; not drawn to scale except for construction tasks.

Reference answer

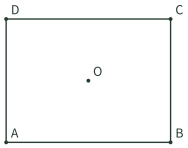
$BC = 5$ cm.

1. BC=AD because they are opposite sides.

- Use the stated conditions and justify the relation before calculating.
- Give an exact answer where possible, with units and any domain restrictions.

Further practice 12

A rectangle ABCD has diagonal AC=10 cm. Its diagonals meet at O. Find AO using a parallelogram property.



Geometry diagram; not drawn to scale except for construction tasks.

Reference answer

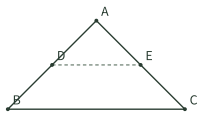
$AO = 5$ cm.

1. A rectangle is a parallelogram, so O bisects AC.
2. AO=10/2=5 cm.

- Use the stated conditions and justify the relation before calculating.
- Give an exact answer where possible, with units and any domain restrictions.

Further practice 13

D,E are midpoints of AB,AC and BC=12 cm. Find DE and its direction relative to BC.



Geometry diagram; not drawn to scale except for construction tasks.

Reference answer

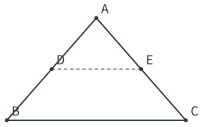
DE=6 cm and DE ∥ BC.

1. The triangle midsegment is parallel to the third side and half its length.

- Use the stated conditions and justify the relation before calculating.
- Give an exact answer where possible, with units and any domain restrictions.

Further practice 14

D,E are midpoints of two triangle sides and DE=7 cm. Find the third side BC.



Geometry diagram; not drawn to scale except for construction tasks.

Reference answer

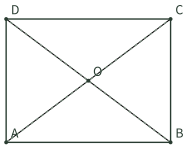
BC=14 cm.

1. DE=BC/2, so BC=2×7=14 cm.

- Use the stated conditions and justify the relation before calculating.
- Give an exact answer where possible, with units and any domain restrictions.

Extension 15

A parallelogram has diagonals AC=BD=10 cm, meeting at O, and AB=8 cm. Are the diagonals perpendicular? Test this using Pythagoras. Then state an extra side condition that would give a rhombus.



Geometry diagram; not drawn to scale except for construction tasks.

Reference answer

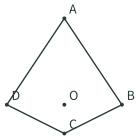
No. $AO = BO = 5$ cm; if the diagonals were perpendicular, $AB^2 = 5^2 + 5^2 = 50$, but $AB^2 = 64$. Equal adjacent sides would give a rhombus.

1. The parallelogram gives two diagonal midpoint conditions.
2. The proposed right triangle would have legs 5 and 5 but hypotenuse 8, contradicting its square relation.

- Use the stated conditions and justify the relation before calculating.
- Give an exact answer where possible, with units and any domain restrictions.

Extension 16

AC bisects BD, but AO≠OC. Must ABCD be a parallelogram? Explain using the shown kite.



Geometry diagram; not drawn to scale except for construction tasks.

Reference answer

No. Both diagonals must bisect each other; one bisection condition is insufficient.

1. BO=OD=2, while AO=3 and OC=1.

- Use the stated conditions and justify the relation before calculating.
- Give an exact answer where possible, with units and any domain restrictions.