

Congruent Triangles: practice solutions, Grade 10 – download the PDF

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

1 Third angle



The angles of a triangle add up to 180° , so the third angle is $180 - 52 - 71 = 57^\circ$.

2 An exterior angle



By the Exterior Angle Theorem, the exterior angle is $38^\circ + 64^\circ = 102^\circ$.

Check: the adjacent interior angle is $180 - 38 - 64 = 78^\circ$, and $78 + 102 = 180$. It works.

3 True or false?



- a. False. SSA is ambiguous: the same data can build two different triangles.
- b. True. The third angles are equal by the angle sum theorem, so AAS becomes ASA.
- c. False. Similar triangles of different sizes have equal angles but are not congruent.
- d. True. Congruent triangles can be matched exactly, so they cover the same area.

4 Corresponding parts



Vertices match in order: $P \leftrightarrow X$, $Q \leftrightarrow Y$, $R \leftrightarrow Z$.

So $XY = PQ = 9$ cm, $YZ = QR = 12$ cm and $m\angle Z = m\angle R = 41^\circ$.

5 Name the criterion



- a. SAS.
- b. ASA.
- c. AAS.
- d. SSS.
- e. None: SSA does not prove congruence.
- f. HL.

6 Isosceles and equilateral



- a. Base angles are equal: $(180 - 38) \div 2 = 71^\circ$ each.
- b. All sides are equal: $45 \div 3 = 15$ in, which is $15 \times 2.54 = 38.1$ cm. Each angle measures 60° .

7 Angles with algebra



The sum is $6x = 180$, so $x = 30$.

The angles are 40° , 40° and 100° . Check: $40 + 40 + 100 = 180$.

Two angles are equal, so the triangle is isosceles (and obtuse), with the two sides opposite the 40° angles equal.

8 Solve for x



Corresponding parts of congruent triangles are equal.

a. $3x + 2 = 5x - 10$ gives $12 = 2x$, so $x = 6$ and $AB = 3 \times 6 + 2 = 20$ cm (check: $5 \times 6 - 10 = 20$).

b. $2y + 9 = 3y - 11$ gives $y = 20$, so $m\angle B = 49^\circ$ (check: $3 \times 20 - 11 = 49$).

9 Exterior angle equation



Exterior angle = sum of remote interior angles: $7x - 5 = 5x + 35$, so $2x = 40$ and $x = 20$.

The exterior angle is 135° ; the remote interior angles are 60° and 75° (sum 135°).

The adjacent interior angle is $180 - 135 = 45^\circ$. Check: $60 + 75 + 45 = 180$.

10 Ladders and HL



Both triangles are right triangles with $AC = DF = 17$ ft and $AB = DE = 8$ ft (hypotenuse and a leg), so $\triangle ABC \cong \triangle DEF$ by HL.

By the Pythagorean theorem, $BC = \sqrt{17^2 - 8^2} = \sqrt{225} = 15$ ft. By CPCTC, $EF = 15$ ft as well. Each foot is 15 ft (about 4.57 m) from its wall.

11 Base angles with algebra



Base angles are equal: $4x - 6 = 2x + 30$, so $2x = 36$ and $x = 18$.

Each base angle is $4 \times 18 - 6 = 66^\circ$. The apex angle is $180 - 66 - 66 = 48^\circ$.

12 Why SSA fails



The height from B is $8 \sin 30^\circ = 4$. Since $4 < 5 < 8$, the side $BC = 5$ can reach line AC in two places.

The foot of the height is $8 \cos 30^\circ \approx 6.93$ from A , and $\sqrt{5^2 - 4^2} = 3$. So $AC \approx 6.93 + 3 = 9.93$ or $AC \approx 6.93 - 3 = 3.93$.

Two different triangles share the same SSA data, so SSA cannot prove congruence.

13 The kite



Draw diagonal $\overline{AC}$, shared by $\triangle ABC$ and $\triangle ADC$.

Statement	Reason
$AB = AD$	Given
$CB = CD$	Given
$AC = AC$	Shared side
$\triangle ABC \cong \triangle ADC$	SSS
$\angle B = \angle D$	CPCTC

14 Congruent on a grid



$AB = 4$ (same y), $AC = 3$ (same x), $BC = \sqrt{4^2 + 3^2} = 5$.

$DE = 3$, $DF = 4$, $EF = \sqrt{3^2 + 4^2} = 5$.

The sides $AB = 4$, $BC = 5$, $CA = 3$ match $DF = 4$, $FE = 5$, $ED = 3$. By SSS, $\triangle ABC \cong \triangle DFE$.

15 Points on an angle bisector

Compare $\triangle PDB$ and $\triangle PEB$.

Statement	Reason
$\angle PDB = \angle PEB = 90^\circ$	Perpendicular segments
$\angle DBP = \angle EBP$	Definition of angle bisector
$BP = BP$	Shared side
$\triangle PDB \cong \triangle PEB$	AAS
$PD = PE$	CPCTC

16 The median of an isosceles triangle

$AB = AC$ (given), $BM = CM$ (midpoint), $AM = AM$ (shared). So $\triangle ABM \cong \triangle ACM$ by SSS.

By CPCTC, $\angle B = \angle C$, and also $\angle AMB = \angle AMC$.

These last two angles are adjacent and form a straight angle: $\angle AMB + \angle AMC = 180^\circ$.

Being equal, each is 90° , so $\overline{AM} \perp \overline{BC}$.

17 The converse

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Compare $\triangle ABD$ and $\triangle ACD$.

Statement	Reason
$\angle B = \angle C$	Given
$\angle BAD = \angle CAD$	AD bisects $\angle BAC$
$AD = AD$	Shared side
$\triangle ABD \cong \triangle ACD$	AAS
$AB = AC$	CPCTC

18 Equal distances in an equilateral triangle

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Compare $\triangle DAC$ and $\triangle EBA$.

$DA = EB$ (given). $AC = BA$ (sides of an equilateral triangle). $\angle DAC = \angle EBA = 60^\circ$ (angles of an equilateral triangle), and these angles lie between the pairs of equal sides.

So $\triangle DAC \cong \triangle EBA$ by SAS, with $D \leftrightarrow E$, $A \leftrightarrow B$, $C \leftrightarrow A$. By CPCTC, $DC = EA$.

19 A rotation on the grid

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a. $AB^2 = 6^2 + 2^2 = 40$, $BC^2 = 4^2 + 3^2 = 25$, $CA^2 = 2^2 + 5^2 = 29$.

$A'B'^2 = 2^2 + 6^2 = 40$, $B'C'^2 = 3^2 + 4^2 = 25$, $C'A'^2 = 5^2 + 2^2 = 29$.

All three sides match, so $\triangle ABC \cong \triangle A'B'C'$ by SSS.

b. Each image is $(x, y) \rightarrow (-y, x)$: $A(1, 1) \rightarrow (-1, 1)$, $B(7, 3) \rightarrow (-3, 7)$,

$C(3, 6) \rightarrow (-6, 3)$. It is a 90° counterclockwise rotation about the origin.

20 Across the pond



Compare $\triangle ABC$ and $\triangle DEC$: $CA = CD$ and $CB = CE$ (by construction), and $\angle ACB = \angle DCE$ (vertical angles).

So $\triangle ABC \cong \triangle DEC$ by SAS, and by CPCTC $AB = DE = 46$ m.

In feet: $46 \times 3.281 \approx 150.9$ ft.

21 Exterior angle and a ratio



The remote interior angles add up to the exterior angle: $m\angle A + m\angle B = 130^\circ$. Split in the ratio **3 : 2** (five parts of 26°): $m\angle A = 78^\circ$ and $m\angle B = 52^\circ$.

The interior angle at C is $180 - 130 = 50^\circ$. Check: $78 + 52 + 50 = 180$.

22 Equal altitudes



Compare $\triangle BEC$ and $\triangle CFB$.

Statement	Reason
$\angle BEC = \angle CFB = 90^\circ$	Altitudes
$\angle ECB = \angle FBC$	Base angles of isosceles $\triangle ABC$
$BC = CB$	Shared side
$\triangle BEC \cong \triangle CFB$	AAS
$BE = CF$	CPCTC



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