

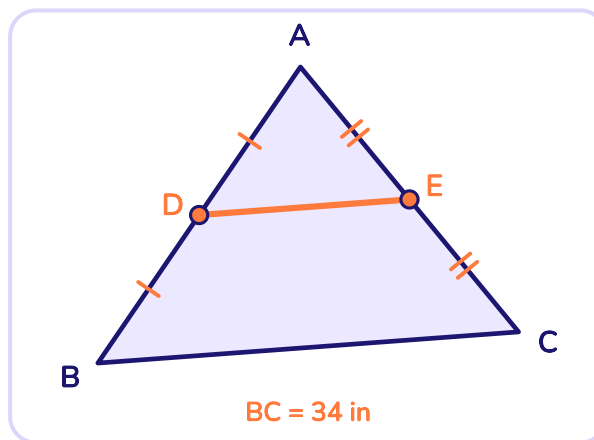
Relationships in Triangles: math practice, Grade 10 – download the PDF

23 problems graded by difficulty (★ easy, ★★ medium, ★★★ hard). Try first, without looking at the solutions!

1 Length of a midsegment

★ ★ ★

In triangle ABC , D and E are the midpoints of $\overline{AB}$ and $\overline{AC}$, and $BC = 34$ in.



Find DE and name the relationship between $\overline{DE}$ and $\overline{BC}$.

2 Doubling a midsegment

★ ★ ★

A midsegment of a triangle measures 9.5 cm. How long is the side of the triangle that is parallel to it?

3

Equal distances from a perpendicular bisector

Point P is on the perpendicular bisector of $\overline{XY}$. Given $PX = 2x + 5$ and $PY = 4x - 7$, find x and PX .

4

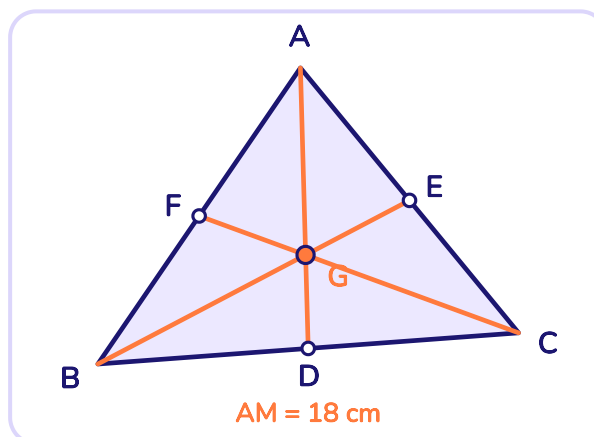
Equal distances from an angle bisector

Point Q is on the bisector of an angle. Its distance to one side of the angle is $4y - 3$ mm and its distance to the other side is $2y + 9$ mm. Find y and the distance.

5

Splitting a median

G is the centroid of triangle ABC and $\overline{AM}$ is a median with $AM = 18$ cm.



Find AG and GM .

6

Which center should you use?

Name the right triangle center for each situation.

- A fire station must be the same distance from three villages that form a triangle.
- A circular pond must touch all three sides of a triangular lawn.
- You want to balance a triangular cardboard tray on the tip of a pencil.

7 Where is the orthocenter?



Tell where the orthocenter lies for each triangle: inside, on a vertex, or outside.

- a. A triangle with angles 50° , 60° and 70° .
- b. A triangle with angles 30° , 60° and 90° .
- c. A triangle with angles 25° , 35° and 120° .

8 Can these lengths form a triangle?



Decide whether each set of lengths can be the sides of a triangle.

- a. 6, 9, 14
- b. 5, 8, 13
- c. 4, 4, 9
- d. 10, 12, 21

9 Midsegment with algebra



In triangle ABC , $\overline{DE}$ joins the midpoints of $\overline{AB}$ and $\overline{AC}$. If $DE = 5x - 4$ and $BC = 12x - 26$, find x , DE and BC .

10 The medial triangle



Triangle ABC has sides 14 cm, 18 cm and 22 cm. A smaller triangle is formed by joining the three midpoints of its sides.

- a. Find the three side lengths of the small triangle.
- b. Compare the perimeters of the two triangles.

11 Three trees and a fountain



Three trees stand at the corners of a triangular park. The distances between them are **20 m**, **21 m** and **29 m**. A fountain must be the same distance from each tree.

- Show that the triangle is a right triangle.
- Where should the fountain go, and how far is it from each tree?

12 The largest pond



A triangular garden bed has sides **9 ft**, **12 ft** and **15 ft**. What is the radius of the largest circular pond that fits inside it?

13 Centroid coordinates



The vertices of a triangle are $A(-3, 2)$, $B(9, 4)$ and $C(3, 12)$.

- Find the centroid G .
- Let M be the midpoint of $\overline{BC}$. Show that G is two thirds of the way from A to M .

14 Medians with algebra



G is the centroid of triangle ABC and $\overline{BE}$ is a median. Given $BG = 5x - 7$ and $GE = x + 1$, find x and the length of BE .

15 Range for the third side



Two sides of a triangle measure **11 cm** and **17 cm**.

- Write an inequality for the third side x .
- If x is a whole number, what are the smallest and largest possible perimeters?

16 Shortest and longest side

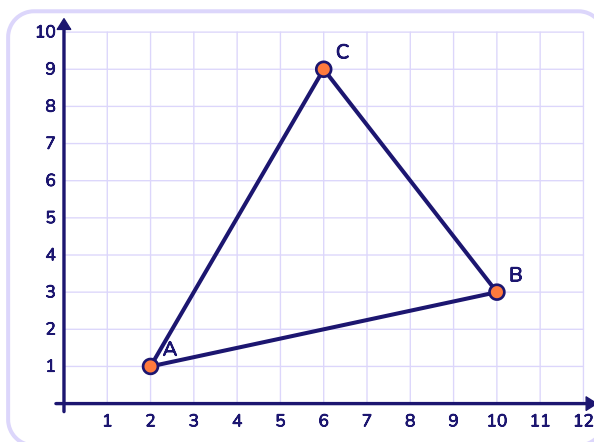


In triangle ABC , $\angle A = 48^\circ$, $\angle B = 75^\circ$ and $\angle C = 57^\circ$. Put the sides in order from shortest to longest.

17 A midsegment on the coordinate plane



Triangle ABC has vertices $A(2, 1)$, $B(10, 3)$ and $C(6, 9)$. Let M and N be the midpoints of $\overline{AB}$ and $\overline{AC}$.



a. Find the coordinates of M and N .

b. Show that $\overline{MN} \parallel \overline{BC}$.

c. Show that $MN = \frac{1}{2} BC$.

18 Finding a circumcenter



Triangle ABC has vertices $A(0, 0)$, $B(10, 0)$ and $C(2, 6)$.

a. Write the equation of the perpendicular bisector of $\overline{AB}$.

b. Write the equation of the perpendicular bisector of $\overline{AC}$.

c. Find the circumcenter O and verify that $OA = OC$.

19 Recover a missing vertex

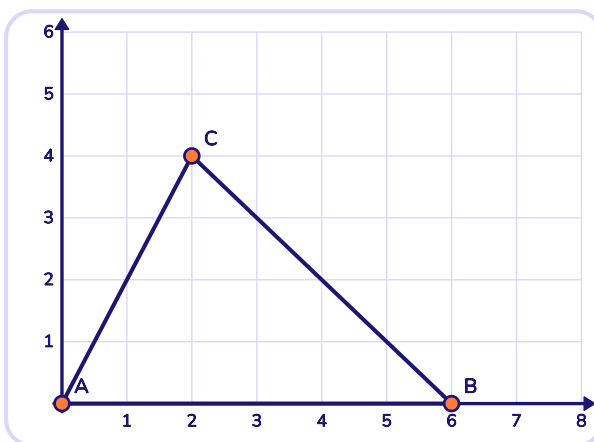
★★★

The centroid of triangle ABC is $G(4, 5)$. Two vertices are $A(2, 1)$ and $B(9, 6)$. Find vertex C .

20 Finding an orthocenter

★★★

Triangle ABC has vertices $A(0, 0)$, $B(6, 0)$ and $C(2, 4)$. Find its orthocenter and use the third altitude to check.

**21 An inequality in the unknown**

★★★

A triangle has sides of length 5 , x and $2x - 3$. Find all possible values of x .

22 Angles with algebra

★★★

In triangle PQR , $\angle P = (2x + 10)^\circ$, $\angle Q = (3x - 5)^\circ$ and $\angle R = (x + 25)^\circ$. Find x , then list the sides from shortest to longest.

23 Three lines in one

★★★

In triangle ABC , $AB = AC$ and M is the midpoint of $\overline{BC}$. Explain why the median $\overline{AM}$ is also the perpendicular bisector of $\overline{BC}$ and an altitude.



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