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Geometry

Sum and difference problems

Do you know the sum and the difference of two sides or two angles? Two formulas give you the answer: greater = (S + D) : 2 and smaller = (S − D) : 2.

In this video we see the method with an animation and solve 3 triangle exercises step by step: sides, angles, and angles in degrees and minutes.

The method

$$\text{greater} = (S + D) : 2$$

$$\text{smaller} = (S - D) : 2$$

Worked examples

Exercise 1

A triangle has a perimeter of 121 cm. One side is 30 cm. The other two sides differ by 23 cm. How long are they?

Data: $p = 121\ \text{cm} \cdot AB = 30\ \text{cm} \cdot BC - AC = 23\ \text{cm}$

1. **Sum of the other two sides: perimeter − known side**

$$S = AC + BC = p - AB$$

$$S = 121 - 30 = 91\ \text{cm}$$

Result: $AC + BC = 91\ \text{cm}$

2. **Greater side = (S + D) : 2**

$$BC = (91 + 23) : 2$$

$$BC = 114 : 2 = 57 \text{ cm}$$

Result: $BC = 57 \text{ cm}$

3. **Smaller side = (S − D) : 2**

$$AC = (91 - 23) : 2$$

$$AC = 68 : 2 = 34 \text{ cm}$$

Result: $AC = 34 \text{ cm}$

✓ Check

$$30 + 57 + 34 = 121 \text{ cm} \checkmark$$

$$57 - 34 = 23 \text{ cm} \checkmark$$

Exercise 2

In a triangle, two angles add up to 115°. Their difference is 25°. How big are the three angles?

Data: $\hat{A} + \hat{B} = 115^\circ \cdot \hat{A} - \hat{B} = 25^\circ$

1. **Greater angle = (S + D) : 2**

$$\hat{A} = (115^\circ + 25^\circ) : 2$$

$$\hat{A} = 140^\circ : 2 = 70^\circ$$

Result: $\hat{A} = 70^\circ$

2. **Smaller angle = (S − D) : 2**

$$\hat{B} = (115^\circ - 25^\circ) : 2$$

$$\hat{B} = 90^\circ : 2 = 45^\circ$$

Result: $\hat{B} = 45^\circ$

3. **Third angle: interior angles add up to 180°**

$$\hat{C} = 180^\circ - 115^\circ = 65^\circ$$

Result: $\hat{C} = 65^\circ$

✓ **Check**

$$70^\circ + 45^\circ + 65^\circ = 180^\circ \checkmark$$

Exercise 3

In a right triangle, the two acute angles differ by 23° 20'. How big is each one?

Data: $\hat{C} = 90^\circ \cdot \hat{A} - \hat{B} = 23^\circ\,20'$

1. **In a right triangle the acute angles add up to 90°**

$$S = \hat{A} + \hat{B} = 180^\circ - 90^\circ = 90^\circ$$

Result: $\hat{A} + \hat{B} = 90^\circ$

2. **Greater angle = (S + D) : 2**

$$\hat{A} = (90^\circ + 23^\circ\,20') : 2$$

$$\hat{A} = 113^\circ\,20' : 2$$

$$\hat{A} = 112^\circ\,80' : 2 = 56^\circ\,40'$$

💡 Tip: 1° = 60', so 113° 20' = 112° 80'

Result: $\hat{A} = 56^\circ\,40'$

3. **Smaller angle = (S − D) : 2**

$$\hat{B} = (90^\circ - 23^\circ\,20') : 2$$

$$\hat{B} = (89^\circ\,60' - 23^\circ\,20') : 2$$

$$\hat{B} = 66^\circ\,40' : 2 = 33^\circ\,20'$$

💡 To subtract minutes: 90° = 89° 60'

Result: $\hat{B} = 33^\circ\,20'$

✓ **Check**

$$56^\circ\,40' + 33^\circ\,20' = 89^\circ\,60'$$

$$89^\circ\,60' = 90^\circ\ \checkmark$$

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