

Name \_\_\_\_\_

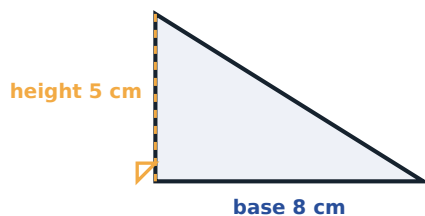
Date \_\_\_\_\_

## 15.4 Area of a triangle — worked answers

Derive and use the formula for the area of a triangle, and use it in compound shapes. · 55 questions

### A · Fluency — Half base times height, and back again.

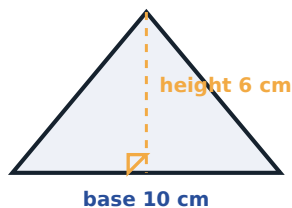
- 1 Find the area of this triangle, in square centimetres.



**Answer: 20**

Area of a triangle =  $\frac{1}{2} \times \text{base} \times \text{height}$ .  $8 \times 5 = 40$ , and  $40 \div 2 = 20 \text{ cm}^2$ .

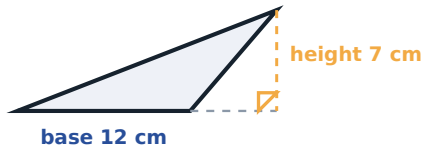
- 2 Find the area of this triangle, in square centimetres.



**Answer: 30**

Area of a triangle =  $\frac{1}{2} \times \text{base} \times \text{height}$ .  $10 \times 6 = 60$ , and  $60 \div 2 = 30 \text{ cm}^2$ .

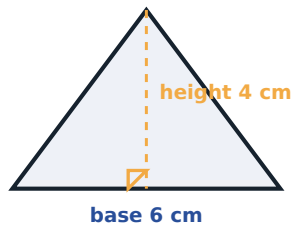
- 3 Find the area of this triangle, in square centimetres.



**Answer: 42**

Area of a triangle =  $\frac{1}{2} \times \text{base} \times \text{height}$ .  $12 \times 7 = 84$ , and  $84 \div 2 = 42 \text{ cm}^2$ .

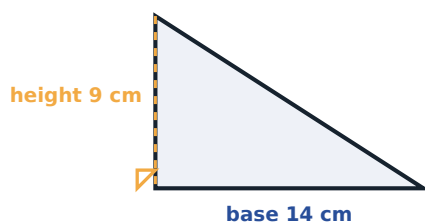
- 4 Find the area of this triangle, in square centimetres.



**Answer: 12**

Area of a triangle =  $\frac{1}{2} \times \text{base} \times \text{height}$ .  $6 \times 4 = 24$ , and  $24 \div 2 = 12 \text{ cm}^2$ .

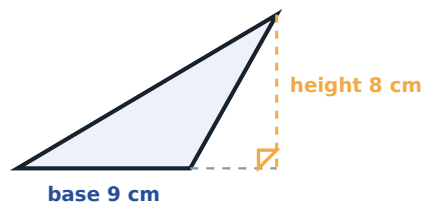
- 5 Find the area of this triangle, in square centimetres.



**Answer: 63**

Area of a triangle =  $\frac{1}{2} \times \text{base} \times \text{height}$ .  $14 \times 9 = 126$ , and  $126 \div 2 = 63 \text{ cm}^2$ .

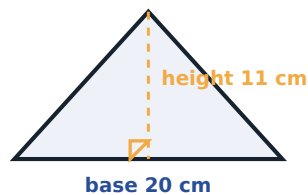
- 6 Find the area of this triangle, in square centimetres.



**Answer: 36**

Area of a triangle =  $\frac{1}{2} \times \text{base} \times \text{height}$ .  $9 \times 8 = 72$ , and  $72 \div 2 = 36 \text{ cm}^2$ .

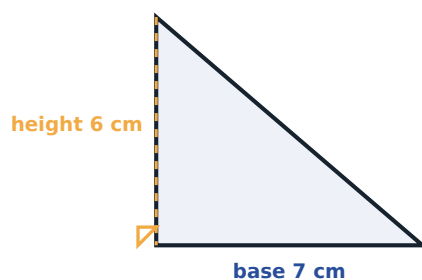
- 7 Find the area of this triangle, in square centimetres.



**Answer: 110**

Area of a triangle =  $\frac{1}{2} \times \text{base} \times \text{height}$ .  $20 \times 11 = 220$ , and  $220 \div 2 = 110 \text{ cm}^2$ .

- 8 Find the area of this triangle, in square centimetres.



**Answer: 21**

Area of a triangle =  $\frac{1}{2} \times \text{base} \times \text{height}$ .  $7 \times 6 = 42$ , and  $42 \div 2 = 21 \text{ cm}^2$ .

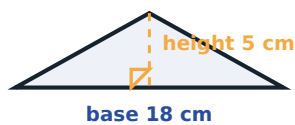
- 9 Find the area of this triangle, in square centimetres.



**Answer: 30**

Area of a triangle =  $\frac{1}{2} \times \text{base} \times \text{height}$ .  $15 \times 4 = 60$ , and  $60 \div 2 = 30 \text{ cm}^2$ .

- 10 Find the area of this triangle, in square centimetres.



**Answer: 45**

Area of a triangle =  $\frac{1}{2} \times \text{base} \times \text{height}$ .  $18 \times 5 = 90$ , and  $90 \div 2 = 45 \text{ cm}^2$ .

- 11 A triangle has base 6 cm and perpendicular height 4 cm. What is its area, in square centimetres?

**Answer: 12**

$6 \times 4 = 24$ , then  $24 \div 2 = 12 \text{ cm}^2$ .

- 12 A triangle has base 10 cm and perpendicular height 3 cm. What is its area, in square centimetres?

**Answer: 15**

$10 \times 3 = 30$ , then  $30 \div 2 = 15 \text{ cm}^2$ .

- 13 A triangle has base 8 cm and perpendicular height 7 cm. What is its area, in square centimetres?

**Answer: 28**

$8 \times 7 = 56$ , then  $56 \div 2 = 28 \text{ cm}^2$ .

- 14 A triangle has base 12 cm and perpendicular height 5 cm. What is its area, in square centimetres?

**Answer: 30**

$12 \times 5 = 60$ , then  $60 \div 2 = 30 \text{ cm}^2$ .

- 15** A triangle has base 9 cm and perpendicular height 6 cm. What is its area, in square centimetres?

**Answer: 27**

$9 \times 6 = 54$ , then  $54 \div 2 = 27 \text{ cm}^2$ .

- 16** A triangle has base 14 cm and perpendicular height 4 cm. What is its area, in square centimetres?

**Answer: 28**

$14 \times 4 = 56$ , then  $56 \div 2 = 28 \text{ cm}^2$ .

- 17** A triangle has base 5 cm and perpendicular height 8 cm. What is its area, in square centimetres?

**Answer: 20**

$5 \times 8 = 40$ , then  $40 \div 2 = 20 \text{ cm}^2$ .

- 18** A triangle has base 11 cm and perpendicular height 10 cm. What is its area, in square centimetres?

**Answer: 55**

$11 \times 10 = 110$ , then  $110 \div 2 = 55 \text{ cm}^2$ .

- 19** A triangle has area  $24 \text{ cm}^2$  and base 8 cm. What is its perpendicular height, in centimetres?

**Answer: 6**

Undo the halving first:  $24 \times 2 = 48$ . Then divide by the base:  $48 \div 8 = 6 \text{ cm}$ .

- 20** A triangle has area  $30 \text{ cm}^2$  and base 10 cm. What is its perpendicular height, in centimetres?

**Answer: 6**

Undo the halving first:  $30 \times 2 = 60$ . Then divide by the base:  $60 \div 10 = 6 \text{ cm}$ .

- 21** A triangle has area  $18 \text{ cm}^2$  and base 6 cm. What is its perpendicular height, in centimetres?

**Answer: 6**

Undo the halving first:  $18 \times 2 = 36$ . Then divide by the base:  $36 \div 6 = 6 \text{ cm}$ .

- 22** A triangle has area  $45 \text{ cm}^2$  and base 9 cm. What is its perpendicular height, in centimetres?

**Answer: 10**

Undo the halving first:  $45 \times 2 = 90$ . Then divide by the base:  $90 \div 9 = 10 \text{ cm}$ .

- 23** A triangle has area  $36 \text{ cm}^2$  and base 12 cm. What is its perpendicular height, in centimetres?

**Answer: 6**

Undo the halving first:  $36 \times 2 = 72$ . Then divide by the base:  $72 \div 12 = 6 \text{ cm}$ .

- 24** A triangle has area  $21 \text{ cm}^2$  and base 7 cm. What is its perpendicular height, in centimetres?

**Answer: 6**

Undo the halving first:  $21 \times 2 = 42$ . Then divide by the base:  $42 \div 7 = 6 \text{ cm}$ .

- 25** A parallelogram has base 8 cm and perpendicular height 5 cm. What is its area, in square centimetres?

**Answer: 40**

A parallelogram is two of those triangles, so there is no halving:  $8 \times 5 = 40 \text{ cm}^2$ .

- 26** A parallelogram has base 12 cm and perpendicular height 4 cm. What is its area, in square centimetres?

**Answer: 48**

A parallelogram is two of those triangles, so there is no halving:  $12 \times 4 = 48 \text{ cm}^2$ .

- 27** A parallelogram has base 9 cm and perpendicular height 7 cm. What is its area, in square centimetres?

**Answer: 63**

A parallelogram is two of those triangles, so there is no halving:  $9 \times 7 = 63 \text{ cm}^2$ .

- 28** A parallelogram has base 15 cm and perpendicular height 6 cm. What is its area, in square centimetres?

**Answer: 90**

A parallelogram is two of those triangles, so there is no halving:  $15 \times 6 = 90 \text{ cm}^2$ .

- 29** A parallelogram has base 10 cm and perpendicular height 10 cm. What is its area, in square centimetres?

**Answer: 100**

A parallelogram is two of those triangles, so there is no halving:  $10 \times 10 = 100 \text{ cm}^2$ .

- 30** A parallelogram has base 6 cm and perpendicular height 11 cm. What is its area, in square centimetres?

**Answer: 66**

A parallelogram is two of those triangles, so there is no halving:  $6 \times 11 = 66 \text{ cm}^2$ .

### **B · Reasoning — Where the formula comes from, and which height to use.**

- 31** Why is the area of a triangle half the base times the height?

- ☐ It just is
- ☐ Two copies of the triangle make a rectangle or parallelogram of base  $\times$  height
- ☐ Because triangles are small
- ☐ Because it has three sides

**Answer: Two copies of the triangle make a rectangle or parallelogram of base  $\times$  height**

Fit a second, upside-down copy alongside and you have the whole rectangle. The triangle is half of it.

- 32** Which height goes in the formula?

- ☐ The longest side
- ☐ The perpendicular height from the base to the opposite vertex
- ☐ Any side
- ☐ The shortest side

**Answer: The perpendicular height from the base to the opposite vertex**

It must be at right angles to the base. A sloping side is longer and gives too big an answer.

- 33** Can the perpendicular height fall outside the triangle?

- ☐ Yes
- ☐ No

**Answer: Yes**

In an obtuse triangle it does. Extend the base with a dashed line and measure to that — the formula still works.

- 34** Two triangles have the same base and the same height. Their areas are ...

- ☐ different
- ☐ equal
- ☐ in the ratio 2 : 1
- ☐ impossible to compare

**Answer: equal**

The formula uses only base and height, so however the apex slides along, the area is unchanged.

**35** A triangle has base 10 cm and height 6 cm. Its area is ...

- ☐ 60 cm<sup>2</sup>
- ☐ 30 cm<sup>2</sup>
- ☐ 16 cm<sup>2</sup>
- ☐ 15 cm<sup>2</sup>

**Answer: 30 cm<sup>2</sup>**

$10 \times 6 = 60$ , and  $60 \div 2 = 30$  cm<sup>2</sup>.

**36** Why does a parallelogram not need the halving?

- ☐ It is bigger
- ☐ It is made of two of the triangles
- ☐ The formula is different
- ☐ It does need it

**Answer: It is made of two of the triangles**

Cut it along a diagonal and you get two congruent triangles.

**37** Is the area of a triangle always a whole number?

- ☐ Yes
- ☐ No

**Answer: No**

If base  $\times$  height is odd, the half is a decimal —  $7 \times 5 = 35$  gives 17.5 cm<sup>2</sup>. That is a real answer, not an error.

**38** To find the height from the area, you ...

- ☐ divide the area by the base
- ☐ double the area, then divide by the base
- ☐ halve the area, then divide by the base
- ☐ multiply

**Answer: double the area, then divide by the base**

Undo the operations in reverse order: the halving first, then the multiplication.

**39** A compound shape is a rectangle with a triangle on top. Its area is ...

- ☐ the difference
- ☐ the sum of the two areas
- ☐ the product
- ☐ half the rectangle

**Answer: the sum of the two areas**

Same principle as section 15.2 — split it into shapes you know.

**40** The units of the area of a triangle are ...

- ☐ cm
- ☐ cm<sup>2</sup>
- ☐ cm<sup>3</sup>
- ☐ there are none

**Answer: cm<sup>2</sup>**

It is an area, so it is measured in squares like any other.

### C · Challenge — Halves, compound shapes and comparisons.

- 41** A triangle has base 7 cm and height 5 cm. What is its area, in square centimetres?

**Answer: 17.5**

$7 \times 5 = 35$ , and  $35 \div 2 = 17.5 \text{ cm}^2$ . An odd product gives a half.

- 42** A triangle has area  $42 \text{ cm}^2$  and height 12 cm. What is its base, in centimetres?

**Answer: 7**

$42 \times 2 = 84$ , and  $84 \div 12 = 7 \text{ cm}$ .

- 43** A shape is a 10 cm by 6 cm rectangle with a triangle of base 10 cm and height 4 cm on top. What is the total area, in square centimetres?

**Answer: 80**

The rectangle is  $10 \times 6 = 60 \text{ cm}^2$ . The triangle is  $10 \times 4 = 40$ , then  $40 \div 2 = 20 \text{ cm}^2$ . Total  $60 + 20 = 80 \text{ cm}^2$ .

- 44** A square of side 8 cm has a triangle cut from it with base 8 cm and height 8 cm. What area is left, in square centimetres?

**Answer: 32**

The square is  $8 \times 8 = 64 \text{ cm}^2$  and the triangle is  $64 \div 2 = 32 \text{ cm}^2$ , so  $64 - 32 = 32 \text{ cm}^2$ . The triangle is exactly half the square.

- 45** A triangle has base 9 cm and area  $27 \text{ cm}^2$ . A second triangle has the same base but twice the height. What is its area, in square centimetres?

**Answer: 54**

Doubling the height doubles the area:  $27 \times 2 = 54 \text{ cm}^2$ .

- 46** A parallelogram has area  $96 \text{ cm}^2$  and base 12 cm. What is its perpendicular height, in centimetres?

**Answer: 8**

$96 \div 12 = 8 \text{ cm}$  — no halving to undo for a parallelogram.

- 47** A triangle has base 6 cm and height 5 cm. How many times larger is the area of a 12 cm by 10 cm rectangle than the area of that triangle?

**Answer: 8**

The triangle is  $6 \times 5 = 30$ , then  $30 \div 2 = 15 \text{ cm}^2$ . The rectangle is  $12 \times 10 = 120 \text{ cm}^2$ , and  $120 \div 15 = 8$ .

#### **D · Word problems — Sails, gables, pennants and fields.**

- 48** A triangular sail has base 4 m and height 6 m. What is its area, in square metres?

**Answer: 12**

$4 \times 6 = 24$ , and  $24 \div 2 = 12 \text{ m}^2$ .

- 49** A triangular flag has base 30 cm and height 20 cm. What is its area, in square centimetres?

**Answer: 300**

$30 \times 20 = 600$ , and  $600 \div 2 = 300 \text{ cm}^2$ .

- 50** A gable end of a house is a triangle with base 8 m and height 3 m. What area must be painted, in square metres?

**Answer: 12**

$8 \times 3 = 24$ , and  $24 \div 2 = 12 \text{ m}^2$ .

- 51** A triangular garden has area  $60 \text{ m}^2$  and base  $15 \text{ m}$ . How far, in metres, is the far corner from the base?

**Answer: 8**

$60 \times 2 = 120$ , and  $120 \div 15 = 8 \text{ m}$  — that distance is the perpendicular height.

- 52** A pennant is a triangle of base  $25 \text{ cm}$  and height  $40 \text{ cm}$ . Fabric costs 2 cents per square centimetre. What does one pennant cost, in cents?

**Answer: 1000**

$25 \times 40 = 1000$ , and  $1000 \div 2 = 500 \text{ cm}^2$ . Then  $500 \times 2 = 1000 \text{ cents}$ .

- 53** A roof is made of two identical triangles, each with base  $10 \text{ m}$  and height  $4 \text{ m}$ . What is the total area, in square metres?

**Answer: 40**

Each is  $10 \times 4 = 40$ , then  $40 \div 2 = 20 \text{ m}^2$ . Two of them make  $20 \times 2 = 40 \text{ m}^2$ .

- 54** A field is a triangle with base  $200 \text{ m}$  and height  $150 \text{ m}$ . What is its area, in hectares?

**Answer: 1.5**

$200 \times 150 = 30000$ , and  $30000 \div 2 = 15000 \text{ m}^2$ . Then  $15000 \div 10000 = 1.5 \text{ ha}$ .

- 55** A window is a  $120 \text{ cm}$  by  $80 \text{ cm}$  rectangle with a triangular top of base  $120 \text{ cm}$  and height  $30 \text{ cm}$ . What is the total area, in square centimetres?

**Answer: 11400**

The rectangle is  $120 \times 80 = 9600 \text{ cm}^2$ . The triangle is  $120 \times 30 = 3600$ , then  $3600 \div 2 = 1800 \text{ cm}^2$ .  
Total  $9600 + 1800 = 11400 \text{ cm}^2$ .