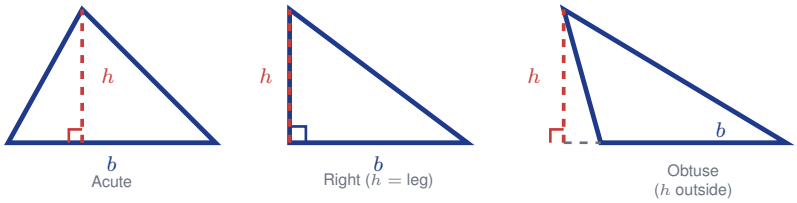
Area of Triangles

Name: _____	Date: _____	Score: _____ / 8

Here is a neat idea: every triangle is exactly *half* of a rectangle or parallelogram that shares its base and height—and that is why $A = \frac{1}{2}bh$ works! The one detail to watch is that the height must be measured **perpendicular** to the base, not along a slanted side. Once you keep base and perpendicular height straight, the formula works for acute, right, *and* obtuse triangles. Try it a few times and it will feel automatic!



Key Concepts & Quick Review

$A = \frac{1}{2} \times b \times h$ where $b =$ base length and $h =$ **perpendicular** height (altitude).

Any side can be the base; the height is always perpendicular to that base. If the triangle is right-angled, use the two legs as base and height.

Examples

① Find the area of a triangle with base $14\ cm$ and height $9\ cm$.

Think It Through: Use the triangle area formula $A = \frac{1}{2}bh$. Here the base is $14\ cm$ and the perpendicular height is $9\ cm$, so first multiply $14 \times 9 = 126$. A triangle is half of a matching parallelogram with the same base and height, so take half of 126 to get 63. Always finish with square units because area measures surface.

Answer: $63\ cm^2$

② A triangular sail has a base of $\frac{5}{2}\ m$ and a height of $\frac{8}{3}\ m$. Find its area in square meters.

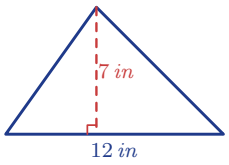
Think It Through: The same formula works even with fractions: $A = \frac{1}{2}bh$. Substitute the base and height, then multiply the numerators and denominators carefully: $\frac{1}{2} \times \frac{5}{2} \times \frac{8}{3} = \frac{40}{12}$. Simplify the fraction to $\frac{10}{3}$, which is about 3.33. Keeping the exact fraction first helps avoid rounding too early.

Answer: $\frac{10}{3} \approx 3.33\ m^2$

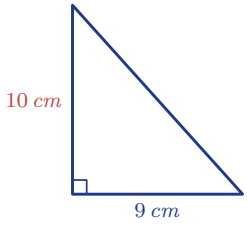
Practice Problems

Find the area of each triangle using $A = \frac{1}{2}bh$.

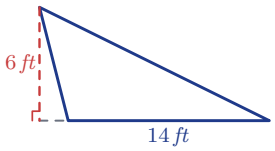
1. Find the area of the triangle.



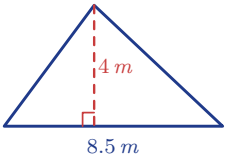
2. Find the area of the right triangle.



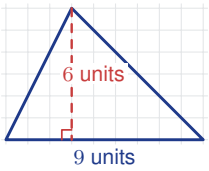
3. The height falls outside. Find the area.



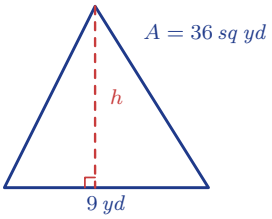
4. Find the area of the triangle.



5. Find the area in square units.



6. The area is $36\ sq\ yd$. Find h.



Study Tips

- The height **must be perpendicular** to the chosen base — a slanted side is never the height.
- For a right triangle, the two **legs** are base and height — no need to draw a separate altitude.
- Working backwards: if you know A and b, solve $h = \frac{2A}{b}$. If you know A and h, solve $b = \frac{2A}{h}$.

Word Problems

7. A triangular garden plot has a base of $18\ m$ and a height of $11\ m$. Fertiliser costs $\$3.50$ per square metre. Find the area of the garden and the total fertilizer cost. A second triangular plot has twice the base and half the height. Is its area the same? Find it and explain.

_____

8. A kite is made from two triangles sharing the same base. The top triangle has base $40\ cm$ and height $25\ cm$. The bottom triangle has the same base but a height of $35\ cm$. Find the total area of the kite. If kite paper costs $\$0.08$ per cm^2, what is the material cost?

_____

Answer Keys

1) $42\ sq\ in$
2) $45\ sq\ cm$
3) $42\ sq\ ft$
4) $17\ sq\ m$
5) 27 sq units
6) $h = 8\ yd$
7) Each area $99\ m^2$; cost \$346.50
8) Top $500\ cm^2$; bottom $700\ cm^2$; total $1{,}200\ cm^2$; cost \$96

Step-by-Step Explanations

Strategy: For Adjacent, Vertical, and Linear Pair Angles, sketch the intersecting lines and label which angles are equal or supplementary before solving. Students should name the angle relationship before writing an equation.

Practice 1: Two angles form a linear pair. One angle is $45°$. Find the other angle. **Answer:** $135°$
For the first sample, use vertical angles as equal and linear pairs as angles that sum to 180 degrees.

Practice 15: Two vertical angles measure $(8 - 2x)°$ and $(2 + 4x)°$. Find each angle measure. **Answer:** $6°$
Late in the set, use vertical angles as equal and linear pairs as angles that sum to 180 degrees.

Word-problem notes:

16. Answer: $4x + 12 = 6x - 8 \Rightarrow x = 10$; angles: $52°, 128°, 52°, 128°$; linear pairs: $(52°, 128°)$.
Since the marked angles are vertical angles, they are equal. Set $4x + 12 = 6x - 8$ and solve: $20 = 2x$, so $x = 10$. Now find the angle measure: $4(10) + 12 = 52°$. Its vertical angle is also $52°$. The two adjacent angles form linear pairs with $52°$, so each is $180° - 52° = 128°$. A linear pair is always two adjacent angles that make a straight line.

17. Answer: $2y - 5 + y + 20 = 180 \Rightarrow y = 55$; angles: $105°, 75°, 105°, 75°$; symmetric X requires $90°$ each — only with perpendicular trim.
These two angles are adjacent and form a linear pair, so they add to $180°$. Write $(2y - 5) + (y + 20) = 180$. Combining like terms gives $3y + 15 = 180$, so $3y = 165$ and $y = 55$. Substitute back to find the angles: $2(55) - 5 = 105°$ and $55 + 20 = 75°$. Their vertical partners match them, so the four angles are $105°, 75°, 105°, 75°$. If all four were equal, each would have to be $90°$, which happens only when the trim pieces are perpendicular.

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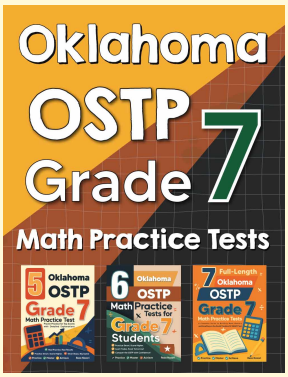

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