Area is the number of non-overlapping square units needed to cover the interior region of a two-dimensional figure or the surface area of a three-dimensional figure. For example, area is the region that is covered by floor tile (two-dimensional) or paint on a box or a ball (three-dimensional).

For additional information about specific shapes, see the boxes below. For additional general information, see the Math Notes box in Lesson 1.1.2 of the *Core Connections, Course 2* text. For additional examples and practice, see the *Core Connections, Course 2* Checkpoint 1 materials.

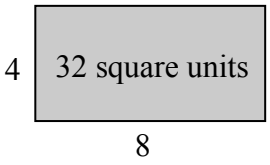
AREA OF A RECTANGLE

To find the area of a rectangle, follow the steps below.

1. Identify the base.
2. Identify the height.
3. Multiply the base times the height to find the area in square units: $A = bh$.

A square is a rectangle in which the base and height are of equal length. Find the area of a square by multiplying the base times itself: $A = b^2$.

Example



base = 8 units

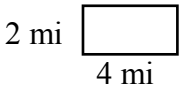
height = 4 units

$A = 8 \cdot 4 = 32$ square units

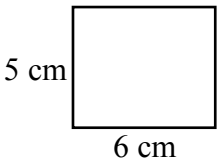
Problems

Find the areas of the rectangles (figures 1-8) and squares (figures 9-12) below.

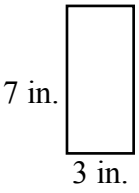
1.



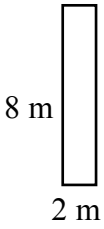
2.



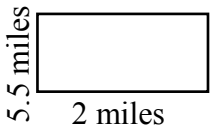
3.



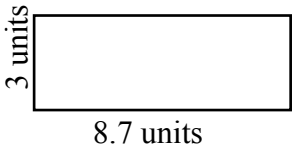
4.



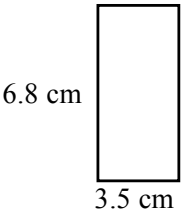
5.



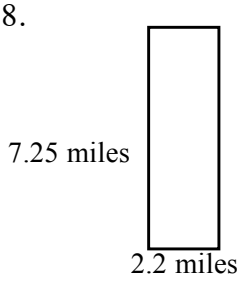
6.



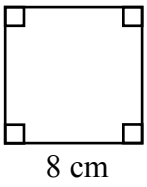
7.



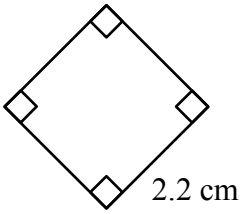
8.



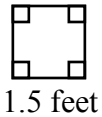
9.



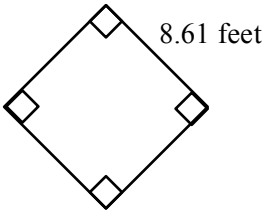
10.



11.



12.

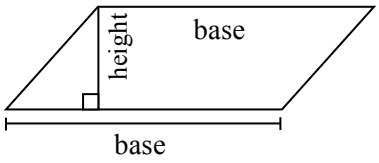


Answers

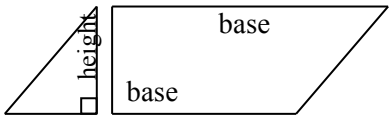
1.	8 sq. miles	2.	30 sq. cm	3.	21 sq. in.	4.	16 sq. m
5.	11 sq. miles	6.	26.1 sq. feet	7.	23.8 sq. cm	8.	15.95 sq. miles
9.	64 sq. cm	10.	4.84 sq. cm	11.	2.25 sq. feet	12.	73.96 sq. feet

AREA OF A PARALLELOGRAM

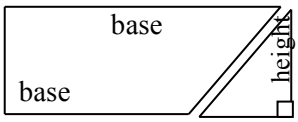
A parallelogram is easily changed to a rectangle by separating a triangle from one end of the parallelogram and moving it to the other end as shown in the three figures below.



parallelogram
Step 1



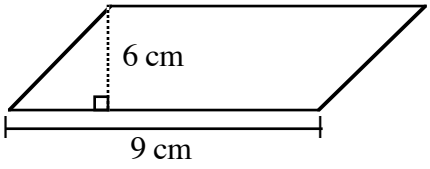
move triangle
Step 2



rectangle
Step 3

To find the area of a parallelogram, multiply the base times the height as you did with the rectangle: $A = bh$.

Example



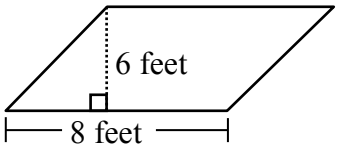
base = 9 cm

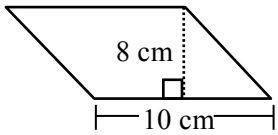
height = 6 cm

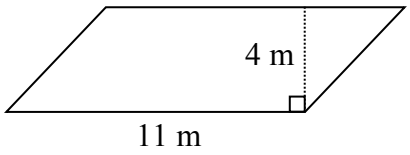
$A = 9 \cdot 6 = 54$ square cm

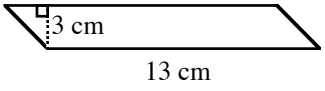
Problems

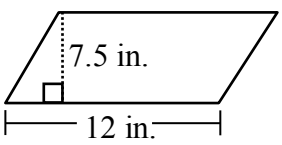
Find the area of each parallelogram below.

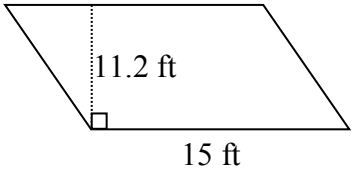
1. 

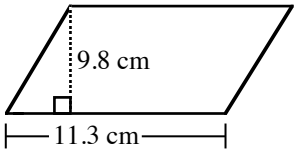
2. 

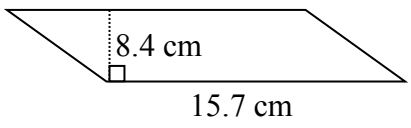
3. 

4. 

5. 

6. 

7. 

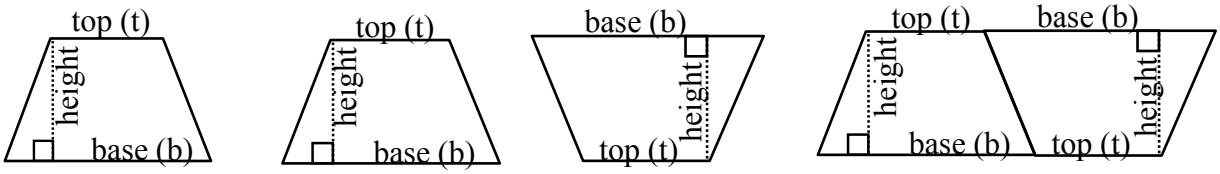
8. 

Answers

1.	48 sq. ft	2.	80 sq. cm	3.	44 sq. m	4.	39 sq. cm
5.	90 sq. in.	6.	168 sq. ft	7.	110.74 sq. cm	8.	131.88 sq. cm

AREA OF A TRAPEZOID

A trapezoid is another shape that can be transformed into a parallelogram. Change a trapezoid into a parallelogram by following the three steps below.



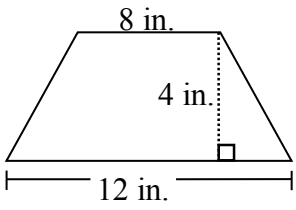
Trapezoid — duplicate the trapezoid and rotate — put the two trapezoids together to form a parallelogram

Step 1 — Step 2 — Step 3

To find the area of a trapezoid, multiply the base of the large parallelogram in Step 3 (base and top) times the height and then take half of the total area. Remember to add the lengths of the base and the top of the trapezoid before multiplying by the height. Note that some texts call the top length the upper base and the base the lower base.

$$A = \frac{1}{2}(b+t)h \quad \text{or} \quad A = \frac{b+t}{2} \cdot h$$

Example



top = 8 in.

base = 12 in.

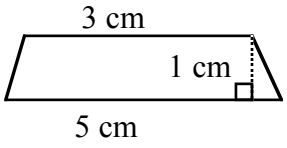
height = 4 in.

$A = \frac{8+12}{2} \cdot 4 = \frac{20}{2} \cdot 4 = 10 \cdot 4 = 40 \text{ in.}^2$

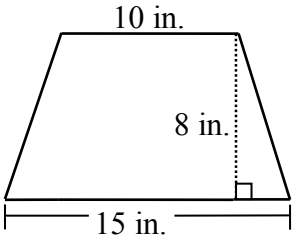
Problems

Find the areas of the trapezoids below.

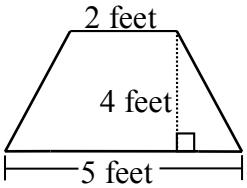
1.



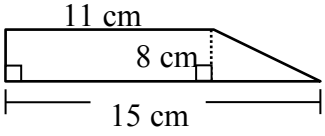
2.



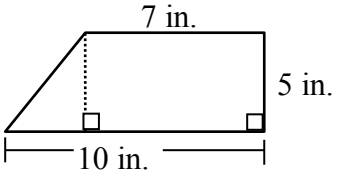
3.



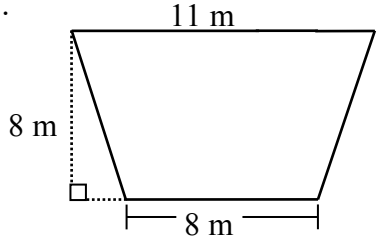
4.



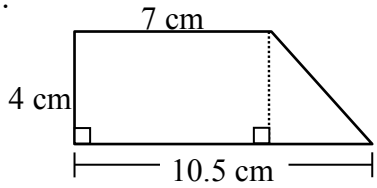
5.



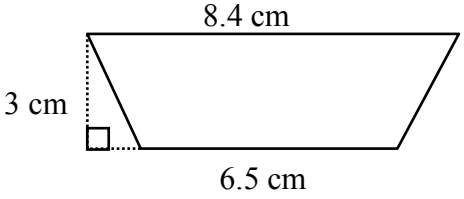
6.



7.



8.

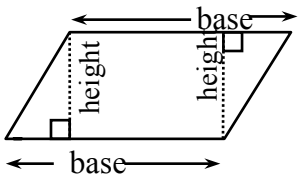


Answers

1.	4 sq. cm	2.	100 sq. in.	3.	14 sq. ft	4.	104 sq. cm
5.	42.5 sq. in.	6.	76 sq. m	7.	35 sq. cm	8.	22.35 sq. cm

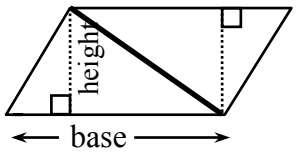
AREA OF A TRIANGLE

The area of a triangle is equal to one-half the area of a parallelogram. This fact can easily be shown by cutting a parallelogram in half along a diagonal (see below).



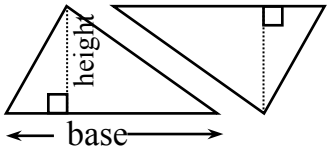
parallelogram

Step 1



draw a diagonal

Step 2



match triangles by cutting apart or by folding

Step 3

As you match the triangles by either cutting the parallelogram apart or by folding along the diagonal, the result is two congruent (same size and shape) triangles. Thus, the area of a triangle has half the area of the parallelogram that can be created from two copies of the triangle.

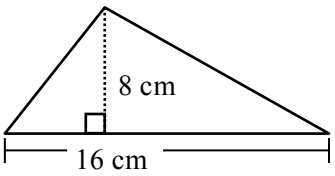
To find the area of a triangle, follow the steps below.

1. Identify the base.
2. Identify the height.
3. Multiply the base times the height.
4. Divide the product of the base times the height by 2: $A = \frac{bh}{2}$ or $A = \frac{1}{2}bh$

Example 1

base = 16 cm

height = 8 cm

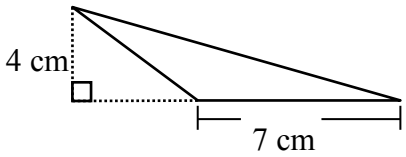


$A = \frac{16 \cdot 8}{2} = \frac{128}{2} = 64 \text{ cm}^2$

Example 2

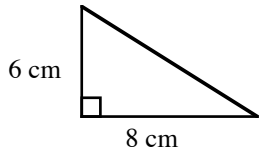
base = 7 cm

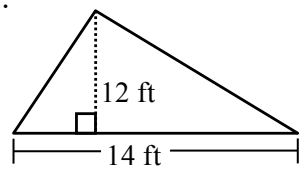
height = 4 cm

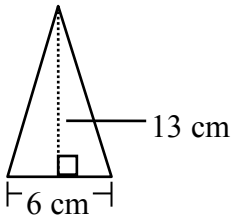


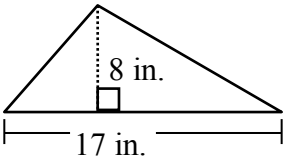
$A = \frac{7 \cdot 4}{2} = \frac{28}{2} = 14 \text{ cm}^2$

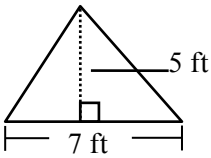
Problems

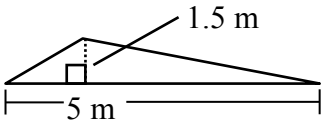
1. 

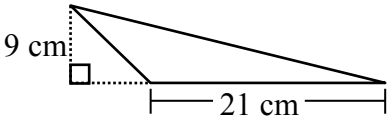
2. 

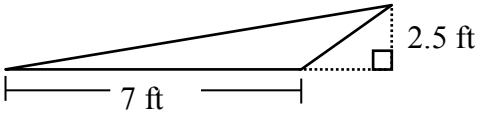
3. 

4. 

5. 

6. 

7. 

8. 

Answers

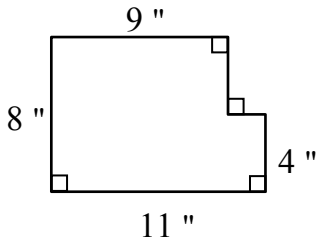
1.	24 sq. cm	2.	84 sq. ft	3.	39 sq. cm	4.	68 sq. in.
5.	17.5 sq. ft	6.	3.75 sq. m	7.	94.5 sq. cm	8.	8.75 sq. ft

CALCULATING COMPLEX AREAS USING SUBPROBLEMS

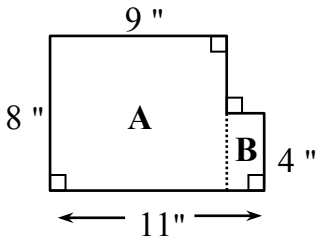
Students can use their knowledge of areas of polygons to find the areas of more complicated figures. The use of subproblems (that is, solving smaller problems in order to solve a larger problem) is one way to find the areas of complicated figures.

Example 1

Find the area of the figure at right.



Method #1



Subproblems:

1. Find the area of rectangle A:

   $8 \cdot 9 = 72$ square inches

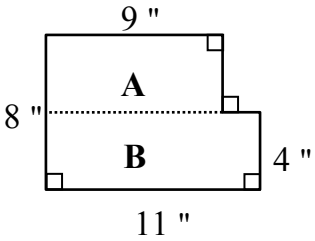
2. Find the area of rectangle B:

   $4 \cdot (11 - 9) = 4 \cdot 2 = 8$ square inches

3. Add the area of rectangle A to the area of rectangle B:

   $72 + 8 = 80$ square inches

Method #2



Subproblems:

1. Find the area of rectangle A:

   $9 \cdot (8 - 4) = 9 \cdot 4 = 36$ square inches

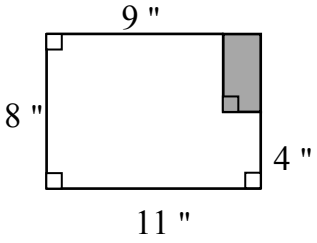
2. Find the area of rectangle B:

   $11 \cdot 4 = 44$ square inches

3. Add the area of rectangle A to the area of rectangle B:

   $36 + 44 = 80$ square inches

Method #3



Subproblems:

1. Make a large rectangle by enclosing the upper right corner.

2. Find the area of the new, larger rectangle:

   $8 \cdot 11 = 88$ square inches

3. Find the area of the shaded rectangle:

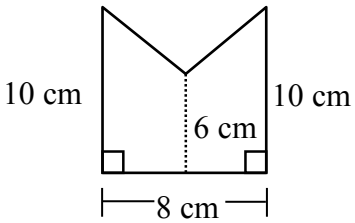
   $(8 - 4) \cdot (11 - 9)$
   $= 4 \cdot 2 = 8$ square inches

4. Subtract the shaded rectangle from the larger rectangle:

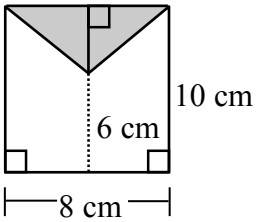
   $88 - 8 = 80$ square inches

Example 2

Find the area of the figure at right.



Subproblems:

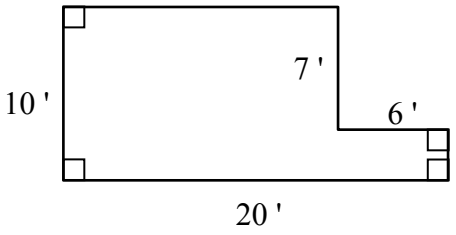


1. Make a rectangle out of the figure by enclosing the top.
2. Find the area of the entire rectangle: $8 \cdot 10 = 80$ square cm
3. Find the area of the shaded triangle. Use the formula $A = \frac{1}{2}bh$. $b = 8$ and $h = 10 - 6 = 4$, so $A = \frac{1}{2}(8 \cdot 4) = \frac{32}{2} = 16$ square cm.
4. Subtract the area of the triangle from the area of the rectangle: $80 - 16 = 64$ square cm.

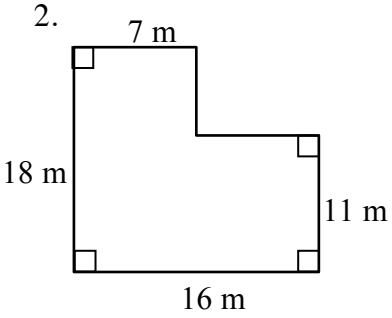
Problems

Find the areas of the figures below.

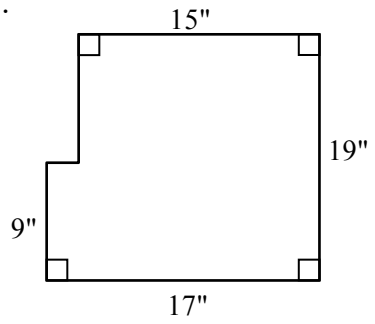
1.



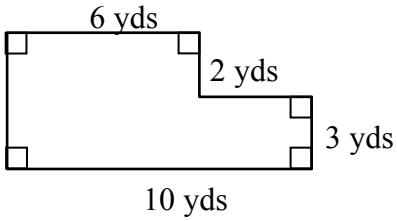
2.



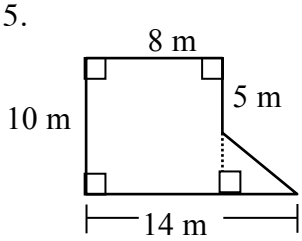
3.



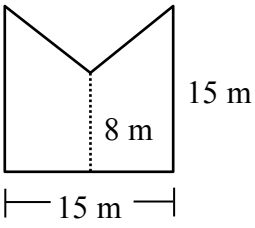
4.



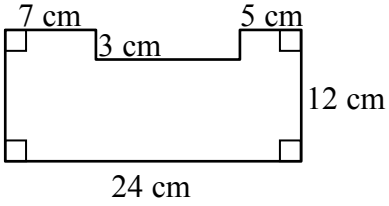
5.



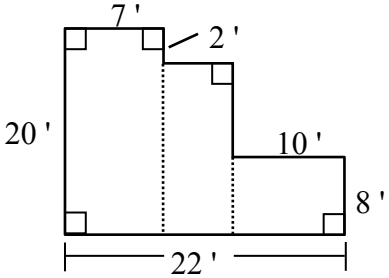
6.



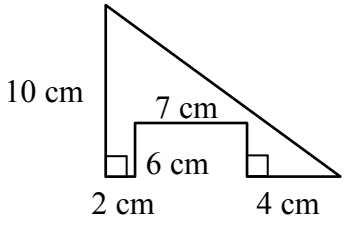
7.



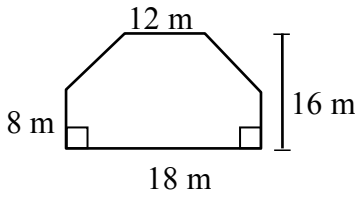
8.



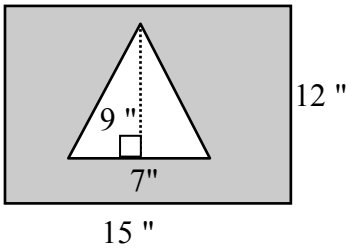
9.



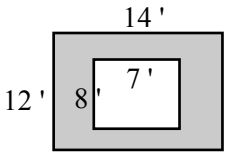
10.



11. Find the area of the shaded region.



12. Find the area of the shaded region.



Answers

1.	158 sq. ft.	2.	225 sq. m.	3.	303 sq. in.	4.	42 sq. yd.
5.	95 sq. m.	6.	172.5 sq. m.	7.	252 sq. cm.	8.	310 sq. ft.
9.	23 sq. cm.	10.	264 sq. m.	11.	148.5 sq. in.	12.	112 sq. ft.

