

Objective

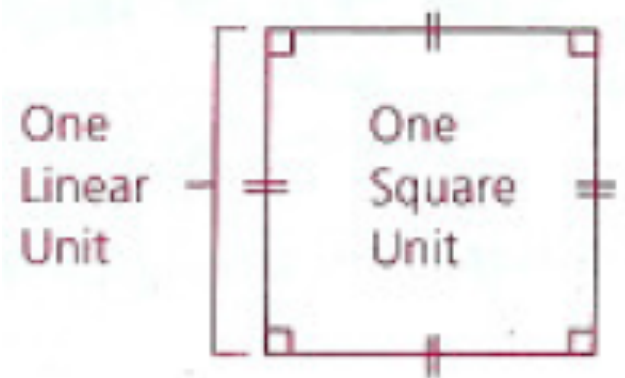
Students will be able to understand the concept of area and find the areas of rectangles, squares, parallelograms, and triangles.

11.1-11.4 Area Quiz on Thursday!

The Concept of Area

When we measure lengths of line segments, we use such standard units as meters, yards, miles, centimeters, and kilometers. These are often called linear units because they are measures of length. The standard unit of area are square units, such as square meters, square yards, and square miles.

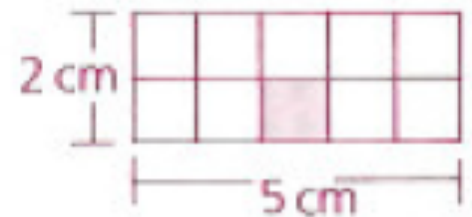
The area of a closed region is the number of square units of space within the boundary of the region.



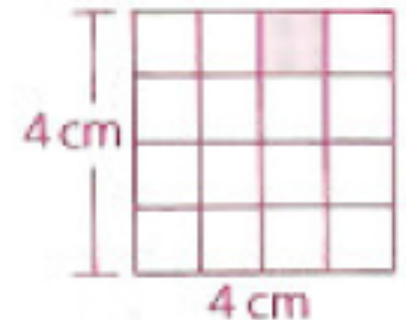
The Areas of Rectangle and Squares

In the figures to the right, there are two ways to find the areas:

- 1) The number of square units can be counted individually.
- 2) The areas can be computed by multiplying the number of columns (the measure of the base) by the number of rows (the height).



Area = 10 sq cm



Area = 16 sq cm

The Areas of Rectangle and Squares

The area of a rectangle:

$$A = bh$$

where b is the length of the base and h is the height

The area of a square:

$$A = s^2$$

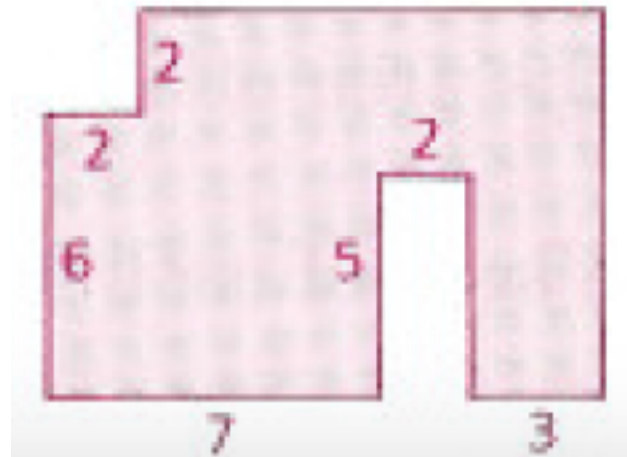
where s is the length of a side

Basic Properties of Area

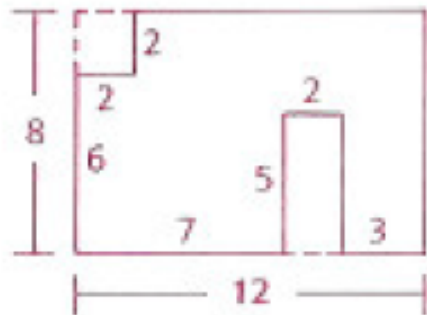
- 1) Every closed region has an area.
- 2) If two closed figures are congruent, then their areas are equal.
- 3) If two closed regions intersect only along a common boundary, then the area of their union is equal to the sum of their individual areas.



Find the area of the shaded region.



Method One:



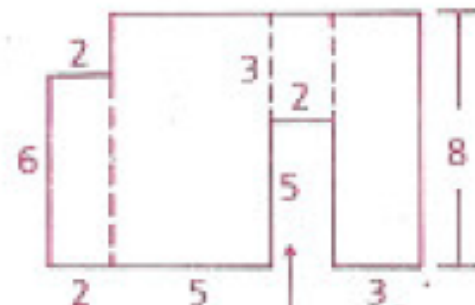
Area of large rectangle = $12 \cdot 8 = 96$

Area of square = $2^2 = 4$

Area of small rectangle = $2 \cdot 5 = 10$

Shaded area = $96 - 4 - 10 = 82$

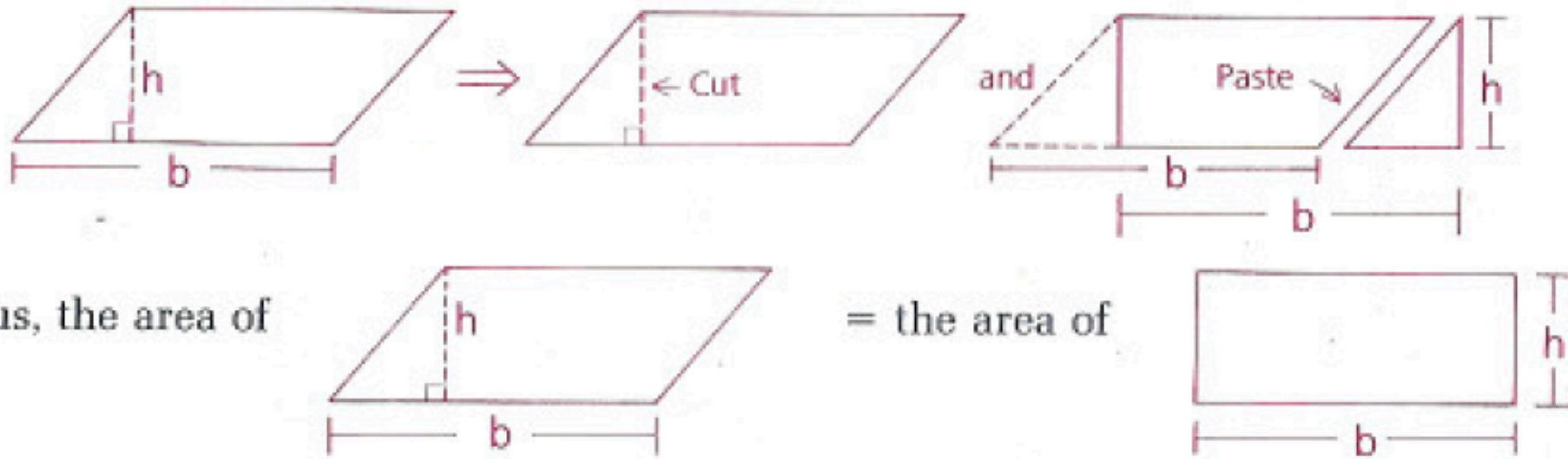
Method Two ("Divide and Conquer"):



$$A = 2 \cdot 6 + 5 \cdot 8 + 2 \cdot 3 + 3 \cdot 8$$

Shaded area = 82

The Area of a Parallelogram



The area of a parallelogram:

$$A = bh$$

where b is the length of the base and h is the height

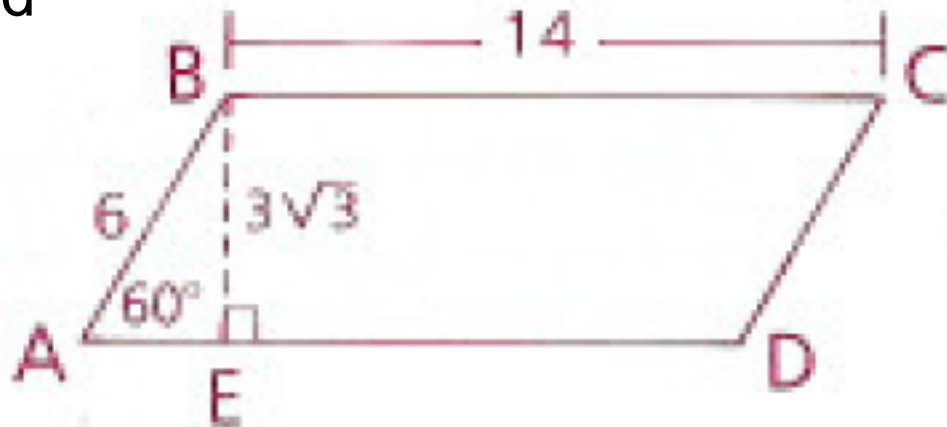
Find the area of a parallelogram whose sides are 14 and 6 and whose acute angle is 60° .

Need to find the height of the triangle, so we can draw the altitude.

30° - 60° - 90° triangle is formed

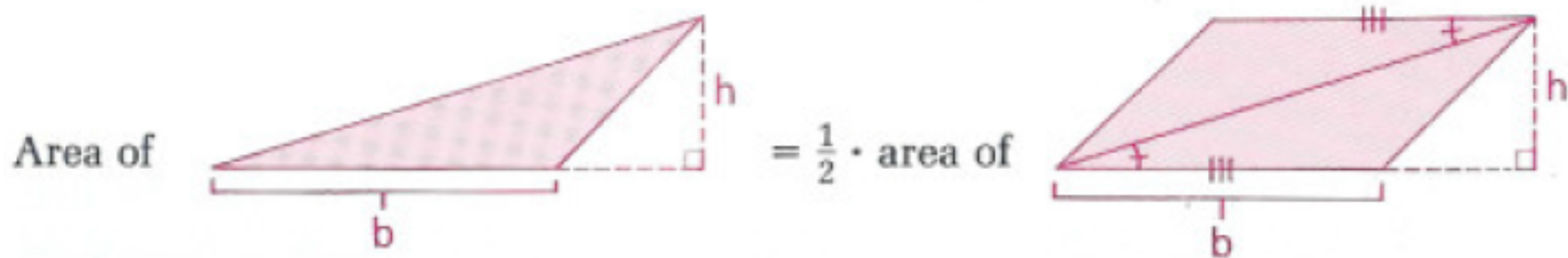
$$h = 3\sqrt{3}$$

$$\begin{aligned} A &= bh = 14(3\sqrt{3}) \\ &= 42\sqrt{3} \end{aligned}$$



The Area of a Triangle

The area of any triangle can be shown to be one half of the area of a parallelogram with the same base and height.

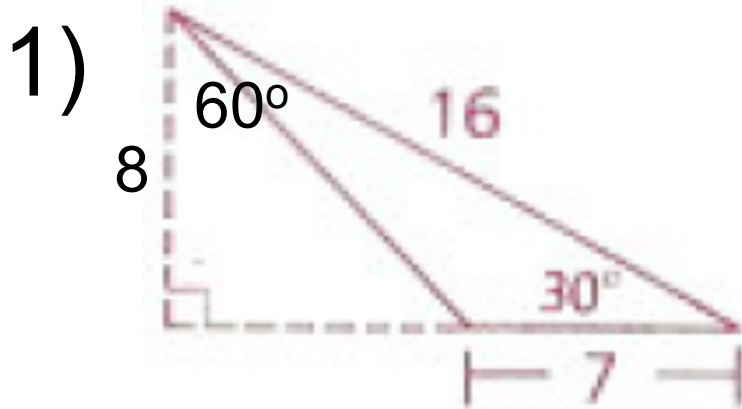


The area of a triangle:

$$A = \frac{1}{2}bh$$

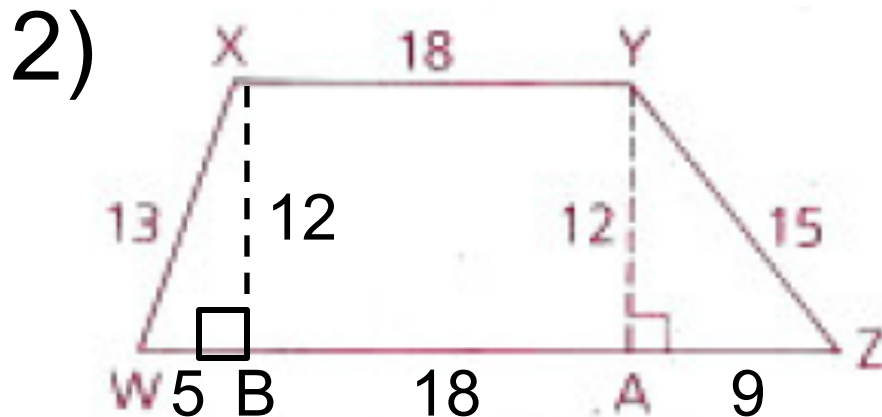
where b is the length of the base and h is the height (altitude)

Find the area of the following figures:



$$A = \frac{1}{2}(7)(8)$$

$$= 28$$



$$12^2 + (AZ)^2 = 15^2$$

$$AZ = 9$$

$$12^2 + (WB)^2 = 13^2$$

$$WB = 5$$

$$\triangle XWB = \frac{1}{2}(5)(12) \quad \triangle YAZ = \frac{1}{2}(9)(12) \quad XYAB = 18(12)$$

$$= 30 \quad = 54 \quad = 216$$

$$WZYX = 30 + 54 + 216 = 300$$

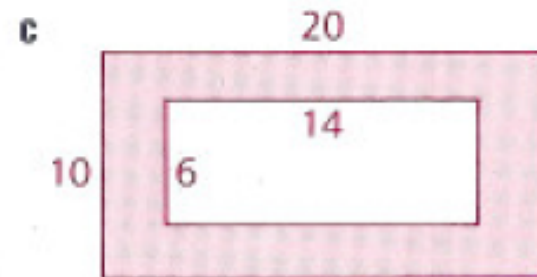
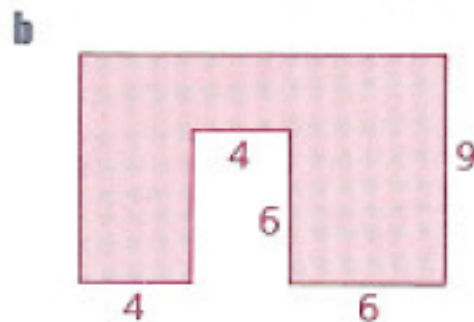
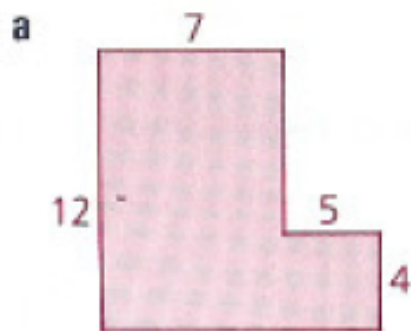
Homework

p. 514: 6, 8, 12

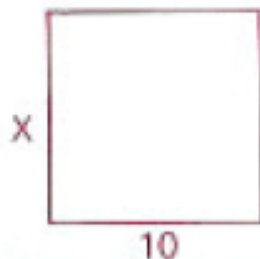
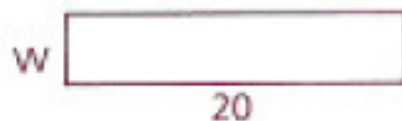
p. 520: 17, 21, 22, 23

p. 514: 6, 8, 12

6 Find the area of each shaded region. (Assume right angles.)

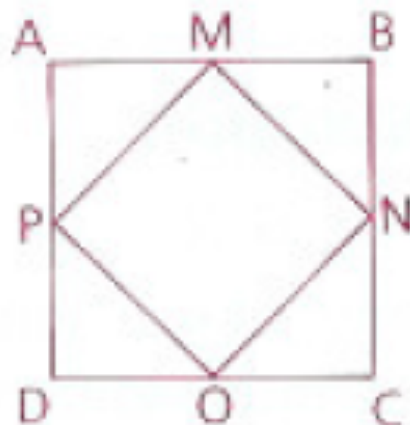


8 Each rectangular garden below has an area of 100.



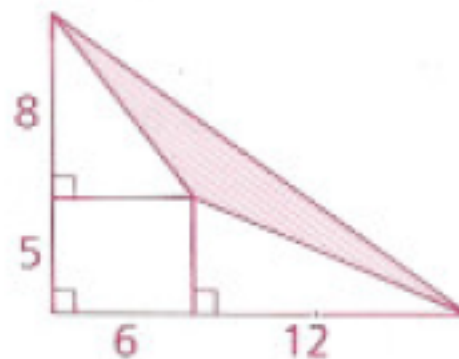
- Find the missing dimension of each.
- What length of fencing is needed to surround each?
- Which figure has the shortest perimeter?
- What do you think must be true about a rectangle that encloses the maximum possible area with the shortest possible perimeter?

- 12** The area of square $ABCD$ is 64 square units. $MNOP$ is formed by joining the midpoints of the sides of $ABCD$. Find the area and the perimeter of $MNOP$.

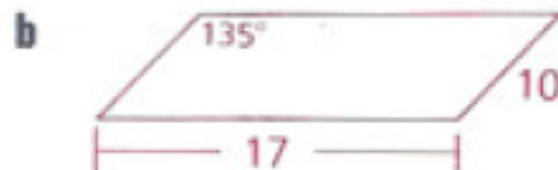


p. 520: 17, 21, 22, 23

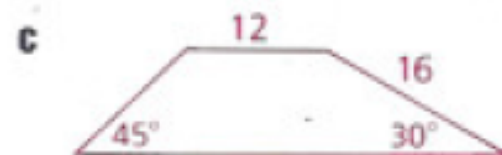
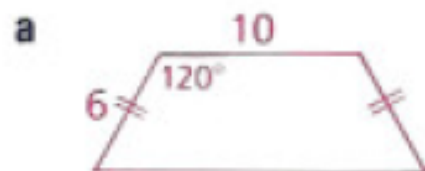
- 17 Find the area of the shaded triangular region.



- 21 Find the area of each parallelogram to the nearest tenth.



- 22 Find the area of each trapezoid by dividing it into other figures (rectangles and triangles or parallelograms and triangles).



- 23 Find the area of $\triangle ABC$ with vertices $A = (1, 3)$, $B = (7, 3)$, and $C = (4, -1)$.

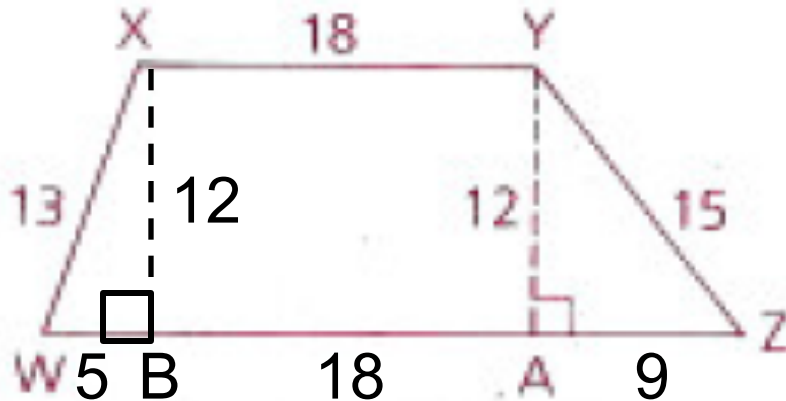
Objective

Students will be able to find the areas of trapezoids and use the measure of a trapezoid's median to find its area.

11.1-11.4 Area Quiz on Thursday!

Science Fair in one week! 😊

Find the area of the trapezoid:



$$12^2 + (AZ)^2 = 15^2$$

$$AZ = 9$$

$$12^2 + (WB)^2 = 13^2$$

$$WB = 5$$

$$\begin{array}{lll} \triangle XWB = \frac{1}{2}(5)(12) & \triangle YAZ = \frac{1}{2}(9)(12) & XYAB = 18(12) \\ = 30 & = 54 & = 216 \end{array}$$

$$WZYX = 30 + 54 + 216 = 300 \text{ units}^2$$

The Area of a Trapezoid

The area of a trapezoid:

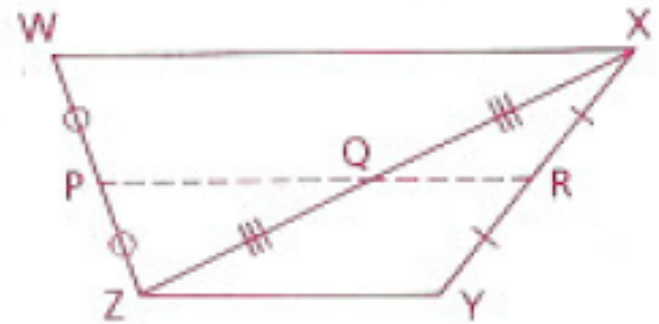
$$A = \frac{1}{2}h(b_1 + b_2)$$

where b_1 is the length of the one base, b_2 is the length of the other base, and h is the height

The Median of a Trapezoid

The line segment joining the midpoints of the nonparallel sides (legs) of a trapezoid is called the median of the trapezoid.

In trapezoid $WXYZ$, P , Q , and R are midpoints of sides of $\triangle WXZ$ and $\triangle XYZ$. P , Q , and R are collinear, because \overline{PQ} and \overline{QR} share Q , and each segment is parallel to \overline{WX} and \overline{ZY} . \overline{PR} is the median of trapezoid $WXYZ$. By the Midline Theorem, $PQ = \frac{1}{2}(WX)$ and $QR = \frac{1}{2}(YZ)$. Thus, $PR = PQ + QR = \frac{1}{2}(WX) + \frac{1}{2}(YZ) = \frac{1}{2}(WX + YZ)$.



The Median of a Trapezoid

The measure of the median of a trapezoid equals the average of the measures of the bases.

$$M = \frac{1}{2}(b_1 + b_2)$$

where b_1 is the length of the one base and b_2 is the length of the other base

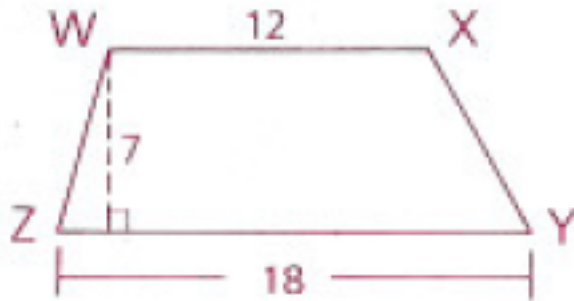
The Median of a Trapezoid

The area of a trapezoid is the product of the median and the height.

$$A_{\text{trap}} = Mh$$

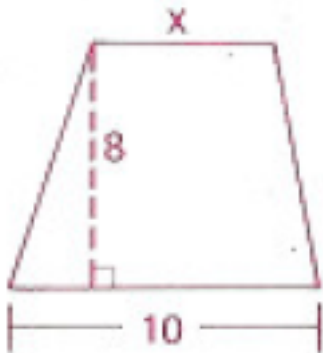
where M is the length of the median and h is the height

- 1) Given: Trapezoid WXYZ, with height 7,
lower base 18, and upper base 12 cm
Find: The area of WXYZ



$$\begin{aligned} A &= \frac{1}{2}h(b_1 + b_2) \\ &= \frac{1}{2}(7)(18 + 12) \\ &= 105 \text{ cm}^2 \end{aligned}$$

- 2) Find the shorter base of a trapezoid if the trapezoid's area is 52, its altitude is 8, and its longer base is 10.



$$\begin{aligned} A &= \frac{1}{2}h(b_1 + b_2) \\ 52 &= \frac{1}{2}(8)(10 + x) \\ 52 &= 4(10 + x) \\ 3 &= x \end{aligned}$$

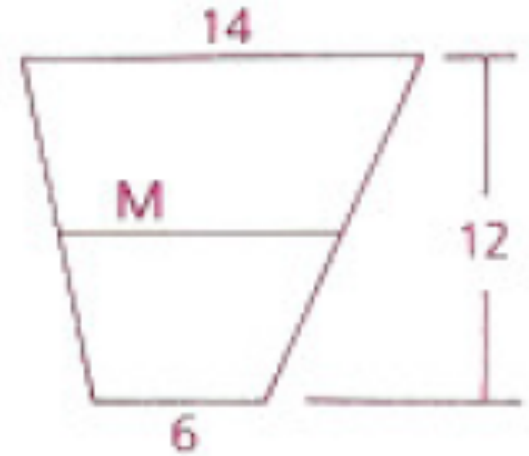
3) The height of a trapezoid is 12 m.
The bases are 6 and 14 m.

a) Find the median.

$$\begin{aligned} M &= \frac{1}{2}(b_1 + b_2) \\ &= \frac{1}{2}(14 + 6) \\ &= 10 \text{ m} \end{aligned}$$

b) Find the area.

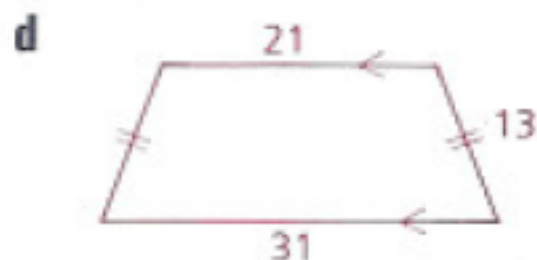
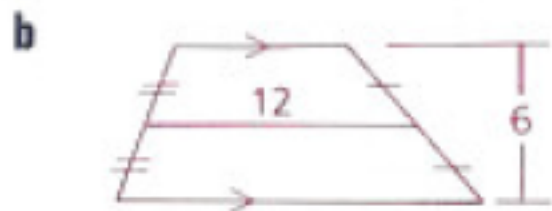
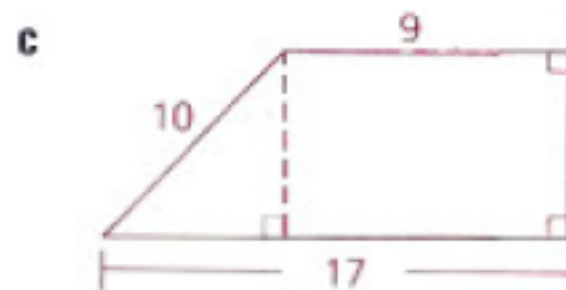
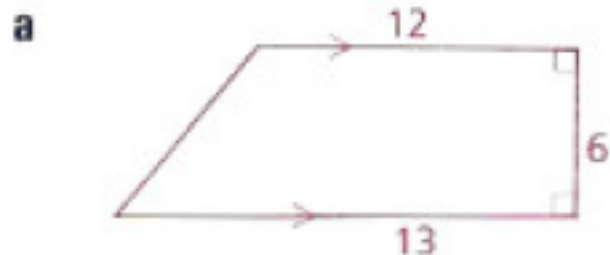
$$\begin{aligned} A_{\text{trap}} &= Mh \\ &= 10(12) \\ &= 120 \text{ m}^2 \end{aligned}$$



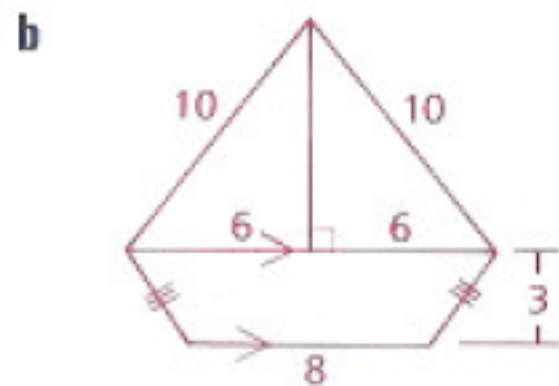
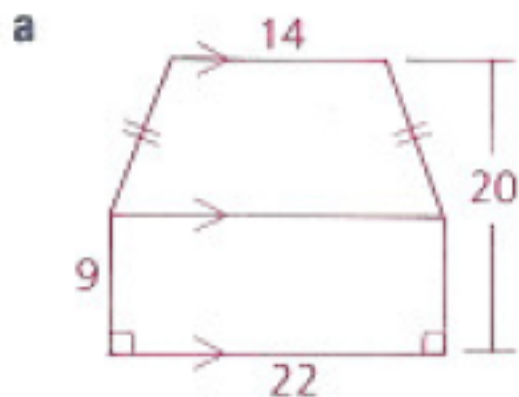
Homework

p.525: 2, 7, 8, 10

2 Find the area of each trapezoid.

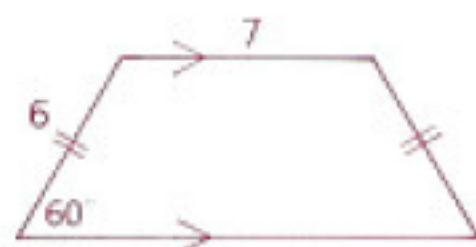


7 Find the total area of each figure.

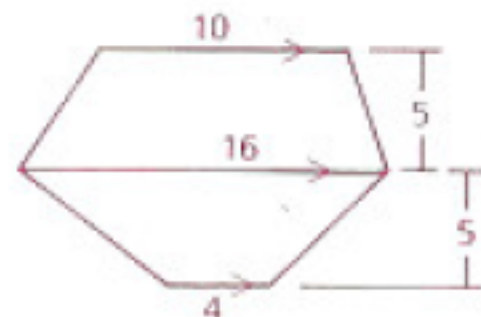


8 Find the total area of each figure.

a



b



- 10** The area of triangle PQS is 25.
The median of trapezoid PQRS is 14.
Base \overline{RS} measures 18.

- Find: **a** The length of base \overline{PQ}
b The height to base \overline{PQ} of $\triangle PQS$
c The height of trapezoid PQRS
d The area of trapezoid PQRS

