2/8 Squaring, Pythagoras' Theorem, and Area

Tuesday, February 8, 2022 2:00 PM

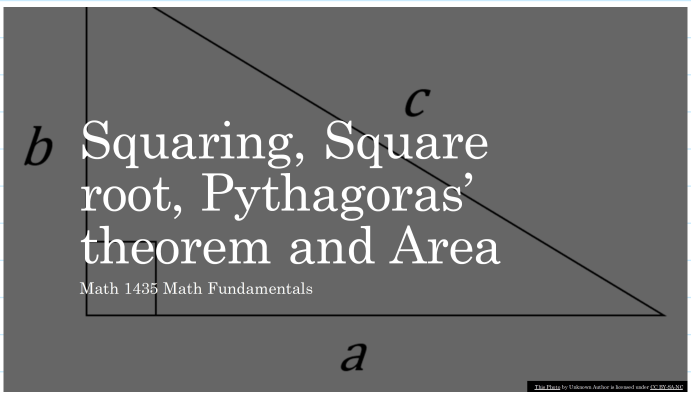
Well done on test 1.

- every one got better than 85%.
- course will be getting more focused on Woodworking
    - but also tougher

This week - Early course check-in instructor evaluations

Upcoming: Assignment 1.

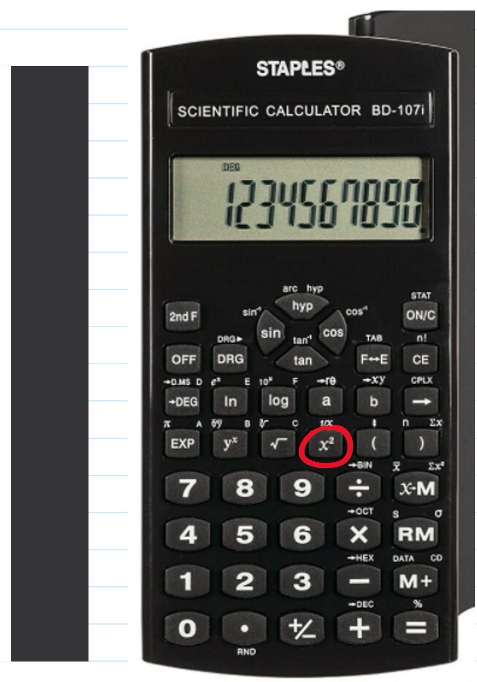
TODAY:



2.

Squaring

- To square a number is to multiply it by its self.
- 7 squared, written 7^2 is equivalent to $7 \times 7 = 49$
- If your calculator has a x^2 button, first enter the number you want too square and then press the x^2 button.
- If your calculator does not have a x^2 button, enter the number you want to square and press the multiplication button (X) then the = button.



Practice

Find the values of the following.

Find the values of the following.

1) $(-1)^2$

$(-1) \times (-1)$

$= 1$

2) 43^2

43×43

$= 1849$

3) 34^2

34×34

$= 1156$

4) $(-14)^2$

196

5) 27^2

729

6) $(-38)^2$

1444

Warn:

$-14^2 = -(14^2) = -196$

$(-14)^2 = (-14) \times (-14) = 196$

3.

Square root

- Square root is the opposite of squaring. When you find the square root of a number, you will find a number when multiplied by itself, gives you the original number in the question.
- The symbol for square root is √.
- Example: The square root of 25 is 5, written as √25 = 5 (5 x 5 = 25)
- Most calculators have a √ or √x button. Simply enter the number you want to find the square root and press the √ button.

Practice:

Solve.

1 a. $\sqrt{36} = 6$

$6 \times 6 = 36$

1 b. $\sqrt{64} = 8$

$8 \times 8 = 64$

2 a. $\sqrt{100} = 10$

$10 \times 10 = 100$

2 b. $\sqrt{169} = 13$

$13 \times 13 = 169$

3 a. $\sqrt{81} = 9$

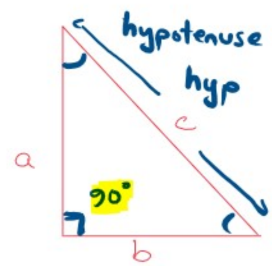
3 b. $\sqrt{289} = 17$

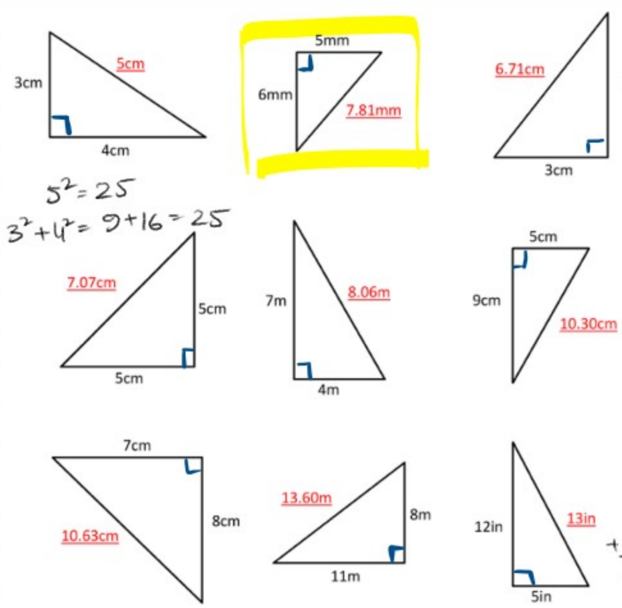
4.

Pythagoras' Theorem

- Pythagoras, a Greek philosopher born about 580 BC, discovered the relation between the length of the sides of right angle triangles (triangle with one 90° angle).
- $a^2 + b^2 = c^2$
- The 3, 4, 5 rule is an example of Pythagoras' theorem
- Pythagoras' theorem only works on right angle triangles.

How is this useful for us?
- Site dimensions (is the corner of a room square)
- Check if a cabinet is square.





$5^2 = 25$

$3^2 + 4^2 = 9 + 16 = 25$

$7.81^2 = 60.9961 = 61$ (2 d.p)

$5^2 + 6^2 = 25 + 36 = 61$

$13^2 = 169$

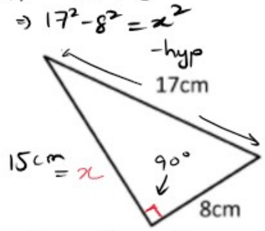
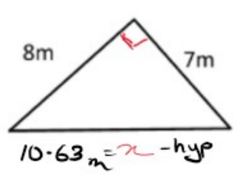
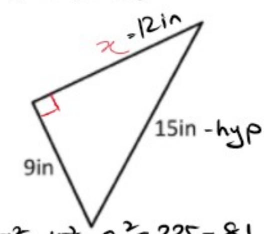
$5^2 = 25$

$+12^2 = 144$

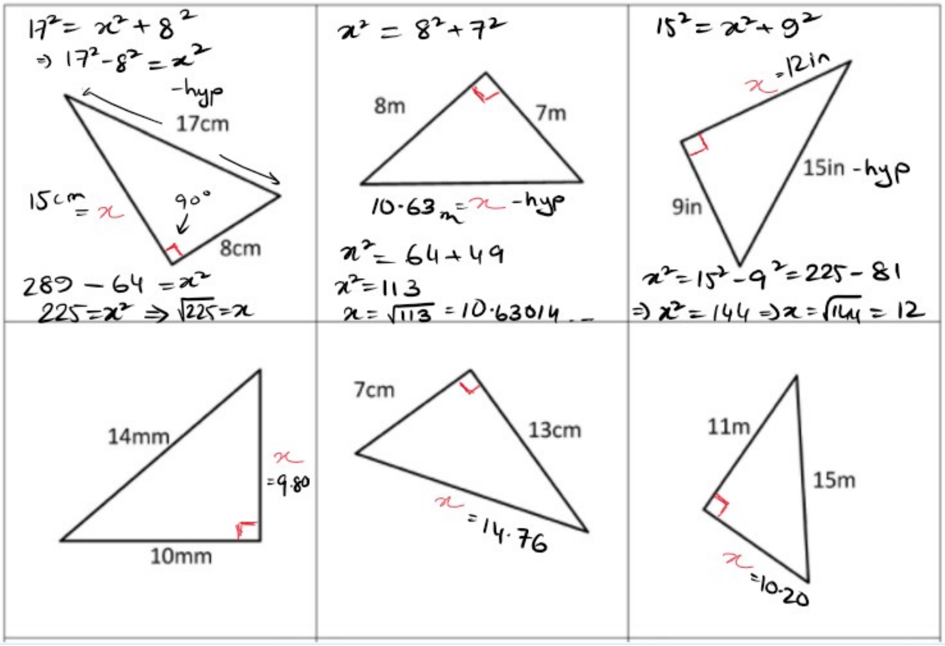
$5^2 + 12^2 = 169 = 13^2$

Practice

Find the length of the missing side each of the right triangles. Give any decimal answers to 2dp.

$17^2 = x^2 + 8^2$ $\Rightarrow 17^2 - 8^2 = x^2$  $289 - 64 = x^2$ $225 = x^2 \Rightarrow \sqrt{225} = x$	$x^2 = 8^2 + 7^2$  $10.63\,m = x$ -hyp $x^2 = 64 + 49$ $x^2 = 113$ $x = \sqrt{113} = 10.63014\ldots$	$15^2 = x^2 + 9^2$  $x^2 = 15^2 - 9^2 = 225 - 81$ $\Rightarrow x^2 = 144 \Rightarrow x = \sqrt{144} = 12$

Find the length of the missing side each of the right triangles. Give any decimal answers to 2dp.



5.

Pythagoras' Theorem example

Example 1:

You have measured a book shelf, the height measures at 48" and the width measures at 36", the diagonal measurement is 60". Is this book shelf square?

$C^2 = A^2 + B^2$

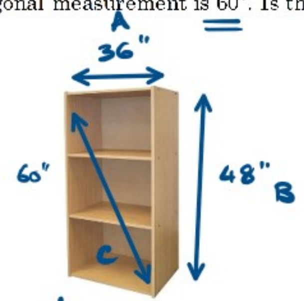
$C^2 = (48^2)+(36^2)$

$C^2 = 2304 + 1296$

$C^2 = 3600$

$C = \sqrt{3600}$

$C = \underline{60}$ ← matches with measurement



Therefore: yes, the bookshelf is square

6.

Pythagoras' theorem example 2

Example 2:

You are on site to take site dimensions for a new job, you need to check to see if the framers made 90° corners but you have forgotten your framing square. You measure 3ft on one wall, 4ft on the other wall. The cross dimension is 4'-10".

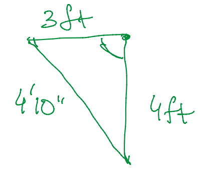
Is the corner square?

If corner were square:

then: cross dimension^2 = $3^2 + 4^2$

= 9+16=25

So cross-dim = 5ft



but measured 4'10" (not 5'), so corner not square

Practice

A ladder is leaning against the side of a 10m house. If the base of the ladder is 3m away from the house, how tall is the ladder?

Draw a diagram and show all work.

The ladder is 10·44 m tall.

7.

Area

- Area is the measurement of a surface. Two dimensions are used to calculate area, most commonly length and width.
- Consistent units: when calculating area, do not mix units i.e. (m & mm) or (inches & feet).
- Area is expressed as units squared. (m^2, ft^2, etc.)

8.

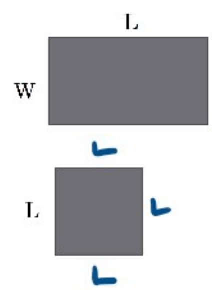
Area - Formulas

Area of a rectangle

L x W = area

Area ~~if~~ of a square

L^2 = area



9.

Area – Formulas – rectangle

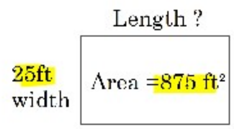
- What if we know the area and one of the dimensions of a rectangle. How do we find the missing dimension?

Area = L x w

875 = L x 25

L = $\frac{875}{25}$

L = 35



10.

Area – Formulas - square

- Can we find the side lengths of a square if all we have is the area?

Area of a square = L^2

25= L^2

L = $\sqrt{25}$

L = 5

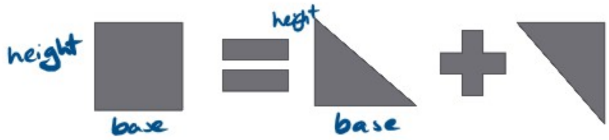
Area = 25 ft²

11.

Area – Formulas

Area of a triangle

The area of a triangle is equal to ½ that of a rectangle with the same measurements.



Area = $\frac{\text{base x height}}{2}$

$\frac{1}{2} \times (\text{base} \times \text{height})$

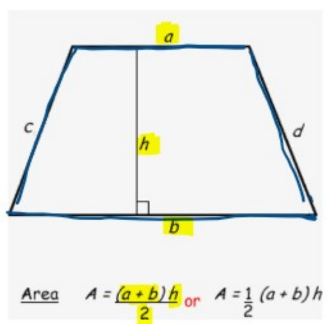
12.

Area – Formulas trapezoid

Trapezoid

To find the area of a trapezoid, calculate the average length of the parallel sides by dividing the total of the parallel sides by 2 then multiplying its answer by the height

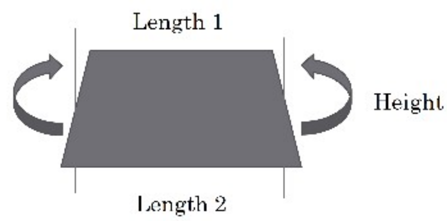
Area = $\frac{(\text{Length 1 + Length 2}) \text{ x height}}{2}$



13.

Area – Formulas trapezoid cont.

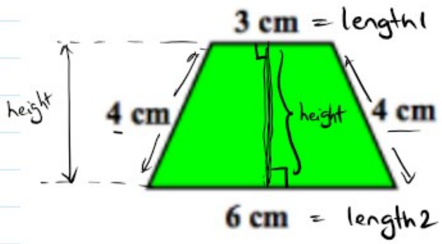
Trapezoid



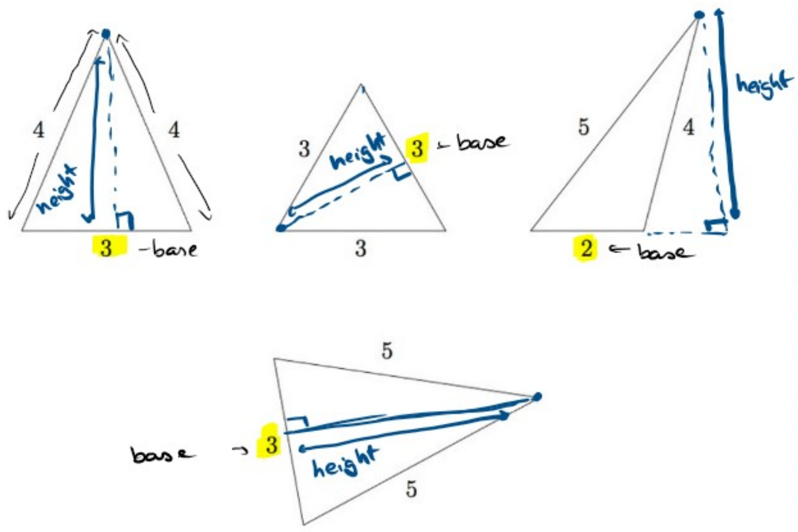
Area = $\left(\frac{\text{Length 1} + \text{Length 2}}{2}\right)$ x height

Area = $\frac{(\text{length}_1 + \text{length}_2) \times \text{height}}{2}$

Discussion: Triangle and Trapezoid Height



Area = ? - not so obvious
what is the height?



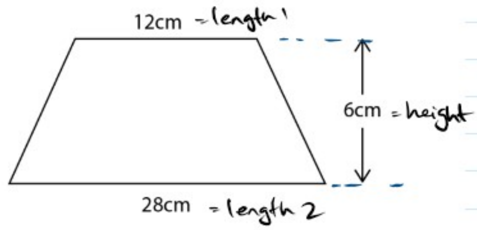
Area = ?

(Formula: $\frac{1}{2}$ x base x height)

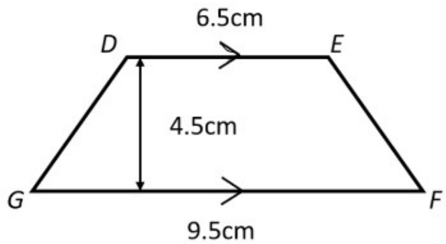
any of the three sides of a triangle can be "base".

height = ?

Practice:



$$\text{Area} = \tfrac{1}{2}(\text{length 1} + \text{length 2}) \times \text{height}$$
$$= \tfrac{1}{2} \times (12 + 28) \times 6$$
$$= \tfrac{1}{2} \times (40) \times 6$$
$$= 120 \text{ cm}^2$$



Area = 36 cm^2

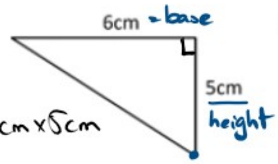
= 36 sq cm

$\text{Area} = \frac{1}{2} \times \text{base} \times \text{height}$

$\frac{1}{2} \times (3mm + 7mm) \times 6mm$

$= \frac{1}{2} \times 10mm \times 6mm$

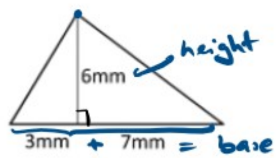
1)



$\frac{1}{2} \times 6cm \times 5cm$

Area = 15 cm^2

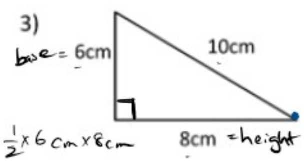
2)



Area = 30 mm^2

$10^2 = 8^2 + 6^2$

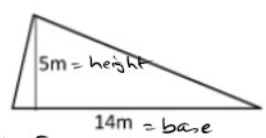
3)



$\frac{1}{2} \times 6cm \times 8cm$

Area = 24 cm^2

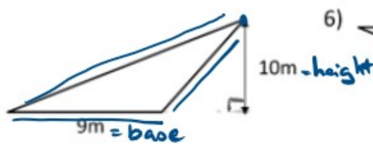
4)



$\frac{1}{2} \times 14m \times 5m$

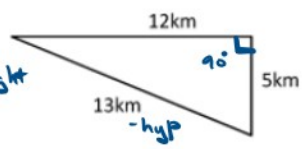
Area = 35 m^2

5)



Area = 45 m^2

6)



Area = 30 km^2

$13^2 = 169$

$12^2 + 5^2 = 144 + 25 = 169$

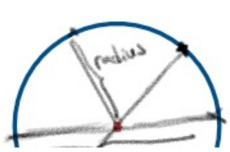
14.

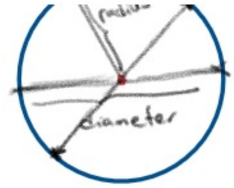
Area – Formulas definitions

Circle

- Diameter (d)- the measurement from one edge of a circle to the other edge, passing through the center.
- Radius (r)- the measurement from the center point to the edge.
- Pi (π) 3.1416. Represents the ratio between the circumference and diameter

fixed number



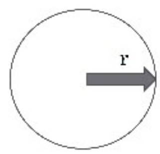


Area – Formulas circle

Circle

Area = πr^2

= pi (3.1416) x (radius)²

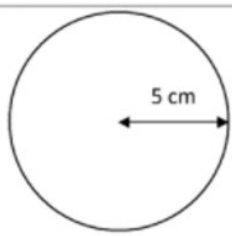


Work out the area of these circles using the radius measurements.
Give your answers to ~~1dp~~*.* 2dp.

Area = πr^2

1)

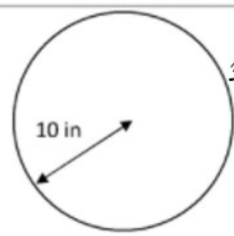
$3.1416 \times (5cm)^2$



A = 78.54 cm²

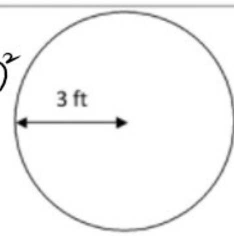
2)

$3.1416 \times (10in)^2$



A = 314.16 in²

3)



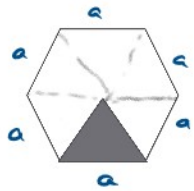
A = 28.27 ft²

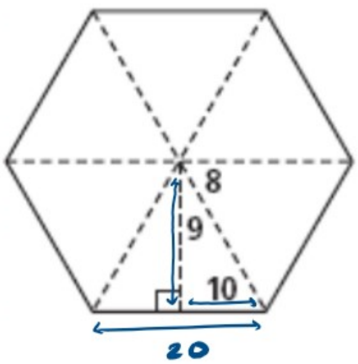
16

Area – Formulas $\underbrace{\text{equilateral}}_{\text{all sides have same length}}$ shapes

Equilateral shapes

- For equilateral shapes such as pentagon, hexagon or octagon, divide the shape into equal triangles then calculate the area of one triangle, multiply that answer by the number of triangles in the shape.
- Area = $\left[\dfrac{\text{base x height}}{2}\right]$ x num. triangles





Area = $\left[\frac{1}{2} \times 20 \times 9\right] \times 6$

$= 90 \times 6 = 540$

17.

Area – Formulas irregular shapes

Irregular shapes

Method 1

- Divide the irregular shape into common shapes such as rectangles, squares, circles or triangles then add up the individual areas.

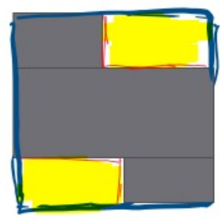
Method 2

- Calculate the total area of the irregular shape then subtract the area for the missing sections.

Area – Formulas irregular shapes cont.

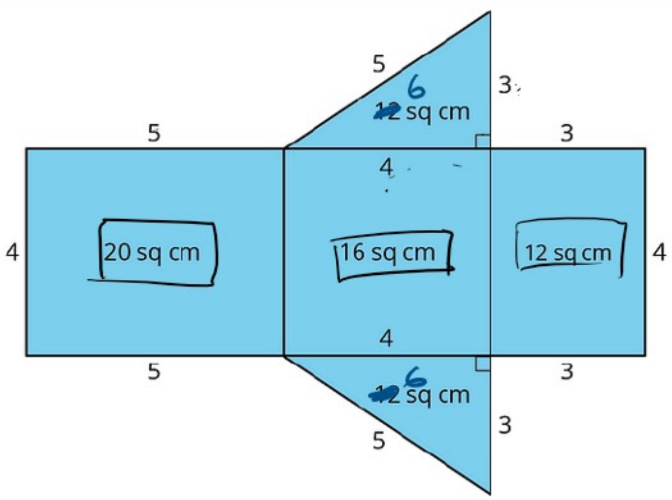
triangle
$+ \frac{1}{2}$ circle

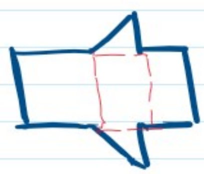
Method 1



Method 2

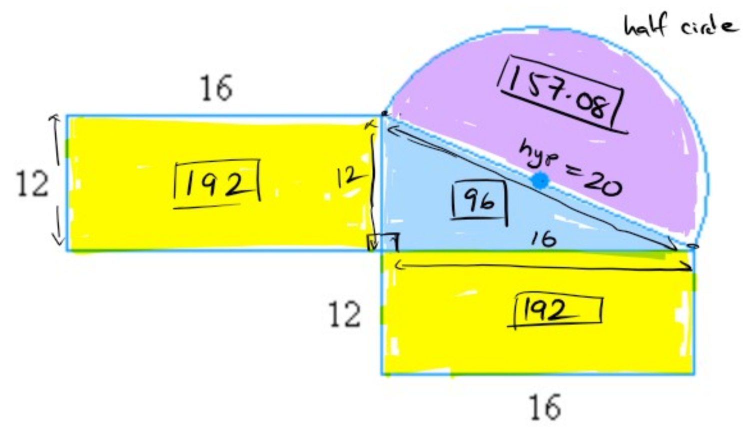
Big Square
$-$
2x area of missing rectangle





Area of shape = 20 + 16 + 6 + 6 + 12 = 60 sq cm

$$\text{Area of circle} = 3.1416 \times \text{radius}^2 = 3.1416 \times 10^2 = 314.16$$



$$hyp^2 = 12^2 + 16^2$$

$$hyp^2 = 400$$

$$hyp = \sqrt{400} = 20$$

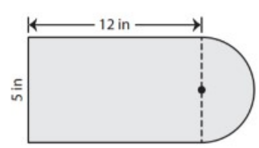
$$\text{diameter} = 20$$

$$\text{radius} = \frac{1}{2} \times 20 = 10$$

$$\text{Total Area} = 192 + 96 + 192 + 157.08 = 637.08$$

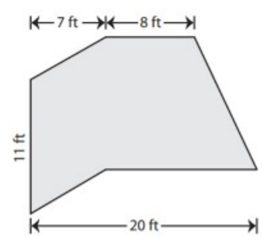
Find the area of each figure. Round your answer to 2 decimal places if required.
(Use π = [redacted] 3.1416

1)



Area = ___________

2)



Area = ___________