AREA

INTRODUCTION

Area is two-dimensional: length and width. In some math texts area is referred to as plane geometry. Area is always measured in square units. In this chapter, you will learn how to calculate the area of different shapes.

$12" = 1'$	$144\ in^2 = 1\ ft^2$	$1{,}728\ in^3 = 1\ ft^3$
↓	↓	↓
perimeter	area	volume
One-dimensional	Two-dimensional	Three-dimensional
inches	in^2	in^3
feet	ft^2	ft^3
yards	yd^2	yd^3
mm	mm^2	mm^3
cm	cm^2	cm^3
m	m^2	m^3

When you have completed this chapter you will be able to:

- ❒ Calculate the area of rectangles, squares, triangles, circles, parallelograms, trapezoids and hexagons using formulas.
- ❒ Calculate the area of complex shapes using a combination of formulas.
- ❒ Calculate lateral area (L.A.) and surface area (S.A.) of cylinders and rectangular solids, square-based and triangular-based frustrums.
- ❒ Solve word problems using area.
- ❒ Solve applications using area.

Calculating Area

Always use the same steps to solve area problems.

Step 1: Draw a diagram and label it. All measurements must be in the same unit of measurement before you calculate area. Refer to the Measurements and Conversions chapter for help converting units.

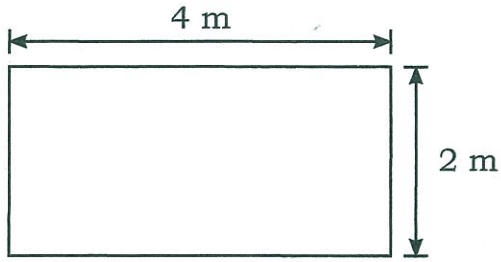
Step 2: Write the formula.

Step 3: Calculate the area. Include the units of measurement as part of your answer.

Example 1:

Calculate the area of a floor that measures four metres long and two metres wide.

Step 1: Draw a diagram and label it.



Step 2: Write the formula.
$A = LW$

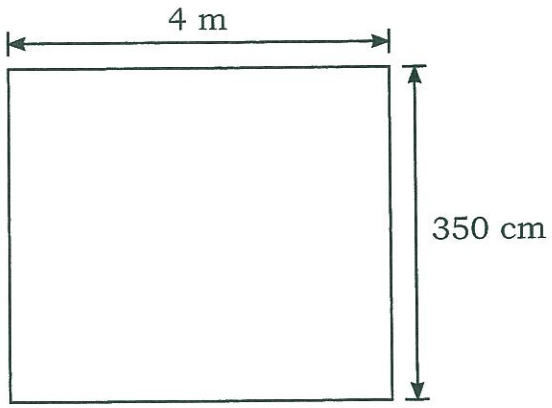
Step 3: Calculate the area.
$A = LW = 4\ m \times 2\ m = 8\ m^2$

The area of the floor is $8\ m^2$.

Example 2:

Calculate the area of a floor that measures 4 metres long and 350 centimetres wide.

Step 1: Draw a diagram and label it.



The two dimensions do not have the same unit of measurement. You need to convert metres to centimetres or centimetres to metres before you can calculate the area.

350 cm = 3.5 m

Step 2: Write the formula.

$A = LW$

Step 3: Calculate the area.

$A = LW = 4\text{ m} \times 3.5\text{ m} = 14\text{ m}^2$

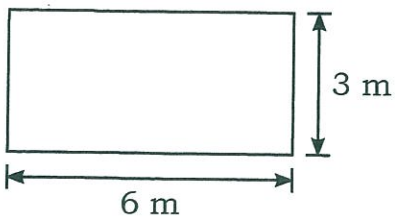
The area of the floor is 14 m^2.

Calculate the area of the following figures. Round off to two decimal places. If your calculator doesn't have π, use 3.1416.

Remember:

Multiplying by a $\frac{1}{2}$ is the same as dividing by 2.

1) A =



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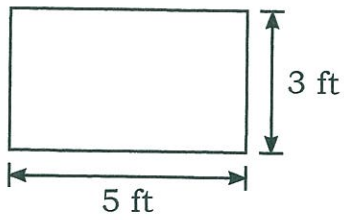

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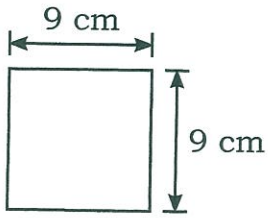

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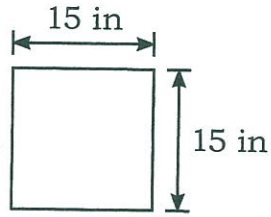
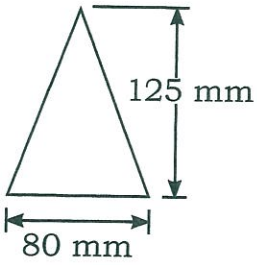


Hint:

Radius is half the diameter.

5) A =



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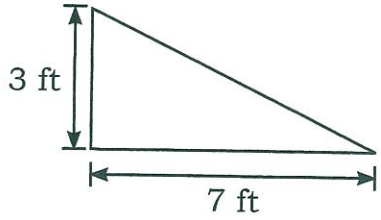

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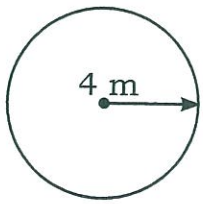

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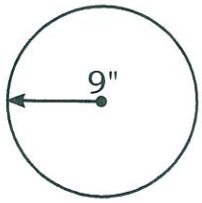

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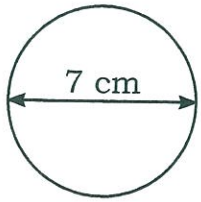

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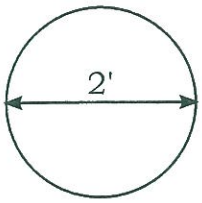

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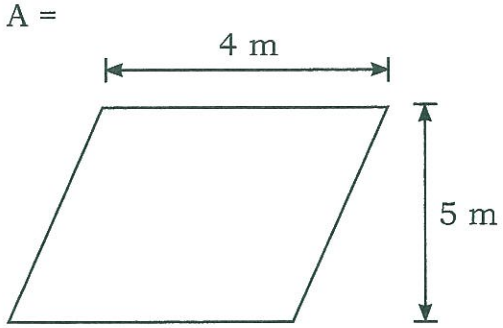

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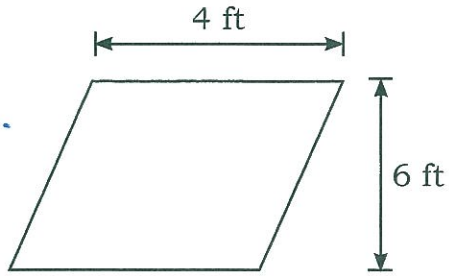

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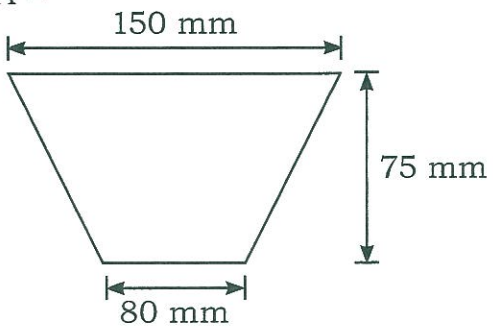

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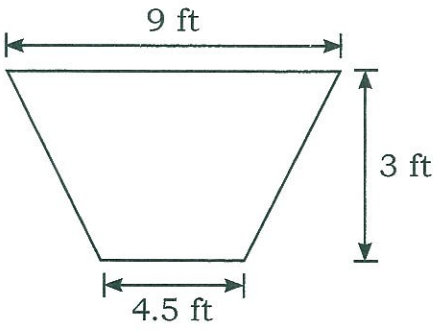

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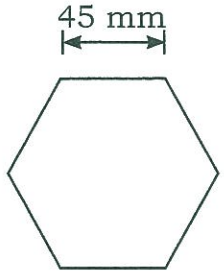

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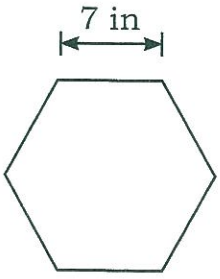

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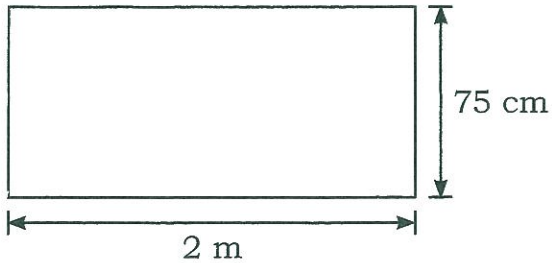

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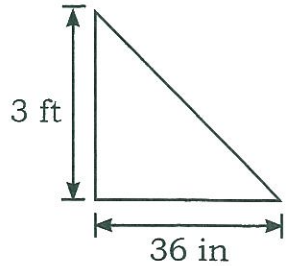

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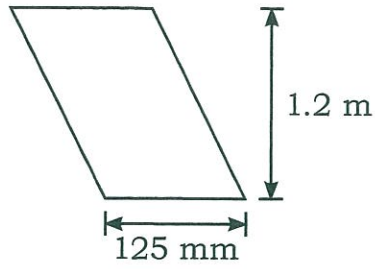

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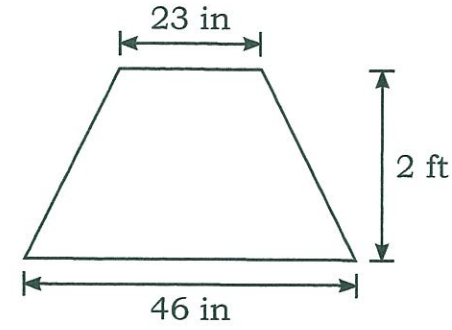

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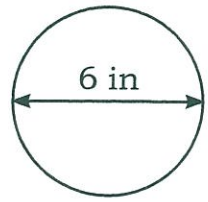

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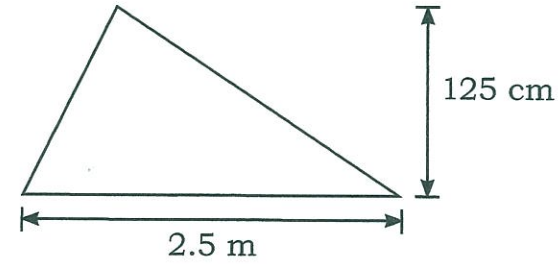

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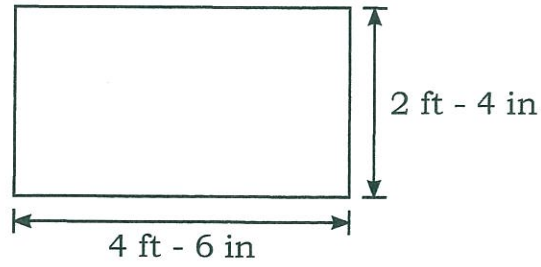

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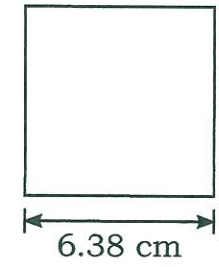

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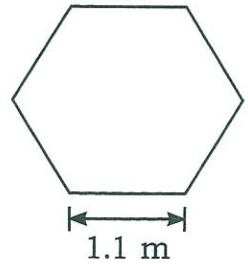

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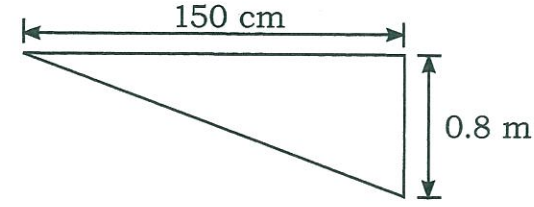
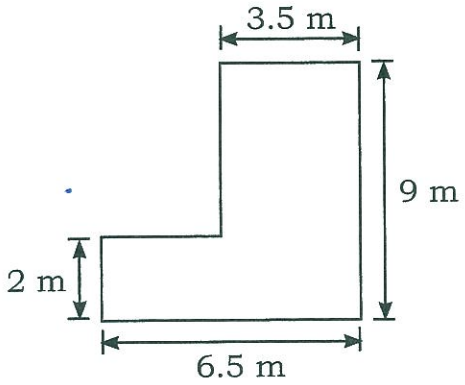


Calculating the Area of Complex Shapes

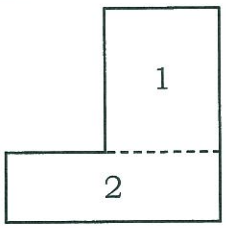
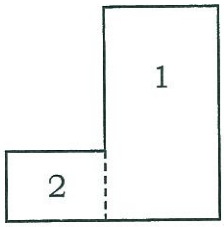
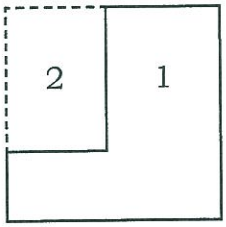
Sometimes you need to do several calculations to get the final answer. Many area problems are a combination of common geometrical shapes. To solve these problems, you will need to divide the drawing into shapes you are familiar with and calculate the area of each of those shapes. You might need to use the same formula several times or you might need to use several different formulas.

Example 1:

Calculate the area of the L-shaped room.



There are three different ways to solve this problem.

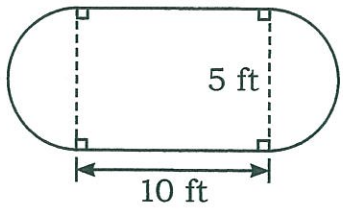
Steps	Method 1	Method 2	Method 3
Draw a diagram and label it.			
Write the formula(s).	A = LW	A = LW	A = LW
Calculate the area.	Area 1: A = 3.5 × 7 = 24.5 m^2 Area 2: A = 6.5 × 2 = 13 m^2 Total Area = 13 m^2 + 24.5 m^2 = 37.5 m^2	Area 1: A = 3.5 × 9 = 31.5 m^2 Area 2: A = 3 × 2 = 6 m^2 Total Area = 31.5 m^2 + 6 m^2 = 37.5 m^2	Area 1: A = 6.5 × 9 = 58.5 m^2 Area 2: A = 3 × 7 = 21 m^2 Total Area = 58.5 – 21 = 37.5 m^2

Remember:

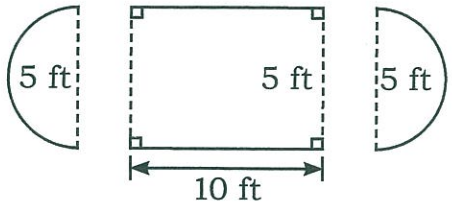
There is often more than one way to solve a math problem.

Example 2:

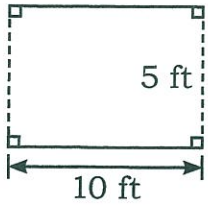
Calculate the area of the deck.

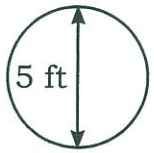


Step 1: Draw a diagram and label it.
Decide what basic shapes make up the diagram.



The two half-circles make one complete circle. You need to calculate the area of a circle plus the area of the rectangle.





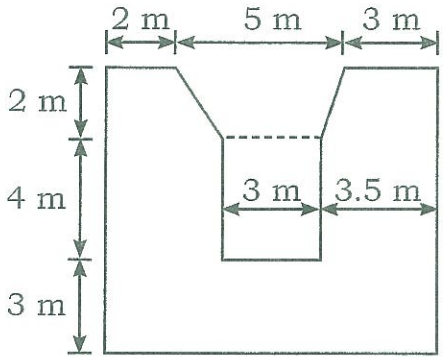
Step 2: Write the formula(s) you need to solve the problem.
Rectangle
$A = LW$
Circle
$A = \pi r^2$

Step 3: Calculate the area.
Calculate the area of a rectangle. Calculate the area of the circle. Calculate the total area by adding area of the rectangle and the area of the circle.
Rectangle
$A = LW = 10 \text{ ft} \times 5 \text{ ft} = 50 \text{ ft}^2$
Circle
The formula for area of a circle uses the radius. You need to divide the diameter by two to get the radius.
$5 \div 2 = 2.5 \text{ ft}$
$A = \pi r^2 = \pi \times (2.5)^2 = 19.6 \text{ ft}^2$

Total Area $= 50 \text{ ft}^2 + 19.6 \text{ ft}^2 = 69.6 \text{ ft}^2$
The area of the deck is 69.6 ft^2.

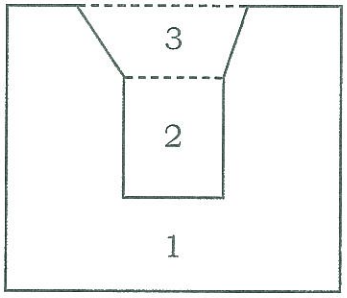
Example 3:

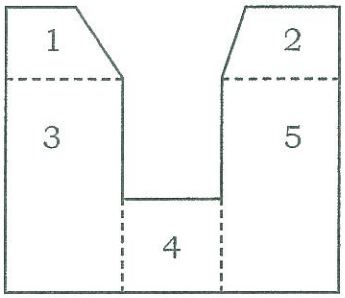
Sometimes it is easier to calculate the area of the empty space and subtract it from the total area than it is to calculate the area of a lot of little shapes and add them up.



Step 1: Draw a diagram and label it.

Think about the easiest way to calculate the area. As you can see there is more than one way to calculate the total area. Method 1 is easier because there are fewer calculations.





Method 1: Calculate three areas.

Calculate the area of 1.

Calculate the area of 2.

Calculate the area of 3.

Subtract the total area of 2 and 3 from 1.

Method 2: Calculate 5 areas.

Calculate the area of 1 and 2.

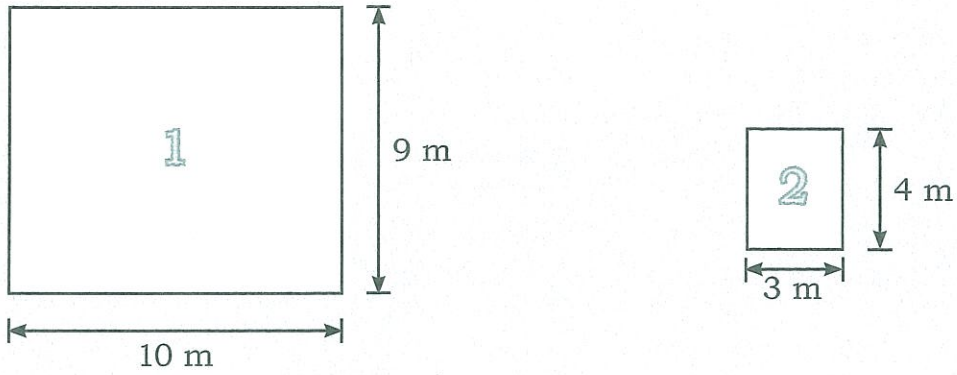
Calculate the area of 3, 4 and 5.

Add 1, 2, 3, 4 and 5 to get the total area.

The example illustrates Method 1.

Step 2: Write the formula(s) you need to solve the problem. Decide what basic shapes make up the diagram. In this example there are two basic shapes: rectangle and trapezoid.

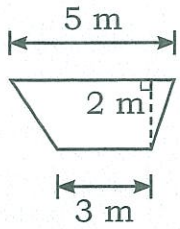
Area 1 and Area 2:



$A = LW$

Area 3:

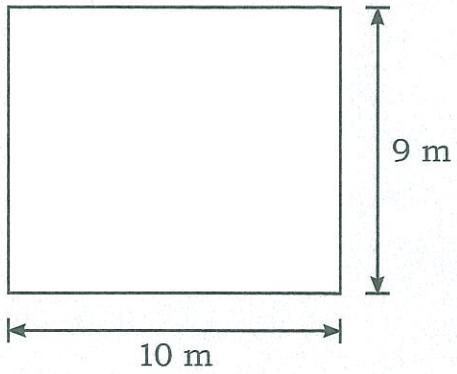
$A = \left(\frac{b_1 + b_2}{2}\right)h$



Step 3: Calculate the area.

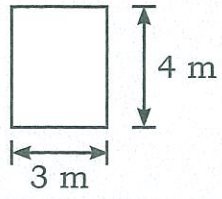
Area 1:

$A = LW = 9 \times 10 = 90\ m^2$



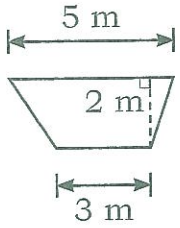
Area 2:

$A = LW = 4 \times 3 = 12\ m^2$



Area 3:

$$A = \left(\frac{b_1 + b_2}{2}\right)h = \left(\frac{5+3}{2}\right)2 = \left(\frac{8}{2}\right)2 = (4)2 = 8 \text{ m}^2$$

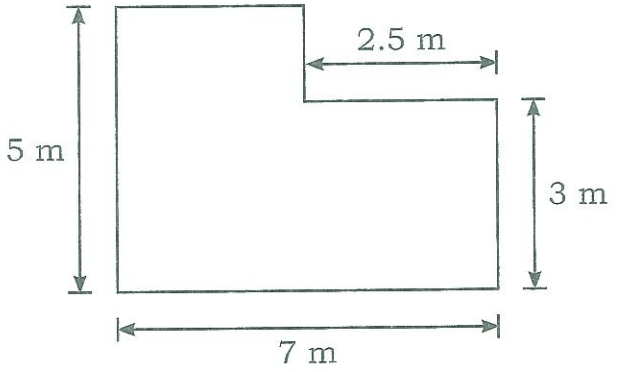


Subtract the area of the trapezoid and the small rectangle from the big rectangle to get the total area.

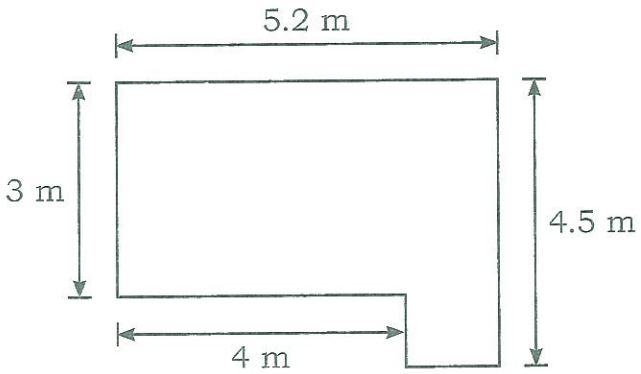
Total Area = 90 – (12 + 8) = 90 – 20 = 70 m²
The area of shaded diagram is 70 m².

Calculate the area of the following shapes. If the shapes have shading calculate the area that is shaded. Round off to two decimal places. If your calculator doesn't have π, use 3.1416.

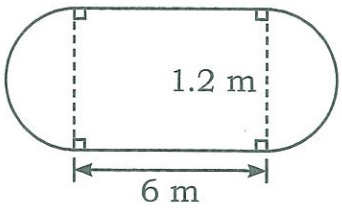
1) A =



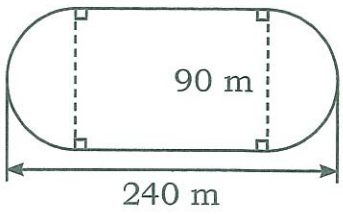
2) A =



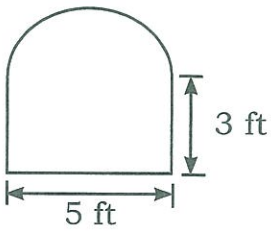
3) A =



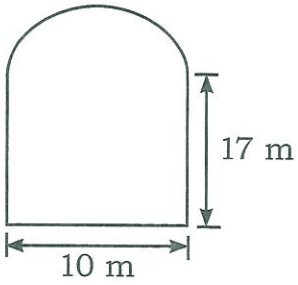
4) A =



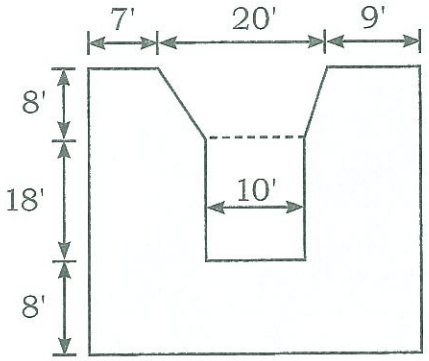
5) A =



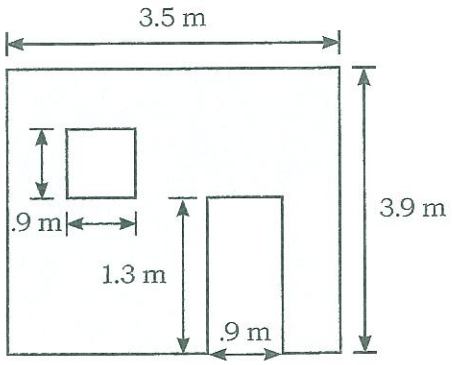
6) A =



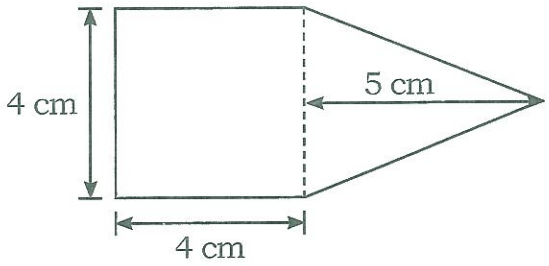
7) A =



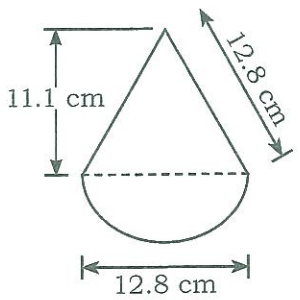
8) A =



9) A =



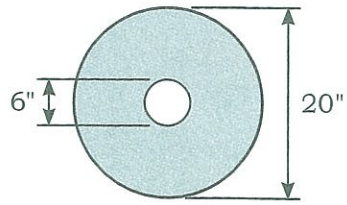
10) A =



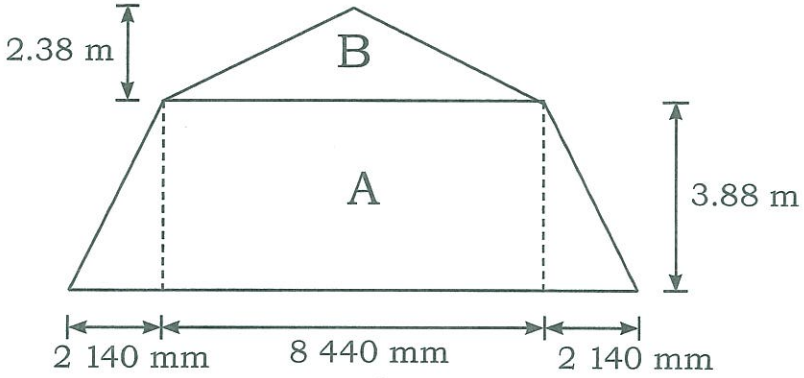
Hint:

Read the diagram carefully. Decide what basic geometric shapes are used. Decide if it is easier to subtract or add to calculate the total area.

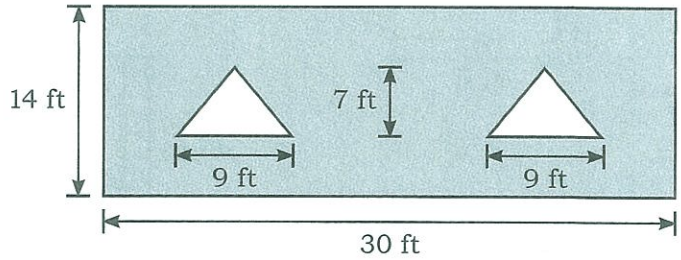
11) A =



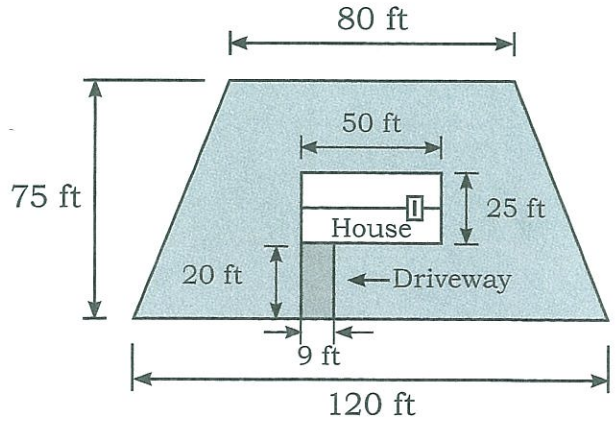
12) A =



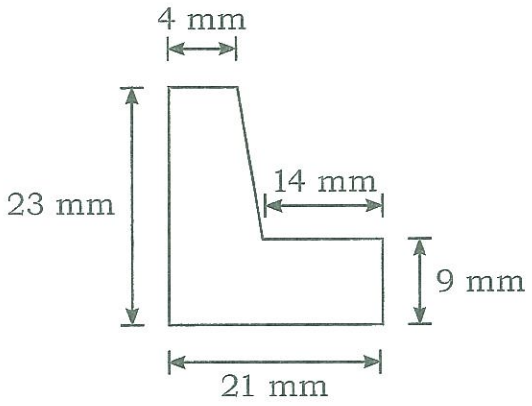
13) A =



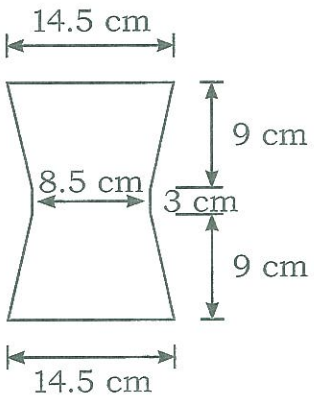
14) A =



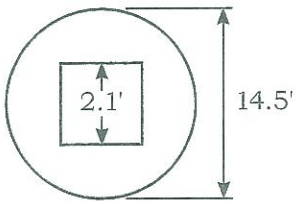
15) A =



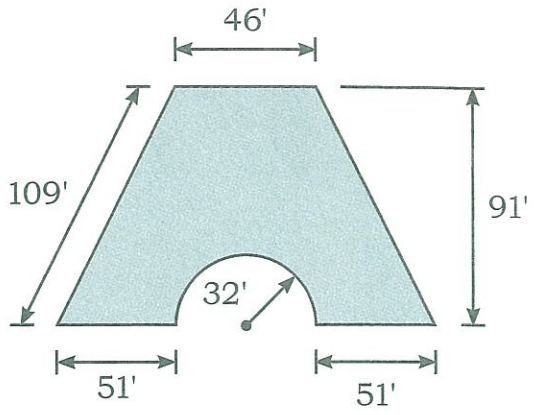
16) A =



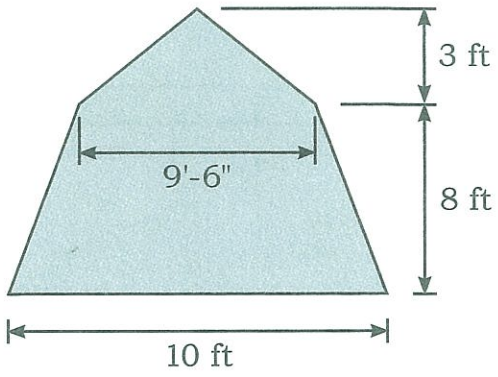
17) A =



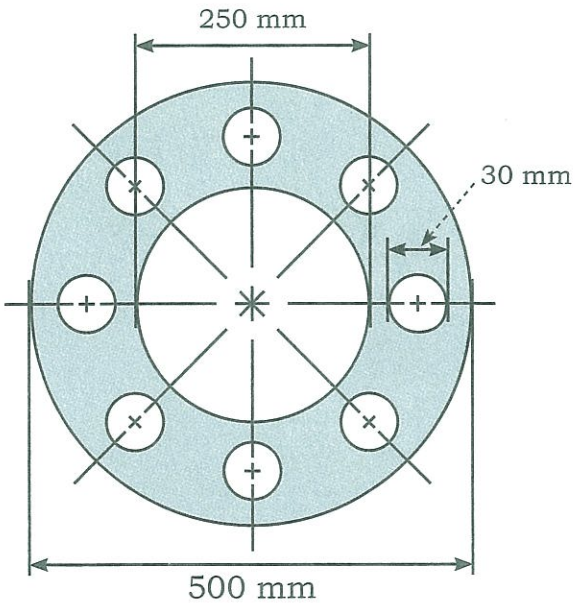
18) A =



19) A =



20) A =



Calculating One of the Sides when You Know the Area

Sometimes you know the area of a shape and need to work backwards to calculate one of the sides. You work with the same formula(s).

Step 1: Draw a diagram and label it with the known information.

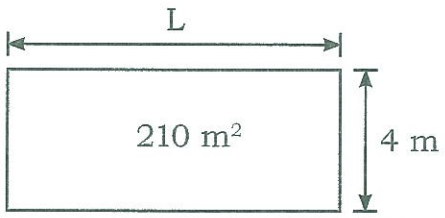
Step 2: Write the formula(s) required.

Step 3: Calculate the side.

Example 1:

Calculate the length of the rectangle in the diagram below.

Step 1: Draw a diagram and label it with the known information.



Step 2: Write the formula(s) required.

$A = LW$

Step 3: Calculate the side.

$A = LW$

$210 \text{ m}^2 = L \times 4 \text{ m}$

$\frac{210}{4} = L$

$\frac{210}{4} = 52.5$

The length of the side is 52.5 m.

Example 2:

Calculate the diameter of the circle in the diagram below.

Step 1: Draw a diagram and label it with the known information.

Step 2: Write the formula(s) required.

$A = \pi r^2$

Step 3: Calculate the diameter.

Note: If your calculator doesn't have π, use 3.1416.

$A = \pi r^2$

$\frac{25}{\pi} = r^2$

$7.96 = r^2$

$\sqrt{7.96} = r$

$2.82 = r$

The radius is 2.82 ft. You were asked to calculate the diameter. Diameter is equal to two times the radius.

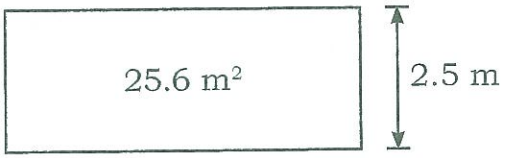
$D = 2.82 \times 2 = 5.64$

The diameter of the circle is 5.64 ft.

Calculate the missing side in the shapes below. Round off to two decimal places. If your calculator doesn't have π, use 3.1416.

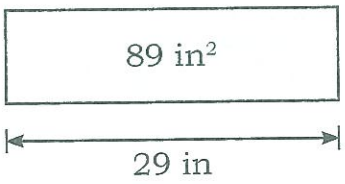
1) Calculate the length of the rectangle.

L =



2) Calculate the width of the rectangle.

W =



3) Calculate the radius of the circle.

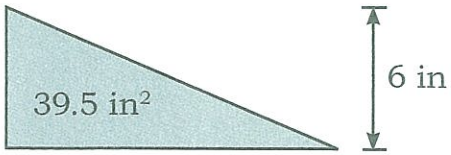
r =

4) Calculate the diameter of the circle.

d =

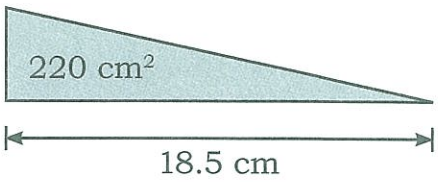
5) Calculate the base of the triangle.

b =



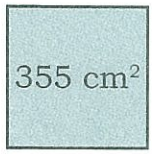
6) Calculate the height of the triangle.

h =



7) Calculate the side of the square.

s =



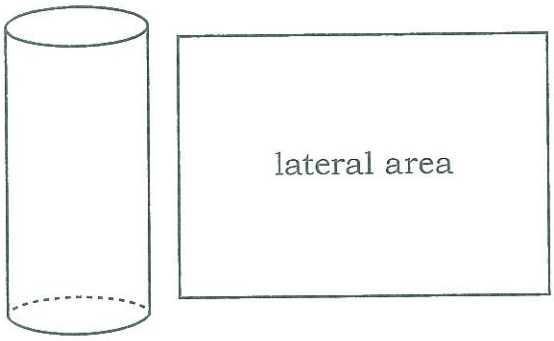
8) Calculate the side of the square.

s =

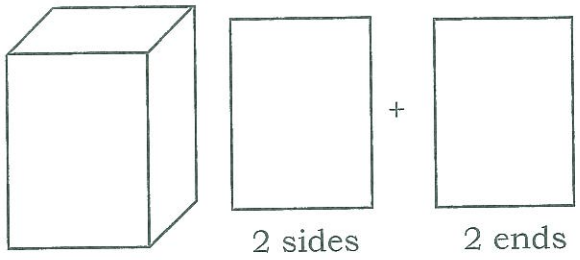
Lateral Area and Surface Area

Lateral Area (L.A.) is the area of all the surfaces except for the bases.

Cylinders

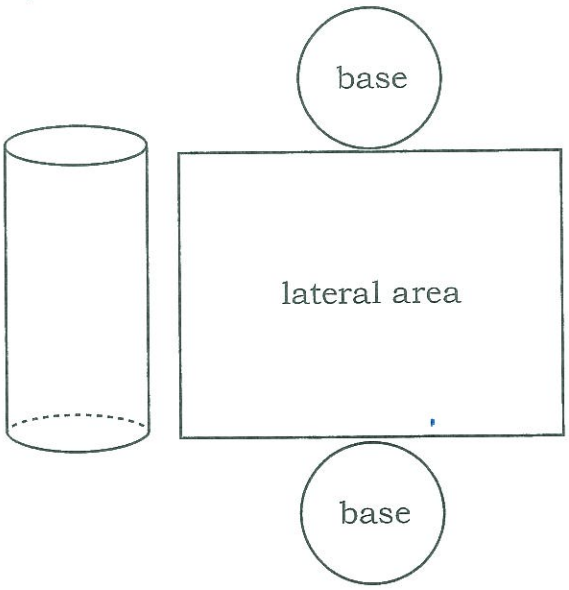


Rectangular solids

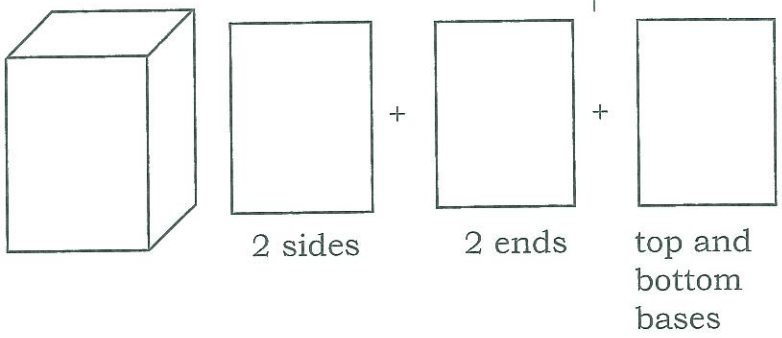


Surface Area (S.A.) is the lateral area plus the area of the two bases.

Cylinders



Rectangular solids

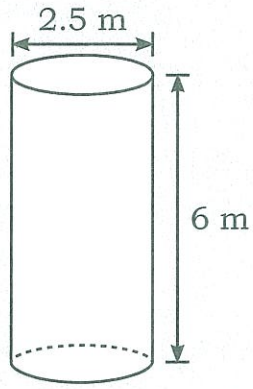


Example 1:

Calculate the lateral surface area (L.A.) and total surface area (S.A.) of a cylinder that is 6 m high and has a diameter of 2.5 m.

Lateral Area

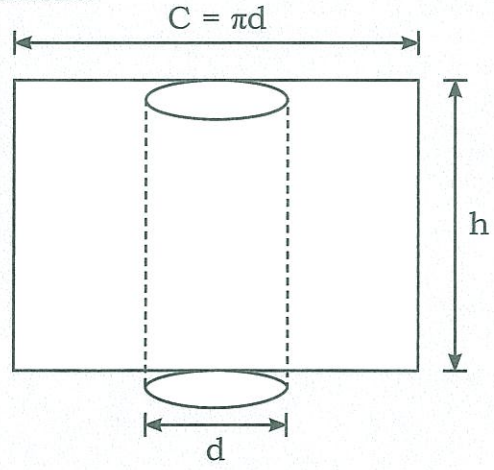
Step 1: Draw a diagram and label it.



Step 2: Write the formula needed to solve the problem.

L.A. = $\pi d \times h$

Think of the cylinder as being laid out flat, so the circumference becomes the width measurement.

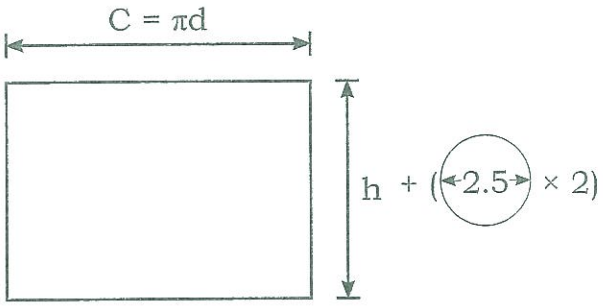


Step 3: Calculate the lateral area.

L.A. = $\pi d \times h = \pi \times 2.5\text{ m} \times 6\text{ m} = 47.12\text{ m}^2$

Surface area:

Step 1: Draw a diagram and label it.



Step 2: Write the formula needed to solve the problem.
S.A. = L.A. + area of the two bases
You have already calculated the L.A.

The two bases are circles. Calculate the area of a circle and multiply by 2 because there are two identical circles.

Radius = diameter ÷ 2 = 2.5 m ÷ 2 = 1.25 m

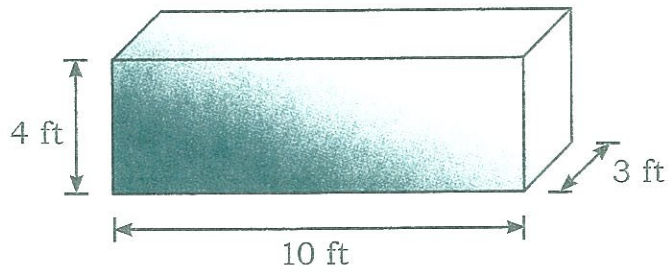
S.A. = L.A. + area of two bases =
$47.12\ m^2 + (\pi r^2 \times 2) = 47.12\ m^2 + (\pi \times (1.25\ m)^2 \times 2) =$
$47.12\ m^2 + 9.04\ m^2 = 56.16\ m^2$

Remember:
BEDMAS.

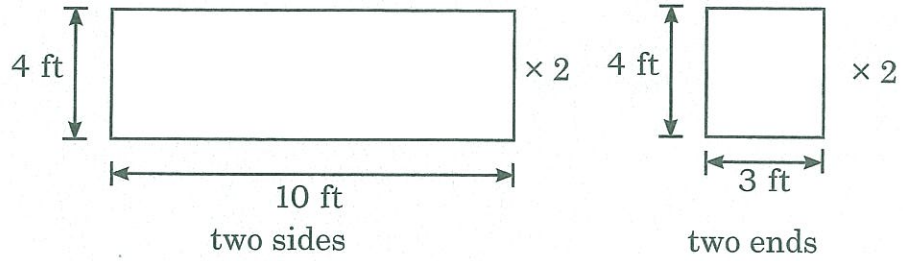
Example 2:
Calculate the lateral area (L.A.) and total surface area (S.A.) of the rectangular solid below.

Lateral Area

Step 1: Draw a diagram and label it.



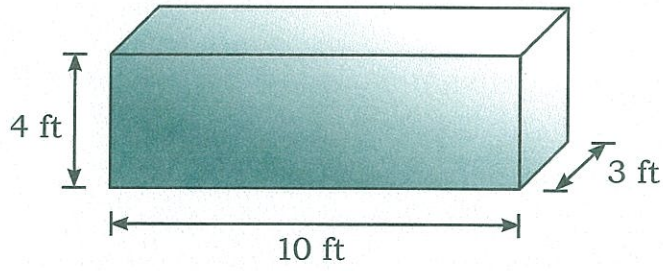
Step 2: Write the formula needed to solve the problem.
$A = LW$



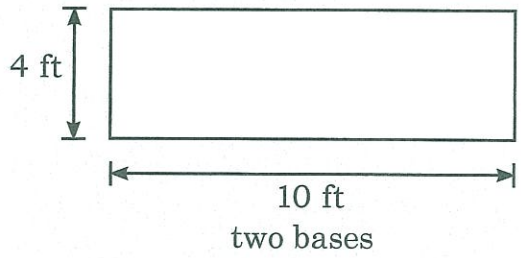
Step 3: Calculate the L.A.
Area of front and back = 10 ft × 4 ft × 2 = 80 ft²
Area of sides = 3 ft × 4 ft × 2 = 24 ft²
L.A. = 80 ft² + 24 ft² = 104 ft²

Surface Area

Step 1: Draw a diagram and label it.



Step 2: Write the formula needed to solve the problem.
S.A. = L.A. + area of two bases
You have already calculated the L.A.

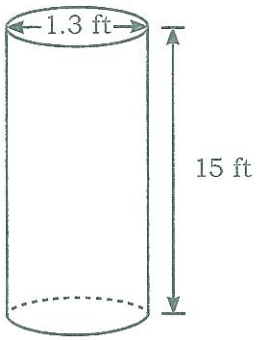


Step 3: Calculate the surface area.
S.A. = L.A. + (L × W × 2) =
104 ft² + (10 ft × 3 ft × 2) =
104 ft² + 60 ft² = 164 ft²

Calculate the lateral area and surface area of the shapes below. Round off answers to two decimal places.

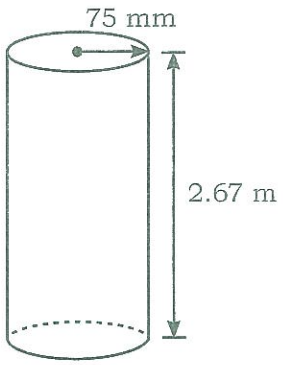
1) L.A. =

S.A. =



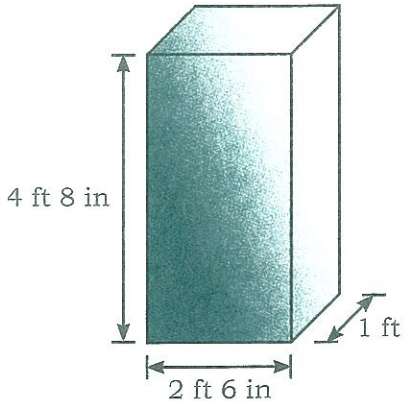
2) L.A. =

S.A. =



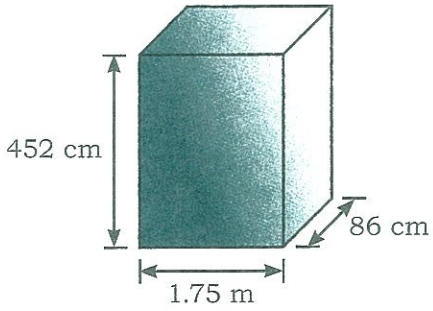
3) L.A. =

S.A. =



4) L.A. =

S.A. =

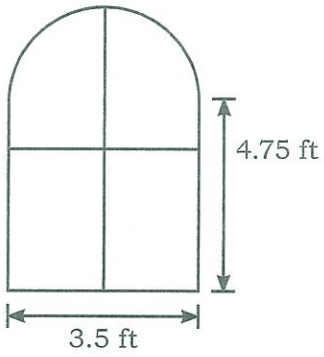


PRACTICE

Complete the following practice problems. Round off answers to two decimal places.

1) Calculate the cost of paving a driveway that measures 6 ft by 15 ft at $5.25 per square foot.

2) Calculate the surface area of the window below.



3) How many square metres of floor space are there in a circular silo that has a diameter of 12 m?

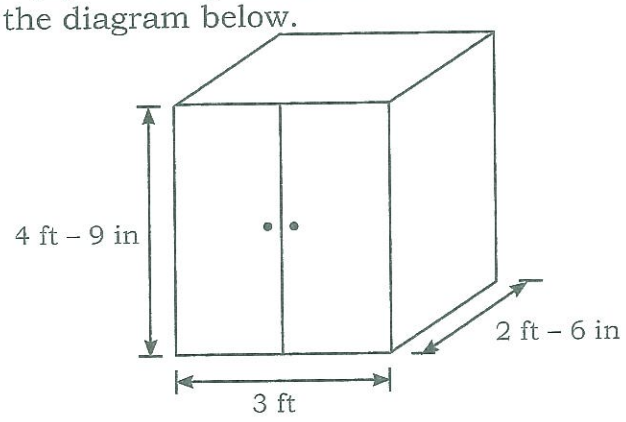
4) a) Calculate the square feet of drywall required for a room that measures 8 ft by 10 ft. The walls are 9 ft high. There are two doors that measure 3 ft by 7 ft and one window that measures 2.5 ft by 4 ft.

Hint:
There are four walls.

b) One sheet of drywall measures 4 ft by 8 ft and costs $38.98. Calculate the total cost.

Hint:
Can't buy part of a sheet of drywall.

5) Calculate the square feet of plywood required to make five cupboards like the one in the diagram below.

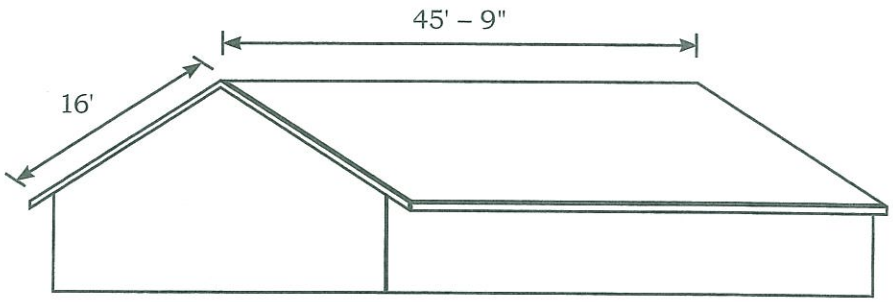


Hint:
You are calculating the surface area.

6) How many square feet of pine are required to line a closet that measures 6.5 feet wide, 4.5 feet deep and 8 feet high? Allow 21 square feet for the door.

Hint:
You are calculating the surface area.

7) The roof shown in the diagram below is to be covered with asphalt shingles. Calculate the square feet of surface to be covered.



8) Calculate the cost of 36 pieces of paneling 4 ft × 8 ft. The panelling costs $1.25 per square foot.

Calculating Volume

Always use the same steps to solve volume problems.

Step 1: Draw a diagram and label it. All measurements must be in the same unit of measurement before you calculate volume. Refer to the Measurements and Conversions chapter for help converting units.

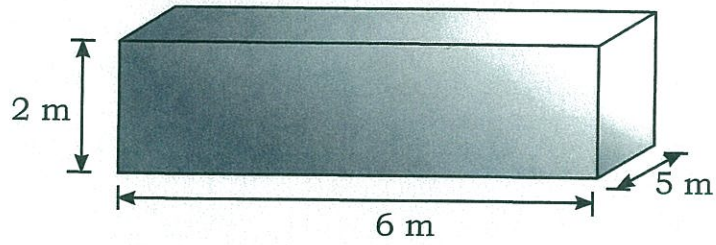
Step 2: Write the formula.

Step 3: Calculate the volume. Include the units of measurement as part of your answer.

Example 1:

Calculate the volume of a rectangular solid that measures 6 m long, 5 m wide and 2 m high.

Step 1: Draw a diagram and label it.



Step 2: Write the formula.
$V = LWH$

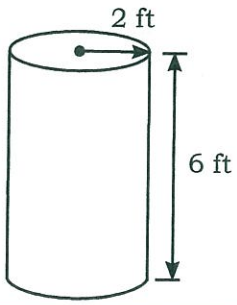
Step 3: Calculate the volume.
$V = LWH = 6 \times 5 \times 2 = 60 \text{ m}^3$

The volume is 60 m^3.

Example 2:

Calculate the volume of a cylinder that has a radius of 2 ft and a height of 6 ft.

Step 1: Draw a diagram and label it.



Step 2: Write the formula.
$V = \pi r^2 h$

Step 3: Calculate the volume.

ANSWER KEY

GEOMETRY - AREA

Page 152, **Calculating Area**

1) $A = L \times W = 6\ m \times 3\ m = 18\ m^2$

2) $A = L \times W = 5\ ft \times 3\ ft = 15\ ft^2$

3) $A = s^2 = (9\ cm)^2 = 81\ cm^2$

4) $A = s^2 = (15\ in)^2 = 225\ in^2$

5) $A = \frac{bh}{2} = \frac{80\ mm \times 125\ mm}{2} = \frac{10\ 000}{2} = 5\ 000\ mm^2$

6) $A = \frac{bh}{2} = \frac{7\ ft \times 3\ ft}{2} = \frac{21}{2} = 10.5\ ft^2$

7) $A = \pi r^2 = \pi \times (4\ m)^2 = 50.27\ m^2$

8) $A = \pi r^2 = \pi \times (9\ in)^2 = 254.47\ in^2$

9) $r = \frac{d}{2} = \frac{7}{2} = 3.5\ cm$

$A = \pi r^2 = \pi \times (3.5\ cm)^2 = 38.48\ cm^2$

10) $r = \frac{d}{2} = \frac{2\ ft}{2} = 1\ ft$

$A = \pi r^2 = \pi \times (1\ ft^2) = 3.14\ ft^2$

11) $A = bh = 4\ m \times 5\ m = 20\ m^2$

12) $A = bh = 4\ ft \times 6\ ft = 24\ ft^2$

13) $A = \left(\frac{b_1 + b_2}{2}\right) h = \left(\frac{150\ mm + 80\ mm}{2}\right) 75\ mm = \left(\frac{230}{2}\right) 75 =$
$115 \times 75 = 8\ 625\ mm^2$

14) $A = \left(\frac{b_1 + b_2}{2}\right) h = \left(\frac{9\ ft + 4.5\ ft}{2}\right) 3 = \left(\frac{13.5}{2}\right) 3\ ft = 6.75 \times 3 = 20.25\ ft^2$

15) $A = 2.59 \times s^2 = 2.59 \times (45\ mm)^2 = 5\ 244.75\ mm^2$

16) $A = 2.59 \times s^2 = 2.59 \times (7\ in)^2 = 126.91\ in^2$

17) $75\ cm = 0.75\ m$
$A = L \times W = 2\ m \times 0.75\ m = 1.5\ m^2$

18) 36 in = 3 ft

$$A = \frac{bh}{2} = \frac{3\text{ ft} \times 3\text{ ft}}{2} = \frac{9}{2} = 4.5\text{ ft}^2$$

19) 125 mm = 0.125 m

$A = bh = 0.125\text{ m} \times 1.2\text{ m} = 0.15\text{ m}^2$

20) 46 in = 3.83 ft, 23 in = 1.92 ft

$$A = \left(\frac{b_1 + b_2}{2}\right)h = \left(\frac{3.83\text{ ft} + 1.92\text{ ft}}{2}\right)2\text{ ft} = \left(\frac{5.75}{2}\right)2 =$$

$2.875 \times 2 = 5.75\text{ ft}^2$

21) $\text{Radius} = \frac{d}{2} = \frac{6\text{ in}}{2} = 3\text{ in}$

$A = \pi r^2 = \pi \times (3\text{ in})^2 = 28.27\text{ in}^2$

22) 125 cm = 1.25 m

$$A = \frac{bh}{2} = \frac{2.5\text{ m} \times 1.25\text{ m}}{2} = \frac{3.125}{2} = 1.56\text{ m}^2$$

23) 4 ft – 6 in = 4.5 ft

2 ft – 4 in = 2.33 ft

$A = LW = 4.5\text{ ft} \times 2.33\text{ ft} = 10.49\text{ ft}^2$

24) $A = s^2 = (6.38\text{ cm})^2 = 40.7\text{ cm}^2$

25) $A = 2.59 \times s^2 = 2.59 \times (1.1\text{ m})^2 = 3.13\text{ m}^2$

26) 150 cm = 1.5 m

$$A = \frac{bh}{2} = \frac{1.5\text{ m} \times 0.8\text{ m}}{2} = \frac{1.2}{2} = 0.6\text{ m}^2$$

Page 159, **Calculating the Area of Complex Shapes**

1) $A = L \times W = 4.5\text{ m} \times 5\text{ m} = 22.5\text{ m}^2$
$A = L \times W = 2.5\text{ m} \times 3\text{ m} = 7.5\text{ m}^2$
$\text{Total Area} = 22.5\text{ m}^2 + 7.5\text{ m}^2 = 30\text{ m}^2$

2) $A = L \times W = 5.2\text{ m} \times 3\text{ m} = 15.6\text{ m}^2$
$A = L \times W = 1.2\text{ m} \times 1.5\text{ m} = 1.8\text{ m}^2$
$\text{Total Area} = 15.6\text{ m}^2 + 1.8\text{ m}^2 = 17.4\text{ m}^2$

3) $\text{Area of rectangle} = 6\text{ m} \times 1.2\text{ m} = 7.2\text{ m}^2$

$$\text{radius} = \frac{d}{2} = \frac{1.2\text{ m}}{2} = 0.6\text{ m}$$

$\text{Area of circle} = \pi r^2 = \pi \times (0.6\text{ m})^2 = 1.13\text{ m}^2$
$\text{Total Area} = 1.13\text{ m}^2 + 7.2\text{ m}^2 = 8.33\text{ m}^2$

4) 240 m – (45 + 45) = 150 m
Area of rectangle = 150 m × 90 m = 13 500 m^2
Radius = diameter ÷ 2 = 90 m ÷ 2 = 45 m
Area of circle = $\pi r^2 = \pi \times (45 \text{ m})^2$ = 6 361.73 m^2
Total area = 13 500 m^2 + 6 361.73 m^2 = 19 861.73 m^2

5) Area of rectangle = LW = 5 ft × 3 ft = 15 ft^2
Radius = diameter ÷ 2 = 5 ÷ 2 = 2.5 ft
Area of circle = $\pi r^2 = \pi \times (2.5 \text{ ft})^2$ = 19.63 ft^2
Area of half circle = 19.63 ft^2 ÷ 2 = 9.82 ft^2
Total area = 15 ft^2 + 9.82 ft^2 = 24.82 ft^2

6) Area of rectangle = LW = 10 m × 17 m = 170 m^2
Radius = diameter ÷ 2 = 10 ÷ 2 = 5 m
Area of circle = $\pi r^2 = \pi \times (5 \text{ m})^2$ = 78.54 m^2
Area of half circle = 78.54 m^2 ÷ 2 = 39.27 m^2
Total area = 170 m^2 + 39.27 m^2 = 209.27 m^2

7) Length of big rectangle = 7 ft + 20 ft + 9 ft = 36 ft
Width of big rectangle = 8 ft + 18 ft + 8 ft = 34 ft
Area of big rectangle = LW = 36 ft × 34 ft = 1 224 ft^2
Area of small rectangle = LW = 10 ft × 18 ft = 180 ft^2
Area of trapezoid =

$$\left(\frac{b_1 + b_2}{2}\right)h = \left(\frac{20 \text{ ft} + 10 \text{ ft}}{2}\right)8 \text{ ft} = \left(\frac{30}{2}\right)8 = 15 \times 8 = 120 \text{ ft}^2$$

Total area = 1 224 ft^2 – (180 ft^2 + 120 ft^2) = 1 224 ft^2 – 300 ft^2 = 924 ft^2

8) Area of big rectangle = LW = 3.5 m × 3.9 m = 13.65 m^2
Area of square = $s^2 = (0.9 \text{ m})^2$ = 0.81 m^2
Area of small rectangle = LW = 0.9 m × 1.3 m = 1.17 m^2
Total area = 13.65 m^2 – (0.81 m^2 + 1.17 m^2) =
13.65 m^2 – 1.98 m^2 = 11.67 m^2

9) Area of square = $s^2 = (4 \text{ cm})^2$ = 16 cm^2
Area of triangle = $\frac{bh}{2} = \frac{4 \text{ cm} \times 5 \text{ cm}}{2} = \frac{20 \text{ cm}}{2}$ = 10 cm^2

Total area = 16 cm^2 + 10 cm^2 = 26 cm^2

10) Area of triangle = $\frac{bh}{2} = \frac{12.8 \text{ cm} \times 11.1 \text{ cm}}{2} = \frac{142.08 \text{ cm}}{2}$ = 71.04 cm^2

Radius = diameter ÷ 2 = 12.8 ÷ 2 = 6.4 cm
Area of circle = $\pi r^2 = \pi \times (6.4 \text{ cm})^2$ = 128.68 cm^2
Area of half circle = 128.68 cm^2 ÷ 2 = 64.34 cm^2
Total area = 71.04 cm^2 + 64.34 cm^2 = 135.38 cm^2

11) Radius = diameter ÷ 2 = 20 in ÷ 2 = 10 in

Area of big circle = $\pi r^2 = \pi \times (10 \text{ in})^2 = 314.16 \text{ in}^2$

Radius = diameter ÷ 2 = 6 in ÷ 2 = 3 in

Area of small circle = $\pi r^2 = \pi \times (3 \text{ in})^2 = 28.27 \text{ in}^2$

Total area = $314.16 \text{ in}^2 - 28.27 \text{ in}^2 = 285.89 \text{ in}^2$

12) Convert mm to m.

2 140 mm = 2.14 m

8 440 mm = 8.44 m

Area of triangle =

$$\frac{bh}{2} = \frac{8.44 \text{ m} \times 2.38 \text{ m}}{2} = \frac{20.09}{2} = 10.05 \text{ m}^2$$

Area of trapezoid =

$$\left(\frac{b_1 + b_2}{2}\right)h = \left(\frac{12.72 \text{ m} + 8.44 \text{ m}}{2}\right)3.88 \text{ m} = \left(\frac{21.16}{2}\right)3.88 =$$

$10.58 \times 3.88 = 41.05 \text{ m}^2$

Total area = $41.05 \text{ m}^2 + 10.05 \text{ m}^2 = 51.10 \text{ m}^2$

13) Area of rectangle = LW = $30 \text{ ft} \times 14 \text{ ft} = 420 \text{ ft}^2$

Area of triangle = $\frac{bh}{2} = \frac{9 \text{ ft} \times 7 \text{ ft}}{2} = \frac{63}{2} = 31.5 \text{ ft}^2$

The two triangles are the same.

Two triangles = $31.5 \text{ ft}^2 \times 2 = 63 \text{ ft}^2$

Total area = $420 \text{ ft}^2 - 63 \text{ ft}^2 = 357 \text{ ft}^2$

14) Area of trapezoid =

$$\left(\frac{b_1 + b_2}{2}\right)h = \left(\frac{120 \text{ ft} + 80 \text{ ft}}{2}\right)75 \text{ ft} = \left(\frac{200}{2}\right)75 = 100 \times 75 = 7\,500 \text{ ft}^2$$

Area of house = LW = $50 \text{ ft} \times 25 \text{ ft} = 1\,250 \text{ ft}^2$

Area of driveway = LW = $9 \text{ ft} \times 20 \text{ ft} = 180 \text{ ft}^2$

Total area = $7\,500 \text{ ft}^2 - (1\,250 \text{ ft}^2 + 180 \text{ ft}^2) =$

$7\,500 \text{ ft}^2 - 1\,430 \text{ ft}^2 = 6\,070 \text{ ft}^2$

15) Area of rectangle = LW = $21 \text{ mm} \times 9 \text{ mm} = 189 \text{ mm}^2$

Area of trapezoid =

$$\left(\frac{b_1 + b_2}{2}\right)h = \left(\frac{7 \text{ mm} + 4 \text{ mm}}{2}\right)14 \text{ mm} = \left(\frac{11}{2}\right)14 = 5.5 \times 14 = 77 \text{ mm}^2$$

Total area = $189 \text{ mm}^2 + 77 \text{ mm}^2 = 266 \text{ mm}^2$

16) Area of rectangle = LW = 8.5 cm × 3 cm = 25.5 cm^2
Area of trapezoid =

$$\left(\frac{b_1 + b_2}{2}\right)h = \left(\frac{14.5\text{ cm} + 8.5\text{ cm}}{2}\right)9\text{ cm} = \left(\frac{23}{2}\right)9 =$$

11.5 × 9 = 103.5 mm^2
There are two trapezoids that are the same.
Two trapezoids = 103.5 cm^2 × 2 = 207 cm^2
Total area = 25.5 cm^2 + 207 cm^2 = 232.5 cm^2

17) Radius = diameter ÷ 2 = 14.5 ft ÷ 2 = 7.25 ft
Area of circle = $\pi r^2 = \pi \times (7.25\text{ ft})^2$ = 165.13 ft^2
Area of square = $s^2 = (2.1\text{ ft})^2$ = 4.41 ft^2
Total area = 165.13 ft^2 – 4.41 ft^2 = 160.72 ft^2

18) Length of b_1 = 51 ft + 32 ft + 32 ft + 51 ft = 166 ft
Area of trapezoid =

$$\left(\frac{b_1 + b_2}{2}\right)h = \left(\frac{166\text{ ft} + 46\text{ ft}}{2}\right)91\text{ ft} = \left(\frac{212}{2}\right)91 =$$

106 × 91 = 9 646 ft^2
Area of circle = $\pi r^2 = \pi \times (32\text{ ft})^2$ = 3 216.99 ft^2
Area of half circle = 3 216.99 ft^2 ÷ 2 = 1 608.50 ft^2
Total area = 9 646 ft^2 – 1 608.50 ft^2 = 8 037.50 ft^2

19) Convert inches to decimals of a foot.
9 ft — 6 in = 9.5 ft
Area of triangle = $A = \frac{bh}{2} = \frac{9.5\text{ ft} \times 3\text{ ft}}{2} = \frac{28.5}{2}$ = 14.25 ft^2
Area of trapezoid =

$$\left(\frac{b_1 + b_2}{2}\right)h = \left(\frac{10 + 9.5}{2}\right)8\text{ ft} = \left(\frac{19.5}{2}\right)8 = 9.75 \times 8 = 78\text{ ft}^2$$

Total area = 14.25 ft^2 + 78 ft^2 = 92.25 ft^2

20) Radius of big circle = diameter ÷ 2 = 500 mm ÷ 2 = 250 mm
Area of big circle = $\pi r^2 = \pi \times (250\text{ mm})^2$ = 196 349.54 mm^2
Radius of inner circle = diameter ÷ 2 = 250 mm ÷ 2 = 125 mm
Area of inner circle = $\pi r^2 = \pi \times (125\text{ mm})^2$ = 49 087.39 mm^2
Radius of small circle = diameter ÷ 2 = 30 mm ÷ 2 = 15 mm
Area of small circle = $\pi r^2 = \pi \times (15\text{ mm})^2$ = 706.86 mm^2
Eight small circles = 8 × 706.86 mm^2 = 5 654.88 mm^2
Total area = 196 349.54 mm^2 – (49 087.39 mm^2 + 5 654.88 mm^2) =
196 349.54 mm^2 – 54 742.27 mm^2 = 141 607.27 mm^2

Page 167, **Calculating One of the Sides when You Know the Area**

1) $A = L \times W$

$25.6\ m^2 = L \times 2.5\ m$

$\frac{25.6\ m^2}{2.5\ m} = L$

$10.24\ m = L$

2) $A = L \times W$

$89\ in^2 = 29\ in \times W$

$\frac{89\ in^2}{29\ in} = W$

$3.07\ in = W$

3) $A = \pi r^2$

$\frac{37}{\pi} = r^2$

$11.78 = r^2$

$\sqrt{11.78} = r$

$3.43\ ft = r$

4) $A = \pi r^2$

$25\ m^2 = \pi \times r^2$

$\frac{25}{\pi} = r^2$

$7.96 = r^2$

$\sqrt{7.96} = r$

$2.82\ m = r$

$d = 2.82 \times 2 = 5.64\ m$

5) $A = \frac{bh}{2}$

$39.5\ in^2 = \frac{b \times 6\ in}{2}$

$39.5\ in^2 \times 2 = b \times 6\ in$

$79 = b \times 6\ in$

$\frac{79\ in^2}{6\ in} = b$

$13.17\ in = b$

6) $A = \frac{bh}{2}$

$220\ cm^2 = \frac{18.5\ cm \times h}{2}$

$220\ cm^2 \times 2 = 18.5\ cm \times h$

$440\ cm^2 = 18.5\ cm \times h$

$\frac{440\ cm^2}{18.5\ cm} = h$

$23.78\ cm = h$

7) $A = s^2$

$355\ cm^2 = s^2$

$\sqrt{355} = s$

$18.84\ cm = s$

8) $A = s^2$

$415\ ft^2 = s^2$

$\sqrt{415\ ft} = s$

$20.37\ ft = s$

Page 173, **Lateral Area and Surface Area**

1) L.A. = $\pi d \times h = \pi \times 1.3\ ft \times 15\ ft = 61.26\ ft^2$
S.A. = L.A. + area of two bases = $61.26\ ft^2 + (\pi r^2 \times 2) =$
$61.26\ ft^2 + (\pi \times 0.65\ ft \times 2) = 61.26\ ft^2 + 2.65\ ft^2 = 63.91\ ft^2$

2) L.A. = $\pi d \times h = \pi \times 0.15\ m \times 2.67\ m = 1.26\ m^2$
S.A. = L.A. + area of two bases = $1.26\ m^2 + (\pi r^2 \times 2) =$
$1.26\ m^2 + (\pi \times (0.075\ m)^2 \times 2) = 1.26\ m^2 + 0.04\ m^2 = 1.30\ m^2$

3) Area of front and back = $2.5\ ft \times 4.67\ ft \times 2 = 23.35\ ft^2$
Area of sides = $1\ ft \times 4.67\ ft \times 2 = 9.34\ ft^2$
L.A. = $23.35\ ft^2 + 9.34\ ft^2 = 32.69\ ft^2$
S.A. = $32.69\ ft^2$ + area of two bases =
$32.69\ ft^2 + (2.5\ ft \times 1\ ft \times 2) = 32.69\ ft^2 + 5\ ft^2 = 37.69\ ft^2$

4) Area of front and back = $1.75\ m \times 4.52\ m \times 2 = 15.82\ m^2$
Area of sides = $0.86\ m \times 4.52\ m \times 2 = 7.77\ m^2$
L.A. = $15.82\ m^2 + 7.77\ m^2 = 23.59\ m^2$
S.A. = $23.59\ m^2$ + area of two bases =
$23.59\ m^2 + (1.75\ m \times 0.86\ m \times 2) = 23.59\ m^2 + 3.01\ m^2 = 26.6\ ft^2$

Page 174, **Practice**

1) $A = LW = 6 \text{ ft} \times 15 \text{ ft} = 90 \text{ ft}^2$
$90 \text{ ft}^2 \times \$5.25 = \$472.50$

2) Area of rectangle $= 3.5 \text{ ft} \times 4.75 \text{ ft} = 16.63 \text{ ft}^2$
Area of circle $= \pi r^2 = \pi \times (1.75 \text{ ft})^2 = 9.62$
Half a circle $= 9.62 \text{ ft}^2 \div 2 = 4.81 \text{ ft}^2$
Total area $= 16.63 \text{ ft}^2 + 4.81 \text{ ft}^2 = 21.44 \text{ ft}^2$

3) Area $= \pi r^2 = \pi \times (6 \text{ m})^2 = 113.1 \text{ m}^2$

4) a. area of doors $= 3 \text{ ft} \times 7 \text{ ft} \times 2 = 42 \text{ ft}^2$
area of window $= 2.5 \text{ ft} \times 4 \text{ ft} = 10 \text{ ft}^2$
area of front and back wall $= 8 \text{ ft} \times 9 \text{ ft} \times 2 = 144 \text{ ft}^2$
area of side walls $= 10 \text{ ft} \times 9 \text{ ft} \times 2 = 180 \text{ ft}^2$
Total area of room $= 180 \text{ ft}^2 + 144 \text{ ft}^2 - (42 \text{ ft}^2 + 10 \text{ ft}^2) = 272 \text{ ft}^2$

b. area of sheet of drywall $= 4 \text{ ft} \times 8 \text{ ft} = 32 \text{ ft}^2$
number of sheets of drywall $= 272 \text{ ft}^2 \div 32 \text{ ft}^2 = 8.5$
Round up 8.5 to 9
$9 \times \$38.98 = \$350.82$

5) Area of top and bottom of cupboard $= 3 \text{ ft} \times 2.5 \text{ ft} \times 2 = 15 \text{ ft}^2$
Area of back and front $= 3 \text{ ft} \times 4.75 \text{ ft} \times 2 = 28.5 \text{ ft}^2$
Area of sides $= 2.5 \text{ ft} \times 4.75 \text{ ft} \times 2 = 23.75 \text{ ft}^2$
Total area $= (15 \text{ ft}^2 + 28.5 \text{ ft}^2 + 23.75 \text{ ft}^2) \times 5 = 336.25 \text{ ft}^2$

6) Front and back of closet $= 6.5 \text{ ft} \times 8 \text{ ft} \times 2 = 104 \text{ ft}^2$
Sides of closet $= 4.5 \text{ ft} \times 8 \text{ ft} \times 2 = 72 \text{ ft}^2$
number of square feet of pine $= 104 \text{ ft}^2 + 72 \text{ ft}^2 - 21 \text{ ft}^2 = 155 \text{ ft}^2$

7) Area of roof $= 16 \text{ ft} \times 45.75 \text{ ft} \times 2 = 1\,464 \text{ ft}^2$

8) Area of one piece of panelling $= 4 \text{ ft} \times 8 \text{ ft} = 32 \text{ ft}^2$
Cost of one piece of panelling $= 32 \text{ ft}^2 \times \$1.25 = \$40.00$
36 pieces of panelling $= \$40.00 \times 36 = \$1\,440.00$