Square Roots and Surface Area

Chapter 1

1.1 Square Roots of Perfect Squares

- Determine the square roots of fractions and decimals that are perfect squares

- Approximate the square roots of fractions and decimals that are non-perfect squares

- Determine the surface areas of composite 3-D objects to solve problems.

1.1 Square Roots of Perfect Squares

This playground has an area of $400\ m^2$.

What length of fence is required to surround the playground?

1.1 Square Roots of Perfect Squares

A **square root** is a number which when multiplied by itself, results in another number (called a **square**)

Ex. $5 \times 5 = 25$ $\sqrt{25} = 5$

Without using your calculator, make a list in your notebook of the squares of all whole numbers between 1 and 20:

Square Root	Square
1	1
2	4
3	9

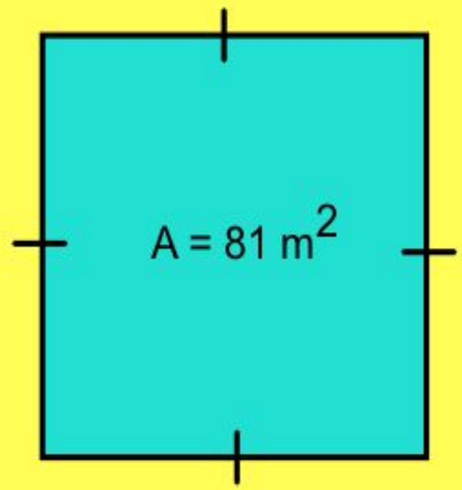
1.1 Square Roots of Perfect Squares

The square of the side length of a square give us the area:

$A = bh$ or $A = s^2$

What is the area of a square with a side length of 11 cm?

What is the side length of a square with an area of 11 cm²



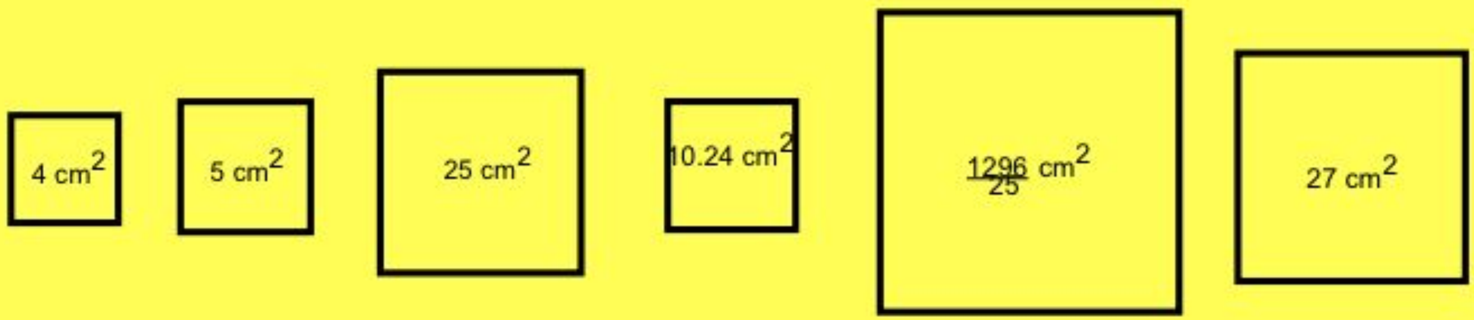
Calculator Check! Know how to use square root and square buttons! What about with a fraction?

1.1 Square Roots of Perfect Squares

A square can be either **perfect** or **non-perfect**. A square is perfect if it's square root is a rational number.*

*Rational numbers include integers, fractions, and all decimal numbers that either "end" or have repeating sequences

Square:

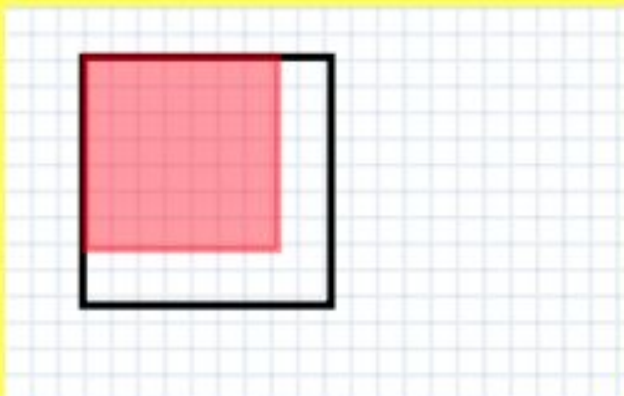


Side Length/
Square Root:

Perfect (Y/N):

1.1 Square Roots of Perfect Squares

Also, a fraction in simplest form is a PERFECT SQUARE if it can be written as a product of 2 equal fractions.



$$\frac{7}{9} \times \frac{7}{9} = \frac{49}{81}$$

$\frac{49}{81}$ is therefore a perfect square

1.1 Square Roots of Perfect Squares

Also, if the numerator is a perfect square AND the denominator is a perfect square, then the entire fraction is a perfect square! (Also called rational numbers)

Which of the following are perfect squares?

$$\frac{50}{128} \qquad \frac{225}{139} \qquad \frac{9}{27}$$

1.1 Square Roots of Perfect Squares

Is it possible for a square to be smaller than it's square root?

Working with decimals:

- When you square a decimal, the product is smaller:

$0.5 \times 0.5 = 0.49$ **WRONG! What is the correct answer?**

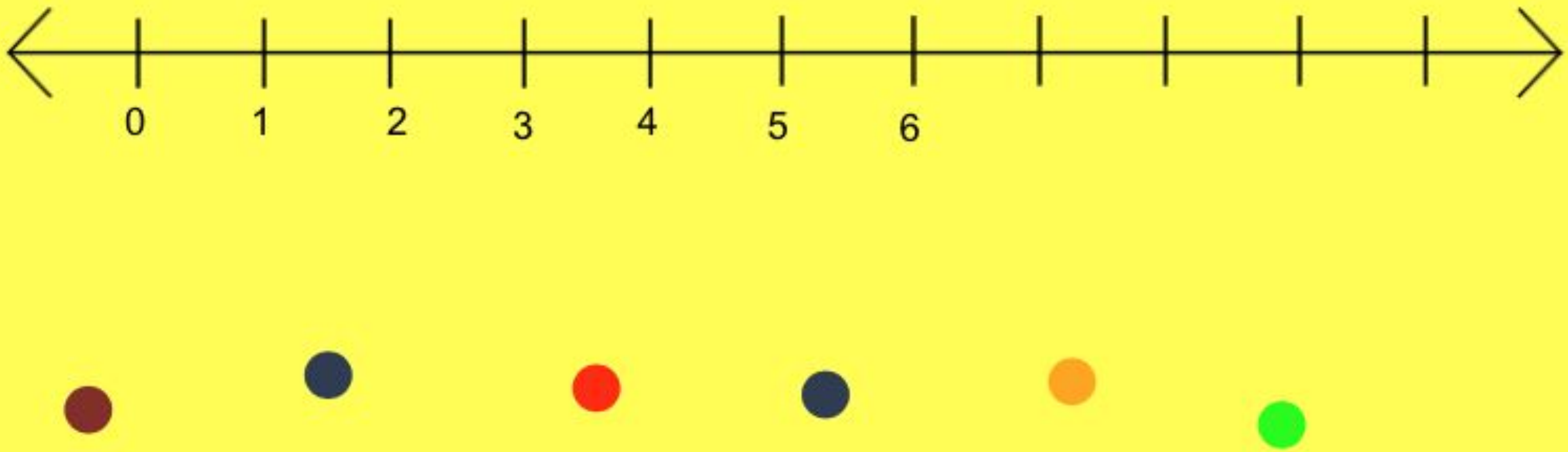
$0.8 \times 0.8 = 0.64$

- Decimal numbers follow the same patterns as non-decimals:

$3 \times 3 = 9$	$0.3 \times 0.3 = 0.09$	$0.03 \times 0.03 \times 0.009$	$300 \times 300 = 90000$
$\sqrt{9} = 3$	$\sqrt{0.09} = 0.3$	$\sqrt{0.009} = 0.03$	$\sqrt{90000} = 300$

1.1 Square Roots of Perfect Squares

Arrange the square roots on the number line without using your calculator:



$\sqrt{30.25}$ $\sqrt{\frac{225}{9}}$ $\sqrt{0.25}$ $\sqrt{\frac{196}{16}}$ $\sqrt{\frac{81}{49}}$ $\sqrt{36}$

1.1 Square Roots of Perfect Squares

- Math Makes Sense 9
  - Practice Page 11-13
  - 3, 5, 7, 8 (a-f), 9 (bdfh), 10(d), 13, 14, 18, 19

  - Use the answers on Page 468 to self- assess *(if you are not getting the correct answer try and work with a partner to figure out why)*
  - Set yourself up for success! LABEL and DATE your page and ORGANIZE your work.

1.2 Square Roots of Non-Perfect Squares

What happens when you try to find the square root of 5.5 on your calculator?

$\sqrt{5.5} = ?$

To find the square root of a non-perfect square, we can benchmarks & estimates, or use a calculator!

Benchmarking & Estimating

$\sqrt{27} = ?$ $\sqrt{\frac{10}{26}} = ?$ $\sqrt{\frac{31}{8}} = ?$

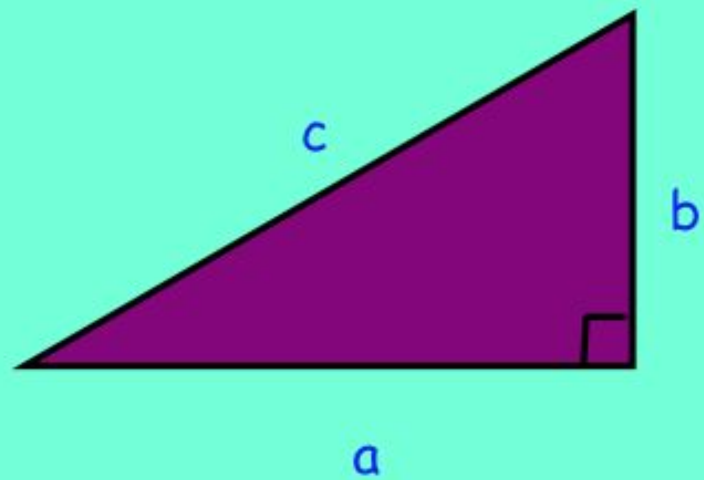
Calculator

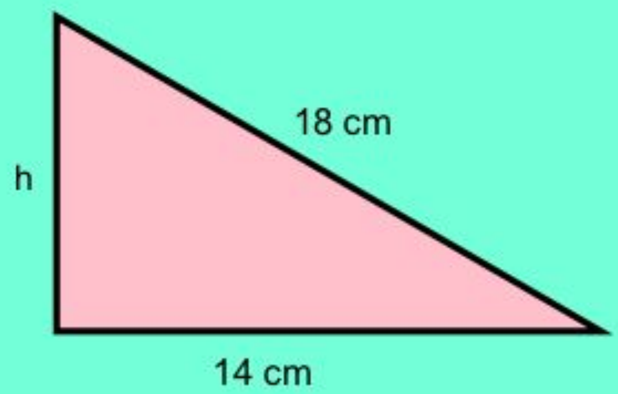
$\sqrt{0.38} = ?$

1.2 Square Roots of Non-Perfect Squares

The **Pythagorean Theorem** often involves non-perfect squares:

$$a^2 + b^2 = c^2$$

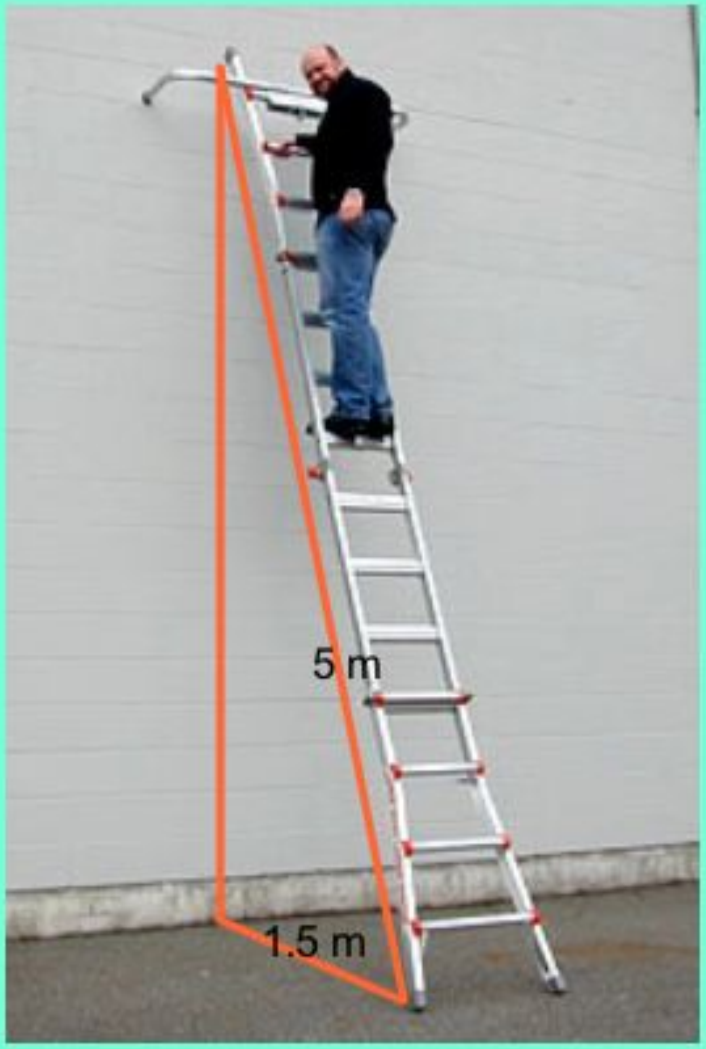




Steps:

1. Identify the hypotenuse (c^2)
2. Replace known variables
3. Solve for the unknown using your mad square root skills!

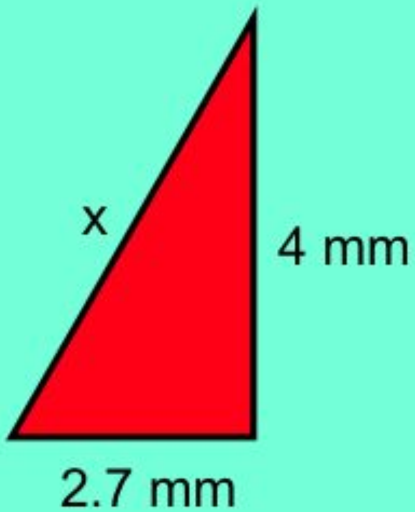
1.2 Square Roots of Non-Perfect Squares

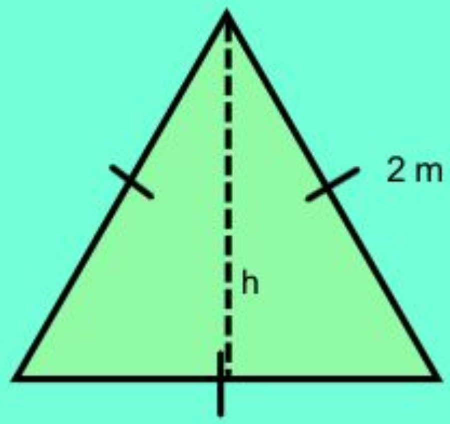


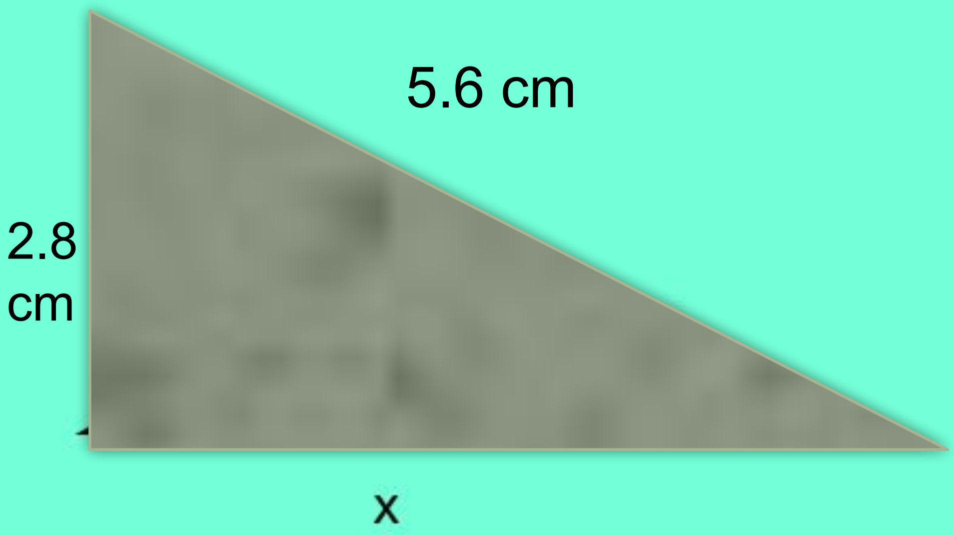
A 5 m ladder is placed against a wall. The base of the ladder is 1.5 m from the wall. How far up the wall does the ladder reach?

1.2 Square Roots of Non-Perfect Squares

Find the value of the unknown side







1.2 Square Roots of Non-Perfect Squares

- Math Makes Sense 9
  - Practice Page 18-20
  - Start with → 4(ab), 5(abc), 6(ab), 7(ac), 9(ac), 10(abd), 13, 17
  - Keep Going → 14
  - Challenge Yourself → 16b, 19ab, 20b

  - Use the answers on Page 469 to self- assess
  - Set yourself up for success! LABEL and DATE your page and ORGANIZE your work.

1.2 Square Roots of Non-Perfect Squares

- Section 1.1 and 1.2 QUIZ on Friday
- *If you want to review (or maybe even practice some questions that will be on the quiz (hint hint) look at page 21 in MMS.*

1.3 Surface Area of Objects Made from Right Rectangular Prisms

Using a piece of graph paper, make a 2D drawing of the front, back, top, bottom, left side, and right side of your model.

<u>Tips to make it easier:</u>

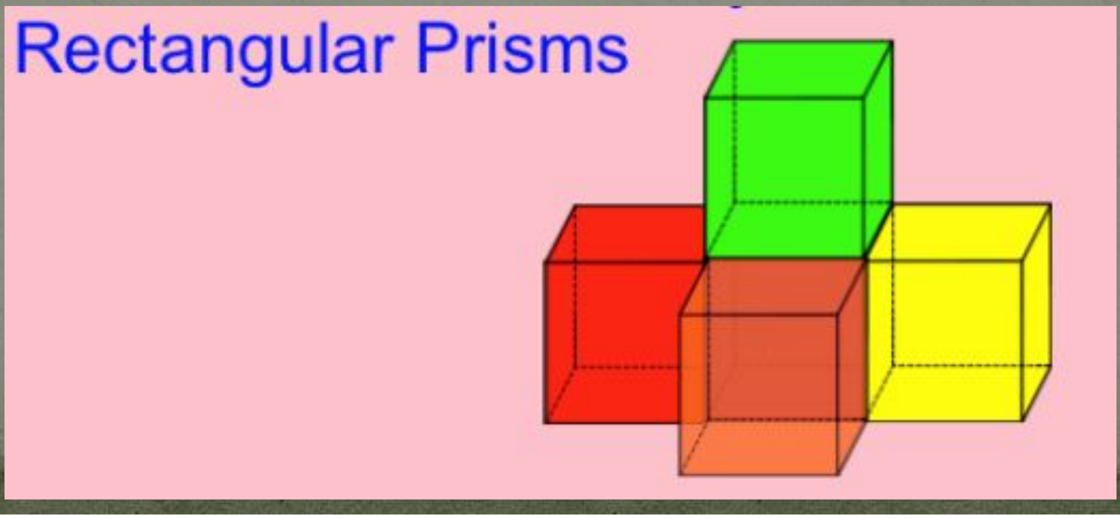
- Make you drawing so that one square on the graph paper equals one block
- You may write "front", "back" etc on your model as long as you erase it after

When finished, assume one face of each cube has an area of 1 unit^2 and calculate the surface area of the model you were given.

1.3 Surface Area of Objects Made from Right Rectangular Prisms

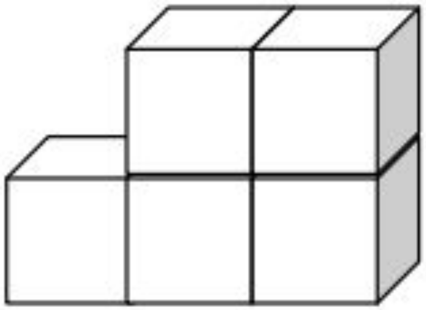
There are several different strategies to determine the surface area of composite objects made from rectangular prisms:

1. Count the squares on all 6 views of the object.
2. Count the square faces of **all** the cubes and subtract those that overlap.
3. Determine the total surface area of each block and subtract the overlapping areas.



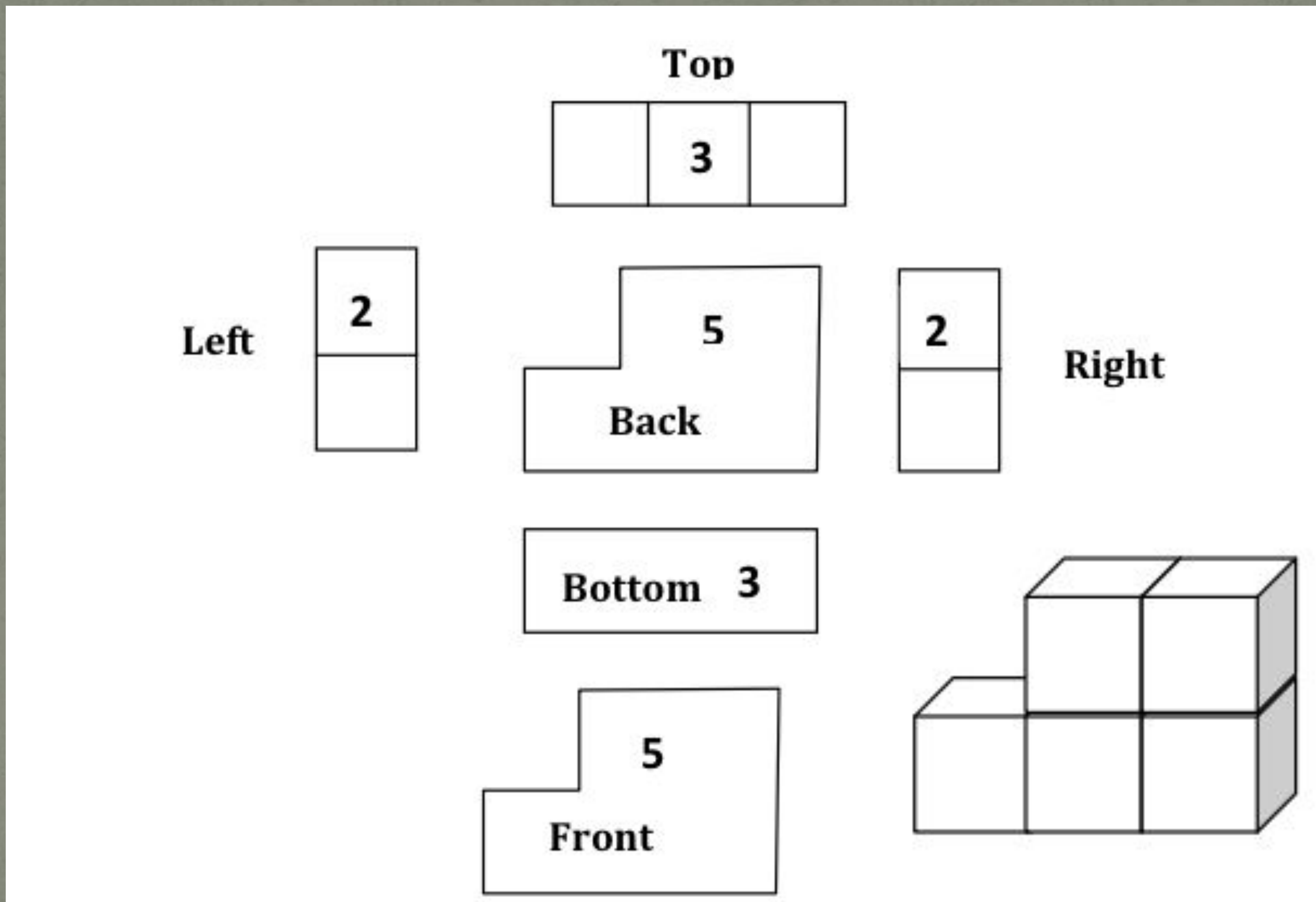
1.3 Surface Area of Objects Made from Right Rectangular Prisms

Method #1: Count the squares on all 6 views of the object.



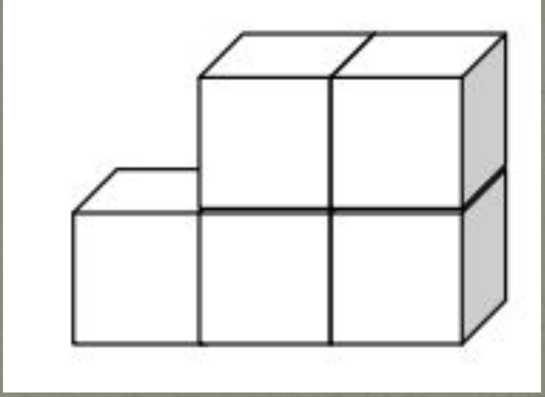
Top, Bottom, Front, Back, Left, Right

1.3 Surface Area of Objects Made from Right Rectangular Prisms



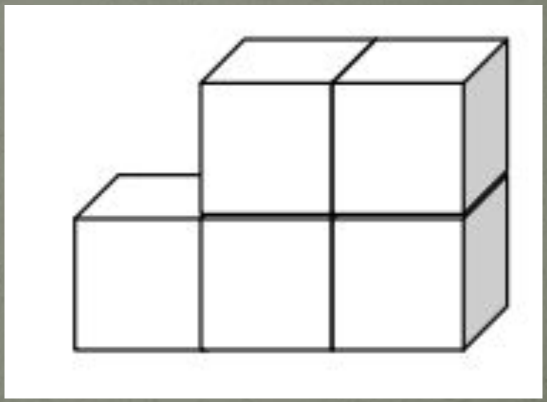
1.3 Surface Area of Objects Made from Right Rectangular Prisms

Method #2: Count the square faces of all the cubes. There are 5 cubes, each with 6 faces, so that's $5 \times 6 = 30$ faces. Now subtract 2 faces for each place that the squares are joined, or overlap. There are 5 places they are joined, so $5 \times 2 = 10$ overlapping faces.

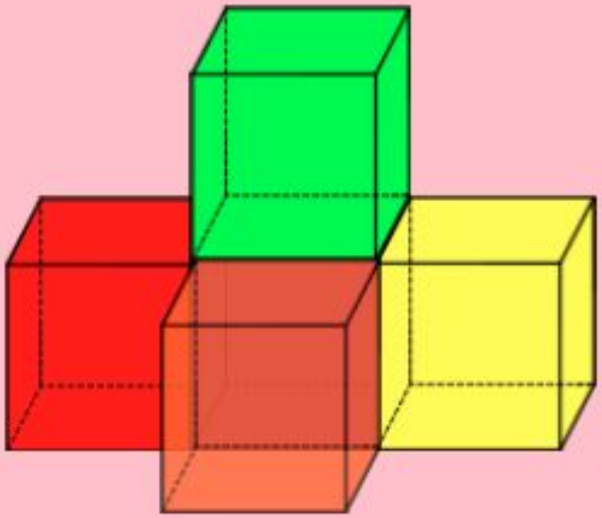


1.3 Surface Area of Objects Made from Right Rectangular Prisms

- Method 3 – Determine the total surface area and subtract overlapping areas.



1.3 Surface Area of Objects Made from Right Rectangular Prisms

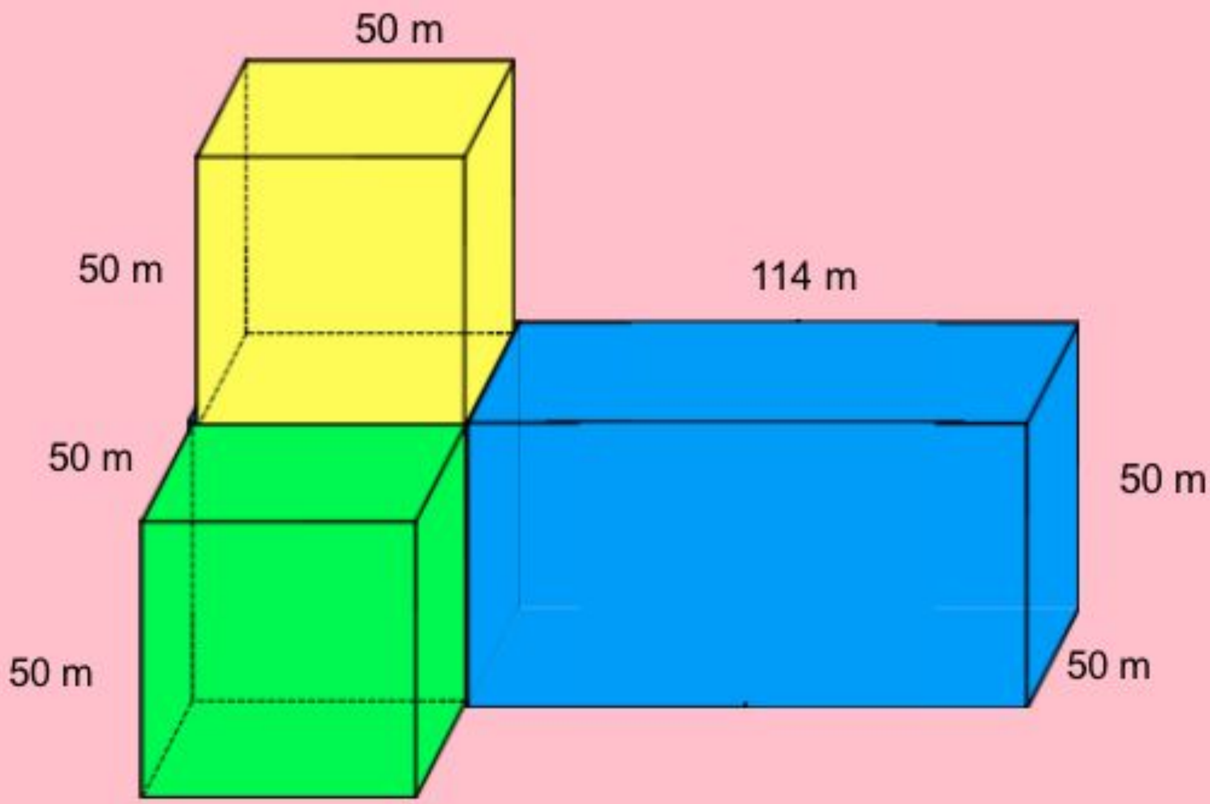


Method 1:

Method 2:

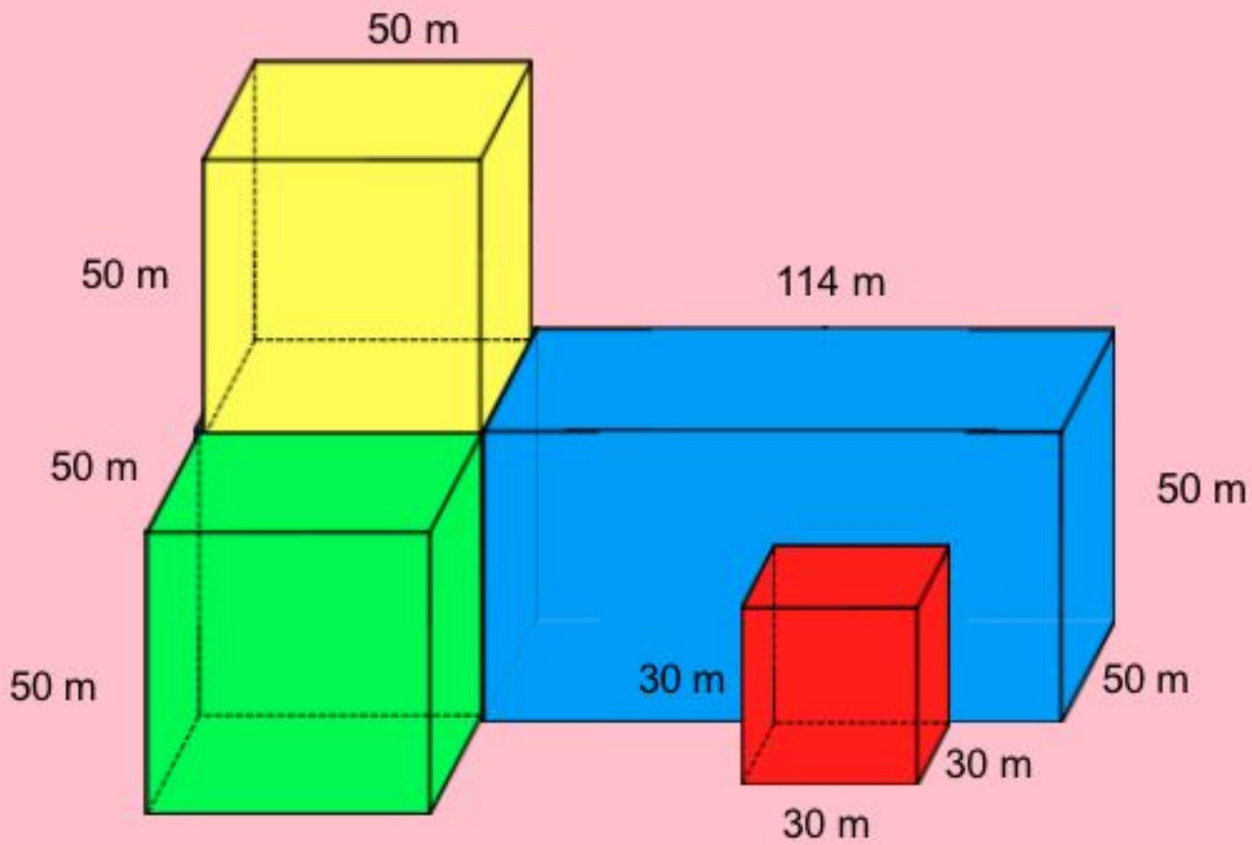
1.3 Surface Area of Objects Made from Right Rectangular Prisms

Sometimes you have to combine different stragtegies:



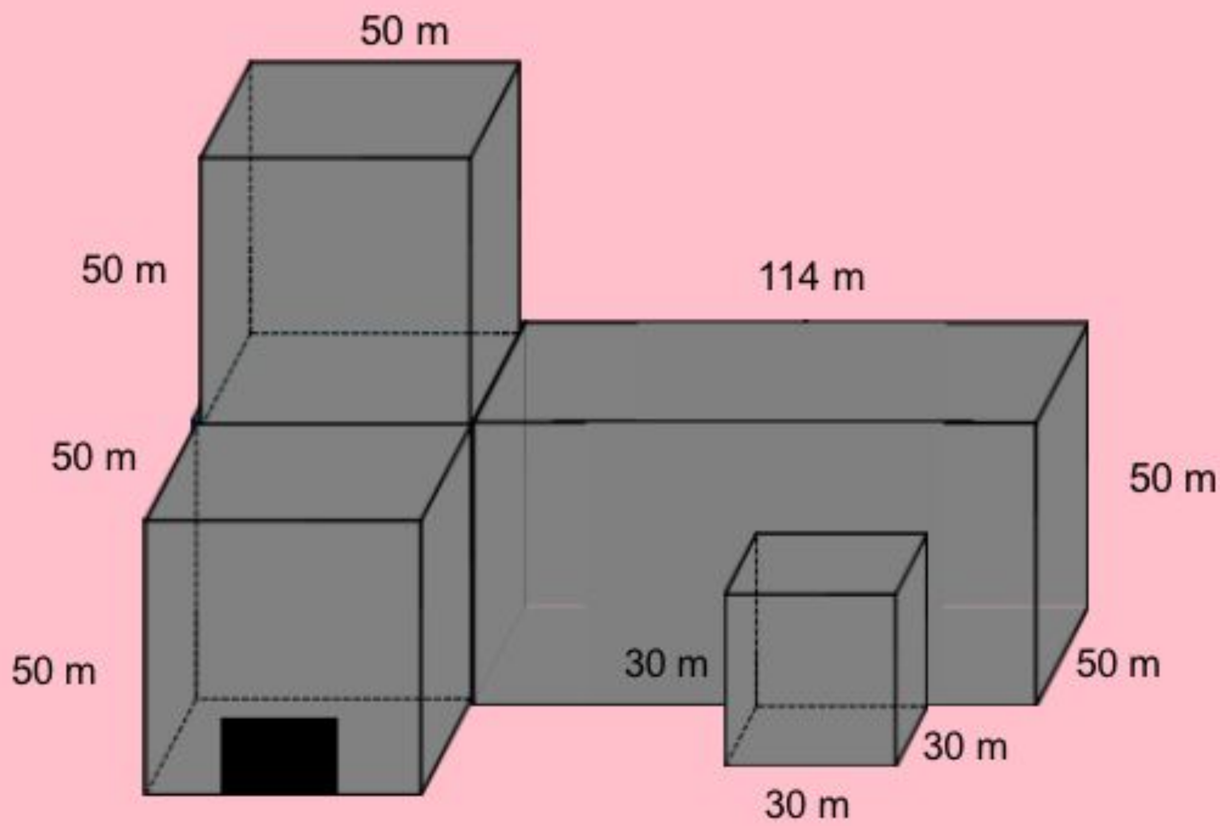
1.3 Surface Area of Objects Made from Right Rectangular Prisms

How would it change if this part was added?



1.3 Surface Area of Objects Made from Right Rectangular Prisms

What if it was a building and had 4 m by 15 m door... and only the outside walls needed to be painted?



1.3 Surface Area of Objects Made from Right Rectangular Prisms

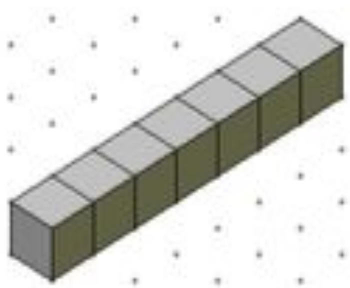
- Practice Pages 30 – 32
  - Questions → 4, 5, 6, 7, 8(ab), 10, 11, 12
  - Just for Fun → Question 17

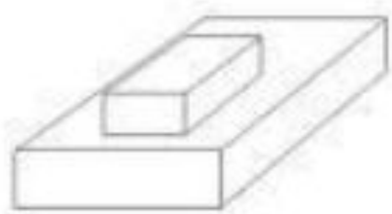
  - Use the answers on page 470 to self-assess

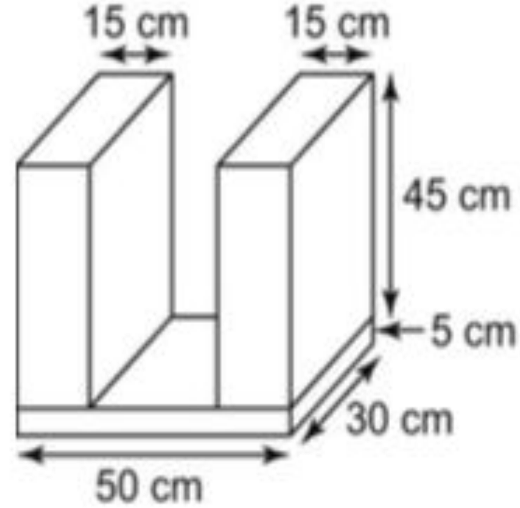
1.4 Surface Areas of Other Composite Objects

- A **composite object** is an object made up of or composed of more than one object. It may be composed of more than one of the same type of object such as a 'train' of cubes or it could be composed of different types of objects.

Examples:







1.4 Surface Areas of Other Composite Objects

Review of Area formulas:

Area of a Rectangle: $A = bh$

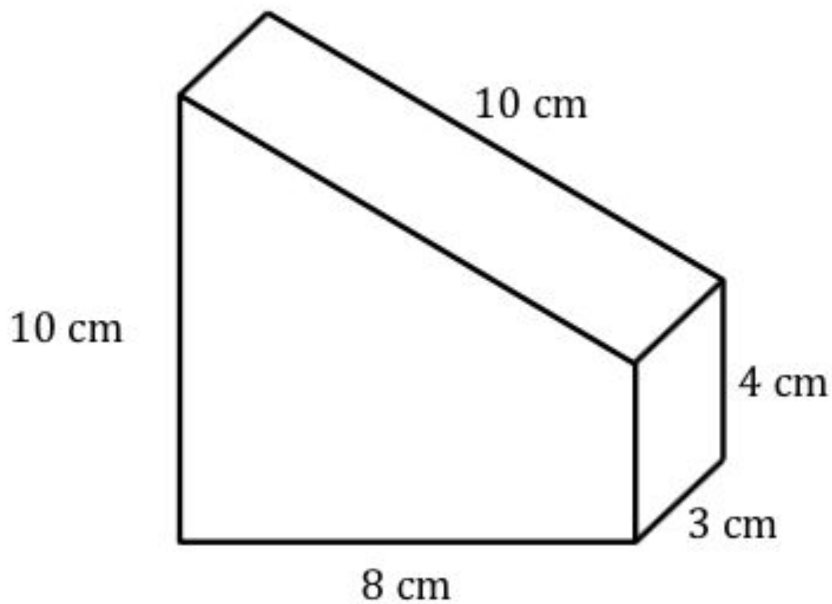
Area of a Triangle: $A = \frac{bh}{2}$

Area of a Circle: $A = \pi r^2$

Also, circumference will be important: $c = \pi d$ or
$c = 2\pi r$

1.4 Surface Areas of Other Composite Objects

Determine surface area of this object.

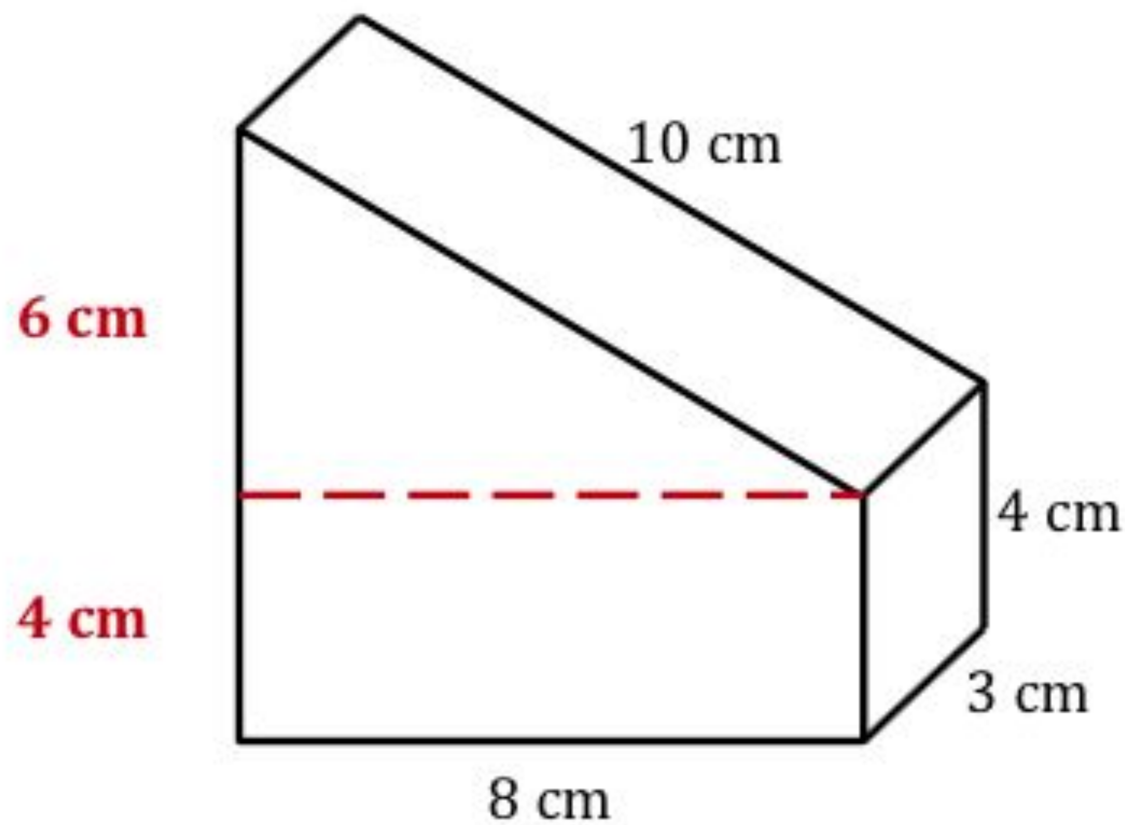


Step 1: What objects make up this whole object?

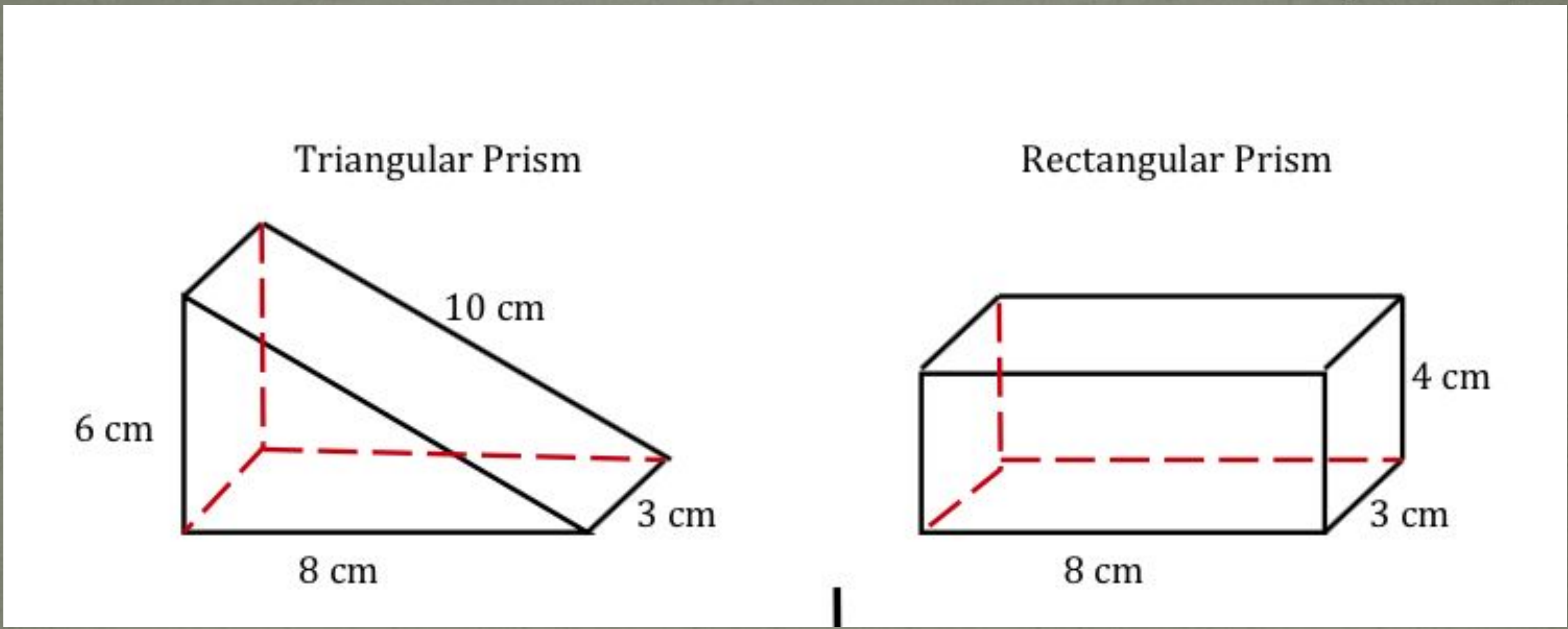
↳ a triangular prism
↳ a rectangular prism

1.4 Surface Areas of Other Composite Objects

Step 2: Find the surface area of each object.

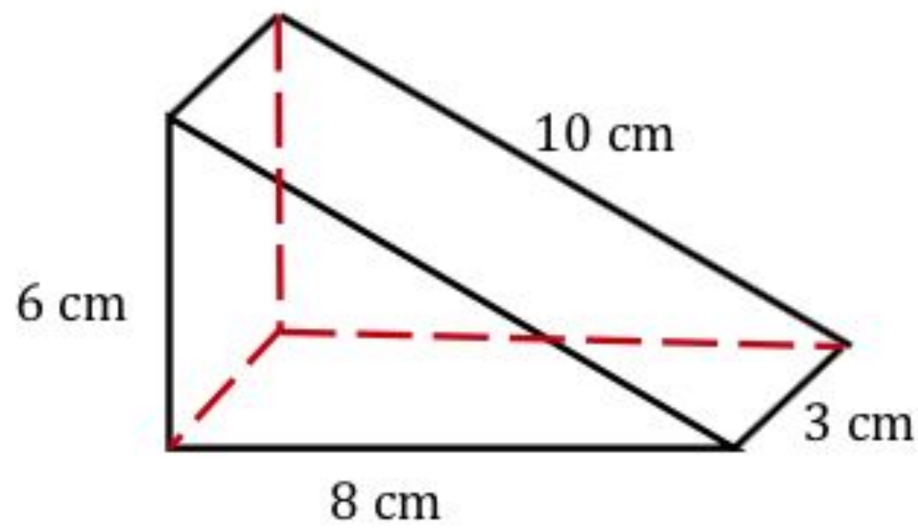


1.4 Surface Areas of Other Composite Objects



1.4 Surface Areas of Other Composite Objects

Triangular Prism



↳ surface area of triangular prism

= 2 triangles + 3 different rectangles

$= 2\left(\frac{b \times h}{2}\right) + (l \times w) + (l \times w) + (l \times w)$

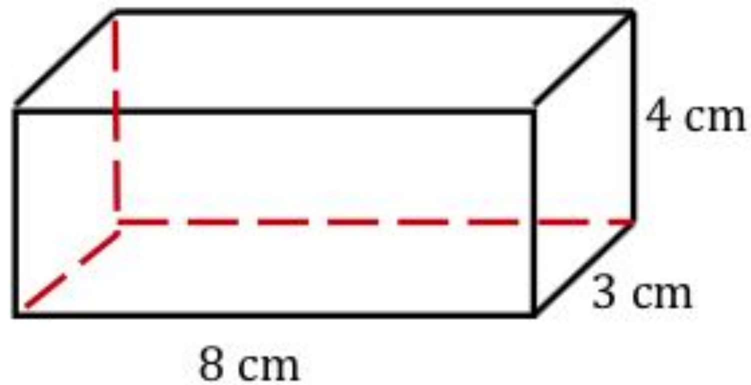
$= 2\left(\frac{8 \times 6}{2}\right) + (8 \times 3) + (6 \times 3) + (3 \times 10)$

$= 48 + 24 + 18 + 30$

$= 120\ cm^2$

1.4 Surface Areas of Other Composite Objects

Rectangular Prism



↳ surface area of rectangular prism

= 2 × front + 2 × right side + 2 × top

$= 2(l \times w) + 2(l \times w) + 2(l \times w)$

$= 2(8 \times 4) + 2(4 \times 3) + 2(3 \times 8)$

= 64 + 24 + 48

= 136 cm^2

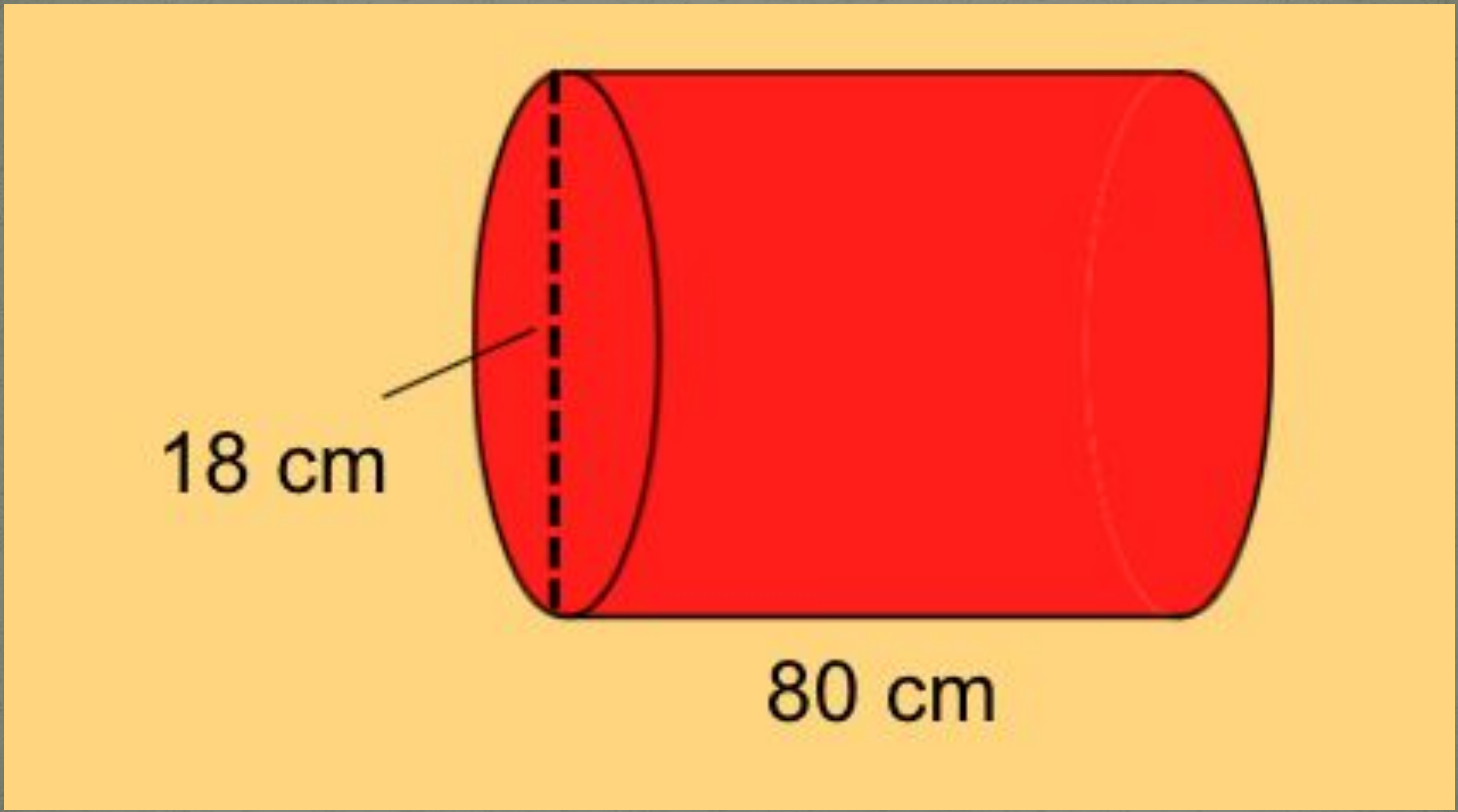
1.4 Surface Areas of Other Composite Objects

Step 3: Find the area of the overlap. Don't forget to double it!

Overlap = $(l \times w)$
= (8×3)
= $24 \times 2 = 48\ cm^2$

Total surface area = SA of triangular prism + SA of rectangular prism – overlap
= 120 + 136 – 48
= $208\ cm^2$

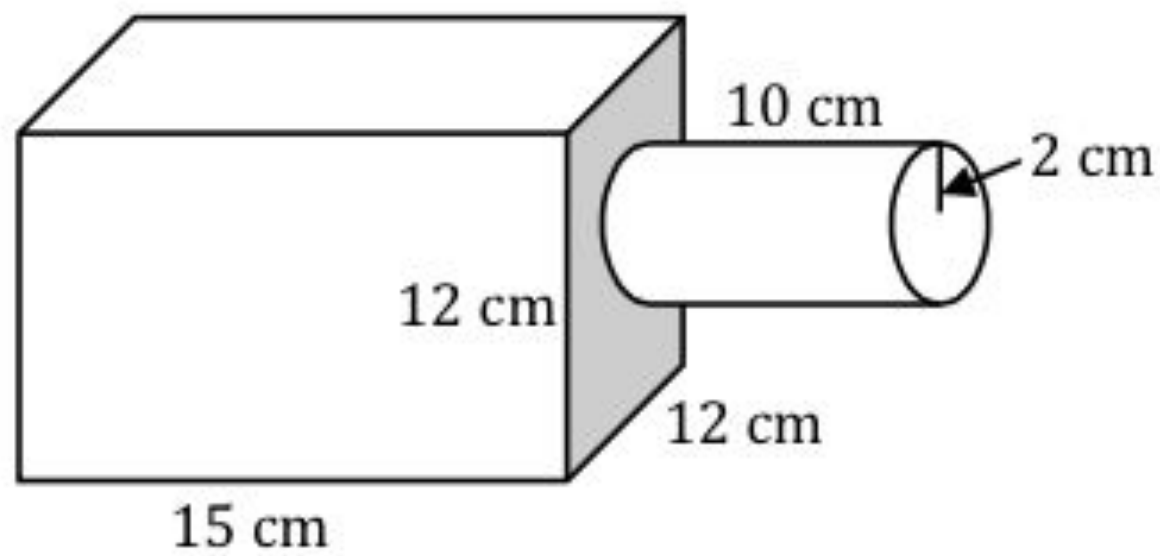
1.4 Surface Areas of Other Composite Objects



1.4 Surface Areas of Other Composite Objects

SA of rectangular prism – SA of cylinder - Overlap

1. Find the surface area of this object.



1. **Surface Area of Rectangular Prism**

Front, Back, Top, Bottom = $4\,(12 \times 15) = 720\ \text{cm}^2$

Left, Right = $2\,(12 \times 12) = 288\ \text{cm}^2$

Total : $1008\ \text{cm}^2$

Surface Area of Cylinder

Top, Bottom = 2 × Area of circle = $2\,(\pi r^2) = 2 \times \pi \times 2^2 = 25.12\ \text{cm}^2$

Curved Surface = $2\pi r \times h = 2 \times \pi \times 2 \times 10 = 125.6\ \text{cm}^2$

Total: $150.72\ \text{cm}^2$

Area of Overlap

Area of a Circle ....don`t forget to double it!

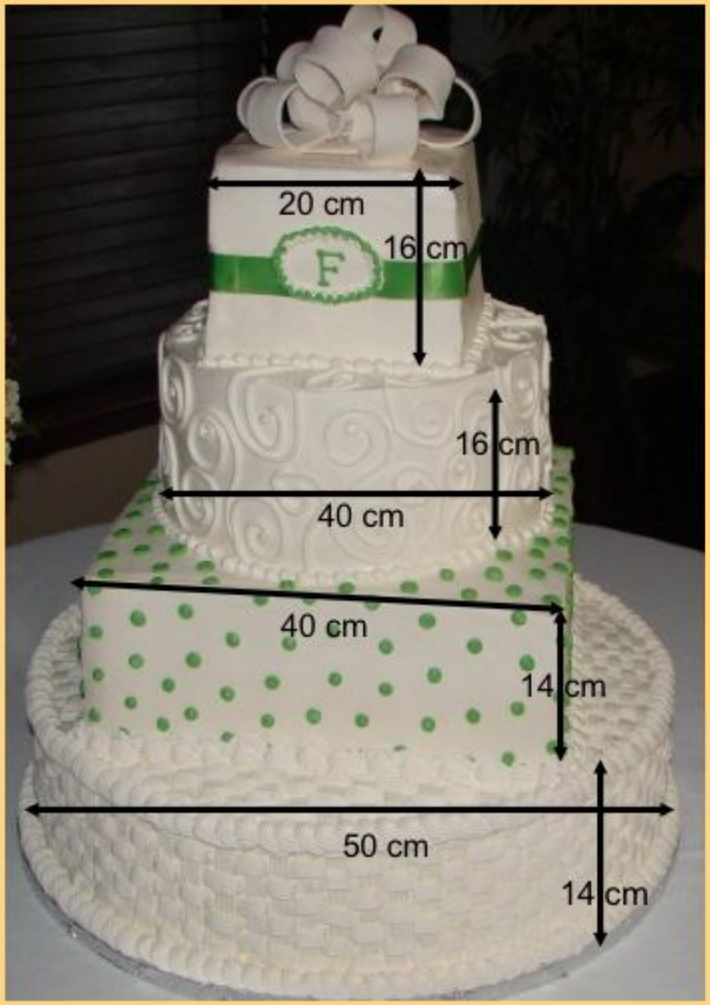
2 × Area of circle = $2\,(\pi r^2) = 2 \times \pi \times 2^2 = 25.12\ \text{cm}^2$

Total Surface Area of the Composite Object

SA of rectangular prism + SA of cylinder – area of overlap

$1008 + 150.72 - 25.12 = 1133.6\ \text{cm}^2$

1.4 Surface Areas of Other Composite Objects



One last one... and it's a tough one!

Excluding the bow how many cm^2 of icing is required for this cake? (There is icing on the top of each layer, but not the bottom)

1.4 Surface Areas of Other Composite Objects

- Practice
  - Pages 40-43 – Numbers 3de, 4b, 5, 7, 8, 11, 12 and 14

Unit 1 – Review (page 44)

Perfect Squares

When a fraction can be written as a product of two equal fractions, the fraction is a perfect square.

For example, $\frac{144}{25}$ is a perfect square because $\frac{144}{25} = \frac{12}{5} \times \frac{12}{5}$; and $\sqrt{\frac{144}{25}} = \frac{12}{5}$

When a decimal can be written as a fraction that is a perfect square, then the decimal is also a perfect square.

The square root is a terminating or repeating decimal.

For example, 12.25 is a perfect square because $12.25 = \frac{1225}{100}$, and $\sqrt{\frac{1225}{100}} = \frac{35}{10}$, or 3.5

Unit 1 – Review (page 44)

Non-Perfect Squares

A fraction or decimal that is not a perfect square is a non-perfect square.
To estimate the square roots of a non-perfect square,
use perfect squares as benchmarks or use a calculator.

For example, $\sqrt{\frac{143}{25}} \doteq \sqrt{\frac{144}{25}}$, which is $\frac{12}{5}$, or 2.4

And, $\sqrt{6.4} \doteq 2.5$ to the nearest tenth

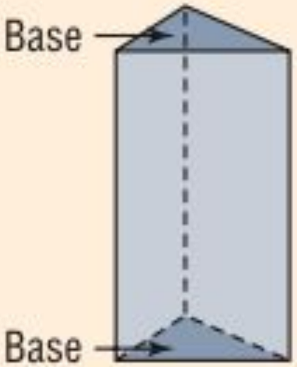
Surface Area of a Composite Object

This is the sum of the surface areas of the objects that make up the composite object, minus the overlap.

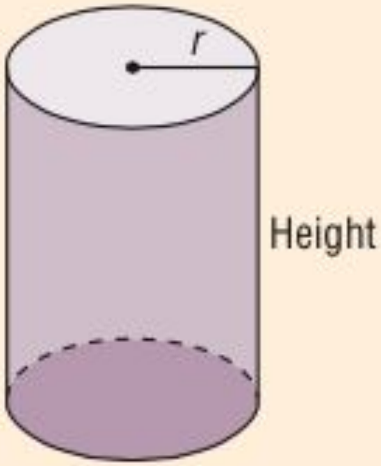
The objects that make up the composite object can be:

- A right rectangular prism with
  Surface area = 2 × area of top face + 2 × area of front face
  + 2 × area of side face

- A right triangular prism with
  Surface area = 2 × area of base + areas of 3 rectangular faces



- A right cylinder, radius r, with
  Surface area = 2 × area of one circular base
  + circumference of base × height of cylinder
  $= 2\pi r^2 + 2\pi r \times$ height



Unit 1 – Review Questions

- Page 48 – Math Makes Sense
  - All 6 Questions
  - If you don't know how to do something please ask, these are all examples of questions you will find on your Unit test.