Concept: Solids … Volume and Surface Area

Name:

COMPUTER COMPONENT

Instructions: In UMATH X follow the **Content Menu** path:

Measurement and Geometry > Solids… Volume and Surface Area

Work through all Sub Lessons of the following Lessons **in order**:

- *In This Topic*
- *Classifying Solids*
- *Surface Area of a Solid*
- *Volume of a Solid*
- *Summary*

As you work through the computer exercises, you will be prompted to make notes in your notebook/math journal.

SUMMARY

1. **By completing these notes, you will be creating a valuable resource that you will be able to refer to as you tackle more complex problems.**

When working with solids, we are using ideas that we experience every day of our lives. This is 3D space. Special Effects Filmmakers and game manufacturers, like PlayStation, try very hard to entertain us in 3D. What do you think this means?

Since a viewing screen is essentially flat, the images are created in 2D form. The use of color and shading has long been a method to create the illusion of 3D (3 dimensions.) Remember the 3D glasses that we sometimes used to experience this …same idea.

A solid is 3D AND it takes up space. If you were given a jar half-filled with water and a small brass cube, how could you prove that the solid cube takes up space?

Archimedes proved a long time ago that a solid placed in water will displace a volume of water exactly equal to its own volume. Therefore, a solid must take up space.

If a solid is made up of a series of flat surfaces, we would find these features:

E D G E S

F A C E S

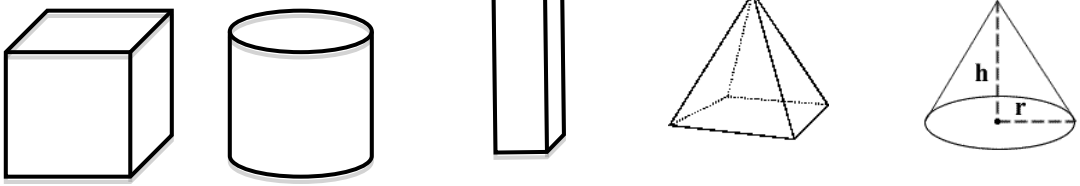
V E R T I C E S

2. *POLYHEDRONS* are 3D shapes that have a series of flat faces made of **polygons.** Do you remember the names of some of the more common polygons? Fill in the following chart to test your skill.

Number of Sides	Name of Polygon	Sketch
3	**Triangle**	***Sketches will vary.***
4	**Quadrilateral**	
5	**Pentagon**	
6	**Hexagon**	
8	**Octagon**	

OFF COMPUTER EXERCISES

1. If these shapes were sorted in to two groups. What might the groups be? (Label each and justify your answers below)



Cube **Cylinder** **Rectangular Prism** **Square-based Pyramid** **Cone**

Justify your sorting rationale

*** *Responses will vary*. These may include sorting based on the number or type of faces, vertices and/or edges.**

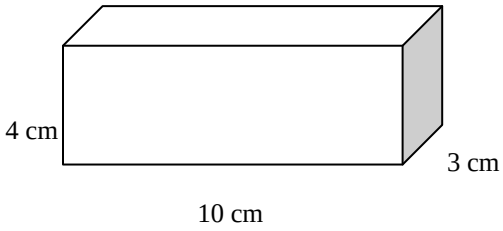
2. In your own words, describe the best strategy for calculating the surface area of a polyhedron.

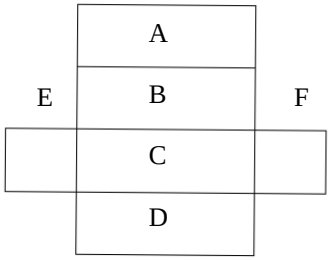
First, create a net by disassembling your polyhedron into polygons that you recognize.

Second, label and find the area of each polygon (face/side).

Lastly, add the areas of each polygon to find the total surface area of your polyhedron.

Draw the component parts that you would observe if this rectangular prism was disassembled into a set of 6 polygons. Try it with a cardboard box of needed.





Use your drawings to assist you in finding the surface for this rectangular prism.

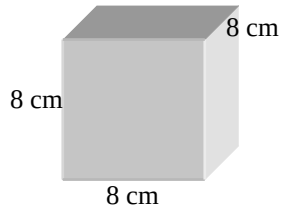
A = l × w **B = l × w** **C = l × w** **D = l × w** **E = l × w** **F = l × w**
= 10 × 3 **= 10 × 4** **= 10 × 3** **= 10 × 4** **= 4 × 3** **= 4 × 3**
= 30 cm^2 **= 40 cm^2** **= 30 cm^2** **= 40 cm^2** **= 12 cm^2** **= 12 cm^2**

<u>Surface Area</u> = A + B + C + D + E + F
= 30 + 40 + 30 + 40 + 12 + 12
= 164 cm^2

3. *Enviro-glo Crayon Company* is exploring possible designs for the packaging of their new line of crayons. Each box holds the same number of crayons. To demonstrate their commitment to the environment, they have decided to use all natural vegetable dyes to decorate their boxes. As they are business, with hopes of being profitable, they also would like to keep costs down. They would like to pick the box with the least amount of paint.

Your Job: While demonstrating your amazing knowledge of surface area, determine which box will require the least amount of paint.

1.



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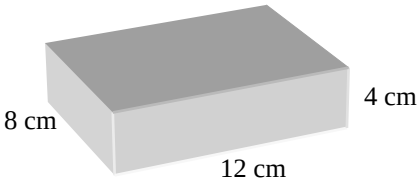

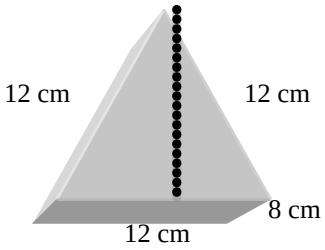

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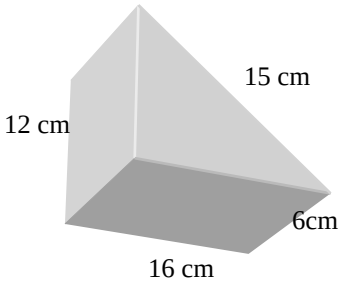
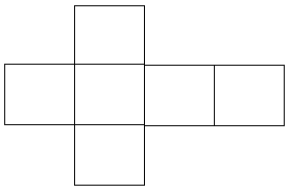


4.

Show all of your work below

Sketches:

1.



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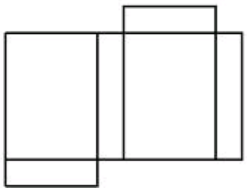

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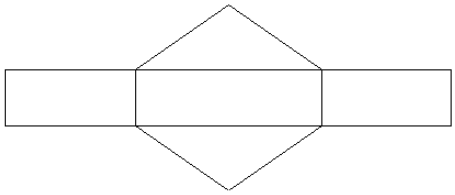

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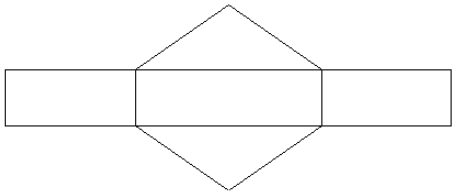


Calculations:

1. Area = 8 × 8 × 6(sides)

= 384 cm^2

2. Area = 12 × 4 × 2(sides) → 96

= 8 × 4 × 2(sides) → 64

= 8 × 12 × 2(sides) → 192

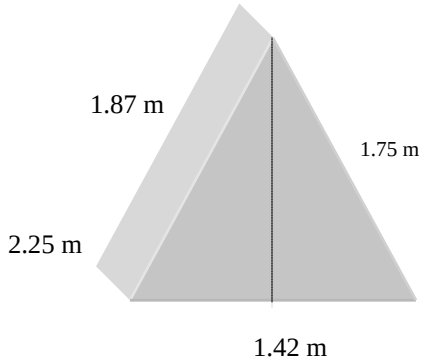
= 352 cm^2

3. Area = ½ of 12 × 10 × 2(sides) → 120
= 12 × 8 × 3(sides) → 288
= 408cm^2

4. Area = 15 × 6 → 90
= 16 × 6 → 96
= 12 × 6 → 72
= ½ of 16 × 22 × 2 (sides) → 192
= 450cm^2

Box 2 (rectangular prism) will require the least amount of paint, as it has a surface area of 352 cm^2

4. Lucy buys a new tent for her class geography trip. It rains on her third night and the floor of the tent is the only part that stays dry.



What is the area of the part of Lucy's tent that gets wet?

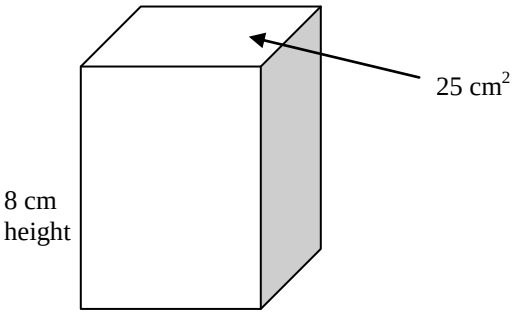
Area = ½ of 1.42 × 1.75 × 2(sides) → 2.49

= 1.87 × 2.25 × 2(sides) → 8.42
=10.91

The area of Lucy's tent that gets wet is 10.91 m^2

5. Finding the volume of a prism (polyhedron) seems to apply a similar strategy.

Find the area of the one end (base) and multiply by ***the height/number of layers*.**
This volume would be ……



Volume = Area of the base × height

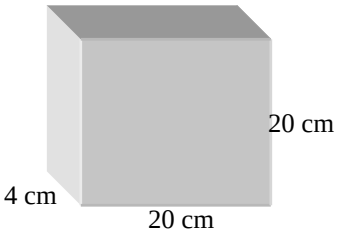
$= 25 \text{ cm}^2 \times 8 \text{ cm}$

$= 200 \text{ cm}^3$

6. A paraffin wax company sells bricks of paraffin in different sizes and shapes. Rudy needs a triangular prism of paraffin with a volume of 120 cm^3. Which rectangular prism should he choose to work with?

Justify your choice.

1.



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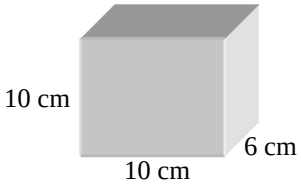

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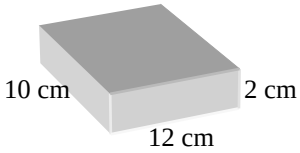


1. Volume = Area of the base × height

= (20 × 4) × 20

= 1600 cm^3

2. Volume = Area of the base × height

= (10 × 6) × 10

= 600 cm^3

3.Volume = Area of the base × height

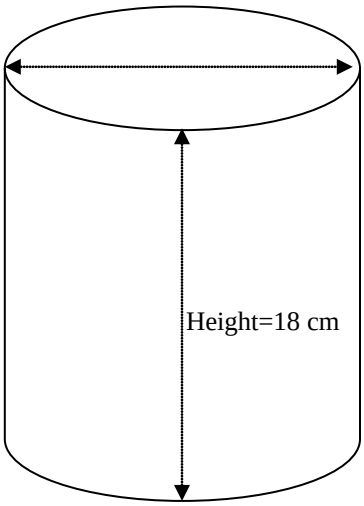
= (12 × 10) × 2

= 240 cm^3

***Rudy should choose the 3rd rectangular prism as it will provide 2 triangular prisms, each with a volume of* 120 cm^3.**

7. This same idea applies to the volume of a cylinder. Once the area of one of the round ends is measured, multiply ***by the height of the cylinder.***

Try the idea with this model.



Diameter is 12 cm
(Be careful. I'm trying to trick you)

Diameter = 12 cm ; radius = 6 cm

Area = π r 2
= 3.14 x 6 x 6
=113.04 cm^2

Volume = area of circle x height
= 113.04 x 18 = 2034.72 cm^3

8. Here's an Indiana Jones Problem to solve … The Egyptian Great Pyramid (Pyramid of Cheops) has a height of 148 meters and a square base with a perimeter of 930 meters. What is the volume of the pyramid? (Suggestion: Draw a model.)

a. Perimeter of square base is 930 m. Therefore one side is 930 ÷ 4 = 232.5m

b. Area of base is l × w (or s^2) 232.5 × 232.5 = 54056.25 m^2

c. Volume of pyramid is 1/3 × area of base × height
= 1/3 × 54056.25 × 148 m
=2 666 775 m^3

(That's a big piece of rock that you can't take for granite…)