UNIT 12

Volume and Surface Area

2016 – 2017

CCM6+

Name: _____

Math Teacher: _____

Projected Test Date: _____

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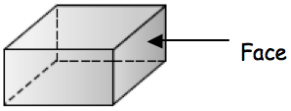
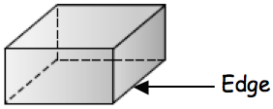
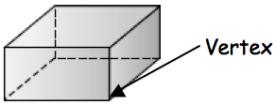
CCM6 Plus Unit 12: Surface Area and Volume Vocabulary

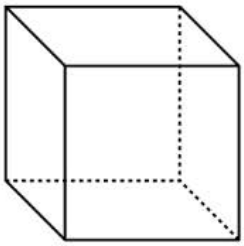
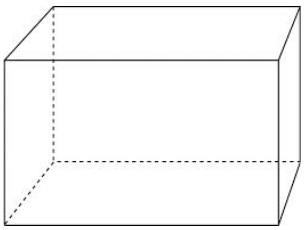
Area	The amount of square units covered by a plane figure measured in square units
Base	One side of a polygon
Decomposing	Break shapes apart into smaller figures
Dimensions	The size of an object
Edge	The line segment along which two faces of a polyhedron intersect
Face	A flat surface of a polyhedron (a 3D figure)
Height	How tall an object is
Isosceles	Two equal sides
Net	An arrangement of two-dimensional figures that can be folded to form a polyhedron (3-D figure); what you get if you “unfold” a shape
Polyhedron	Three-dimensional figure whose surfaces, or faces, are all polygons
Pyramid	A polyhedron that has a polygon base and triangular lateral faces
Right Rectangular Prism	A solid (3-dimensional object) which has six faces that are rectangles
Surface area	The sum of the area of the faces of a 3D figure
Triangular Prism	A solid (3-dimensional object) which has five faces (3 rectangles and 2 triangles)
Vertices	A point where three or more edges intersect; the “corners”
Volume	The number of cubic units needed to fill a given space

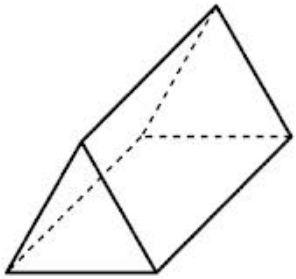
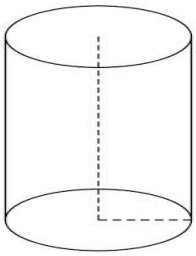
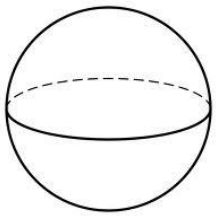
NOTES – 3D FIGURES

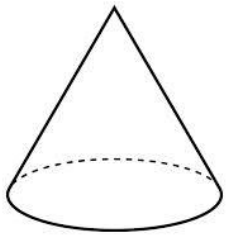
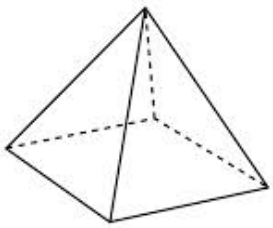
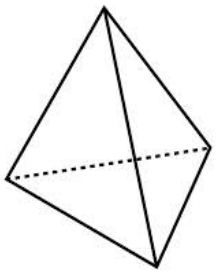
Face	Edge	Vertex
A _____ surface of a polyhedron.	The line segment which ____ faces _____.	A _____ where ____ or more edges intersect.
		

Net: An arrangement of _____ figures that can be _____ to form a _____ figure.

Prisms	Pyramids
▪ Have _____ identical bases. ▪ Named by the _____ of their base. ▪ The sides of a prism are _____.	▪ Have only _____ base. ▪ Named by the _____ of their base. ▪ The sides of a pyramid are _____.

3D Figure	Net	Properties of Figure
		**Shape of Base:** _____ **Name of Figure:** _____ _____ _____ _____ Faces Vertices Edges
		**Shape of Base:** _____ **Name of Figure:** _____ _____ _____ _____ Faces Vertices Edges

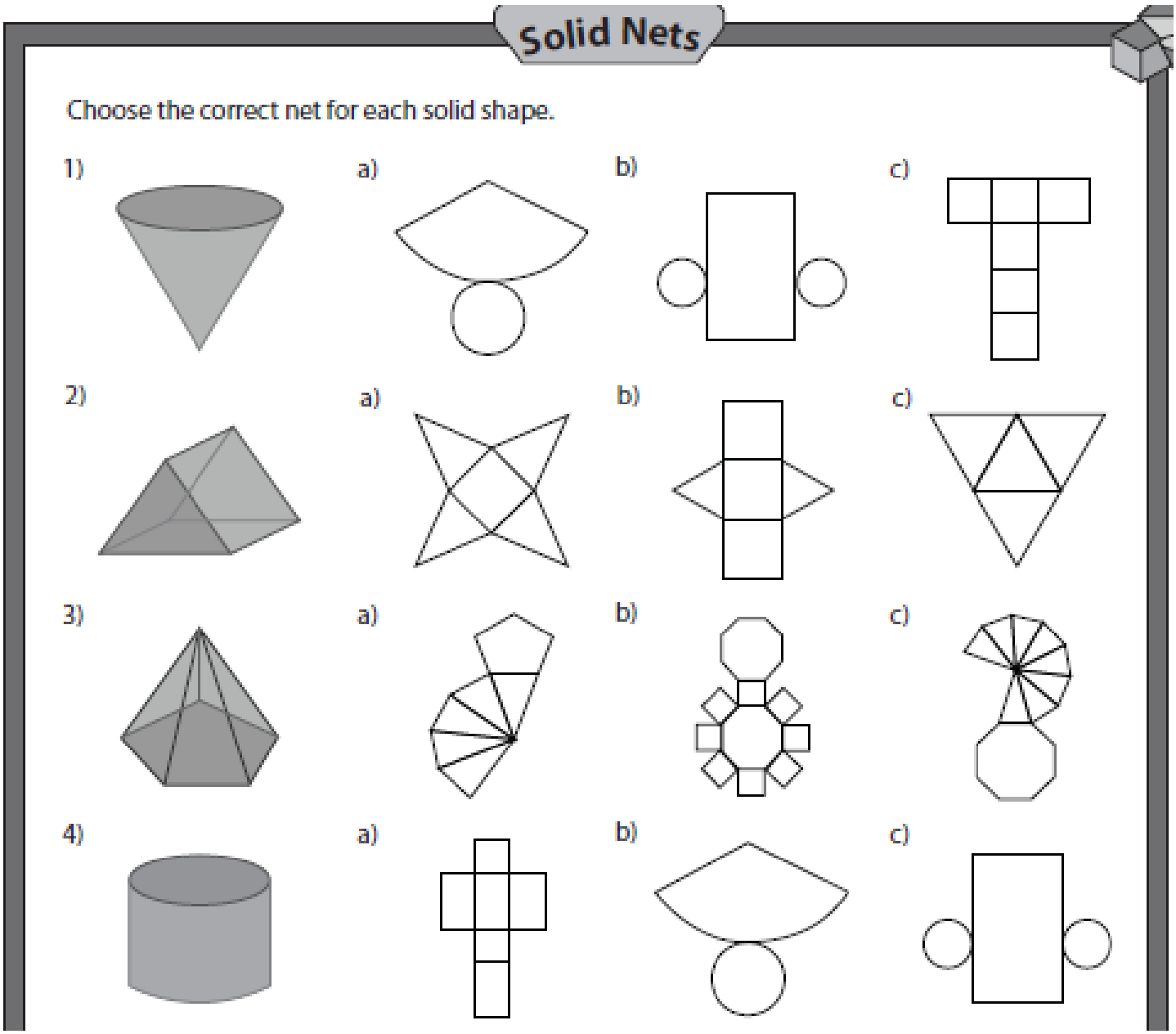
		**Shape of Base:** _____ **Name of Figure:** _____ _____ _____ _____ **Faces** **Vertices** **Edges**
3D Figure	**Net**	**Properties of Figure**
		Shape of Base: _____ Name of Figure: _____ _____ _____ _____ Faces Vertices Edges
		Shape of Base: _____ Name of Figure: _____ _____ _____ _____ Faces Vertices Edges

		Shape of Base: _____ Name of Figure: _____ _____ _____ _____ Faces Vertices Edges
		Shape of Base: _____ Name of Figure: _____ _____ _____ _____ Faces Vertices Edges
		Shape of Base: _____ Name of Figure: _____ _____ _____ _____ Faces Vertices Edges

Real-World Examples of 3D Figures

Cube	Triangular Prism	Cylinder	Sphere	Cone	Pyramid

3D FIGURES HOMEWORK



BIG IDEAS:

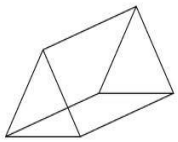
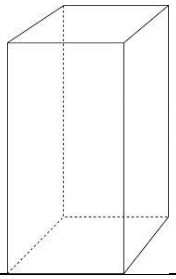
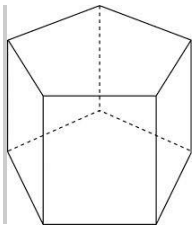
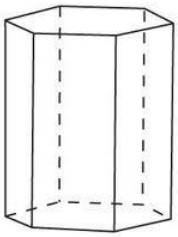
Why can't you just name a shape as a "prism" or a "pyramid?"

What else is required in the name of a 3-D shape?

If a "POLYHEDRON" is only made of polygons, which shapes on this page are NOT polyhedra?

POLYHEDRON PATTERNS

Complete these charts to discover the polyhedron patterns.

	Triangular Prism 	**Rectangular Prism** 	**Pentagonal Prism** 	**Hexagonal Prism** 
Base's # of Sides				
# of Faces				
# of Vertices				
# of Edges				

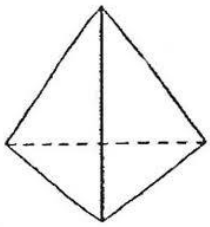
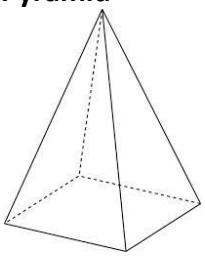
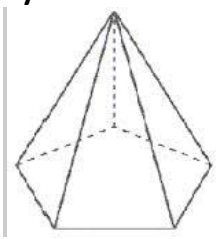
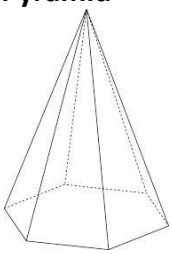
PRISM PATTERNS:

If n=the number of sides on the base shape of the prism, write an **algebraic expression** for:

- the number of faces: _____
- the number of vertices:_____
- the number of edges: _____

POLYHEDRON PATTERNS Continued

Complete these charts to discover the polyhedron patterns.

	Triangular Pyramid 	**Rectangular Pyramid** 	**Pentagonal Pyramid** 	**Hexagonal Pyramid** 
Base's # of Sides				
# of Faces				
# of Vertices				
# of Edges				

PYRAMID PATTERNS:

If n=the number of sides on the base shape of the pyramid, write an **algebraic expression** for:

- the number of faces: _____
- the number of vertices:_____
- the number of edges: _____

LESSON 12.5

Volume of Rectangular Prisms

Goal: Find the volume of rectangular prisms.

For Your Notebook

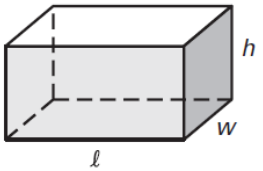
Vocabulary

Volume: The volume of a solid is the amount of space it contains.

Volume of a Rectangular Prism

Words The volume V of a rectangular prism is the product of the length, width, and height.

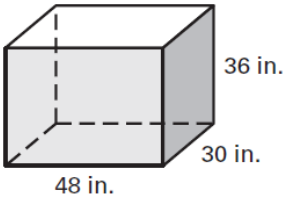
Algebra $V = \ell wh$



**** V = _____ • _____ where _____ is the _____ of the _____****

EXAMPLE 1 **Volume of a Rectangular Prism**

Freezer The Gilbert family has a chest freezer that has a length of 48 inches, a width of 30 inches, and a height of 36 inches. What is the volume of the freezer?

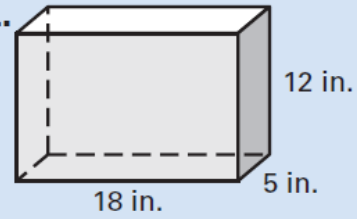
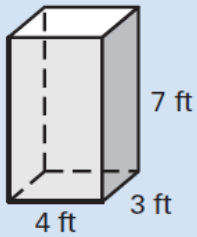
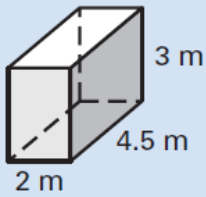


Solution

$V = \ell wh$	Write formula for volume of a rectangular prism.
$= (\ \ )(\ \ )(\ \ )$	Substitute ___ for ℓ, ___ for w, and ___ for h.
$=$ ___	Multiply.

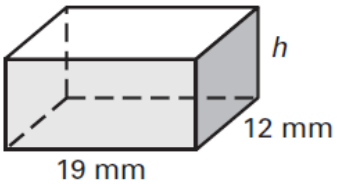
Answer: The freezer will hold ___ cubic inches.

Your turn now **Find the volume of the rectangular prism.**

1.	2.	3.
		
1080 in.^{3}	84 ft^3	27 m^3

EXAMPLE 2 Finding the Height of a Rectangular Prism

The rectangular prism shown has a volume of 2052 cubic millimeters. Find the prism's height.



Solution

$V = \ell wh$	Write formula for volume of a rectangular prism.
$2052 = (19)(12)h$	Substitute 2052 for V, 19 for ℓ, and 12 for w.
$2052 = 228h$	Multiply.
$\frac{2052}{228} = \frac{228h}{228}$	Divide each side by 228.
$9 = h$	Simplify.

Answer: The height of the prism is 9 millimeters.

Your turn now **Find the unknown length, width, or height of the rectangular prism.**

4. $V = 144\ \text{ft}^3$, $\ell =$?, $w = 3$ ft, $h = 6$ ft

5. $V = 308\ \text{cm}^3$, $\ell = 7$ cm, $w =$?, $h = 11$ cm

6. $V = 78\ \text{m}^3$, $\ell = 6.5$ m, $w = 4$ m, $h =$?

EXAMPLE 3 Using the Volume of a Rectangular Prism

Snack Mix A cereal box is 6 inches long, 10 inches tall, and 1.5 inches wide. Marta is mixing a snack mix in a tin canister that holds 585 cubic inches. How many boxes of cereal will Marta open in order to fill her container?

Solution

1. Find the volume of the cereal box.

$$V = \ell wh$$
$$= (\square)(\square)(\square)$$
$$= \square\ \text{in.}^3$$

2. To find the number of cereal boxes Marta will open, divide $\square$ cubic inches by $\square$ cubic inches.

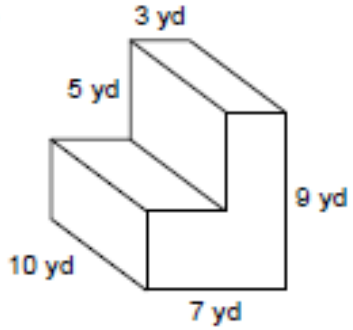
$$\square\ \text{in.}^3 \div \square\ \text{in.}^3 = \square$$

Answer: Because it doesn't make sense to open $\square$ boxes, Marta must open $\square$ boxes of cereal to fill the container.

VOLUME HOMEWORK

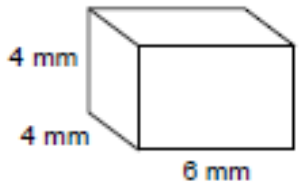
Calculate the volume of each solid.

(1)



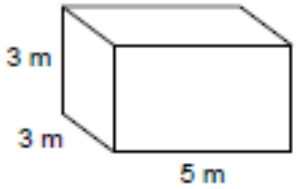
Volume: _____

(2)



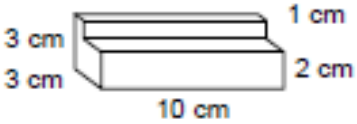
Volume: _____

(3)



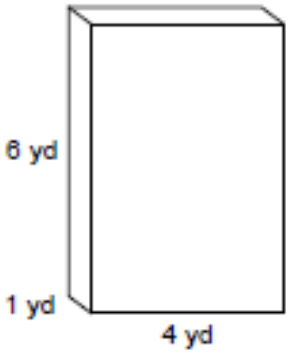
Volume: _____

(4)



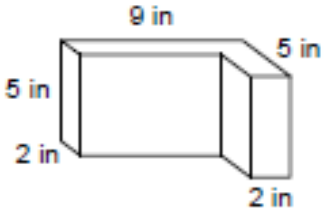
Volume: _____

(5)



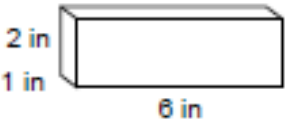
Volume: _____

(6)



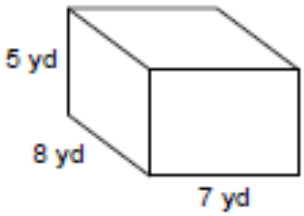
Volume: _____

(7)



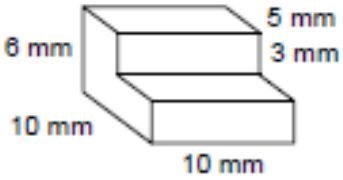
Volume: _____

(8)



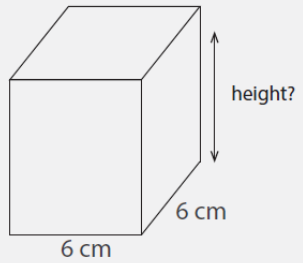
Volume: _____

(9)



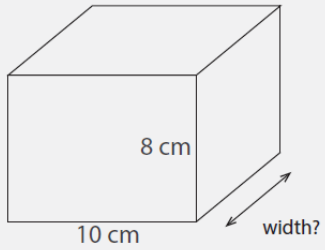
Volume: _____

Calculate the length of the unknown edges.



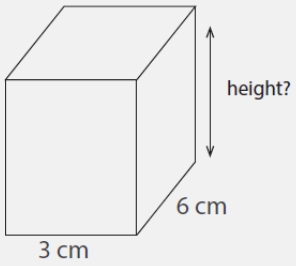
Volume: 288 cm^3

Height: _____ cm



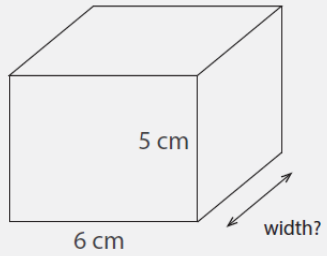
Volume: 720 cm^3

Width: _____ cm



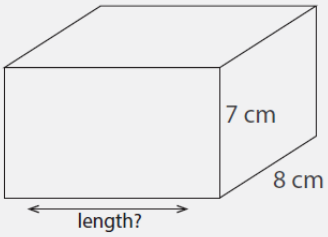
Volume: 180 cm^3

Height: _____ cm



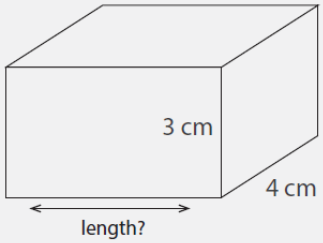
Volume: 210 cm^3

Width: _____ cm



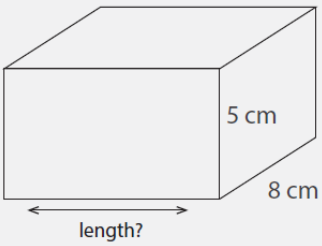
Volume: 560 cm^3

Length: _____ cm



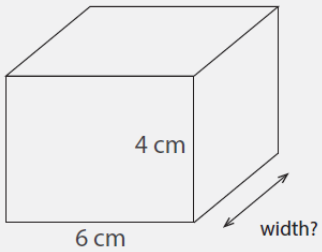
Volume: 72 cm^3

Length: _____ cm



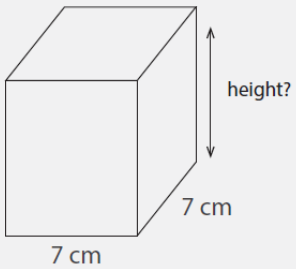
Volume: 360 cm^3

Length: _____ cm



Volume: 120 cm^3

Width: _____ cm



Volume: 343 cm^3

Height: _____ cm

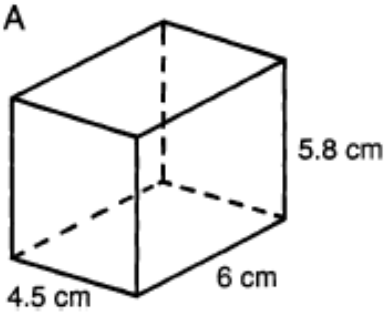
VOLUME WITH FRACTIONAL EDGES

Does $V = Bh$ *work for other prisms?*

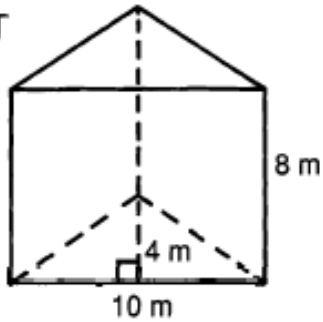
What Is Big, Gray, and Lives in California?

Find the volume of each prism. Write the letter of the exercise in the box above the answer at the bottom of the page.

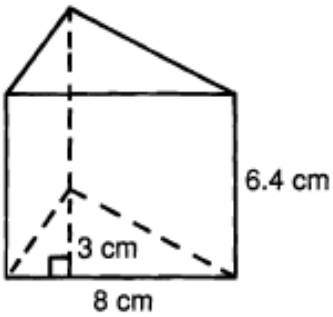
A



T



N



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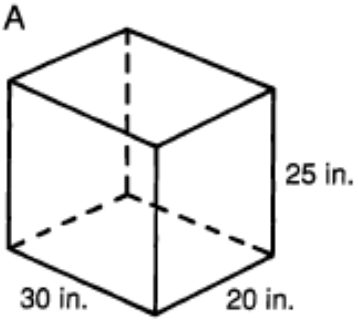
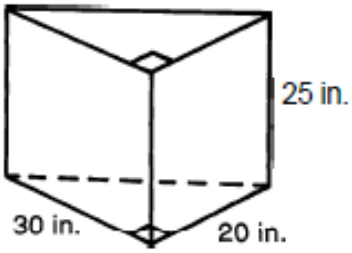
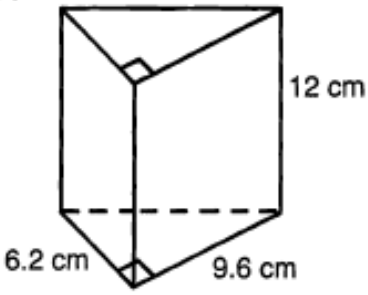


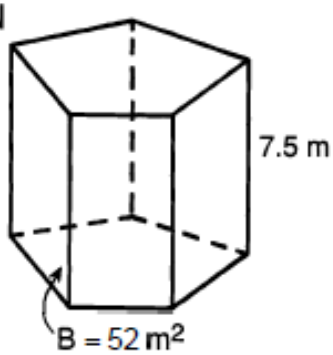
P



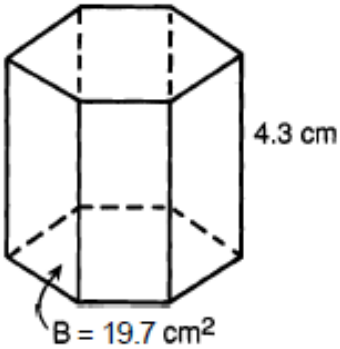
A



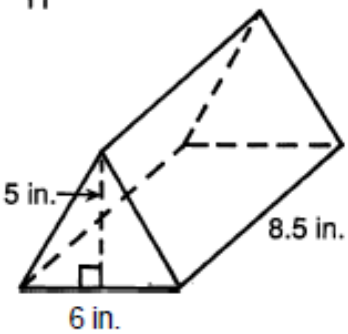
N

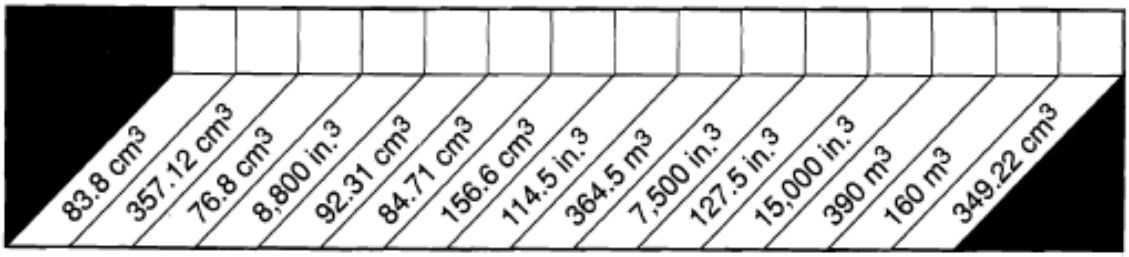


L



H





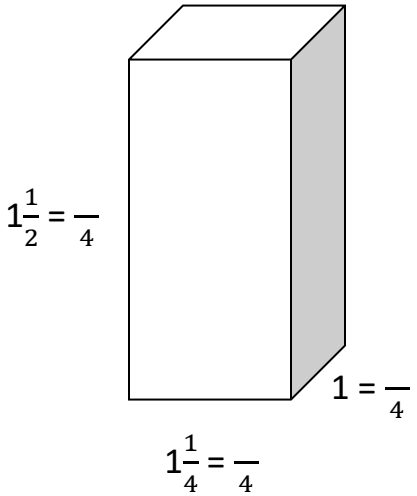
A right rectangular prism has edges of $1\frac{1}{4}$", 1" and $1\frac{1}{2}$". How many cubes with side lengths of $\frac{1}{4}$ would be needed to fill the prism? What is the volume of the prism?

Woah…let's break this down!

Step 1: We need to convert our measures into quarters…so

$$1\frac{1}{4} = \frac{\quad}{4} \qquad 1 = \frac{\quad}{4} \qquad 1\frac{1}{2} = \frac{\quad}{2} = \frac{\quad}{4}$$

Step 2: If each measure is "fourths" I can draw how many "fourth of a cube" edges there area on each side.



Step 3: Using "fourths of cubes," how many blocks are at each dimension?
Fill these in below:

$$\frac{____}{4} \bullet \frac{____}{4} \bullet \frac{____}{4} = \frac{____}{4}$$

So, how many blocks that are "fourths" are in the volume? _____

Step 4: Calculate the Volume w/o a calculator: V = _____ = _____ = _____ in^3

1. A rectangular container has a length of 6 inches, a width of 2 ½ inches, and height of 4 ¼ inches. What is the Volume?

2. A flower box is 4ft. long, $2\frac{3}{4}$ ft. wide, and ½ ft. deep. How many cubic feet of dirt can it hold?

3. Explain why the volume of a cube with side lengths $1\frac{1}{2}$in, $1\frac{1}{2}$in , $1\frac{1}{2}$in is $3\frac{3}{8}\ in^3$. Draw the diagram to match this prism.

HOMEWORK: VOLUME WITH FRACTIONAL EDGES

1. A right rectangular prism has edges of, $2\frac{1}{4}$ in, 2 in and $1\frac{1}{2}$in. How many cubes with lengths of $\frac{1}{4}$in would be needed to fill the prism? What is the volume?

2. Find the volume of a rectangular prism with dimensions $1\frac{1}{2}$ in , $1\frac{1}{2}$ in and $2\frac{1}{2}$ in .How many cubes with lengths of $\frac{1}{2}$ in would be needed to fill the prism?

3. A flower box is 3feet long, $1\frac{3}{4}$ feet wide, and $\frac{1}{2}$ feet deep. How many cubic feet of dirt can it hold?

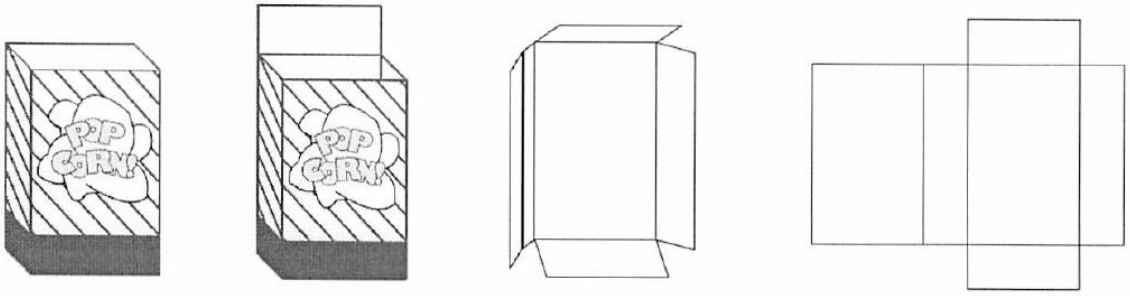
4. Draw a diagram to match the rectangular prism whose length is $5\frac{1}{2}$in, width is 4in and height is $4\frac{1}{2}$in.

5. Mr. White is trying to store boxes in a storage room with length of 8yd, width of 5yd and height of 2yd. How many boxes can fit in this space if each is box is $2\frac{1}{4}$ feet long $1\frac{1}{2}$ feet wide and 1 foot deep ?

6. Linda keeps her jewelry in a box with dimensions $8\frac{1}{4}$ in by $3\frac{3}{4}$ in by 4in. Find the volume of Linda's jewelry box.

Review of Nets

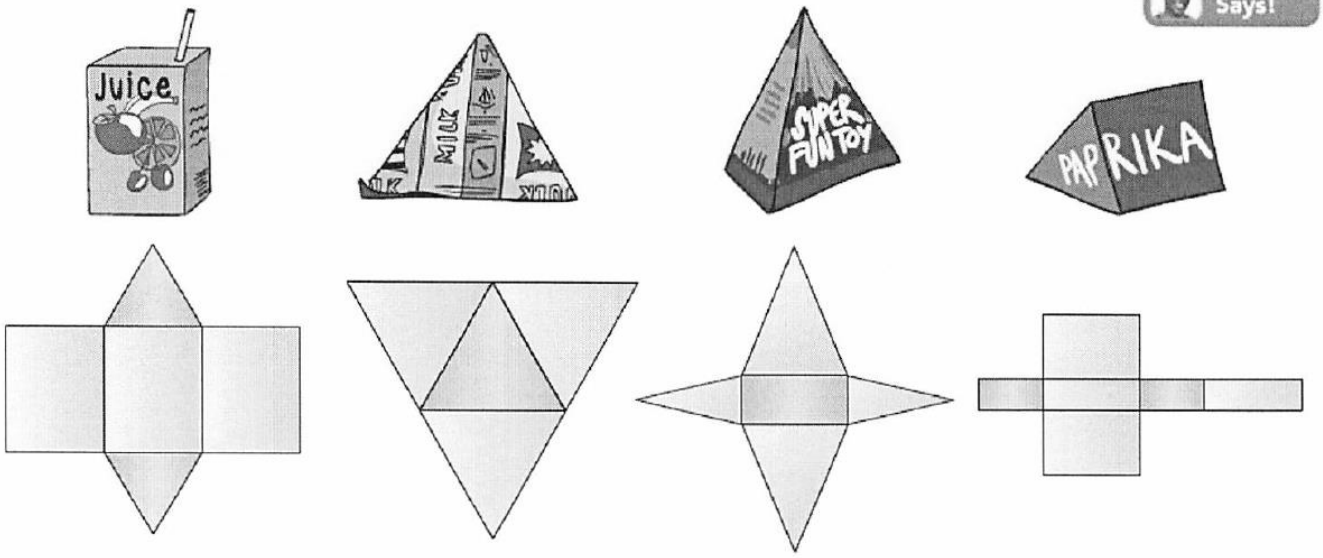
A **net** is a two-dimensional pattern that you can fold to form a three-dimensional figure. A net of a figure shows all the surfaces of that figure in one view.



Example

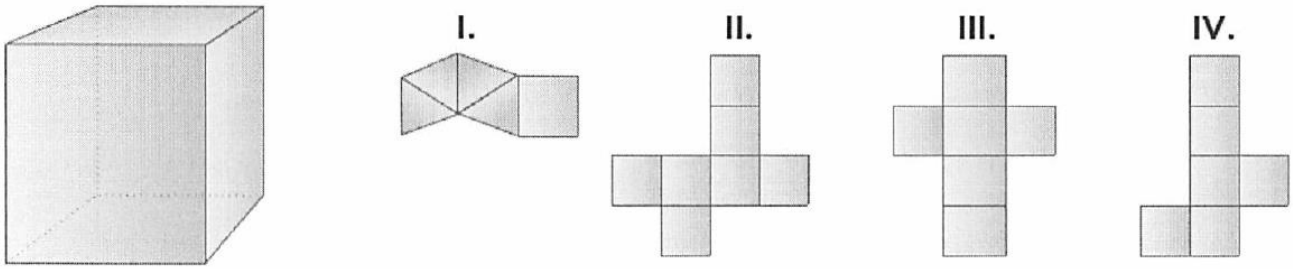
Match each package with its net.

Jay Says!



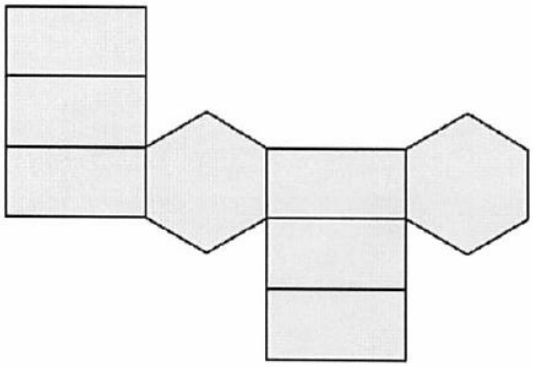
Got It?

Match the cube with its net.



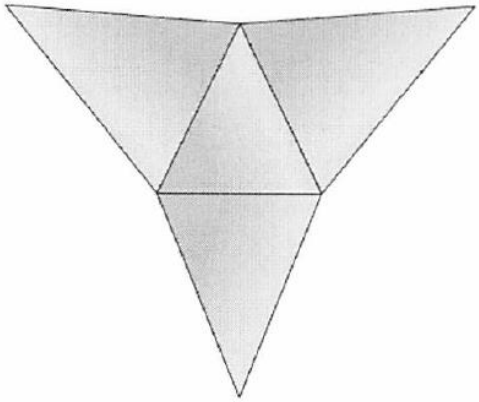
Example

Identify the regular three-dimensional figure that the given net forms.



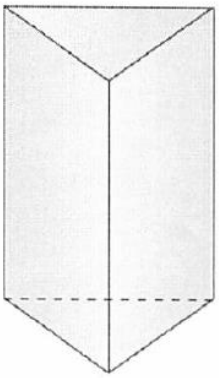
Got It?

Identify the three-dimensional figure that the given net forms.



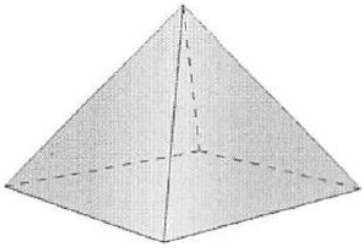
Example

Draw a net for the given triangular prism.



Got It?

Draw a net for the square pyramid.



SURFACE AREA

- Looking at the shape below right, how many faces are there? _____

- What is the name of this shape? _____

- What is the **area** of each face?

  Top: _____

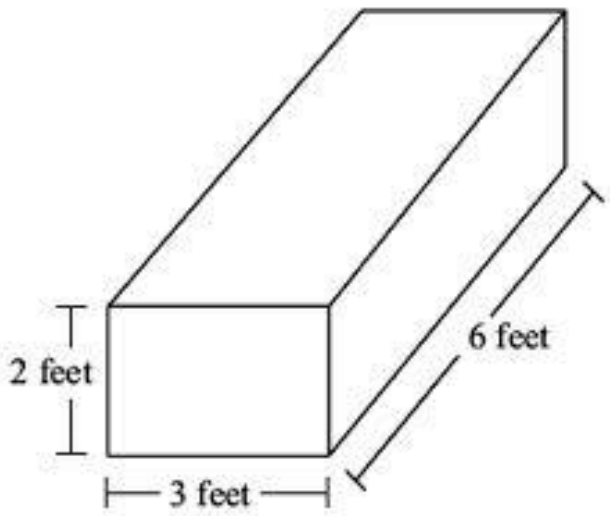
  Bottom: _____

  Left: _____

  Right: _____

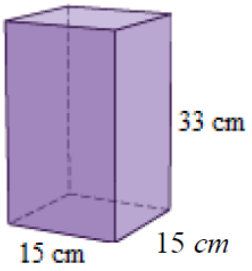
  Front: _____

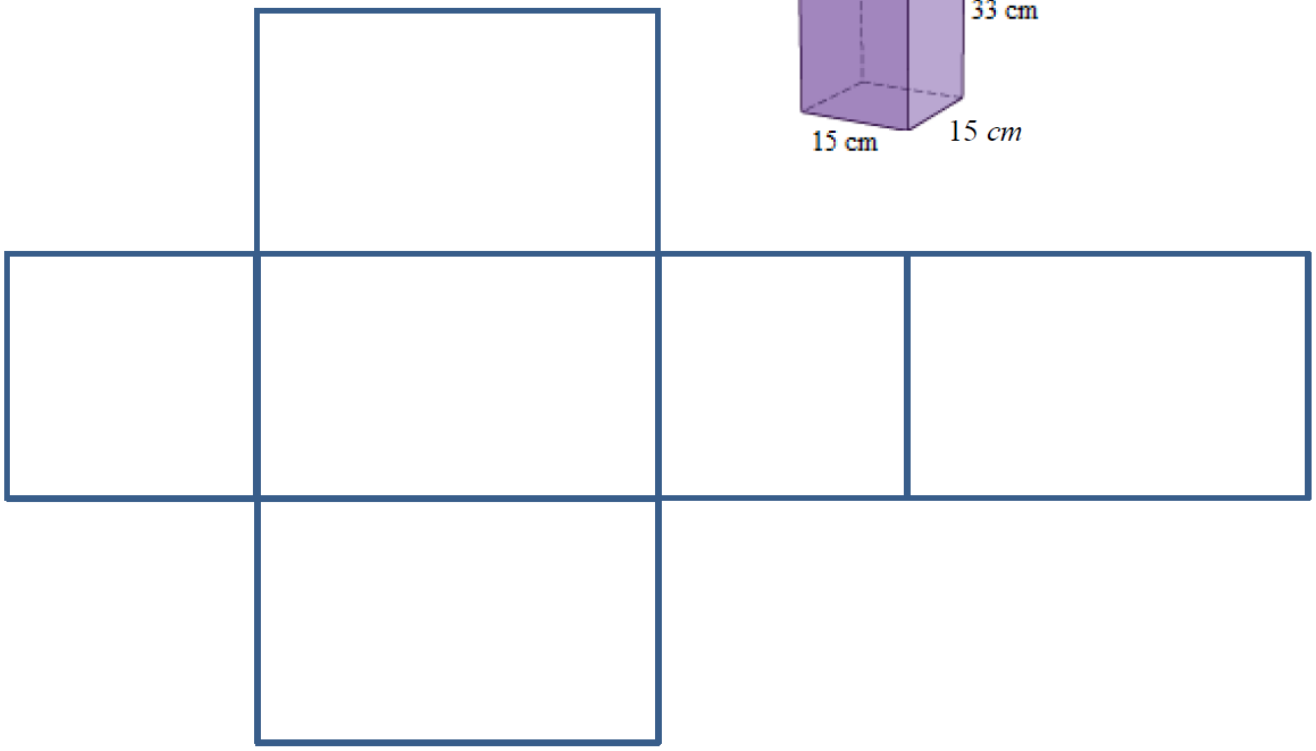
  Back: _____



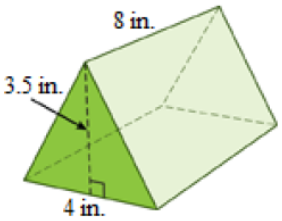
- What do you notice about the areas of the faces?

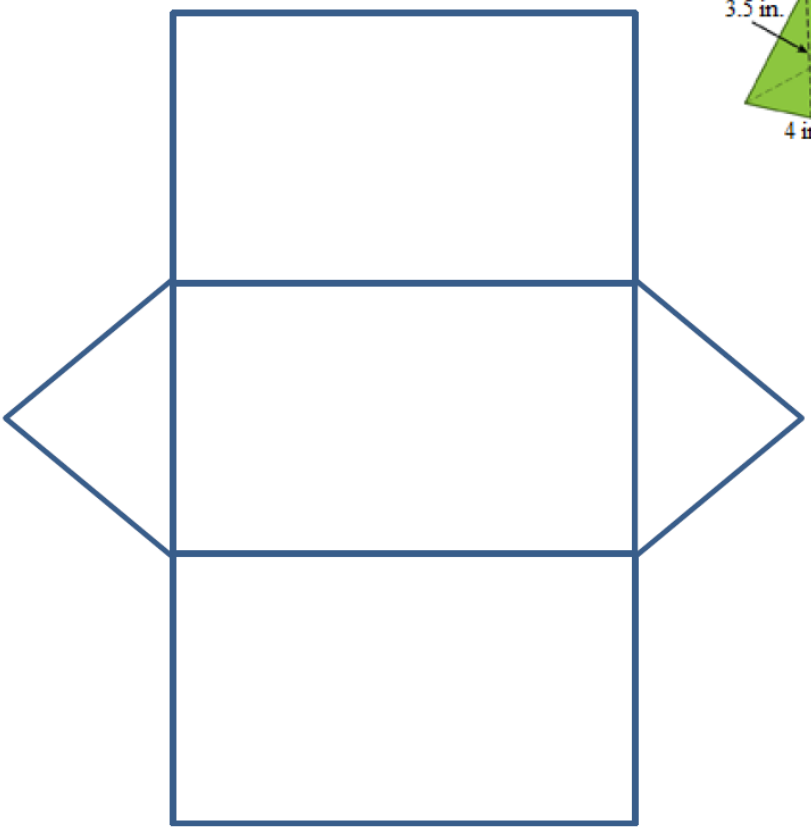
1. Find the Surface Area of the Rectangular Prism.



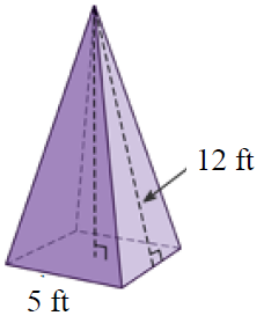


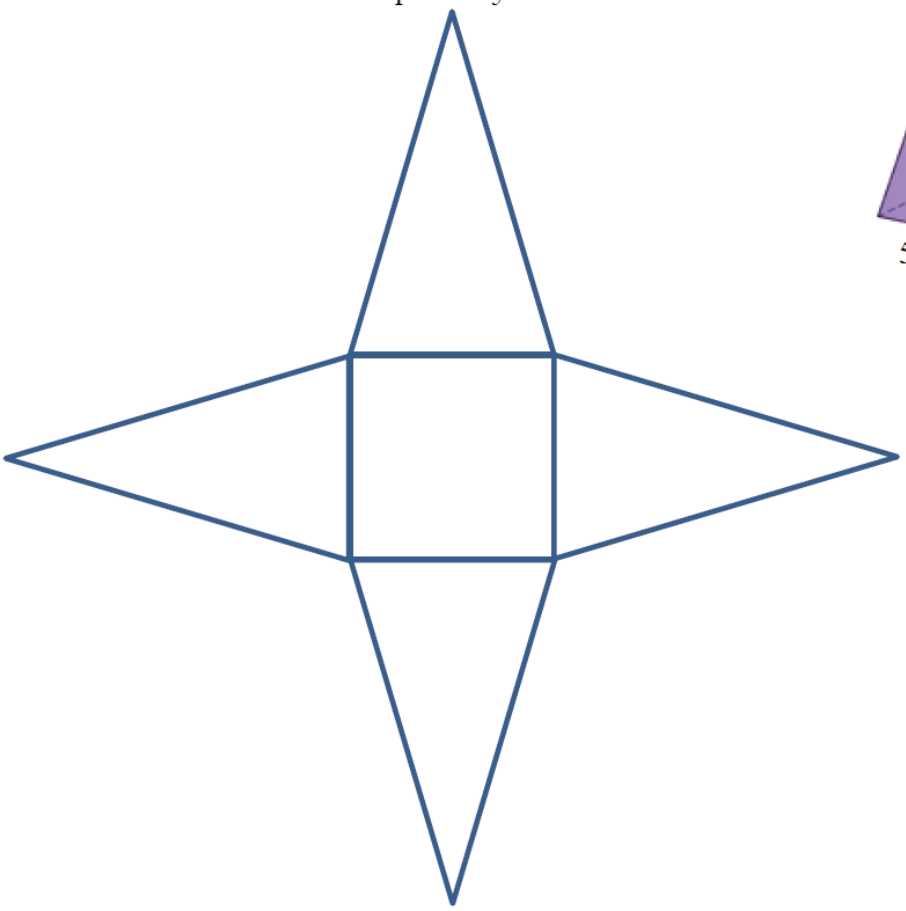
2. Find the Surface Area of the Triangular Prism.



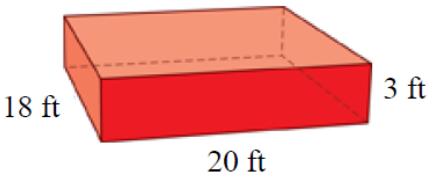


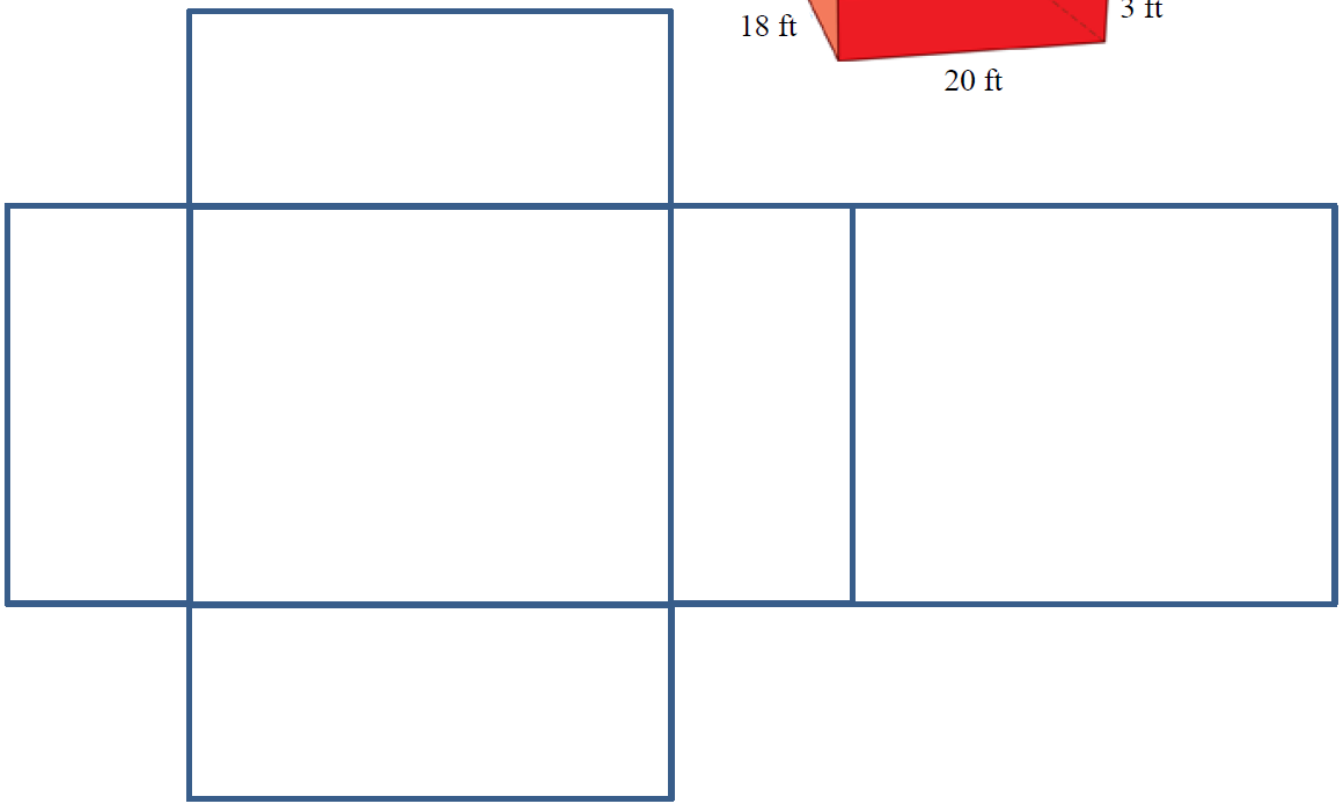
4. Find the Surface Area of the Square Pyramid.



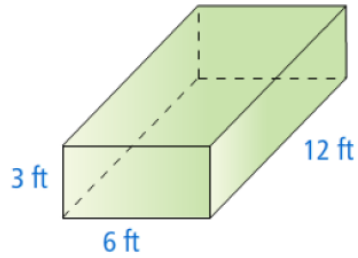


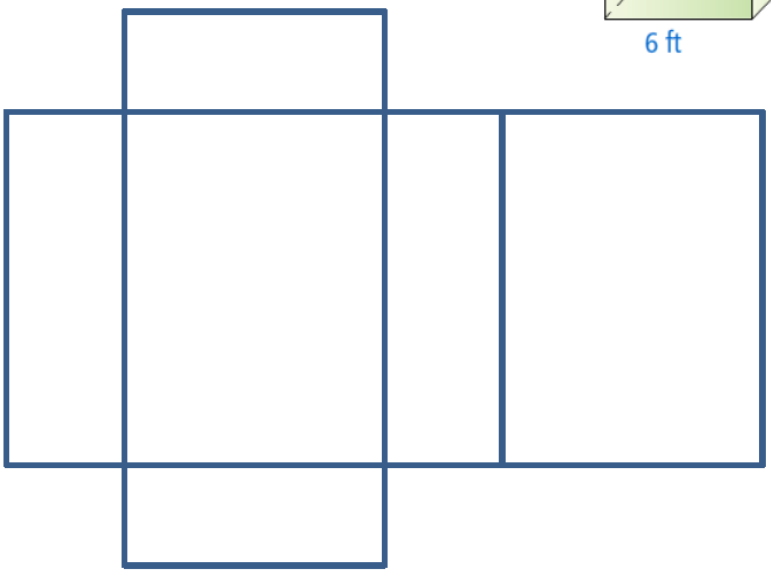
3. Find the Surface Area of the Rectangular Prism.



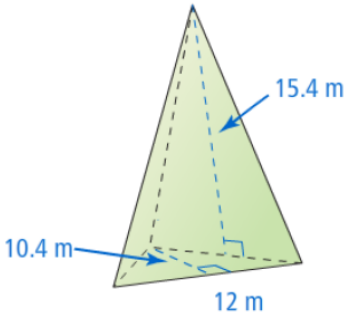


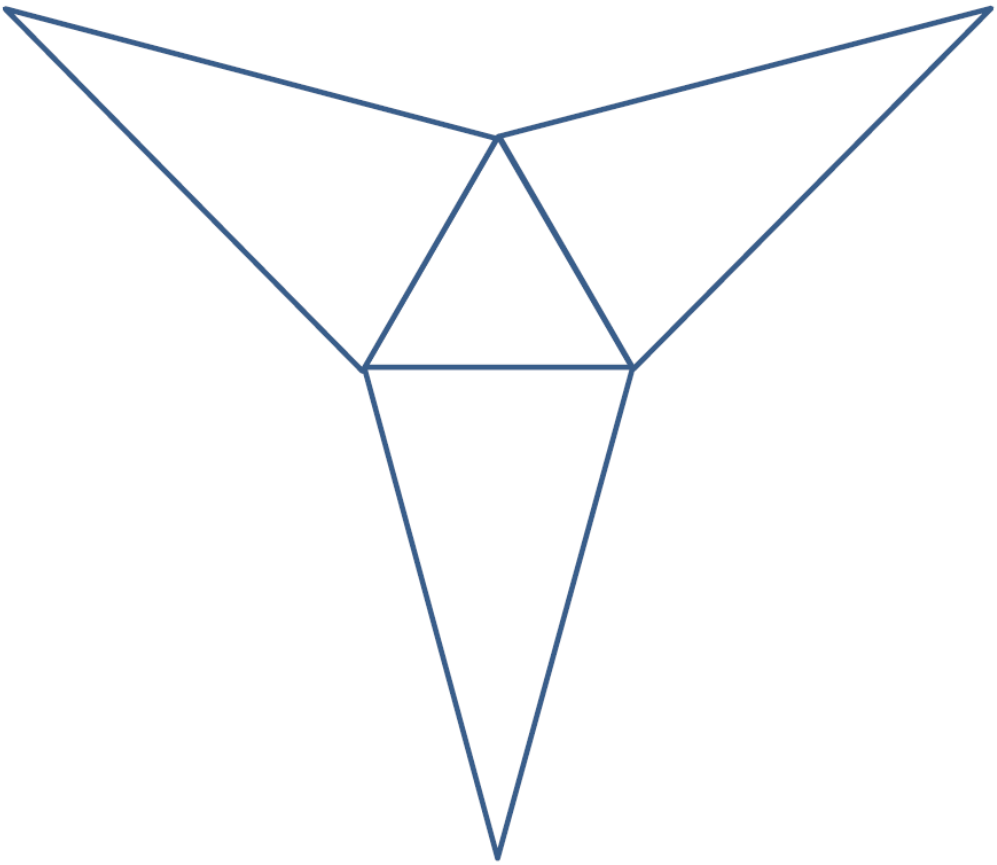
4. Find the Surface Area of the Rectangular Prism.





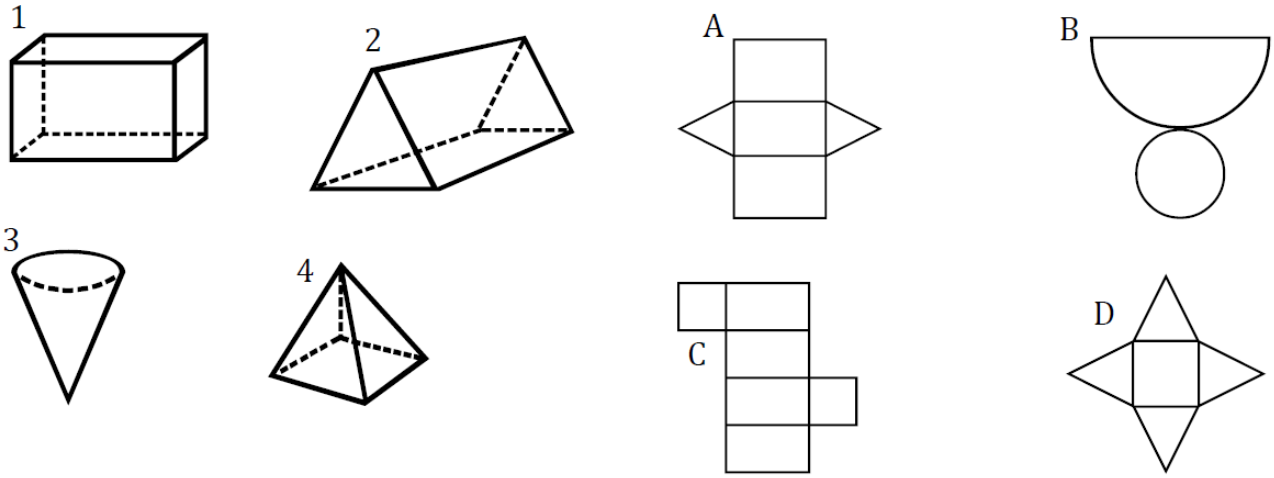
5. Find the Surface Area of the Regular Triangular Pyramid.



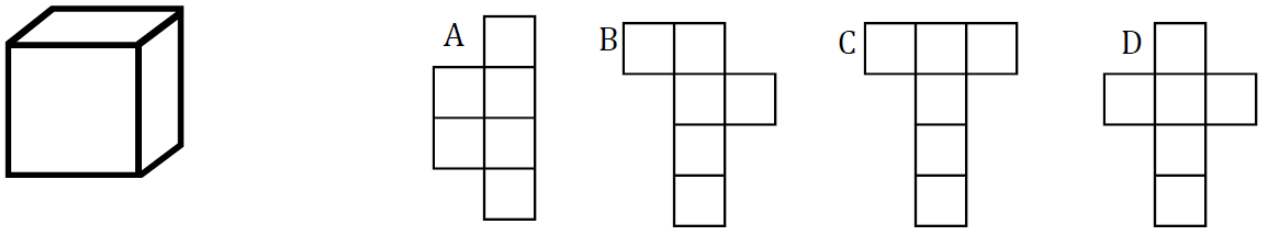


SURFACE AREA AND NETS HOMEWORK

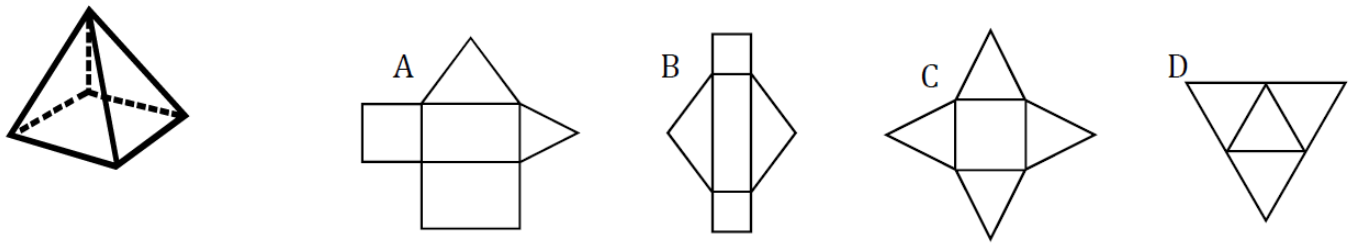
Match the 3D shape to the net.



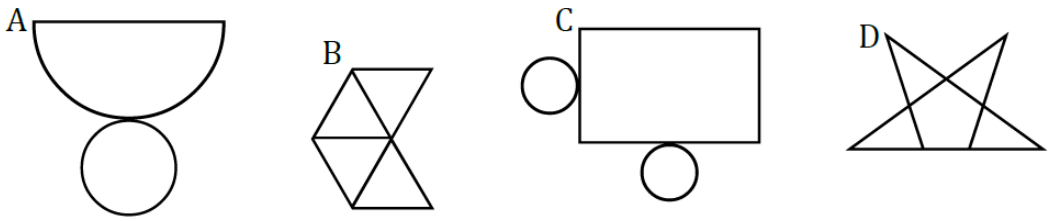
5 Which net <u>cannot</u> be used for this shape?



6 Which net <u>can</u> be used for this shape?

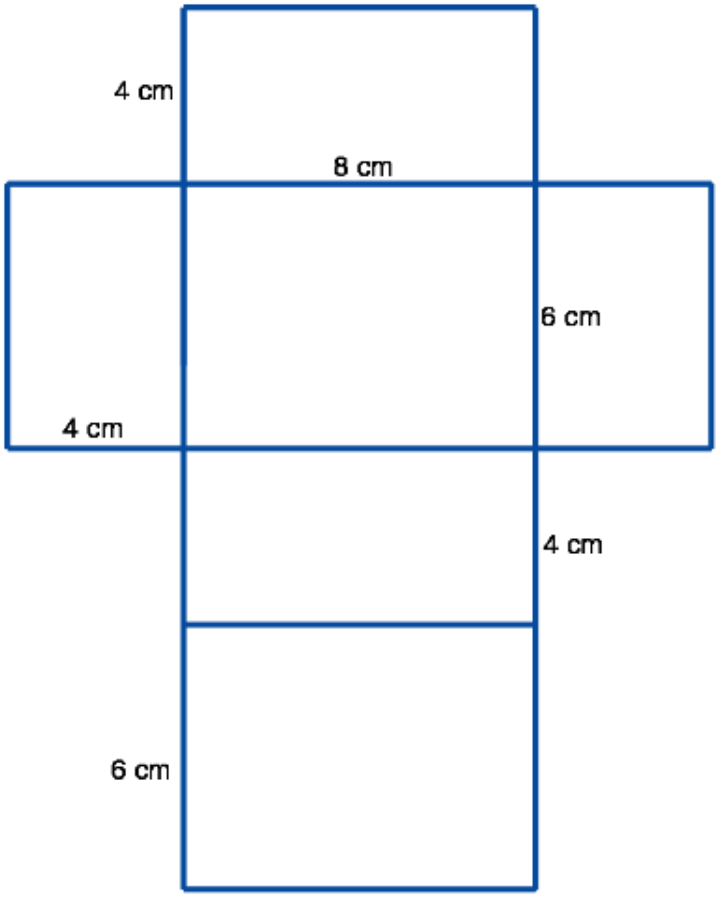


7 Which net <u>can</u> be folded to make a 3D shape?

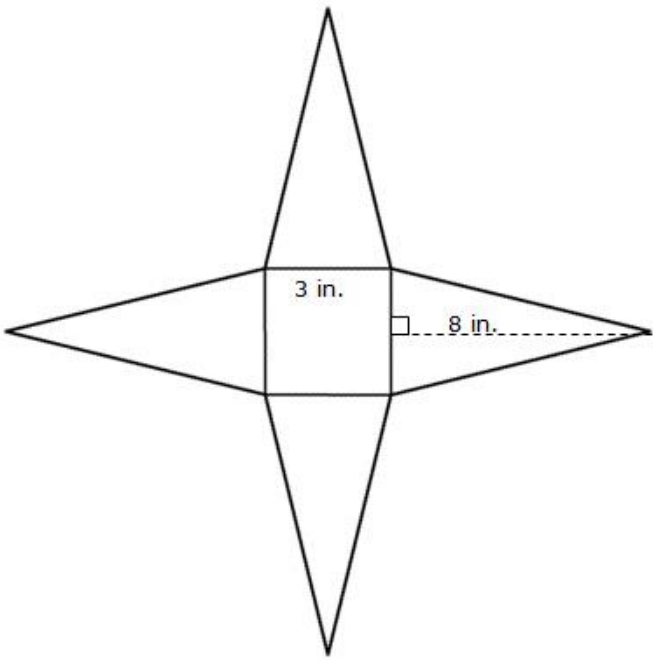


Find the total surface area of each shape using the nets provided.

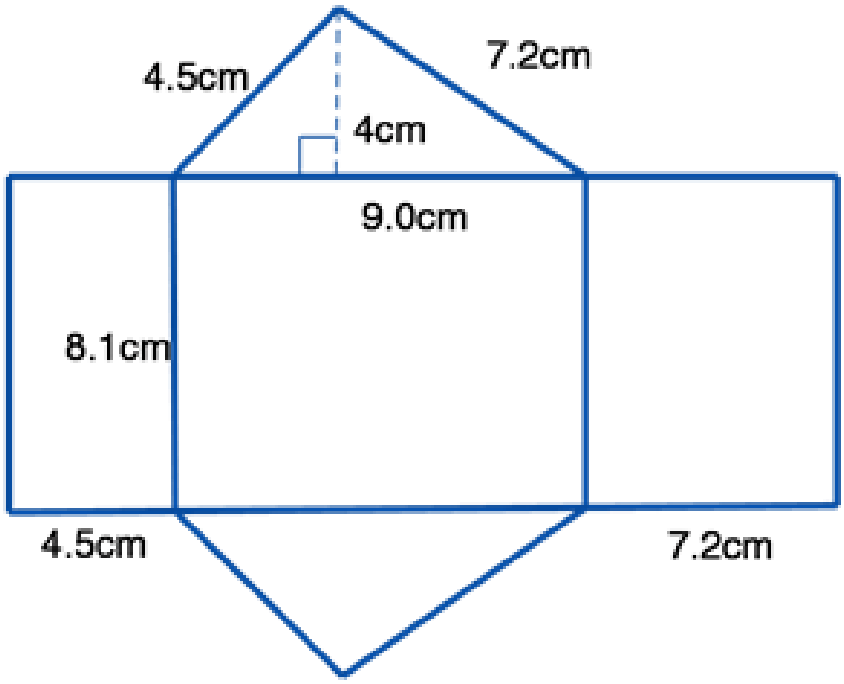
RECTANGULAR PRISM



SQUARE PYRAMID

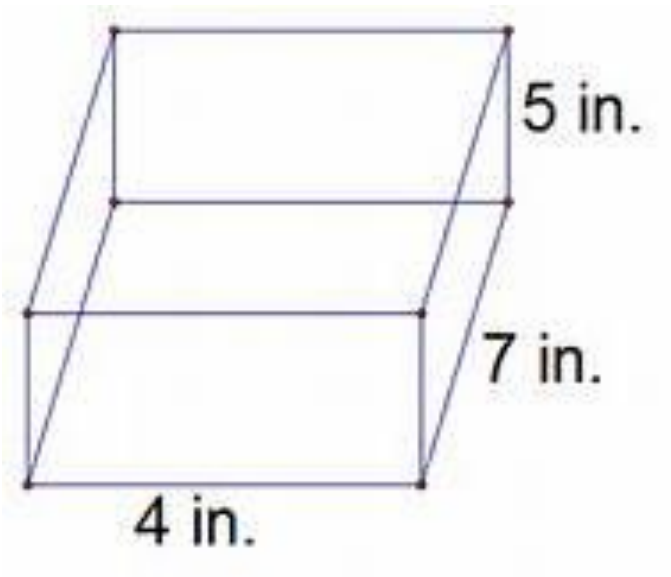


TRIANGULAR PRSIM

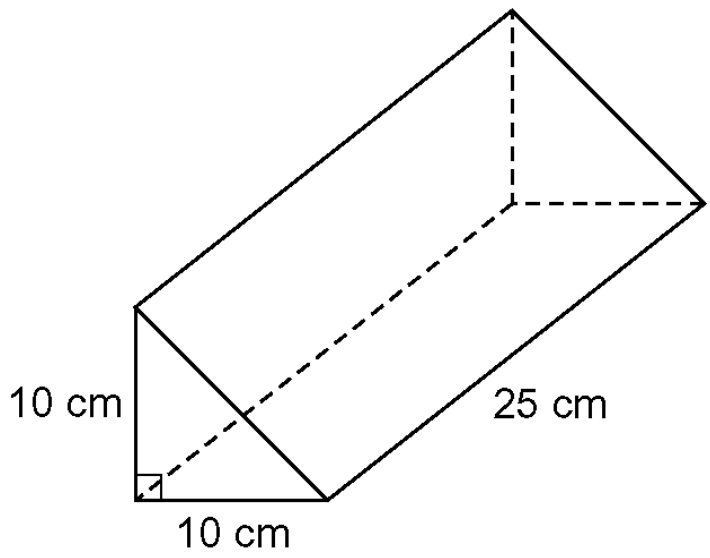


Find the surface area of each shape by drawing nets.

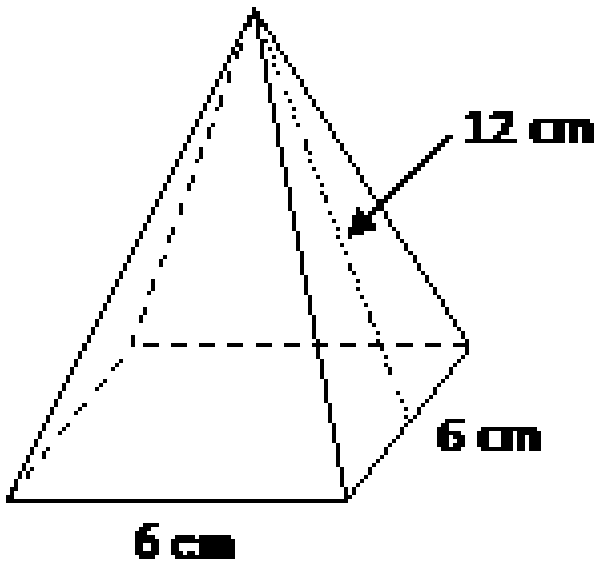
RECTANGULAR PRISM



TRIANGULAR PRISM

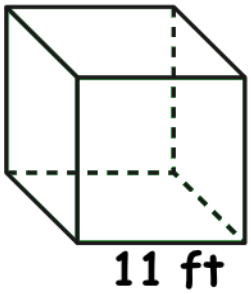


SQUARE PYRAMID



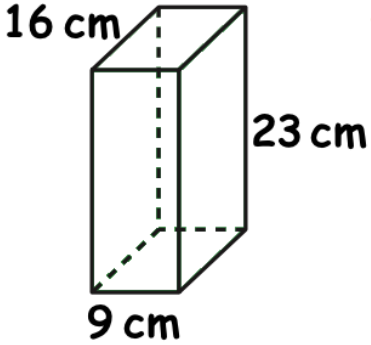
1.

Find the surface area of the prism.



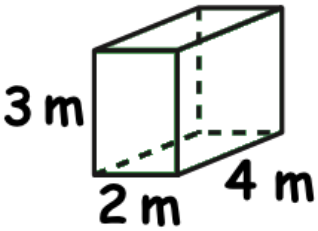
2.

Find the surface area of the prism.



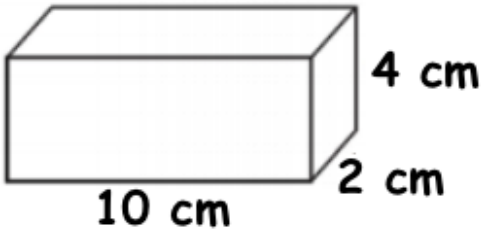
3.

Find the surface area of the prism.



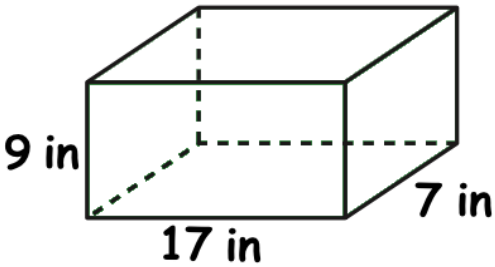
4.

Find the surface area of the prism.



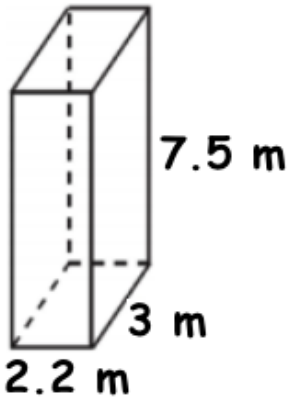
5.

Find the surface area of the prism.



6.

Find the surface area of the prism.

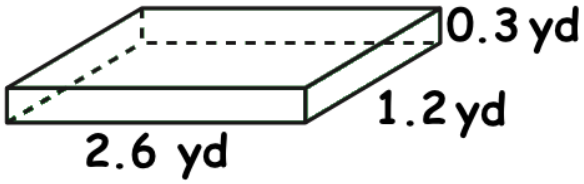


7.

Find the surface area of the prism.

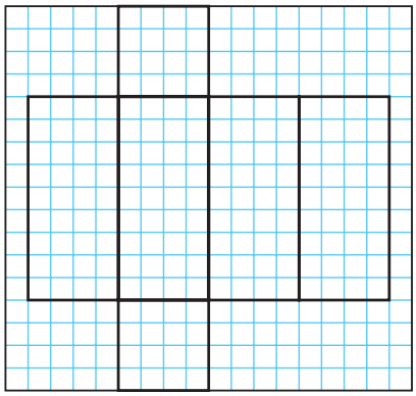
8.

Find the surface area of the prism.



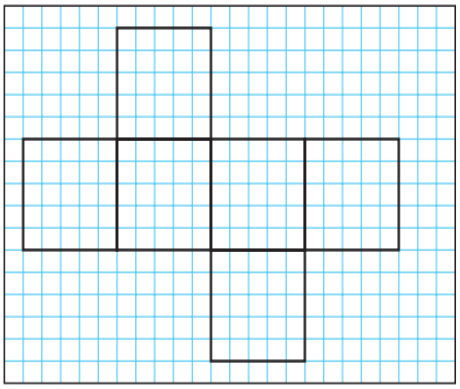
9.

Find the surface area of the prism.



10.

Find the surface area of the prism.



11.

Ms. Green is painting the outside of a wooden box that is 9 feet long, 4.5 feet wide and 6 feet tall. If one cup of paint can cover up to 20 feet^2, how many cups of paint will Ms. Green need?

12.

The length of the base of a square prism is 5.5 m. If the height of the prism is 6.75 m, what is the surface area of the figure in centimeters?

13.

A DVR box measures 17 inches by 15 inches by 3 inches. What is the minimum surface area of a box needed to hold the DVR box?

14.

Casey is wrapping a present that is in a box with a length of 19 cm, a width of 15 cm and a height of 20 cm. If wrapping paper costs $0.04 per square cm, how much will she spend on wrapping paper?

15.

The volume of a rectangular prism is 112 cubic inches. The prism has a height of 7 inches and a width of 8 inches. Find the surface area of this prism.

16.

Apple is deciding which box to use for their new iPad. The first box measures 8 in by 6.25 in by 10.5 in. The second box measures 9 in by 5.5 in by 11.75 in. Which box would require more material to make?

17.

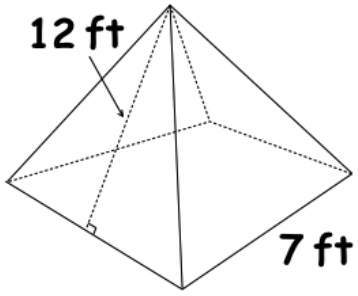
Ashley is baking a rectangular cake that is 9 in wide, 13 in long and 2 in high. She removes the cake from the pan to frost it. How many square inches of frosting does she need?

She does not frost the bottom!

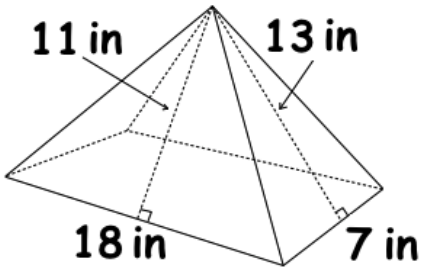
18.

Your school gym is 45 ft long, 30 ft wide, and 14 ft high. They are going to paint the four walls and the ceiling of the gym. If one gallon of paint costs $12.50 and can cover 300 ft^2, how much will it cost your school to paint?

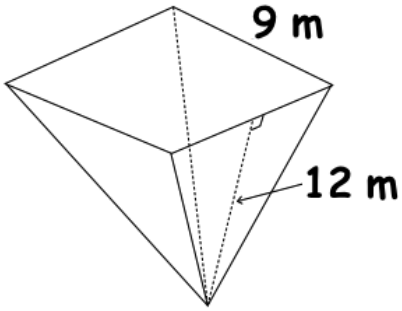
1. Find the surface area.



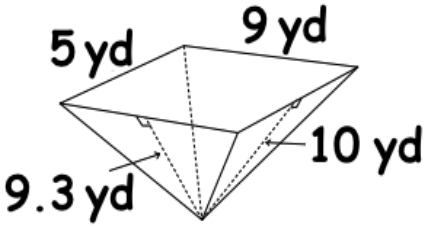
2. Find the surface area.



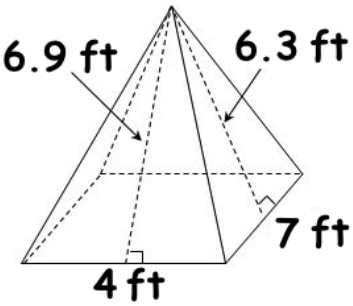
3. Find the surface area.



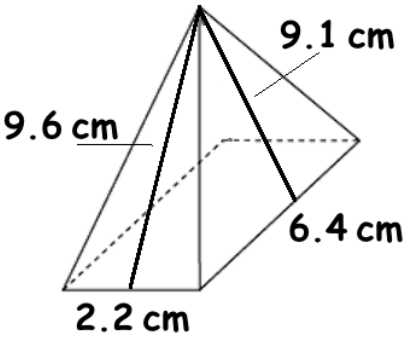
4. Find the surface area.



5. Find the surface area.



6. Find the surface area.



7. Find the surface area of the real-life pyramid:

Pyramid of Caius Cestius in Rome
Side of base ≈ 22 m
Slant Height ≈ 29 m

8. Find the surface area of the real-life pyramid:

Muttart Conservatory in Edmonton
Side of base ≈ 26 m
Slant Height ≈ 27 m

9. Find the surface area of the real-life pyramid:

Cheops Pyramid in Egypt
Side of base ≈ 230 m
Slant Height ≈ 186 m

10. Find the surface area of the real-life pyramid:

Luxor Hotel in Las Vegas
Side of base ≈ 600 ft.
Slant Height ≈ 461 ft.

11. Find the surface area of the real-life pyramid:

The Pyramid of the Sun in Mexico
Side of base ≈ 223.5 m
Slant Height ≈ 132.5 m

12. Find the surface area of the real-life pyramid:

Louvre Pyramid in Paris
Side of base ≈ 35 m
Slant Height ≈ 28 m

PROBLEM SOLVING WITH VOLUME AND SURFACE AREA

Directions:

(1) Choose & write whether the problem is asking you to find SURFACE AREA or VOLUME
(2) Write the formula (if needed) which you would use to solve the problem.
(3) Do STEPS 1 & 2 for all problems before you start solving so we can make sure everyone has the correct formulas to start ☺
(4) Solve
(5) Label your answer with the correct units

1. Elena wants to paint her jewelry box blue. The jewelry box is in the shape of a cube and has an edge length of 4 in. How much blue paint will Elena need?

2. Nicholas has a pepper shaker in the shape of a cylinder. It has a radius of 9 mm and a height of 32 mm. How much pepper will fit in the shaker?

3. Reynaldo builds a pool in his backyard. The pool measures 55 feet long, 28 feet wide, and 9 feet deep. How much water will fit in the pool?

4. How many square feet of cardboard does Jessica need to make a rectangular prism with length of 16 inches, width of 9 inches, and height of 4 inches?

5. How much gift wrap is needed to cover a box which measures 3 feet by 2 feet by 3 feet?

6. A package shaped like a cube has an edge that is 28 cm long. How much space is available to pack inside the box?

7. A cylindrical fish tank is 1 foot tall. The radius of the fish tank is 5 inches. How much water does it take to fill the tank? (Be careful – look at the units you are given)

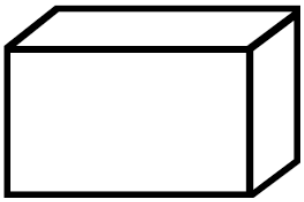
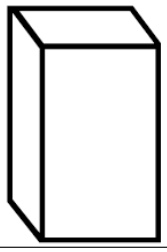
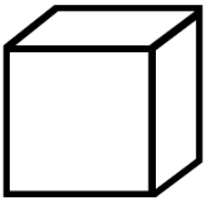
8. Kissie needs to paint the ***top and sides*** of a rectangular prism. The prism has a length of 25 mm, a width of 15 mm, and a height of 9 mm. How much paint does she need to cover the ***top and sides***?

9. Brittany is going to cover the label on a Pringle's can and decorate it for Easter. The can has a diameter of 4.5 in. and a height of 14 in. She only needs to cover the label, not the top or bottom of the can, what is the minimum amount of paper needed?

10. A cereal company decided to make an odd-shaped box for a promotion they are doing. The new design is a rectangular prism with length of 10 in, width of 8 in., and height of 4 in. and attached to the rectangular prism is a cylinder with a radius of 2 in. and a height of 10 in. How much cereal will fit in the box?

Application of Surface Area and Volume Homework

Margo and her mom have developed the world's best chocolate chip cookie dough recipe. They are ready to start selling their yummy creation, but they are struggling to find the best way to package it for shipping. Their options for different sized cartons are below.

Option	Length	Width	Height	How much does it hold?	How much label is needed?
1 	8 in	3 in	3 in		
2 	3 in	4 in	6 in		
3 	4 in	4 in	4 in		

1. Which option holds the most cookie dough inside? Is this surface area or volume?

2. Which option would use the least amount of label, assuming they covered the entire outside of the carton with a label? Is this surface area or volume?

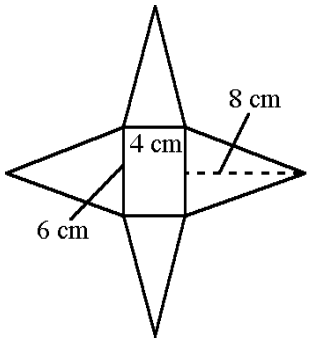
3. Which carton would you use? Justify your answer.

Unit 12 STUDY GUIDE

Multiple Choice
Identify the choice that best completes the statement or answers the question.

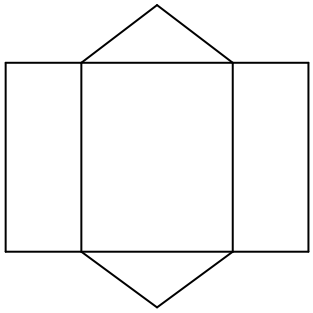
Name the space figure you can form from the net.

____ 1.



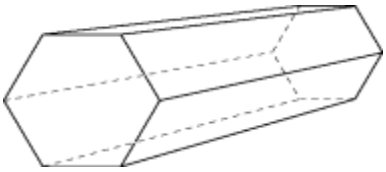
a. rectangular pyramid
b. square pyramid
c. rectangular prism
d. triangular prism

____ 2.



a. rectangular pyramid
b. triangular prism
c. rectangular prism
d. triangular pyramid

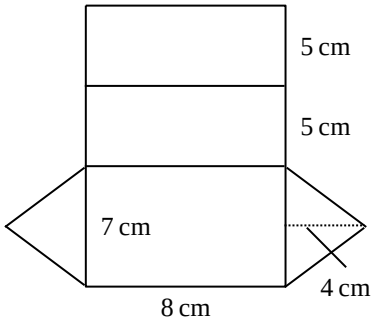
____ 3. Name the solid figure represented by the object.



a. Hexagonal pyramid
b. Pentagonal pyramid
c. Pentagonal prism
d. Hexagonal prism

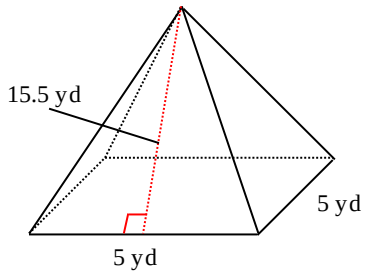
Find the surface area of the space figure represented by the net.

____ 4.



a. 124 cm^2 b. 110 cm^2 c. 150 cm^2 d. 164 cm^2

____ 5. Find the surface area of the pyramid to the nearest hundredth.

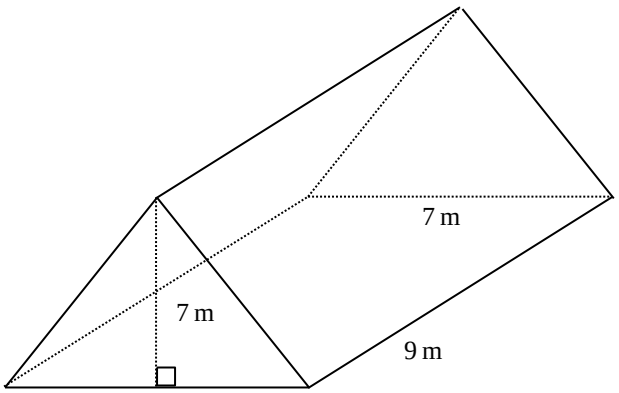


a. 77.7 yd^2
b. 155 yd^2
c. 3,875 yd^2
d. 180 yd^2

____ 6. Find the surface area of a rectangular prism that is 16 inches long, 12 inches wide, and 5 inches high.

a. 960 $in.^2$ b. 689 $in.^2$ c. 714 $in.^2$ d. 664 $in.^2$

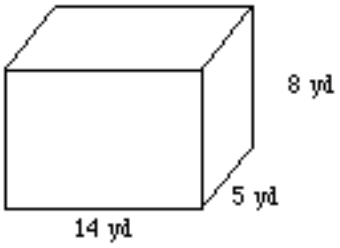
____ 7. Find the volume of the triangular prism.



a. 24.5 m^3 b. 441 m^3 c. 31.5 m^3 d. 220.5 m^3

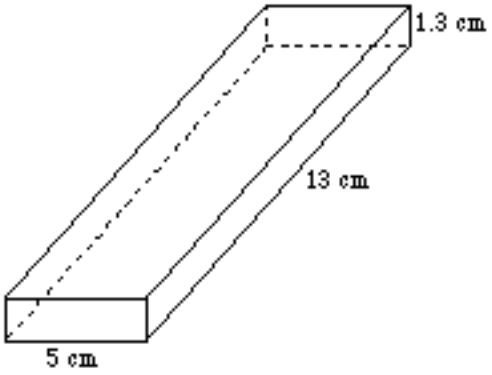
Find the volume of the rectangular prism.

____ 8.



a. 108 yd^3 b. 540 yd^3 c. 560 yd^3 d. 444 yd^3

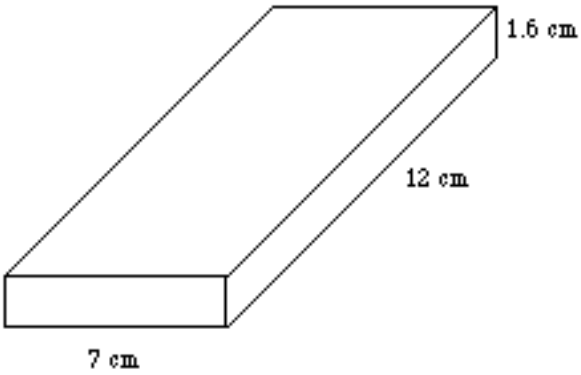
____ 9.



a. 77.2 cm^3 b. 81.9 cm^3 c. 88.4 cm^3 d. 84.5 cm^3

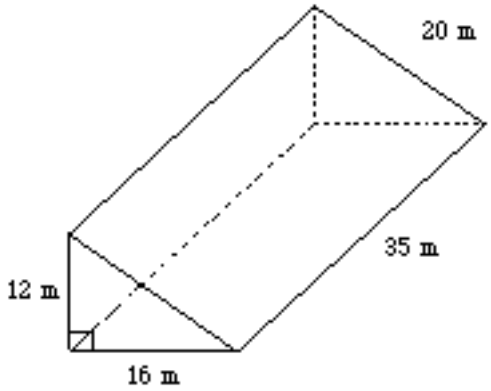
Find the surface area of the prism.

____ 10.



a. 228.8 cm^2 b. 114.4 cm^2 c. 206.4 cm^2 d. 190.4 cm^2

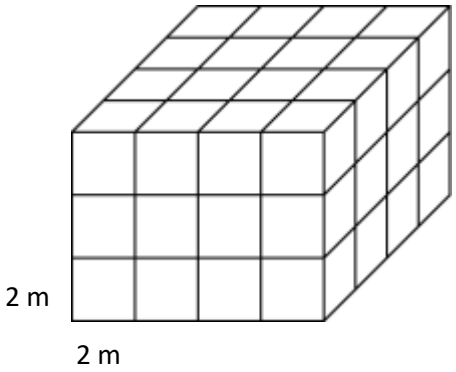
____ 11. Find the surface area.



a. 6,720 m^2 b. 1,662 m^2 c. 1,872 m^2 d. 3,360 m^2

Short Answer

____ 12. Determine the surface area of the rectangular prism. The prism is made up of congruent cubes, each measuring 2 m x 2 m x 2 m. **Hint: Each block is NOT 1 m x 1 m x 1 m!**



13. Michelle wants to make a packing box from some cardboard she has. She wants the box to be a rectangular prism with dimensions 10 in x 12 in x 8 in. Draw a possible net and label dimensions for the packing box and find the total Surface Area.

14. A rectangular prism has a Volume of 24 in^3. Name two different sets of possible dimensions for this rectangular prism.

V=_____ x _____ x _____

V=_____ x _____ x _____

15. Megan has a large packing box shaped as a cube with a volume of 216 cubic feet.

a. What is the side length for the cubical box? Explain how you find the length.

b. Megan would like to design a box that is a rectangular prism, but not a cube. What are a possible length, width, and height that she could use if she wants this box to have the same volume as the cube? Explain how you find the dimensions.

16. A rectangular prism has dimensions of $\mathbf{3\frac{1}{2} \times 4 \times 3\frac{1}{2}}$

What is the volume of the rectangular prism? Show your work without a calculator!