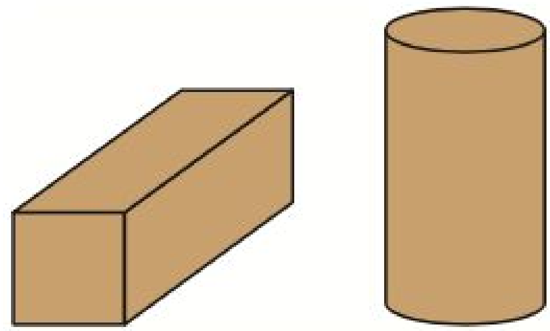
IM2 Problem Set 1.12 - Further Explorations of 3D Shapes

BIG PICTURE of this UNIT:	• mastery with linear algebraic skills to be used in our work with coordinate geometry (midpoint, length, slope) • understanding various geometric properties of quadrilaterals, triangles & circles • how do you really "prove" that something is "true"? • introduction to working with 3D shapes

Part 1 – EXPLORATION



Diane showed Michael and Katie two packages, one a square-based prism and one a cylinder. Each package had a volume of 1331 cm^3 and a surface area of 728 cm^2.

• Michael wanted one of each type with the same volume and least possible surface area.

• Katie wanted one of each type with the same surface area and greatest possible volume.

	Diane's Packages		Michael's Packages		Katie's Packages	
	Cylinder	Square-Based Prism	Cylinder	Square-Based Prism	Cylinder	Square-Based Prism
Volume	1331 cm^3	1331 cm^3	1331 cm^3	1331 cm^3	greatest volume	greatest volume
Surface Area	728 cm^2	728 cm^2	least surface area	least surface area	728 cm^2	728 cm^2

INVESTIGATION QUESTION: How can Michael and Katie determine the optimum dimensions for their packages?

PART A: Complete the table, showing possible dimensions for five to ten square-based prisms with a volume of 1331 cm^3.

Prism	Volume (cm^3)	Base Side Length (cm)	Height (cm)	Surface Area (cm^2)
1	1331			
2	1331			

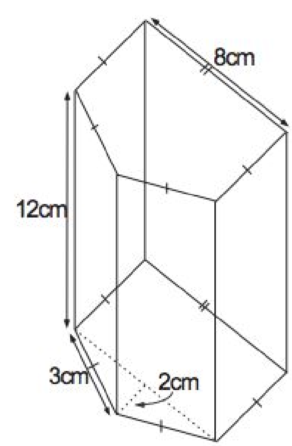
PART B: Graph the relationship between base side length and surface area. Use the base side length as the independent variable.

PART C: Repeat parts A and B for cylinders. This time, graph the relationship between the surface area and radius of the base using the radius as an independent variable.

PART D: Use strategies like those in parts A and C to investigate what happens when the surface area remains at 728 cm^2 and the volume changes.

Part 2 – NEW Skills & PRACTICE

1. Forty-two cubes with 2 cm edges are glued together to form a rectangular prism. If the area of the base of the prism is 24 cm and the width of the base is greater than 2 cm, what is the height of the prism?



2. Daisy bought herself a vase to fill with potpourri for Christmas. If the vase has the dimensions as shown, how much potpourri will she need to fill the vase up to the top?

3. Find the smallest cylinder than can fit a cube of 1000 m^3.

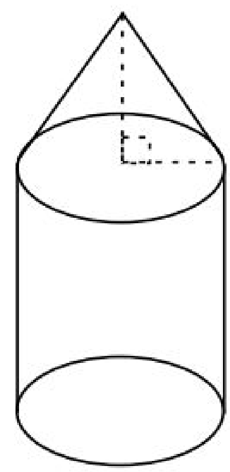
4. A business downtown keeps erasers in boxes with dimensions 24 cm x 28 cm x 13 cm. The erasers have dimensions 2 cm x 4 cm x 1 cm. One of the boxes is half full with erasers.

    a. How much room is left in the box to put more erasers?
    b. How many erasers can fit into the empty half of the box?

5. Calculate the amount of metal needed to make 8 cylindrical cans with a diameter of 6 cm and a height of 16 cm.

6. Dean is building a swimming pool in his backyard. The swimming pool will be 18 m long, 24 m wide, and 4.5 m deep. The pool is going to be tiled, with a tile size if 1 m^2 , and it will cost 15 cents per square meter.

    a. What will it cost to tile the pool?
    b. How much water can the pool hold?



7. A small water bottle can hold 389.36 ml of water. Assuming for simplicity, the shape of a typical water bottle is a cylinder with a cone on top, as shown, with a radius of 5 cm. If the total height of the bottle is 6.37 cm, and the height of the cone is half the height of the cylinder, what is the height of the cylinder, and what is the height of the cone?

8. A new tablet is formed through attaching two hemispheres to the ends of a cylinder with a height of 610 mm and radius r. If the volume of the tablet is equal to the volume of a cone of height 189 cm and radius r, find the value of r in mm.