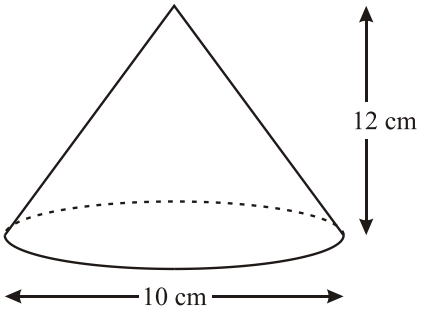
BIG PICTURE of this Unit

- How can we extend our algebra skills to interchange between standard and factored form of polynomial equations? (i.e. synthetic division, factoring)
- Can we use our new polynomial algebra skills in order to find a method for solving EVERY polynomial equation (especially those that don't factor?)
- How can use the equation of a polynomial to analyze for key features of a graph of a polynomial (i.e. end behavior, multiplicity of roots, optimal points, intervals of increase/decrease).
- When and how can polynomial functions be used to model real world scenarios?

1. The following application questions are based upon three dimensional geometry (hence the interest in working with cubic functions) ➔ volumes and surface areas of 3D solids. You will go online to find the following six formulas: {17}
   i. Volume and surface area of a sphere
   ii. Volume and surface area of a cylinder
   iii. Volume and surface area of a cone

(i) The diagram represents a cone. The height of the cone is 12 cm. The diameter of the base of the cone is 10 cm.

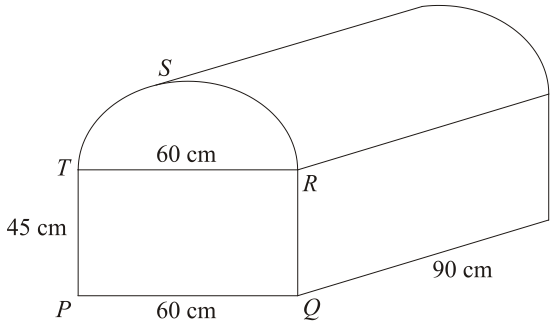
Calculate the curved surface area as well as the volume of the cone. Give your answer as a multiple of π.



(ii) The diagram shows a prism of length 90 cm. The cross section, PQRST, of the prism is a semi-circle above a rectangle. PQRT is a rectangle. RST is a semi-circle with diameter RT.

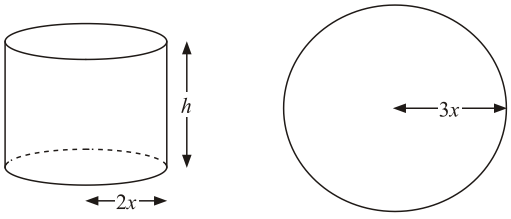
PQ = RT = 60 cm. PT = QR = 45 cm.

Calculate the surface area and the volume of the prism. Give your answer correct to 3 significant figures.



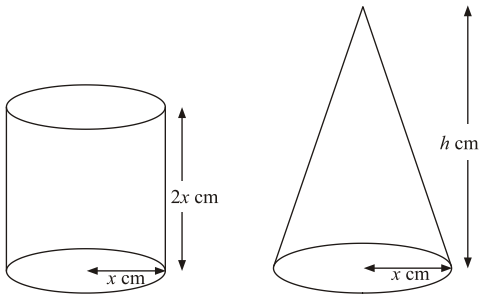
(iii) The diagram shows a cylinder and a sphere. The radius of the base of the cylinder is 2x cm and the height of the cylinder is h cm. The radius of the sphere is 3x cm. The volume of the cylinder is equal to the volume of the sphere.

Express h in terms of x. Give your answer in its simplest form.



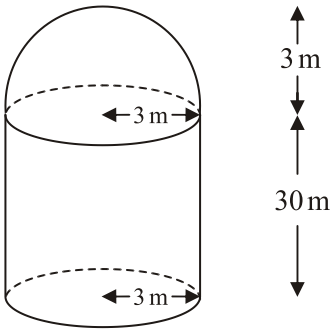
(iv) A cylinder has base radius x cm and height 2x cm. A cone has base radius x cm and height h cm. The volume of the cylinder and the volume of the cone are equal.

Find h in terms of x. Give your answer in its simplest form.



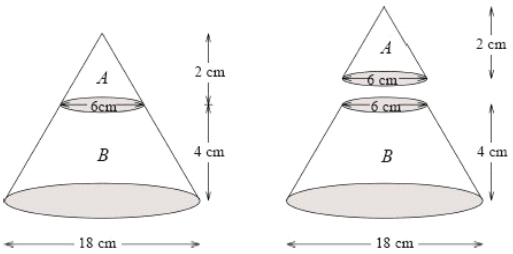
(v) The diagram shows a storage tank. The storage tank consists of a hemisphere on top of a cylinder. The height of the cylinder is 30 metres. The radius of the cylinder is 3 metres. The radius of the hemisphere is 3 metres.

Calculate the total volume of the storage tank. Give your answer correct to 3 significant figures.



(vi) The diagram represents a large cone of height 6 cm and base diameter 18 cm. The large cone is made by placing a small cone A of height 2 cm and base diameter 6 cm on top of a frustum B.

Calculate the volume of the frustum B. Give your answer in terms of π.



15 A soft drink manufacturer is looking to repackage cans of soft drink to minimise the cost of packaging while keeping the volume constant.

Consider a can of soft drink with a capacity of 400 mL.

a If the soft drink was packaged in a spherical can:

- **i** find the radius of the sphere
- **ii** find the total surface area of this can.

b If the soft drink was packaged in a cylindrical can with a radius of 3 cm:

- **i** find the height of the cylinder
- **ii** find the total surface area of this can.

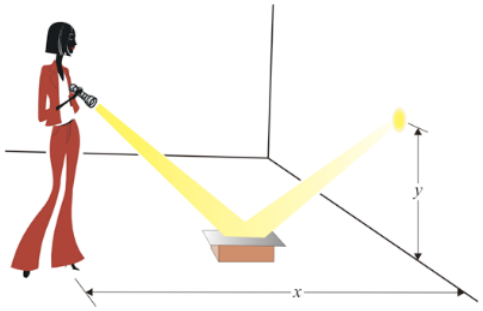
c If the soft drink was packaged in a square-based pyramid with a base side length of 6 cm:

- **i** find the height of the pyramid
- **ii** find the total surface area of this can.

d Which can would you recommend the soft drink manufacturer use for its repackaging? Why?

2. For this experiment, you will need: {4,7,8}

   - Laser pointer (or a small flashlight)
   - Small, flat mirror
   - Tape measures (2)
   - Wooden block, about 10 cm tall (or a thick book)
   - Tape
   - Graphing calculator (optional)



a. Tape one of the tape measures to the wall, beginning at floor level. Place the other tape measure along the floor to measure the distance from the wall to the flashlight. Place the block 25 cm from the wall. Place the mirror on top of the block. Stand on the side of the mirror opposite the wall. Aim the laser pointer toward the center of the mirror so that its image is reflected onto the tape measure attached to the wall. (See figure above.)

b. It is very important that you hold the laser pointer (or flashlight) at the same height throughout the experiment. Let x represent the distance from the wall to the laser pointer. Let y represent the distance that the reflection appears up the wall. Measure both x and y in centimeters.

   i. What is the distance from the wall to the center of the mirror? _____

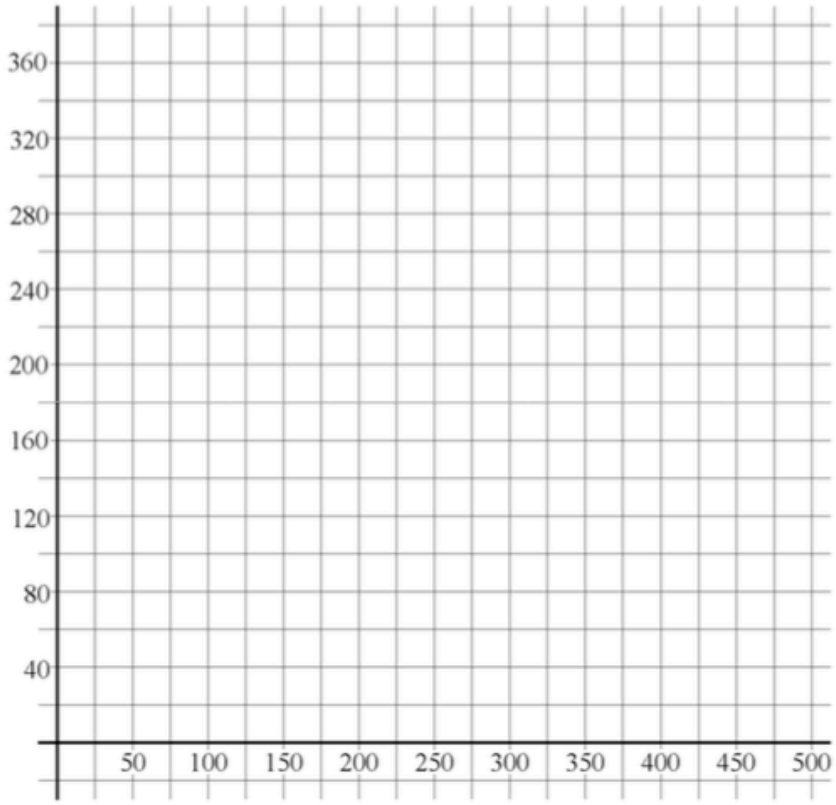
   ii. What is the distance from the laser pointer to the floor? _____

   iii. What is the distance from the floor to the mirror? _____

c. Collect at least eight data points and enter them in the table below.

DISTANCE FROM THE WALL TO THE LASER POINTER (x)								
DISTANCE FROM THE FLOOR TO THE REFLECTION (y)								

d. Sketch a graph of your data using the grid below.



e. Use the information in parts (a) and (b) to determine the values of b and c in the equation $y = \frac{a}{x-b} + c$

$b =$ _____ $c =$ _____

f. Use your graph from (d) and the information from (e) to determine an equation for your graph.

Equation: _____

g. If the information in parts (a) and (b) is also true for Bart and Lisa's situation, determine the distance that they should stand from the wall if the target is . . .

i. 1 meter from the floor. _____
ii. 3 meters from the floor. _____
iii. 10 meters from the floor. _____