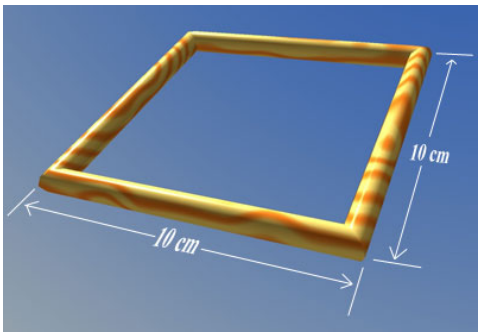
AIMSSEC

AFRICAN INSTITUTE FOR MATHEMATICAL SCIENCES
SCHOOLS ENRICHMENT CENTRE
TEACHER NETWORK

WOODWORK



This stand is made from cylindrical wooden dowel of diameter 1 cm joined at the corners with 45 degree mitres.

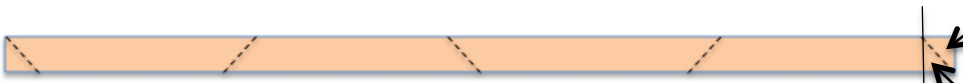
The external dimensions of the stand are 10 cm by 10 cm. What are the volume and surface area of the stand?

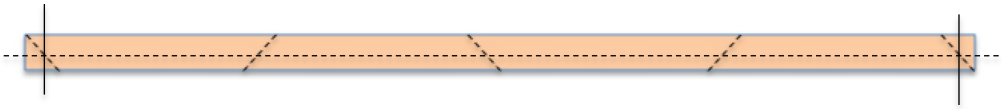
The sketch below shows how I marked out the dowel before cutting it. What length of dowel do I need to make this stand?

Find a formula linking the volume, radius and external edge measurement of the stand.

SOLUTION

The two small bits cut off the end are wasted. The stand is made from 4 pieces measuring 10cm on the longest edge and 8 cm on the shortest edge.





Volume = $\pi(\frac{1}{2})^2 \times 36 = 9\pi$ cm^3.

Surface area = $2\pi\ (\frac{1}{2}) \times 36 = 36\pi$ cm^2.

The formula linking the volume V, radius r, and external edge measurement l is:
$V = \pi r^2(4l - 8r) = 4\pi r^2(l - 2r)$

In cutting wood there is always a small wastage in sawdust. Corners have to be cut very accurately to make mitre joints. The sketch shows a length of dowel of 37 cm. But to allow for the wastage in sawdust, and the need for accurate cutting, I would start with a length of 40 cm at least. In practice I would probably start by cutting 4 cylindrical lengths of 11 cm with straight cuts and then make the 45^o cuts for the mitres after that.

NOTES FOR TEACHERS

Why do this activity?

This activity provides a practical context for finding the volume of a cylinder and for visualising the assembly of a wooden construction.

Intended learning outcomes

Practice in finding volume and surface area.

Possible approach

Print worksheets from the top part of page 1 or write this problem on the board. To give learners practice in reading and extracting information from written questions for themselves do not read the question for them at the start of the lesson or tell the learners how to proceed. Simply ask learners to work in pairs to solve the problem.

If some learners are stuck give them two cardboard wrapping paper tubes or toilet paper holders that you have cut at the ends so that they fit together with a 45 degree mitre joint. The learners can then place them end to end in a line and rotate them so that they fit together at 90° to each other. These can be handed round the class.

If some learners finish ahead of the others give them the extension question below.

In the plenary ask pairs of learners to explain their working at the board. One learner can draw the diagram while the other learner explains the calculations. Then discuss the practicalities of doing the woodwork.

Finally discuss the formula.

Key questions

If the outside measurements of the frame are a 10 cm by 10 cm square what are the inside measurements? Why?
If you cut the 4 lengths as shown in the sketch how would you make them into the frame?

Possible extension

If I doubled the volume of wood used but did not change the radius of the dowel - what would the outside dimension of the stand be?

$V = 4\pi r^2(l - 2r)$ gives $18\pi = 4\pi(½)^2(l - 1)$
so $l = 19$ cm.

If, instead, I doubled the radius of the dowel but kept the same volume of wood, what would the outside dimension of the stand be then?

$V = 4\pi r^2(l - 2r)$ gives $9\pi = 4\pi(1)^2(l - 2)$
So $l = 17/4 = 4.25$ cm

Possible support

Two pieces of dowel placed end-to-end and rotated should reveal a "neat" fit. Some cardboard wrapping paper tubes or toilet paper holders can be very useful in illustrating this point.