

PYRAMIDS IN A CUBE

To make a model showing how cubes are made up of three square based pyramids, you will need a cardboard box, some string, some colouring pens and scissors or a knife to cut the box.

From one corner of a box cut squares all exactly the same size to form 3 faces of a cube, and colour the squares as in A.

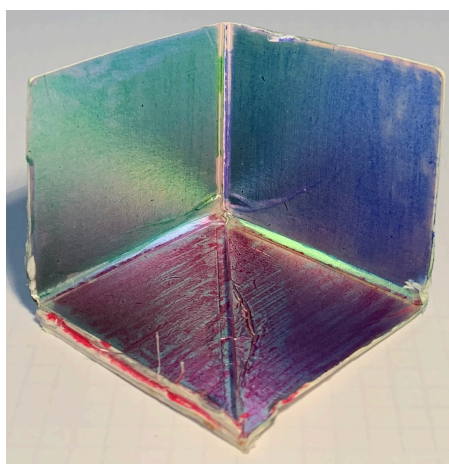
Repeat this and the two pieces together make a cube.

Use one of these pieces and imagine 3 square based pyramids as shown in 3 different colours in C, D and E. These pyramids fit together to form the cube.

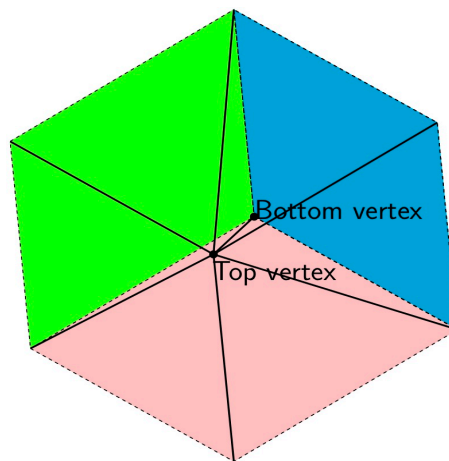
The 7 black lines in B represent strings joining the top vertex to the other 7 vertices of the cube. If the strings are the right lengths they form the sloping edges of the 3 square based pyramids.

Imagine you are looking down on the cube from above. You will see that you can hang the model so that the 3 card faces are at the bottom.

If you need help to find the correct lengths for the strings see <https://aiminghigh.aimssec.ac.za/grades-8-to-12-cuboids-and-roots>

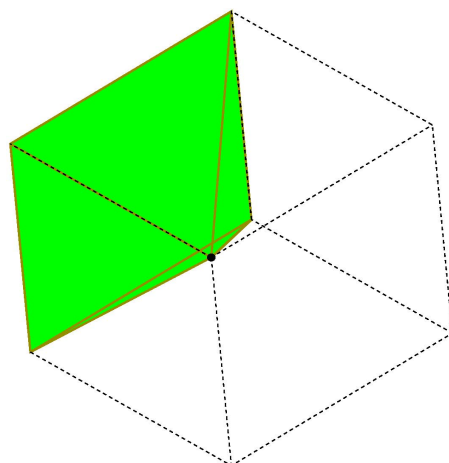


A

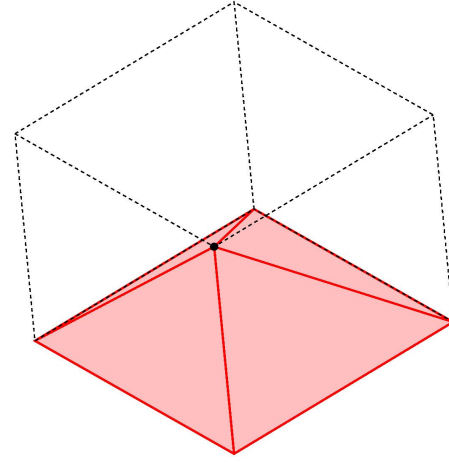


B

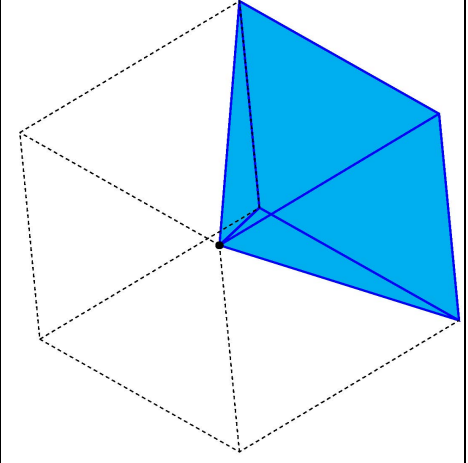
The easiest way to complete the model so that you can hang it up is to make the strings longer than needed, to attach the strings to the card, then to measure and mark the point for the top vertex on each string and bind the strings together at that point. Either use selotape to attach the string to the card or make small holes in the card, poke the string through the holes and tie knots at the ends.



C



D



E

SOLUTION

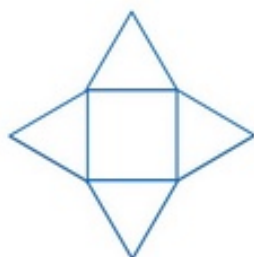
If the edges of the cube are length l cm then you need 3 strings of length l cm, 3 strings of length $l\sqrt{2}$ cm and one string of length $l\sqrt{3}$ cm.

NOTES FOR TEACHERS

Diagnostic Assessment This should take about 5–10 minutes.

1. Write the question on the board, say to the class:
“Put up 1 finger if you think the answer is A, 2 fingers for B, 3 fingers for C and 4 fingers for D”.
2. Notice how the learners responded. Ask a learner who gave answer A to explain why he or she gave that answer and DO NOT say whether it is right or wrong but simply thank the learner for giving the answer.
3. Then do the same for answers B, C and D. Try to make sure that learners listen to these reasons and try to decide if their own answer was right or wrong.
4. Ask the class again to vote for the right answer by putting up 1, 2, 3 or 4 fingers. Notice if there is a change and who gave right and wrong answers. It is important for learners to explain the reason for their answer otherwise many learners will just make a guess.
5. If the concept is needed for the lesson to follow, explain the right answer or give a remedial task.

The following diagram shows the net of a 3D shape. How many edges does it have?



- A 12
B 8
C 4
D 5

B. is the correct answer.

Common Misconceptions

- A. Learners may have counted 12 edges not understanding that 4 pairs of edges join to form single edges.
C. Probably a guess.
D. Learners could be counting the faces instead of edges.

<https://diagnosticquestions.com>

Why do this activity?

This practical activity uses boxes that would otherwise get thrown away. Making models, handling the models, and viewing them from different angles helps learners to visualise objects in 3D.

Intended learning outcomes

- For students to learn that a cube can be cut into 3 congruent square based pyramids and to be able to visualise how the pyramids fit together.
- For students to experience using Pythagoras theorem in 3D for right angled triangles that are not in the same plane.
- For students to recognise 3-fold rotational symmetry in 3D.

Suggestions for teaching

The diagnostic quiz introduces the topic of square based pyramids and it will remind the students of the basic facts.

Tell the students that they are going to make models to showing how cubes are made up of three square based pyramids and they will use string as well as card so they can look inside the models to see the pyramids.

Students could be asked to bring boxes from home. If you ask them a few days in advance and they work in pairs to make the models you should have enough boxes. Ideally give each pair a copy of page 1 so that they have full instructions. You can go around and give guidance as needed.

Key questions

- Can you imagine fitting together the pyramids shown in diagrams C, D and E to make a cube?
- Show me the black lines (strings) in diagram B that are edges of the cube.
- Show me the black lines (strings) in diagram B that are diagonals of faces of the cube.
- Show me the black line (string) in diagram B that is the diagonal from one vertex of the cube to the opposite vertex.
- Can you see any right angled triangles that you could use to work out the lengths of the strings?

Possible extension

Students could work out the volume and surface area of the square based pyramid.

Possible support

The activity Cuboids and Roots provides a good introduction to this topic

<https://aiminghigh.aimssec.ac.za/grades-8-to-12-cuboids-and-roots>

Note: The Grades or School Years specified on the AIMING HIGH Website correspond to Grades 4 to 12 in South Africa and the USA, to Years 4 to 12 in the UK and up to Secondary 5 in East Africa.

Note: The mathematics taught in Year 13 (UK) and Secondary 6 (East Africa) is **not** included in the school curriculum for Grade 12 SA.

	Lower Primary or Foundation Phase Age 5 to 9	Upper Primary Age 9 to 11	Lower Secondary Age 11 to 14	Upper Secondary Age 15+
South Africa	Grades R and 1 to 3	Grades 4 to 6	Grades 7 to 9	Grades 10 to 12
USA	Kindergarten and G1 to 3	Grades 4 to 6	Grades 7 to 9	Grades 10 to 12
UK	Reception and Years 1 to 3	Years 4 to 6	Years 7 to 9	Years 10 to 13
East Africa	Nursery and Primary 1 to 3	Primary 4 to 6	Secondary 1 to 3	Secondary 4 to 6