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2019 General Mathematics

Year 11 Problem Solving Task

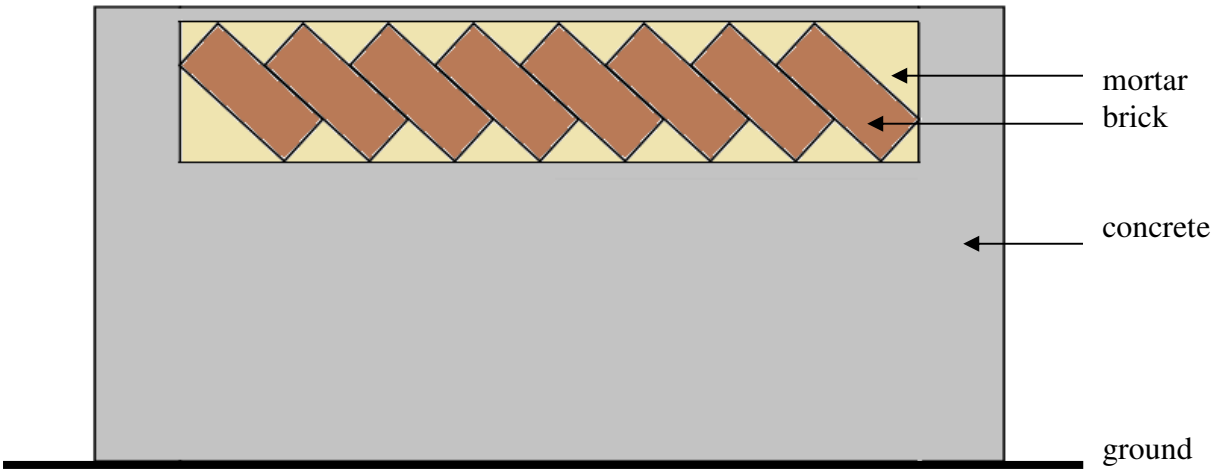
(Time allowed: 75 minutes plus)

2019 General Mathematics Assessment Task (75-90 minutes)

Problem Solving Task
Measurements and similarity
Assumed knowledge: Length, area and volume of regular shapes/solids, similar 2D and 3D shapes/solids

Problem 1 Building walls

The following diagram shows the front view of a rectangular wall to be built.
The rectangular wall is 1.00 m in length, 102.5 **mm** in depth and 0.50 m in height.
Each brick is 215 mm in length, 102.5 mm in depth and 65 mm in height. The diagram shows only the length and the height.
The bricks are sloping at $45°$ angle with the horizontal.



a. Explain why the triangles in the diagram are similar.

b. There are three different size triangles in the diagram. For each size, find the length of the shortest side.

Largest triangle:

Medium size:

Smallest triangle:

c. Find the length and height of the rectangular region filled with mortar and bricks.

d. Find the total volume of bricks used in building the wall.

e. Find the total volume of mortar used in building the wall.

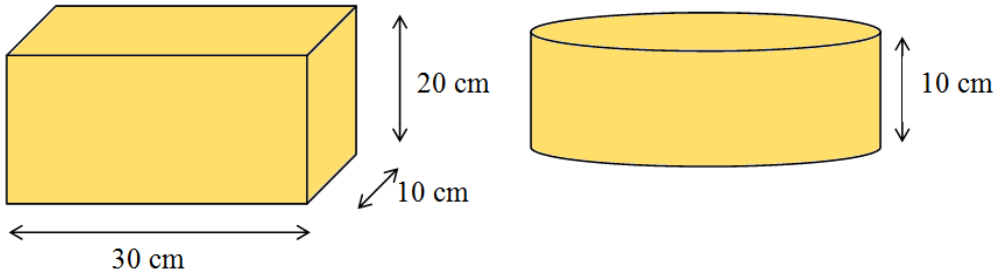
f. Find the total volume of concrete used in building the wall above the ground.

The builder wants to build a similar looking wall of the same depth but double in length, height and number of bricks in the same row.

g. Determine the **extra** volume of concrete above the ground required to build the wall.

Problem 2 Cutting cakes

The following diagrams show a rectangular cake and a cylindrical cake. **The cakes have the same volume**.



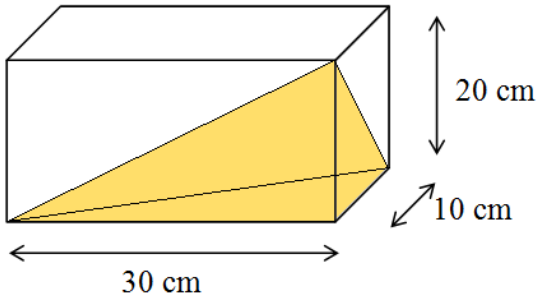
a. Calculate the radius of the cylindrical cake. Write your answer in exact form and as an approximation correct to 2 decimal places.

b. The cylindrical cake is divided into six pieces of equal volume using vertical cuts through the centre of the cake. Determine the total surface area of a piece.

c. A **similar** rectangular cake is made. Its volume is 1.331 times the volume of the rectangular cake shown in the above diagram. Calculate the dimensions of the larger cake. Correct your answers to 2 decimal places.

d. A **similar** cylindrical cake is made. Its volume is a half of the volume of the cylindrical cake shown in the above diagram. Calculate the height and radius of this smaller cake. Correct your answers to 2 decimal places.

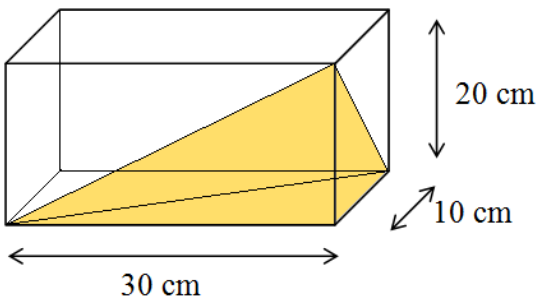
A piece of the first rectangular cake is cut from the top corner to the bottom two corners as shown below.

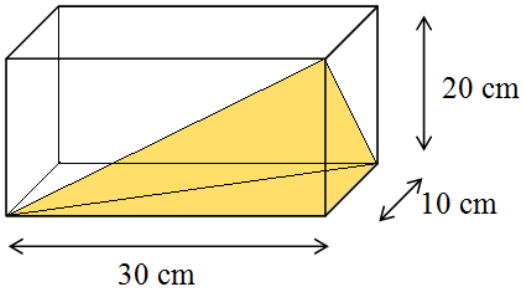


e. Determine the value of the following volume ratio.

$$\frac{\text{volume of the cutout piece}}{\text{volume of the remaining larger piece}}$$

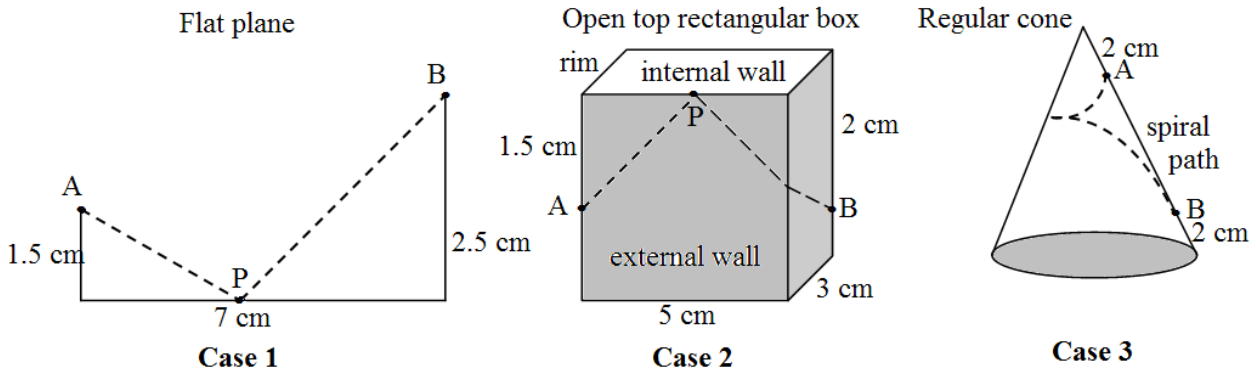
f. The shaded piece is removed. Another piece of cake exactly the same shape and volume can be cut from the remaining larger piece. Show two different ways to do it by drawing lines on each diagram below.





Problem 3 Longest and shortest paths

Three different paths (dotted) from point A to point B are shown below.
The diagrams are not drawn to scale.
Express each answer either in exact form or as an approximation correct to 2 decimal places.



Specifications:

In the first diagram (Flat plane), point P is a variable point along the 7 cm straight line.
The perpendicular distance from point A to the 7 cm straight line is 1.5 cm, and from point B it is 2.5 cm.

For the box, point A is on the external wall corner and point B is on the internal wall corner of the box.
The dotted path goes over the rim. Point P is a variable point on the rim.

The cone is made from a sector cut out of a circular (radius 10 cm) piece of paper.
The sector is a quarter of the circular piece of paper. It is joined at the two straight edges to form the cone.
Point A is 2 cm from the vertex and point B is 2 cm from the bottom along the straight edge.
The dotted path is on the external curved surface of the cone.

a. Find the **longest** path (length of the dotted path) possible in each of the above cases if the dotted path always heads forward from point A to point B.

Case 1.

Case 2.

Case 3.

b. Find the **shortest** path (length of the dotted path) possible from point A to point B in each of the above cases.

Case 1.

Case 2.

Case 3.

c. In Case 1 find the length of line AP for the shortest path.

d. In case 2 find the length of line AP for the shortest path.

End of task