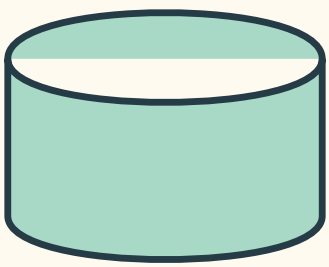
MATHS FIELD GUIDE · GRADE 10

Exposed area and material cost

OPENING PROBLEM

Only the curved outside receives paint at ₹2 per square unit. What does it cost?



r = 3, h = 4

02 Sketch the join before choosing add or subtract
03 Rules and worked cases
04 From the givens to the answer
05 Count only the exposed surfaces
06 Check your reasoning
07 Check your reasoning

ILLUSTRATED PROBLEM SHEET

Sketch the join before choosing add or subtract

Volume follows the material present. Surface area follows the boundary exposed.

1

Cylinder r = 3, h = 4
↓
Hemisphere r = 3
↓
36π + 18π

A dome sits on the cylinder. Find the combined volume.

54π cubic units. The solids share a face and have no overlapping volume.

2

Same cylinder and dome
↓
Wall 24π + dome 18π
↓
Base 9π

Find the external area including the bottom.

51π square units. The matching top and bottom disks at the join are hidden.

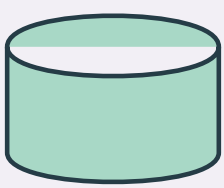
3

Cylinder r = 3, h = 6
↓
Matching cone removed
↓
54π − 18π

How much material remains after drilling the cone?

36π cubic units. A void subtracts volume.

4



r = 3, h = 4

Only the curved outside receives paint at ₹2 per square unit. What does it cost?

The wall is 24π square units. Cost is ₹48π.

Hollow out a cavity
material volume decreases.

An accessible cavity
exposed surface area may increase.

CHAPTER PROBLEM

A cylinder radius 3,height 5, has a hemisphere radius 3 on top and its bottom exposed. Write area as cπ. Find c.

57. Cylinder wall 6hπ, hemisphere 18π, bottom 9π.

MATHS REFERENCE · GRADE 10

Exposed area and material cost

Rules, conditions and worked cases

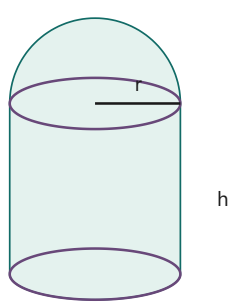
Recognise the case	Mathematical reasoning
Count exposed faces	Join two cubes of side 2 face to face. Their 48 total square units lose two shared faces of 4, leaving 40.
Curved cap on a cylinder	Count the cylinder wall, lower disk and hemisphere's curved surface. Exclude the joined disk.
Cost	Convert to the quoted unit first. At ₹12 per m², 25,000 cm² = 2.5 m² costs ₹30.

Read the representations

Only exposed faces contribute to the outside area

Joining solids hides faces. For a cylinder with a cone on top, add both curved surfaces and the exposed bottom disk; omit the circular join.

For a cylinder plus hemisphere, the same circular join is internal. A surface inventory prevents counting a covered disk.



The circular join is internal, so omit it from outside area.

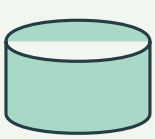
Area cost uses covering units

Multiply exposed area by cost per square unit, converting units first.

If a tin is open at one end, omit that disk. If both sides of a sheet are coated, count both only when the problem says so.

Cylinder radius r, height h

Object	Exposed area
Closed cylinder	$2\pi rh+2\pi r^2$
Open-top cylinder	$2\pi rh+\pi r^2$
Cylinder + hemisphere, base exposed	$2\pi rh+3\pi r^2$



r = 3, h = 5

Find the dimensions of its unrolled wall.

Height 5 and width 6π. The curved area is 30π square units.

WORKED EXAMPLES

From the givens to the answer

Paint a cylinder with a hemispherical top

1. Radius is 7 cm, cylindrical height 10 cm, and the bottom is exposed.
2. Curved cylinder=140π; hemisphere=98π; bottom=49π. Total=287π cm².
3. Using the specified approximation π≈22/7 gives area≈902 cm². At 2 per cm², cost≈1804.
4. The shared disk is omitted from both component inventories.

Price only the painted surface

An open cylindrical bin has radius 2 dm and height 5 dm. Paint its curved outside and the outside of its base at ₹3 per dm².

1. The curved surface is 20π dm² and the base adds 4π dm². The total price is ₹72π. There is no top disk in the area being painted.

Check another case

Example 1

An open-top cylinder has radius 2,height 9. Write area as cπ. Find c.

40

Wall 4hπ plus one disk 4π.

Example 2

Cylinder r=3,h=10 is topped by a cone r=3,slant=5. Bottom exposed. Write outside area as cπ. Find c.

84

Wall 6hπ, cone 15π and bottom 9π.



120°

A cone has base radius 3 and slant height 9. Why is the sector angle 120°?

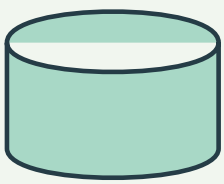
A full radius-9 circle has circumference 18π. The rim needs 6π, or one third of a turn.

ILLUSTRATED PROBLEM SHEET

Count only the exposed surfaces

List the parts before adding their areas. A joined face disappears inside the finished solid.

1

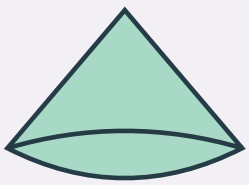


r = 2, h = 5

Which area is exposed on an open-top cylinder with a base?

Curved outside 20π plus base 4π gives 24π square units.

2



r = 3, l = 5

Find the curved area and the total area.

πrl = 15π. Add the circular base 9π for 24π square units.

3



r = 3

A solid hemisphere rests on its flat face. What is its curved area?

Half the full sphere's surface gives $2\pi r^2 = 18\pi$. Count another 9π only if the flat face is exposed.

4

Cylinder r = 2, h = 5

↓

Matching hemisphere on top

↓

20π + 8π + 4π

Find the area including the bottom.

32π square units. Count the cylinder wall, hemispherical dome and bottom. The joining disks are internal.

Remove a cylinder lid
subtract πr^2 from closed surface area.

Join two matching flat disks
subtract $2\pi r^2$ from the sum of exposed areas.

CHAPTER PROBLEM

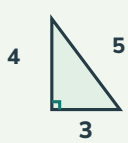
An open-top cylinder has radius 2,height 6. Write area as cπ. Find c.

28. Wall 4hπ plus one disk 4π.

QUESTION BANK · FOLD OR COVER THE RIGHT COLUMN

Check your reasoning

Try the problem	Solution and reasoning
01 If a hemisphere is detached from its matching cylinder, how much exposed area appears?	Two previously hidden circular faces appear. Together they add $2\pi r^2$.
02 If every length is tripled, must the painting cost triple at a fixed price per unit area?	Exposed area scales by nine, so the cost scales by nine.
03 Cylinder r=3,h=8 is topped by a cone r=3,slant=5. Bottom exposed. Write outside area as $c\pi$. Find c.	72 Wall $6h\pi$, cone 15π and bottom 9π.
04 Coating 9 m^2 costs 25 per m^2. Find the total cost.	225 Area times the unit rate.
05 Two solids join along a full circular face. How often is that face counted in the external area? A) Twice B) Once C) Zero times D) Only its circumference counts as area	Zero times The joined face is internal, not exposed.
06 Convert 4 m^2 into cm^2.	40000 Each length scale is 100, so area scale is 10,000.



A cone has radius 3 and vertical height 4. Which measure is the sector radius?

The slant height 5. It runs along the surface from tip to rim.

QUESTION BANK · FOLD OR COVER THE RIGHT COLUMN

Check your reasoning

Try the problem	Solution and reasoning
07 Derive the external area of a cylinder of radius r,height h topped by a matching hemisphere, with bottom exposed.	Cylinder curved area is $2\pi rh$. Hemisphere curved area is $2\pi r^2$ and bottom disk is πr^2. Total $2\pi rh+3\pi r^2$; omit the join.
08 Why can adding two total-surface-area formulae overcount a joined solid?	Each component total includes its joining face. Remove both copies of a shared face from that sum.
09 A cylinder radius 3,height 6, has a hemisphere radius 3 on top and its bottom exposed. Write area as cπ. Find c.	63 Cylinder wall 6hπ, hemisphere 18π, bottom 9π.
10 An open-top cylinder has radius 2,height 7. Write area as cπ. Find c.	32 Wall 4hπ plus one disk 4π.
11 A cylinder radius 3,height 8, has a hemisphere radius 3 on top and its bottom exposed. Write area as cπ. Find c.	75 Add the cylinder wall (48π), the curved hemisphere (18π) and the circular base (9π). The shared circular face is inside the solid. Total exposed area is 75π square units.

Curved area = π × 3 × 5
↓
Base area = 9π
↓
Total = 24π

What changes if the cone is open at the base?

Only the 15π curved surface remains.

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