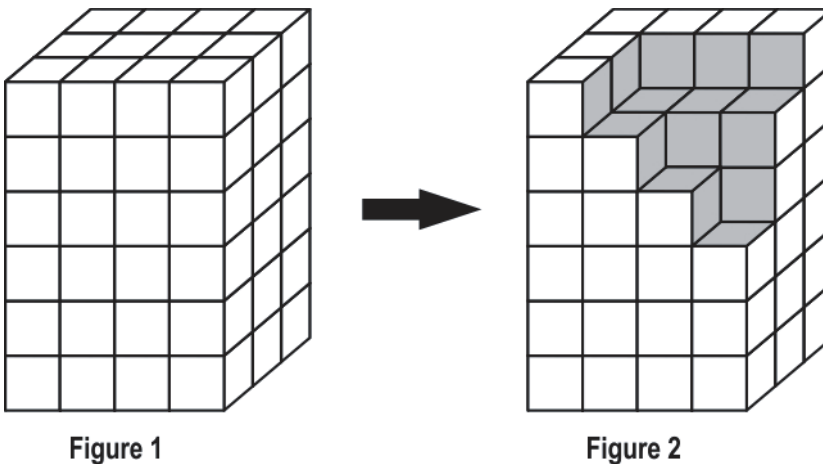# Chapter - 13
Surface Areas and Volumes

Q: 1 Figure 1 below is a solid cuboid made of unit cubes. Figure 2 is obtained after removing some unit cubes from figure 1.

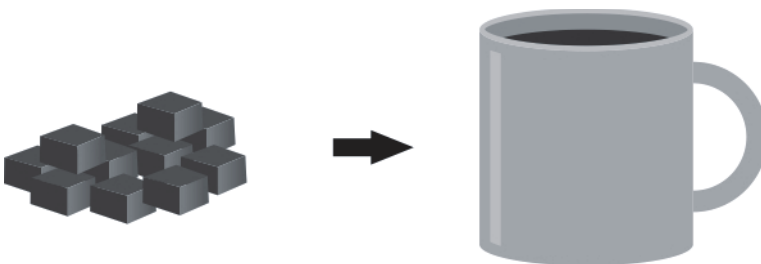Figure 1   Figure 2

(Note: The figures are not to scale.)

Based on the figures shown above, the surface area of the cuboid in Figure 1 is _____ the surface area of the solid in Figure 2.

1 less than
2 more than
3 equal to
4 (cannot be concluded with the given information)

Q: 2 Anishka melted 11 chocolate cubes in a cylindrical cup as shown.

(Note: The figures are not to scale.)

If the length of the side of each cube is *k* cm and the radius of the cup is *r* cm, which of these represents the height of the melted chocolate in the cup?

(Note: Take π = $\frac{22}{7}$.)

1 $\frac{7k^3}{4r}$ cm

2 $\frac{7k^3}{2r^2}$ cm

3 $\frac{7k^2}{4r}$ cm

4 $\frac{7k^2}{2r^2}$ cm

Q: 3 A container with a grey hemispherical lid has radius R cm. In figure 1, it contains water upto a height of R cm. It is then inverted as shown in figure 2.
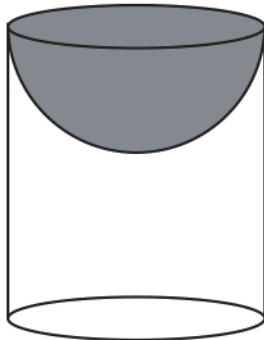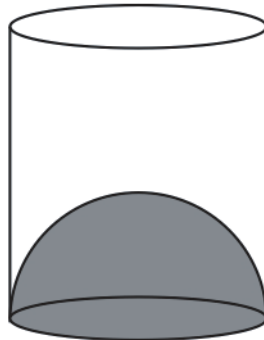

Figure 1   Figure 2
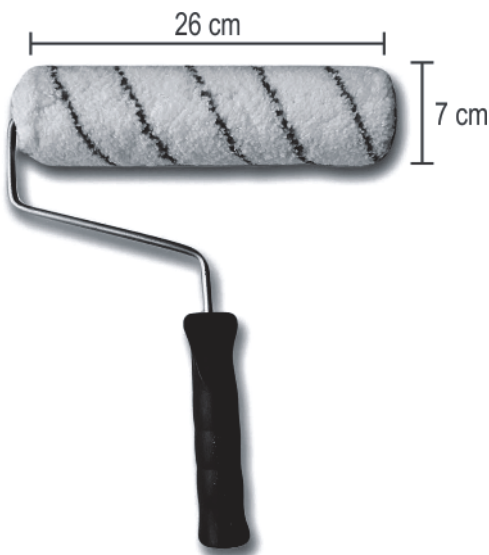
What is the height of water in figure 2?

1 R cm

3 2R cm

2 $\frac{5R}{3}$ cm

4 $\frac{7R}{3}$ cm

Q: 4 A paint roller is a paint application tool used for painting large flat surfaces rapidly and efficiently. One such roller is shown below, which is 26 cm long with an outer diameter of 7 cm.   **[2]**
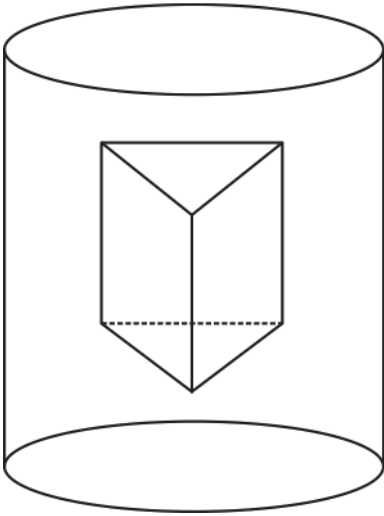

26 cm

7 cm

(Note: The figure is not to scale.)

Find the maximum area of the surface that gets painted when the roller makes 6 complete rotations vertically. Show your work.

(Note: Take π = $\frac{22}{7}$.)

Q: 5 **Shown below is a triangular prism and a cylinder.** **[1]**

On filling the cylinder with water and completely submerging the prism inside the filled cylinder, some water was forced to overflow out of the cylinder. When the prism was removed again, it was noticed that the cylinder had exactly $\frac{3}{5}$ of its water remaining.

If the volume of the cylinder is K litres, what is the volume of the prism? Show your steps and give valid reason.

Q: 6 **Shown below is a cake that Subodh is baking for his brother's birthday. The cake is 21** **[3]**
cm tall and has a radius of 15 cm. He wants to surprise his brother by filling gems inside the cake. In order to do that, he removes a cylindrical portion of cake out of the centre as shown. The piece that is removed is 21 cm tall.
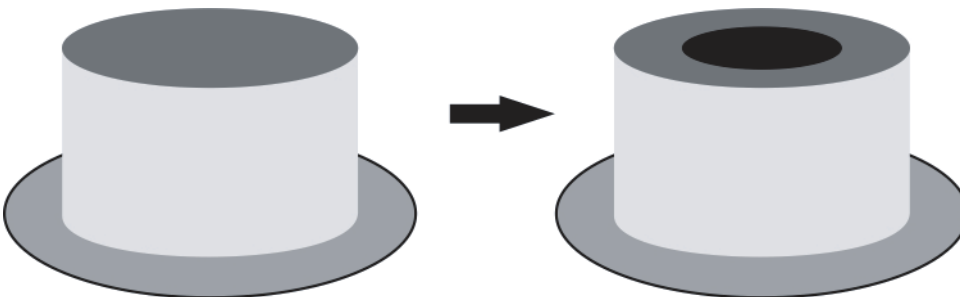
If the cake weighs 0.5 g per cubic cm and the weight of the cake that is left after removing the central portion is 6600 g, find the radius of the central portion that is cut. Show your steps.

(Note: Take π = $\frac{22}{7}$.)

Q: 7 Dinesh is building a greenhouse in his farm as shown below. The base of the greenhouse is circular having a diameter of 12 m and it has a hemispherical dome on top.

[2]

12 m
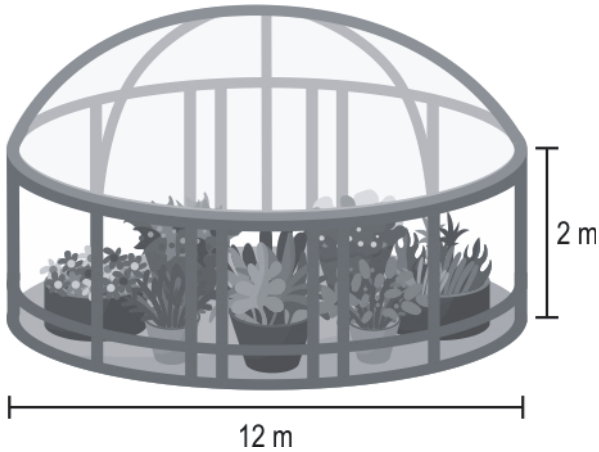
(Note: The image is not to scale.)

How much will it cost him to cover the walls and top of the greenhouse with transparent plastic, if the plastic sheet costs Rs 77 per sq m? Show your steps.

(Note: Take π = $\frac{22}{7}$.)

Q: 8 Shifali made a lampshade using cane web as shown below.

[3]
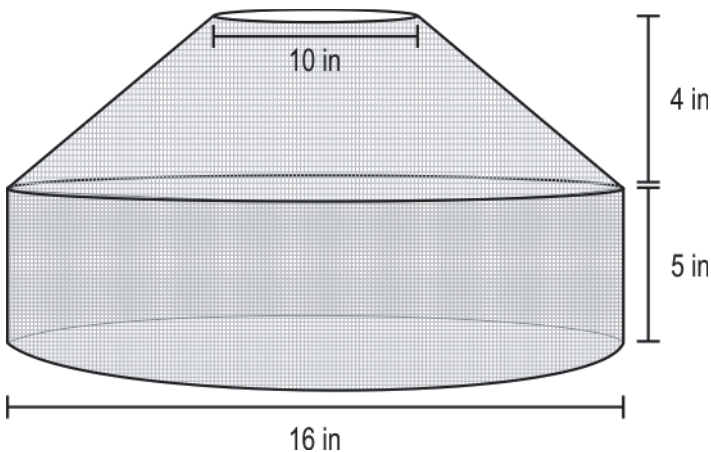
Find the minimum number of sheets of cane web required to make this lamp if each sheet has an area of 44 square inches.

(Note: Take π = $\frac{22}{7}$.)

Q: 9 Shown below is a solid made of a cone, a cylinder and a hemisphere.   [3]
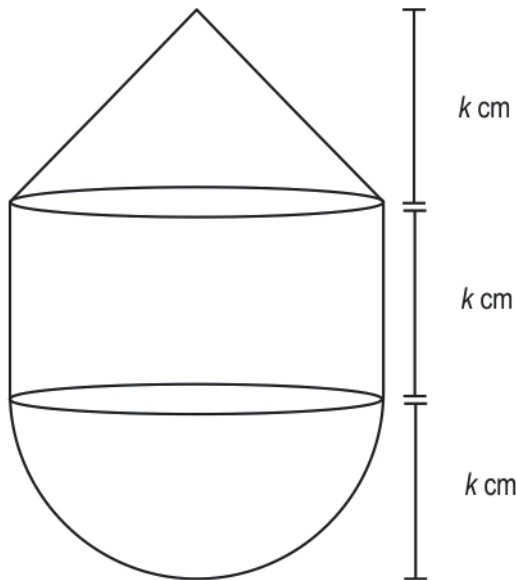
(Note: The figure is not to scale.)

Prove that the total volume of the solid is twice the volume of the cylinder.

Q: 10 A cloche is used to cover dishes before serving. Shown below is a hemispherical glass   [2]
cloche of radius 13 cm. Kanan wants to use it to cover a cylindrical cake of volume
3168 cm^3.

(Note: The figure is not to scale.)

Find one set of values of radius and height of the cake, such that the cloche does not
touch the cake when covered. Show your steps.

(Note: Take $\pi = \frac{22}{7}$.)

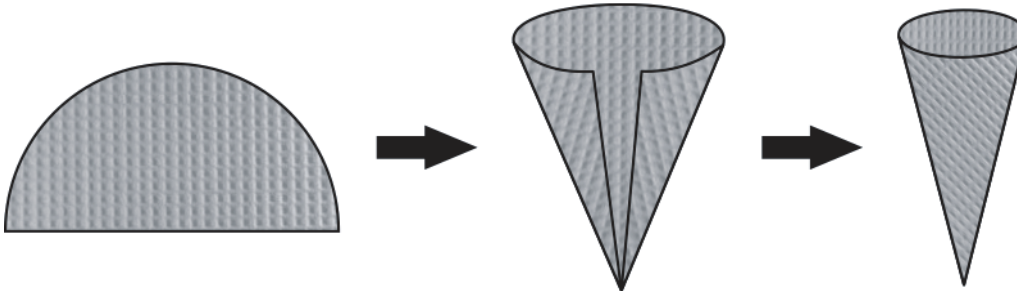**Q: 11** A semi-circular waffle sheet of radius 5 cm is folded into an ice-cream cone as shown below.   [3]

(Note: The figures are not to scale.)

Due to overlap while folding, the radius of the base of the cone is 80% of what it would be without overlap.

Find the approximate volume of the cone. Show your work.

(Note: Take π = $\frac{22}{7}$.)

Q: 12 A bird feeder tube has a diameter of 8 cm and height of 28 cm. The tube has 7 circular [5] openings of 2 cm diameter each for the birds to eat from. The tube can hold a maximum of 3 kg of bird food.

(Note: The image is for visual representation only.)

If the birds eat an average of 75 g of food per hour, what will be the height of the food in the tube after 5 hours? Show your work.

(Note: Take π = $\frac{22}{7}$.)

Q: 13 Two people have an equal amount of moulding clay. They make different solids of the   **[2]**
same circular radius out of it - cylinder and hemisphere.

State true or false for the below statements and justify your answer.

i) Simran said, "The curved surface area of the cylinder is larger."
ii) Manoj said, "Both the solids have the same curved surface area."

Q: 14 A 5.54 litre watering can sprinkles water at the rate of 500 mL/min. The can has a   **[2]**
diameter of 14 cm and is initially filled to its full capacity.

What is the height of water in the can after it is used for 8 minutes? Show your work.

(Note: Take π = $\frac{22}{7}$.)

Q: 15 Shown below is a small model of a cement mixer. The radius of the bottom of the drum [3] is 5 cm and that of the top of the drum is 2 cm.
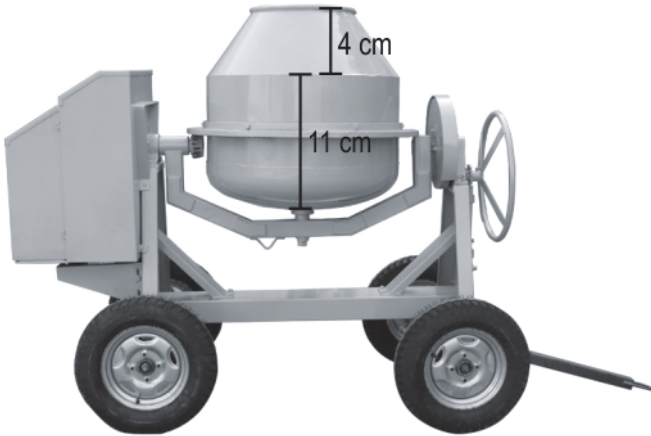
(Note: The figure is not to scale.)

Find the maximum quantity of cement, rounded to the nearest whole number, that the drum can hold. Show your steps.

(Note: Take π = $\frac{22}{7}$.)

Q: 16 The surface area of a solid spherical ball is S cm^2. It is cut into 4 identical pieces as [1] shown below.
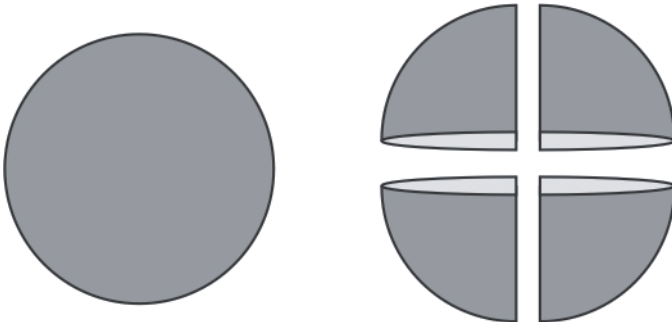
Find the total surface area of 4 identical pieces of the solid spherical ball in terms of S. Show your work.

Answer Key

The table below gives the correct answer for each multiple-choice question in this test.

Q.No	Correct Answers
1	3
2	2
3	2

Q.No	Teacher should award marks if students have done the following:	Marks
4	Identifies that the area that gets painted is the curved surface area of the roller and writes the formula to find the curved surface area of the roller as $2 \times \pi \times \frac{7}{2} \times 26$.	1
	Finds the maximum area of the surface that gets painted when the roller makes 6 complete rotations vertically as $6 \times 2 \times \pi \times \frac{7}{2} \times 26 = 3432$ cm^2.	1
5	Writes that the volume of the prism is equal to the volume of water overflowed which is $\frac{2}{5}$ of the volume of the cylinder.	0.5
	Find the volume of the prism as $\frac{2}{5}$ K litres.	0.5
6	Finds the volume of the cake without the hole as $(\pi \times 15^2 \times 21)$ cm^3.	0.5
	Finds the weight of the cake without hole as $(\pi \times 15^2 \times 21 \times 0.5)$ gm.	0.5
	Uses the above step and the given information to find the weight of the central portion that is removed as $(\pi \times 15^2 \times 21 \times 0.5)$ - 6600 = 825 g	0.5
	Finds the volume of the central portion that is removed as $825 \div 0.5 = 1650$ cm^3.	0.5
	Finds the radius of the central portion that is removed as $\sqrt{(1650 \div 21\pi)} = 5$ cm. (Award full marks if the correct answer is obtained using an alternate method.)	1
7	Finds the CSA of the hemispherical roof as $(2 \times \pi \times 6^2)$ m^2.	0.5
	Finds the CSA of the cylindrical wall as $(2 \times \pi \times 6 \times 2)$ m^2.	0.5
	Finds the total surface area of the greenhouse to be covered as $(72\pi + 24\pi) = 96\pi$ m^2.	0.5
	Finds the cost of the plastic sheet required to cover the entire greenhouse as $(96\pi \times 77) = $ Rs 23232.	0.5
8	Finds the CSA of the top portion of the lampshade as $\pi(5 + 8)5$ sq in. (Award 0.5 marks if just the formula to find the surface area of frustum of cone is correctly written.)	1

Q.No	Teacher should award marks if students have done the following:	Marks
	Finds the CSA of the bottom portion of the lampshade as (2 × π × 8 × 5) sq in. (Award 0.5 marks if just the formula to find the surface area of cylinder is correctly written.)	1
	Finds the total area of the cane web used to make the lampshade as 145π sq in and the minimum number of sheets of cane web required to make this lamp as $\frac{145 \times 22}{44 \times 7} \approx 11$ sheets.	1
9	Finds the volume of the cone as $\frac{\pi}{3} k^3$ cm^3.	0.5
	Finds the volume of the cylinder as π k^3 cm^3.	0.5
	Finds the volume of the hemisphere as $\frac{2}{3}$ π k^3 cm^3.	0.5
	Finds the total volume of the solid as $\frac{\pi}{3} k^3 + \pi k^3 + \frac{2}{3} \pi k^3 = 2\pi k^3$ cm^3.	1
	Uses steps 2 and 4 and concludes that the total volume of the solid is twice the volume of the cylinder.	0.5
10	Assumes the radius of the cylindrical cake as r cm and height as h cm writes: π $r^2 h$ = 3168 => $r^2 h$ = 1008	0.5
	Writes the prime factorisation of 1008 as 2 × 2 × 2 × 2 × 3 × 3 × 7.	0.5
	Finds a set of values of radius and height of the cake as 12 cm and 7 cm. (Award 1.5 marks if another method is used to find a correct set of values.)	1
11	Equates the circumference of the base to the curved surface area of the waffle sheet as 2π r = π r and find the base radius of the cone without overlap as $\frac{5}{2}$ cm.	1
	Finds the radius of the cone with overlap as $\frac{80}{100} \times \frac{5}{2} = 2$ cm.	1

Q.No	Teacher should award marks if students have done the following:	Marks
	Finds the volume of the cone by considering the approximate height of the cone as 5 cm as $\frac{1}{3} \times \frac{22}{7} \times 2 \times 2 \times 5 = \frac{440}{21}$ cm$^3 \sim$ 20 cm^3. (Award 0.5 marks if only the formula for the volume of a cone is correctly written.)	1
12	Finds the volume of the tube as $\frac{22}{7} \times 4 \times 4 \times 28 = 1408$ cm^3. (Award 0.5 marks if only the formula for the volume of a cylinder is correctly written.)	1
	Finds the quantity of bird food eaten in 5 hours as $75 \times 5 = 375$ g.	0.5
	Writes that 3000 g is equivalent to 1408 cm^3, hence 375 g is equivalent 176 cm^3.	1.5
	Finds the volume of the tube that is filled after 5 hours as 1408 - 176 = 1232 cm^3.	0.5
	Finds the height of the food in the tube as $\frac{1232 \times 7}{22 \times 4 \times 4} = 24.5$ cm.	1.5
13	Writes the ratio of curved surface area to volume of a: cylinder as $\frac{2}{r}$ hemisphere as $\frac{3}{r}$ where *r* is the circular radius.	1.5
	Uses the above step to conclude that both Simran's and Manoj's statements are false.	0.5
14	Finds the volume of water left after 8 minutes as 5.54 - $(8 \times \frac{1}{2})$ = 1.54 litres or 1540 cm^3.	1
	Writes the equation for the height of the can, *h* as $\frac{22}{7} \times (7)^2 \times h = 1540$.	0.5
	Solves the above equation for *h* as 10 cm.	0.5

Q.No	Teacher should award marks if students have done the following:	Marks
15	Finds the volume of the cylindrical portion as $\frac{22}{7} \times 5 \times 5 \times 11 = \frac{6050}{7}$ cm^3. (Award 0.5 marks if only the formula for the volume of a cylinder is correctly written.)	1
	Finds the volume of the frustum portion as $\frac{1}{3} \times \frac{22}{7} \times 4 \times (5^2 + 2^2 + 10) = \frac{1144}{7}$ cm^3. (Award 0.5 marks if only the formula for the volume of a frustum is correctly written.)	1
	Finds the maximum quantity of cement that the drum can hold as $\frac{6050}{7} + \frac{1144}{7} = \frac{7194}{7}$ cm^3.	0.5
	Writes $\frac{7194}{7}$ in decimal form as 1027.71 and rounds it off to the nearest whole number as 1028 cm^3.	0.5
16	Assumes the radius of the solid spherical ball as *r* cm and writes that the total surface area of 4 identical pieces of solid spherical ball = $4\pi r^2 + 2\pi r^2 + 2\pi r^2 = 8\pi r^2 = (2 \times 4\pi r^2)$ cm^2	0.5
	Finds the total surface area of the 4 identical pieces of solid spherical ball as $2 \times S$ cm^2.	0.5