



Exercise Set 14.4 – Complete Solutions

Chapter 14: Math of Space: Surface Area and Volume

For π , use $\pi \approx 22/7$ or $\pi \approx 3.14$.

1. A ball bearing has a radius of 0.7 cm. Find its surface area.

Given:

$$r = 0.7 \text{ cm}$$

Surface area of a sphere:

$$A = 4\pi r^2$$

Using $\pi = 22/7$:

$$A = 4 \times 22/7 \times (0.7)^2$$

$$= 4 \times 22/7 \times 0.49$$

$$= 6.16 \text{ cm}^2$$



Answer:

$$\text{Surface area} = 6.16 \text{ cm}^2$$

2. Two solid spheres made of the same metal have weights 5920 g and 740 g.

Determine the radius of the larger sphere, if the diameter of the smaller one is 5 cm.

Since both spheres are made of the **same metal**, their weights are proportional to their volumes.

Therefore:

$$V_1/V_2 = 5920/740$$

$$= 8$$

For spheres:

$$V \propto r^3$$

Therefore:

$$R^3/r^3 = 8$$

So:

$$R/r = 2$$

Diameter of smaller sphere = 5 cm

Therefore:

$$r = 5/2 = 2.5 \text{ cm}$$

Hence:

$$R = 2 \times 2.5$$

$$= 5 \text{ cm}$$

 **Answer:**

Radius of larger sphere = 5 cm

3. The diameter of the moon is approximately one fourth the diameter of the earth. Given that the moon and earth are both roughly spherical, find the ratio of their surface areas.

Given:

$$\text{Diameter of Moon : Diameter of Earth} = 1 : 4$$

Therefore:

$$\text{Radius of Moon : Radius of Earth} = 1 : 4$$

Surface area of sphere:

$$A = 4\pi r^2$$

Therefore:

Surface area ratio:

$$A_m : A_e = 1^2 : 4^2$$

$$= 1 : 16$$

 **Answer:**

$$\text{Surface area of Moon : Surface area of Earth} = 1 : 16$$

4. Find (i) the curved surface area and (ii) the total surface area of a hemisphere of radius 21 cm.

Given:

$$r = 21 \text{ cm}$$

(i) Curved Surface Area

For a hemisphere:

$$\text{CSA} = 2\pi r^2$$

$$= 2 \times \frac{22}{7} \times 21^2$$

$$= 2 \times \frac{22}{7} \times 441$$

$$= 2772 \text{ cm}^2$$

 **Answer:**

Curved surface area = 2772 cm²

(ii) Total Surface Area

$$\text{TSA} = 3\pi r^2$$

$$= 3 \times \frac{22}{7} \times 441$$

$$= 4158 \text{ cm}^2$$

 **Answer:**

Total surface area = 4158 cm²

5. Metal spheres, each of radius 2 cm, are packed into a rectangular box of internal dimensions 16 cm × 8 cm × 8 cm. When 16 spheres are packed, the box is filled with

preservative liquid. Find the volume of this liquid. Round your answer to the nearest integer.

Step 1: Volume of the box

$$V = l \times w \times h$$

$$= 16 \times 8 \times 8$$

$$= 1024 \text{ cm}^3$$

Step 2: Volume of one sphere

Radius:

$$r = 2 \text{ cm}$$

Volume:

$$V = \frac{4}{3} \pi r^3$$

$$= \frac{4}{3} \times \pi \times 2^3$$

$$= 32\pi/3$$

Using $\pi = 22/7$:

$$= 704/21 \text{ cm}^3$$

$$\approx 33.52 \text{ cm}^3$$

Step 3: Volume of 16 spheres

$$= 16 \times 33.52$$

$$\approx 536.32 \text{ cm}^3$$

Step 4: Volume of preservative liquid

$$= \text{Volume of box} - \text{Volume of spheres}$$

$$= 1024 - 536.32$$

$$= 487.68 \text{ cm}^3$$

Rounded to the nearest integer:

 **Answer:**

$$488 \text{ cm}^3$$

6. The radius of a sphere is increased by 10%. Show that the volume increases by approximately 33.1%.

Let the original radius be r .

Original volume:

$$V = \frac{4}{3} \pi r^3$$

New radius:

$$r' = 110\% \text{ of } r$$

$$= 1.1r$$

New volume:

$$V' = \frac{4}{3} \pi (1.1r)^3$$

$$= \frac{4}{3} \pi \times 1.331r^3$$

Therefore:

$$V' = 1.331V$$

Increase in volume:

$$= 1.331V - V$$

$$= 0.331V$$

Percentage increase:

$$= 0.331 \times 100\%$$

$$= 33.1\%$$

✓ **Answer:**

The volume increases by approximately 33.1%.

★ **7. The radius of a sphere is increased by $x\%$. The volume of the sphere increases by 72.8%. Find the value of x .**

Original radius = r

New radius:

$$r(1 + x/100)$$

Since volume is proportional to the cube of radius:

$$\text{New volume} / \text{Original volume} = (1 + x/100)^3$$

The volume increases by 72.8%, so:

$$\text{New volume} = 172.8\% \text{ of original volume}$$

Therefore:

$$(1 + x/100)^3 = 1.728$$

Now:

$$1.2^3 = 1.728$$

Therefore:

$$1 + x/100 = 1.2$$

$$x/100 = 0.2$$

$$x = 20$$

✓ Answer:

$$x = 20\%$$

8. The hemispherical dome of a building needs to be painted. If the circumference of the base of the dome is 35.2 m, find the cost of painting it, given that the cost of painting is ₹10 per 100 cm².

Given circumference:

$$2\pi r = 35.2 \text{ m}$$

Using $\pi = 22/7$:

$$2 \times 22/7 \times r = 35.2$$

$$44r/7 = 35.2$$

$$r = 35.2 \times 7/44$$

$$r = 5.6 \text{ m}$$

The dome is hemispherical, so we need its **curved surface area**:

$$\text{CSA} = 2\pi r^2$$

$$= 2 \times 22/7 \times (5.6)^2$$

$$= 2 \times 22/7 \times 31.36$$

$$= 197.12 \text{ m}^2$$

Convert to cm²:

$$1 \text{ m}^2 = 10,000 \text{ cm}^2$$

Therefore:

$$197.12 \text{ m}^2 = 1,971,200 \text{ cm}^2$$

Cost = ₹10 per 100 cm².

Number of 100 cm² units:

$$1,971,200 \div 100 = 19,712$$

Cost:

$$19,712 \times ₹10$$

$$= ₹197,120$$

 **Answer:**

Cost of painting = ₹1,97,120