

# Mathematics Grade 8

## Surface Area & Total Surface Area.

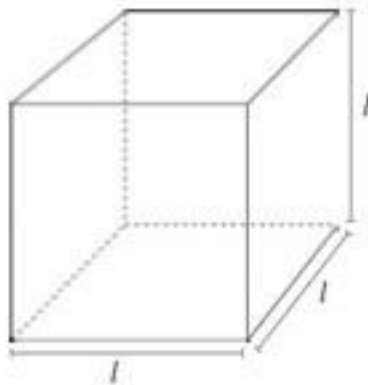
### Total surface area of a cube

The total surface area of a cube is the sum of the areas of all the faces of the cube.

We can make use of the net of the cube to determine the total surface area of the cube.

$$\text{Area of 1 face} = \text{length} \times \text{breadth} = l \times l = l^2$$

$$\begin{aligned} \text{Total surface area of cube} &= \text{Sum of the areas of the 6 faces of the cube} \\ &= 6 l^2 \text{ units}^2 \end{aligned}$$



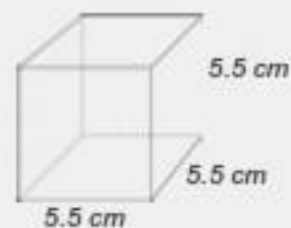
### Example 1

Find the total surface area of a cube of edge 5.5 cm long.

#### Solution

$$\begin{aligned} \text{Area of one face of the cube} &= 5.5 \text{ cm} \times 5.5 \text{ cm} \\ &= 30.25 \text{ cm}^2 \end{aligned}$$

$$\begin{aligned} \text{Total surface area of cube} &= \text{Area of 6 faces of cube} \\ &= \text{Area of 1 face} \times 6 \\ &= 30.25 \text{ cm}^2 \times 6 \\ &= 181.5 \text{ cm}^2 \end{aligned}$$



## Example: 2 & 3

The total surface area of a cube is  $486 \text{ cm}^2$ . Find the length of the edge of the cube.

### Solution

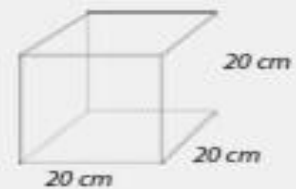
Total surface area of cube =  $486 \text{ cm}^2$

Area of one face of cube =  $486 \div 6 = 81 \text{ cm}^2$

Length of cube =  $\sqrt{81} = 9 \text{ cm}$

Ali buys a gift for his friend. He places the gift in a cubic box of edge 20 cm. He buys one sheet of wrapping paper of length 60 cm and width 37.5 cm to wrap the gift box.

- What is the minimum area of wrapping paper needed to completely cover the gift box?
- Is one sheet of wrapping paper enough for Ali to wrap the gift? Explain your answer.



### Solution

- (i) Minimum area of wrapping paper needed = total surface area of cubic box

Total surface area of box =  $20 \text{ cm} \times 20 \text{ cm} \times 6 = 2\,400 \text{ cm}^2$

Hence, the minimum area of wrapping paper needed =  $2\,400 \text{ cm}^2$

- (ii) Area of one sheet of wrapping paper =  $60 \text{ cm} \times 37.5 \text{ cm} = 2\,250 \text{ cm}^2$

No, one sheet of wrapping paper is not enough as the total surface area of the box is greater than the area of one sheet of wrapping paper.

## Exercise

1. Find the total surface area of a cube having an edge of:

- |           |            |                     |
|-----------|------------|---------------------|
| (a) 2 cm  | (b) 3.5 mm | (c) 8 cm            |
| (d) 35 cm | (e) 4.3 mm | (f) $\frac{1}{2}$ m |

2. Find the length of the edge of each of the cubes having total surface area:

- |                         |                        |                                  |
|-------------------------|------------------------|----------------------------------|
| (a) $150 \text{ cm}^2$  | (b) $1350 \text{ m}^2$ | (c) $3.84 \text{ m}^2$           |
| (d) $8.64 \text{ mm}^2$ | (e) $294 \text{ cm}^2$ | (f) $\frac{27}{50} \text{ cm}^2$ |

## Total surface area of a cuboid

The total surface area of a cuboid is the sum of the areas of all the faces of the cuboid.

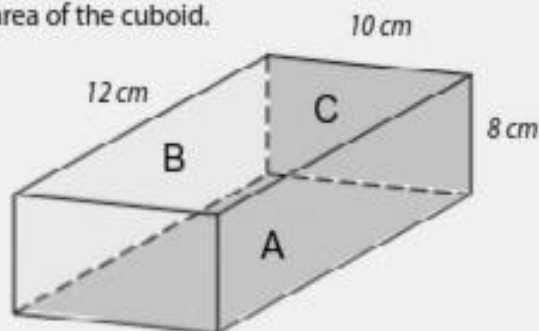
We can make use of the net of the cuboid to find its total surface area. Using Fig. 1,

$$\begin{aligned}\text{Area of net} &= \text{Area of rectangle A} + \text{Area of rectangle B} + \text{Area of rectangle C} + \\ &\quad \text{Area of rectangle D} + \text{Area of rectangle E} + \text{Area of rectangle F} \\ &= (2 \times 3 + 3 \times 6 + 3 \times 2 + 6 \times 2 + 2 \times 6 + 3 \times 6) \text{ cm}^2 \\ &= 2(2 \times 3 + 3 \times 6 + 6 \times 2) \text{ cm}^2 \\ &= 72 \text{ cm}^2\end{aligned}$$

We say that the total surface area of the cuboid =  $(2lb + 2lh + 2bh)$  units<sup>2</sup>  
or  $2(lb + lh + bh)$  units<sup>2</sup>

### Example 1

Find the total surface area of the cuboid.



#### Solution

Consider the rectangles A, B and C.



$$\text{Area of rectangle A} = 10 \times 12 = 120 \text{ cm}^2$$

$$\text{Area of rectangle B} = 12 \times 8 = 96 \text{ cm}^2$$

$$\text{Area of rectangle C} = 10 \times 8 = 80 \text{ cm}^2$$

$$\begin{aligned}\text{Total surface area} &= 2 \times (\text{Area of rectangle A}) + 2 \times (\text{Area of Rectangle B}) + 2 \times (\text{Area of Rectangle C}) \\ &= (2 \times 120) + (2 \times 96) + (2 \times 80) \text{ cm}^2 \\ &= (240 + 192 + 160) \text{ cm}^2 = 592 \text{ cm}^2\end{aligned}$$

#### OR

$$\begin{aligned}\text{Total surface area} &= 2lb + 2lh + 2bh \\ &= 2(12 \times 10) + 2(12 \times 8) + 2(10 \times 8) \text{ cm}^2 = 592 \text{ cm}^2\end{aligned}$$

**Note:** There will be 2 rectangles A, 2 rectangles B and 2 rectangles C.

### Example 2

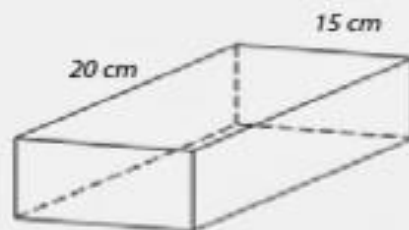
The total surface area of a cuboid is  $1\,300\text{ cm}^2$ . The length and width of the cuboid are  $20\text{ cm}$  and  $15\text{ cm}$  respectively. Find the height of the cuboid.

#### Solution

$$\begin{aligned}\text{Total surface area of cuboid} &= 2lb + 2lh + 2bh = 1\,300\text{ cm}^2 \\ 2(20 \times 15) + 2(20 \times h) + 2(15 \times h) &= 1\,300\text{ cm}^2\end{aligned}$$

$$\begin{aligned}600 + 40h + 30h &= 1\,300\text{ cm}^2 \\ 70h &= 700\text{ cm}^2 \\ h &= \frac{700}{70} = 10\text{ cm}\end{aligned}$$

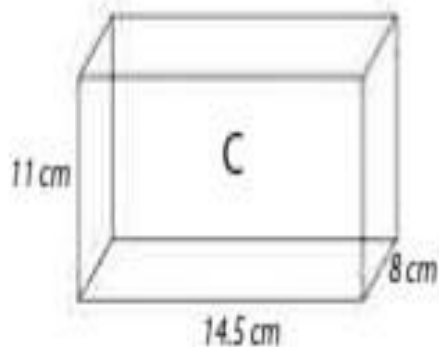
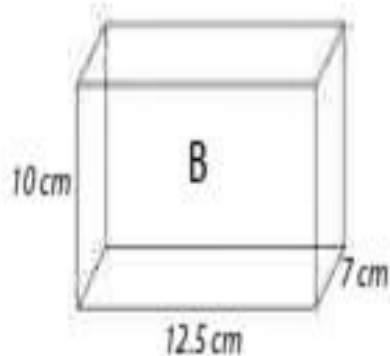
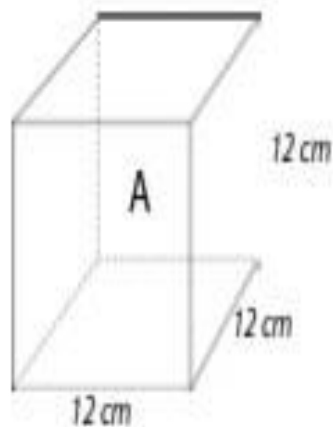
Height of cuboid =  $10\text{ cm}$



3. Which of the following boxes has:

(i) the greatest total surface area?

(ii) the least total surface area?



4. A building is in the form of a rectangular prism of dimensions 50 m by 30 m by 120 m. Windows cover a third of the building.
- (a) What is the total area of the windows to be washed?
- (b) The window washing company charges Rs 50 per  $\text{m}^2$  of window to be washed. What is the total cost of washing all the windows of the building?
5. A cereal packaging company is designing the box for a pack of cereals. There are 2 choices for the dimensions of the box:
- Box A: 21 cm by 8 cm by 28 cm **or**
- Box B: 25 cm by 25 cm by 8 cm.
- Which of the two boxes (A or B) would require more cardboard material to make?
6. Melanie needs to paint the walls of a room for an art exhibition. The room is in the shape of a rectangular prism, measuring 6 m by 2.5 m by 3 m. She needs to paint the walls, the ceiling and the floor with 3 layers of paint. A 2-Litre can of paint covers  $20 \text{ m}^2$ . If there is an opening in one of the walls with dimensions 1.2 m by 2.5 m, what is the minimum number of 2-Litre cans of paint that Melanie should buy?

7. Find the total surface area of the following figures:

