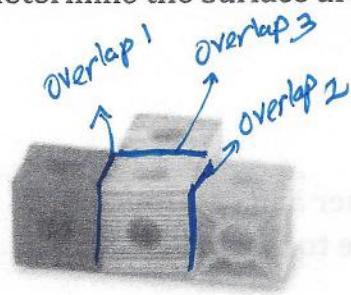


Here is an object made from 4 cubes. What is the surface area? How did you determine the surface area?

2 Methods:



Method 1 "Views"

FRONT		3
BACK		3
TOP		4
BOTTOM		4
RIGHT		2
LEFT		2
		<u>18 cm²</u>

Method 2

Cubes: 4

$$\text{Total faces} = 4 \times 6 = 24$$

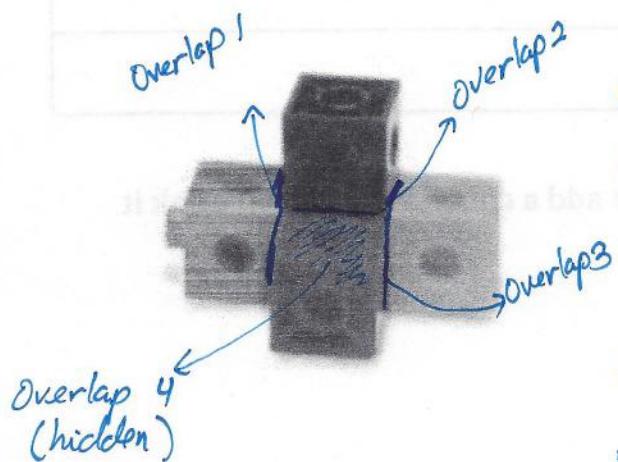
Overlaps = 3

$$\text{Overlapped faces} = 3 \times 2 = 6$$

$$\begin{aligned}\text{Area} &= \text{Total faces} - \text{Overlapped faces} \\ &= 24 - 6 \\ &= 18 \text{ cm}^2\end{aligned}$$

We could easily find the surface area by finding the total surface area of each block, adding them together and then subtracting the Overlaps!

Find the surface area of the object below:



Method 1

FRONT		4
BACK		4
BOTTOM		4
TOP		4
RIGHT		3
LEFT		3
		<u>22 cm²</u>

Method 2

Cubes: 5

$$\text{total faces} = 5 \times 6 = 30$$

Overlays: 4

$$\text{Overlapped faces} = 4 \times 2 = 8$$

$$\text{total area} = \frac{\text{total faces} - \text{overlapped faces}}{\text{faces}} = \frac{30 - 8}{22} = 22 \text{ cm}^2$$

Surface Area of Square/Rectangular Prisms

To find the surface area of any prism, we need to individually find the area of all surfaces and add them together. In the case of a rectangular prism, all the faces are rectangles so we use the same formula for all six rectangles.

Formula for the Area of a Rectangle: base × height

Example 1:

Front/Back: (Because they are equal)

$$\begin{aligned} \text{Area} &= b \times h \\ &= (10 \text{ cm}) \times (8 \text{ cm}) \\ &= 80 \text{ cm}^2 \end{aligned}$$

BUT Front = back so

$$80 \text{ cm}^2 \times 2 = \underbrace{\{160 \text{ cm}^2\}}$$

Top/Bottom: (Because they are equal)

$$\begin{aligned} \text{Area} &= b \times h \\ &= (10 \text{ cm}) \times (6 \text{ cm}) \\ &= 60 \text{ cm}^2 \end{aligned}$$

BUT Top = Bottom so

$$(60 \times 2) \text{ cm}^2 = \underbrace{120 \text{ cm}^2}$$

Side/Side:

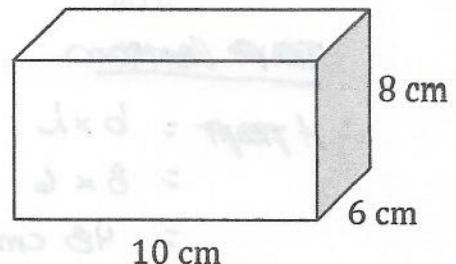
$$\begin{aligned} \text{Area} &= b \times h \\ &= 6 \text{ cm} \times 8 \text{ cm} \\ &= 48 \text{ cm}^2 \end{aligned}$$

BUT Right = left sides, so

$$(48 \times 2) \text{ cm}^2 = \underbrace{96 \text{ cm}^2}$$

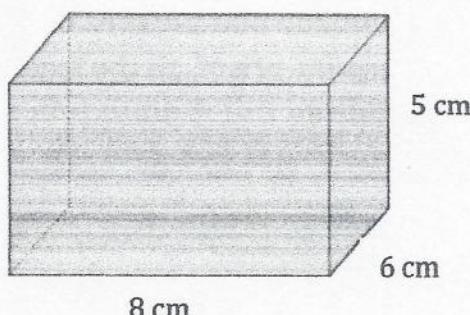
Total Surface Area:

$$\text{Sum of Areas of All sides} = 160 + 120 + 96 = 376 \text{ cm}^2$$



Try these:

a)



Top/bottom

$$\begin{aligned} A_{\text{top}} &= b \times h \\ &= 8 \times 6 \text{ cm}^2 \\ &= 48 \text{ cm}^2 \end{aligned}$$

But ~~Top = bottom~~, so

$$\begin{aligned} (48 \times 2) \text{ cm}^2 \\ 96 \text{ cm}^2 \end{aligned}$$

$$\begin{aligned} \text{Surface area} &= \frac{\text{Area}}{\text{Top/Bottom}} + \frac{\text{Area}}{\text{Front/Back}} \\ &\quad + \frac{\text{Area}}{\text{Right/Left}} \end{aligned}$$

$$\begin{aligned} &= 96 \text{ cm}^2 + 80 \text{ cm}^2 + 60 \text{ cm}^2 \\ &= 236 \text{ cm}^2 \end{aligned}$$

front/back

$$\begin{aligned} A_{\text{front}} &= b \times h \\ &= 8 \text{ cm} \times 5 \text{ cm} \\ &= 40 \text{ cm}^2 \end{aligned}$$

But front = back, so

$$\begin{aligned} (40 \times 2) \text{ cm}^2 \\ 80 \text{ cm}^2 \end{aligned}$$

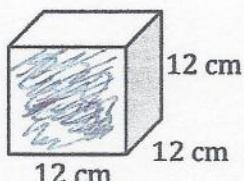
Right/Left

$$\begin{aligned} A_{\text{right}} &= b \times h \\ &= 6 \text{ cm} \times 5 \text{ cm} \\ &= 30 \text{ cm}^2 \end{aligned}$$

But Right = Left, so

$$(30 \times 2) = 60 \text{ cm}^2$$

b)



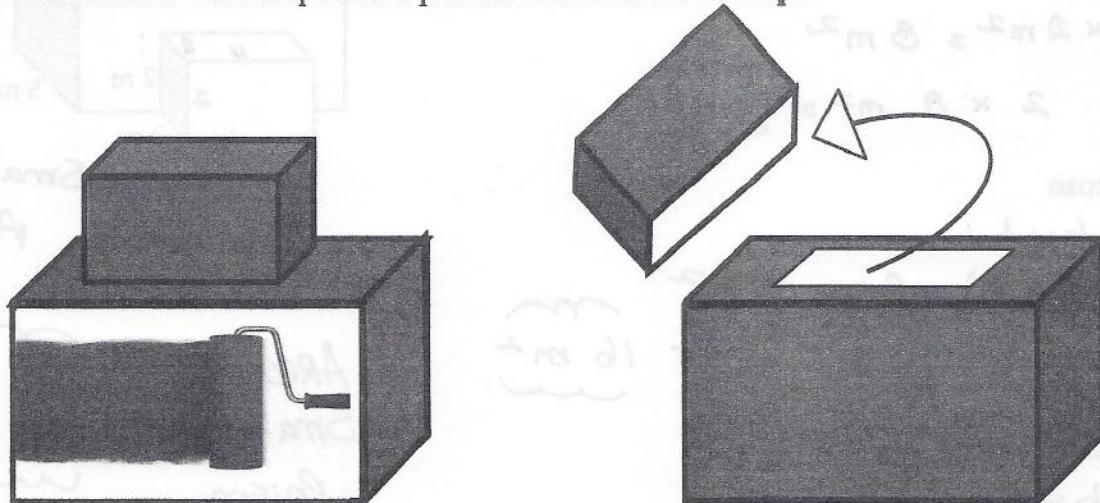
A cube! This figure has 6 equal faces

- Area of front face = $b \times h = 12 \times 12 = 144 \text{ cm}^2$
- Since there are 6 faces,

$$\begin{aligned} T.A &= \text{Area of 6 faces} \\ &= (144 \text{ cm}^2) \times 6 \\ &= 864 \text{ cm}^2 \end{aligned}$$

A COMPOSITE object is composed of two or more objects.

To find the surface area of a composite object, imagine dipping the object in paint. What happens when you separate the blocks below once they have been painted? – You will have an area on each block that is not painted because it was touching the other block. This unpainted part is called the **overlap**.



To find the surface area, we calculate the area of all the faces covered in paint. The overlap is not painted, so it is not part of the surface area; thus we find the total surface area of each block, add them together and subtract the overlap from the total at the end.

Example 1:

- First calculate the surface area of the larger prism.

Front/Back:

$$A_{\text{front}} = b \times h = (10 \times 6) \text{ cm}^2 = 60 \text{ cm}^2$$

So $A_{\text{front/back}} = 60 \text{ cm}^2 \times 2 = \underline{\underline{120 \text{ cm}^2}}$

Top/Bottom

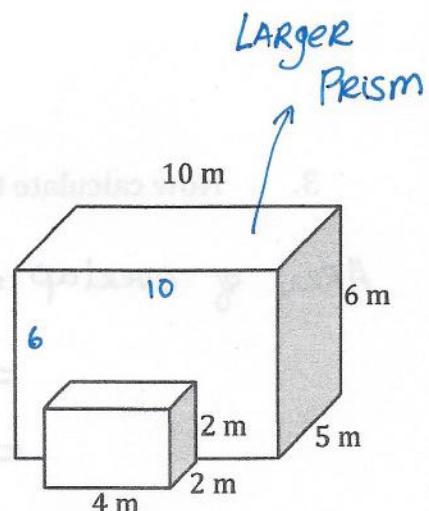
$$A_{\text{top}} = b \times h = (10 \times 5) \text{ cm}^2 = 50 \text{ cm}^2$$

So $A_{\text{top/bottom}} = 50 \text{ cm}^2 \times 2 = \underline{\underline{100 \text{ cm}^2}}$

Side/Side: $A_{\text{side}} = (5 \times 6) \text{ cm}^2 = 30 \text{ cm}^2$
So $A_{\text{side/side}} = 30 \text{ cm}^2 \times 2 = \underline{\underline{60 \text{ cm}^2}}$

Total Surface Area:

TOTAL AREA: Sum of all areas = $(120 + 100 + 60) \text{ cm}^2 = 280 \text{ cm}^2$



2. Second, calculate the surface area of the smaller prism.

Front/Back:

$$A_{\text{front}} = b \times h \\ = (4 \times 2) \text{ m}^2 = 8 \text{ m}^2$$

$$A_{\text{front/back}} = 2 \times 8 \text{ m}^2 = 16 \text{ m}^2$$

Top/Bottom

$$A_{\text{top}} = b \times h \\ = (4 \times 2) \text{ m}^2 = 8 \text{ m}^2$$

$$A_{\text{top/bottom}} = 2 \times 8 \text{ m}^2 = 16 \text{ m}^2$$

Side/Side:

$$A_{\text{side}} = b \times h \\ = (2 \times 2) \text{ m}^2 = 4 \text{ m}^2$$

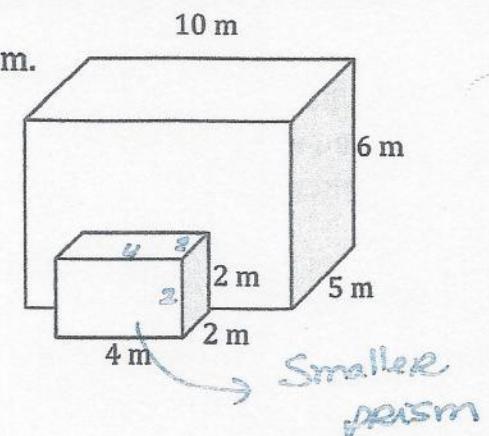
$$A_{\text{side/side}} = 2 \times 4 \text{ m}^2 = 8 \text{ m}^2$$

Total Surface Area:

$$\begin{aligned} \text{Total Surface Area} &= \text{Sum of all areas} \\ &= 16 + 16 + 8 \text{ m}^2 \\ &= 40 \text{ m}^2 \end{aligned}$$

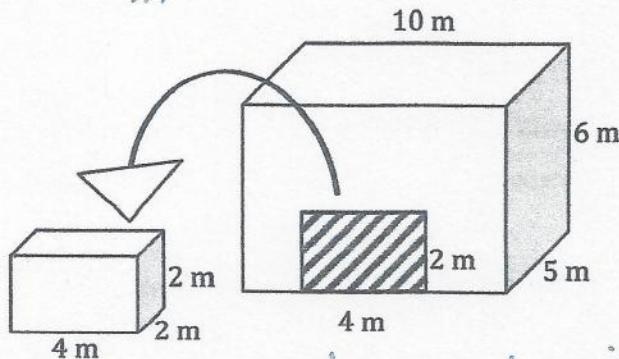
3. Now calculate the overlap.

$$\begin{aligned} \text{Area of overlap} &= b \times h \\ &= (4 \times 2) \text{ m}^2 \\ &= 8 \text{ m}^2 \end{aligned}$$



$$\begin{aligned} \text{Area of} \\ \text{Smaller} \\ \text{Prism} &= 40 \text{ m}^2 \end{aligned}$$

Remember, Overlaps are multiplied by 2

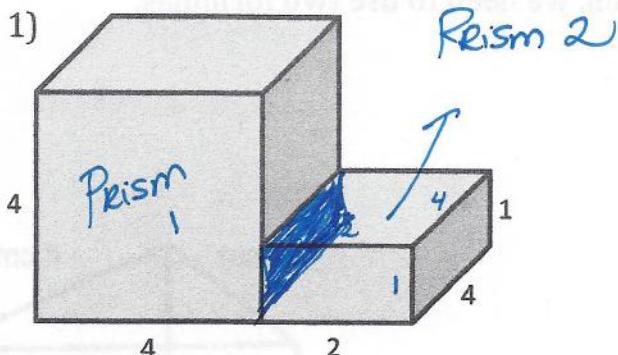


the overlap is
a rectangle with
 $b = 4 \text{ m}$ $h = 2 \text{ m}$

Total Surface Area of the Composite Figure:

$$\begin{aligned} 280 \text{ m}^2 + 40 \text{ m}^2 - (2 \times 8) \text{ m}^2 &= 304 \text{ m}^2 \\ \text{SA}_{\text{area}} \text{ of Large Object} + \text{SA}_{\text{area}} \text{ of Small Object} - 2 \times \text{Overlap} \\ 320 \text{ m}^2 - 16 \text{ m}^2 & \end{aligned}$$

The overlap is
Try These: 



Prism 1 → Cube!

$$\begin{aligned} \text{Area of Cube} &= (\text{Area of } 1 \text{ face}) \times 6 \\ &= (b \times h) \times 6 \\ &= (4 \times 4) \times 6 \\ &= \underline{\underline{96 \text{ units}^2}} \end{aligned}$$

Prism 2 → Rectangular Prism

$$\begin{aligned} \text{Front} &= \text{back} \\ \text{Top} &= \text{bottom} \\ \text{Right} &= \text{Left} \end{aligned}$$

$$\begin{aligned} A_{\text{front/back}} &= (b \times h) \times 2 \\ (2 \times 1) \times 2 &= \underline{\underline{4 \text{ units}^2}} \end{aligned}$$

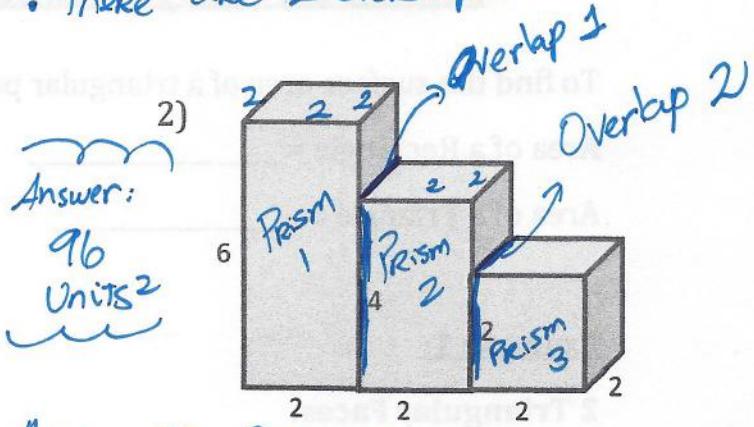
$$\begin{aligned} A_{\text{top/bottom}} &= (b \times h) \times 2 \\ (2 \times 4) \times 2 &= \underline{\underline{16 \text{ units}^2}} \end{aligned}$$

$$\begin{aligned} A_{\text{right/left}} &= (b \times h) \times 2 \\ (4 \times 1) \times 2 &= \underline{\underline{8 \text{ units}^2}} \end{aligned}$$

$$\begin{aligned} \text{Area of Prism 2} &= 4 + 16 + 8 = \underline{\underline{28 \text{ units}^2}} \end{aligned}$$

$$\begin{aligned} \text{Overlap} &\rightarrow b \times h = 4 \times 1 = \underline{\underline{4 \text{ units}^2}} \end{aligned}$$

- Figure made of 3 prisms
- there are 2 overlaps



Area of Prism 1

$$\begin{aligned} A_{\text{front/back}} &= 2 \times (2 \times 6) = 2 \times 12 = 24 \text{ units}^2 \\ A_{\text{top/bottom}} &= 2 \times (2 \times 2) = 2 \times 4 = 8 \text{ units}^2 \\ A_{\text{right/left}} &= 2 \times (2 \times 6) = 2 \times 12 = 24 \text{ units}^2 \\ &\hline \underline{\underline{56 \text{ units}^2}} \end{aligned}$$

Area of Prism 2

$$\begin{aligned} A_{\text{front/back}} &= 2 \times (2 \times 4) = 2 \times 8 = 16 \text{ units}^2 \\ A_{\text{top/bottom}} &= 2 \times (2 \times 2) = 2 \times 4 = 8 \text{ units}^2 \\ A_{\text{right/left}} &= 2 \times (2 \times 4) = 2 \times 8 = \underline{\underline{16 \text{ units}^2}} \\ &\hline \underline{\underline{40 \text{ units}^2}} \end{aligned}$$

Area of Prism 3 (A cube)

$$A = \text{Area of face} \times 6 = (2 \times 2) \times 6 = \underline{\underline{24 \text{ units}^2}}$$

Overlap 1 → A. Rectangle 

$$A = 4 \times 2 = \underline{\underline{8 \text{ units}^2}}$$

Overlap 2 → A Square 

$$A = 2 \times 2 = \underline{\underline{4 \text{ units}^2}} \quad \text{SO}$$

$$\begin{aligned} \text{Total Area} &= \frac{\text{Sum of all areas}}{\text{areas}} - \frac{\text{Sum of overlaps}}{\text{overlaps} \times 2} \\ &= (56 + 40 + 24) - ((8 \times 2) + (4 \times 2)) \\ &= 120 - (16 + 8) = 120 - 24 \end{aligned}$$

$$T.A = \underline{\underline{96 \text{ units}^2}}$$

$$\therefore S.A. = \underline{\underline{116 \text{ Units}^2}}$$