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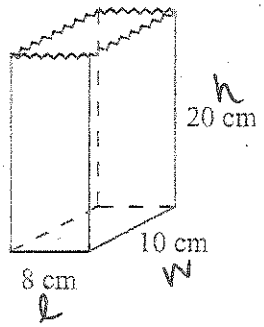
1.3B SURFACE AREA: Nets of Composite Objects

Surface Area of Cubes and Rectangular Solids

The surface area of a solid is the sum of the area of all its faces. Some examples are: the amount of material to build a house, or the amount of material to make a cardboard box, or to make a tin can.

Example 1 Consider a paper bag. How much paper is needed to make the bag?

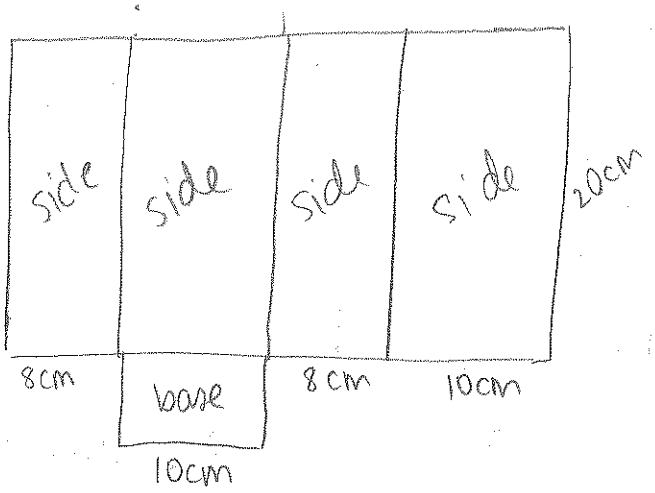


▶ *Solution:* Draw a NET for the bag

↓

A net is a 2-D figure of the component parts of the 3-D figure

* there are 5 faces for a paper bag



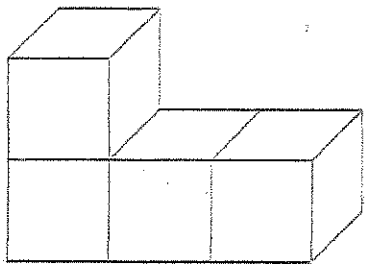
$SA = \boxed{2}lw + 2lh + 2wh$

$= 1 \cdot 8 \cdot 10 + 2 \cdot 8 \cdot 20 + 2 \cdot 10 \cdot 20$

$= 80 + 320 + 400$

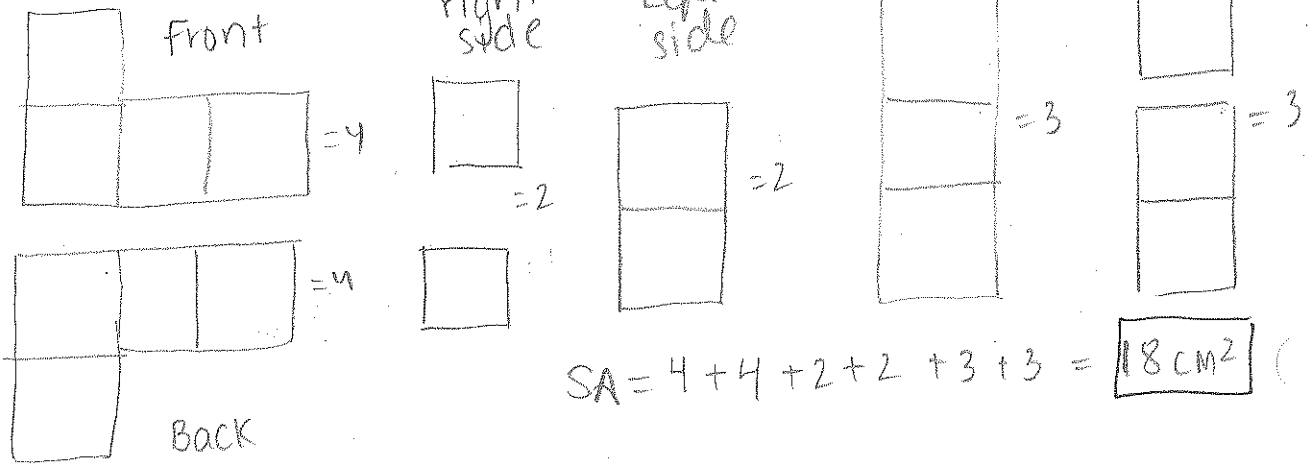
$= \boxed{800\ cm^2}$

Example 2 Determine the surface area of the composite of cubes.



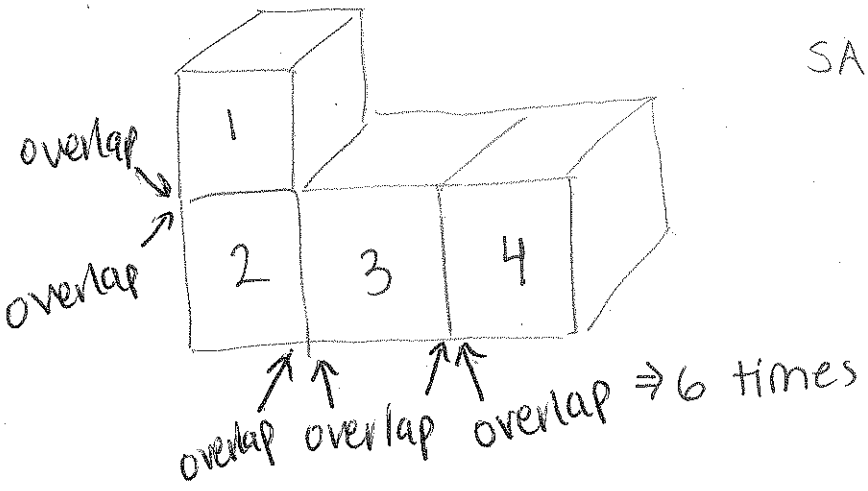
▶ *Solution*:

Method 1: Draw a net



SA = 4 + 4 + 2 + 2 + 3 + 3 = $\boxed{18\ cm^2}$

Method 2: consider a cube



SA of 1 cube $= 6a^2$

$= 6 \cdot 1^2$

$= 6 \cdot 1 = 6\ cm^2$

$\times 4$ cubes

$= 24\ cm^2$

$- 6\ cm^2$

$\boxed{18\ cm^2}$

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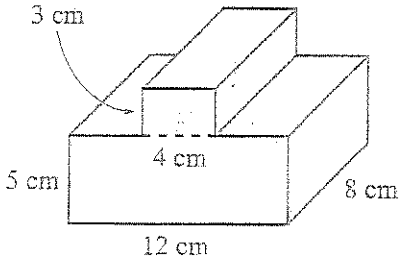
Example 5 Determine the surface area of the composite figure.

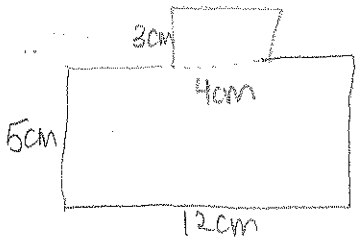


144 + 192 + 80 + 48 = 464 cm²

▶ *Solution:*

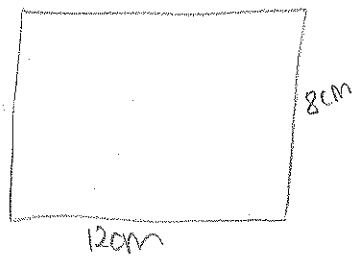
Method 1: Draw a net

front/back



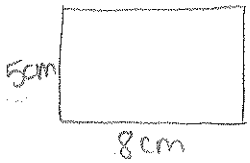
(5×12) + (3×4)
60 + 12 = 72
× 2
144 cm²

bottom/top



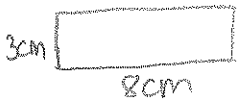
2(8×12) = 192 cm²

sides



2(8×5)
= 80 cm²

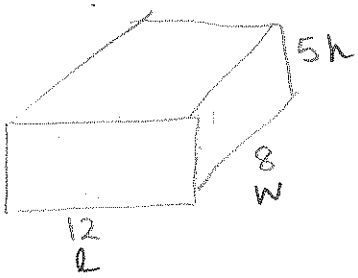
smaller sides



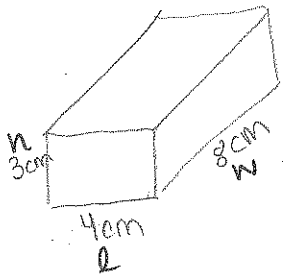
2(8×3)
= 48 cm²

Method 2:

→ 2 rectangular solids minus OVERLAP



SA = 2lw + 2lh + 2wh
= 2·12·8 + 2·12·5 + 2·8·5
= 192 + 120 + 80 = 392 cm²



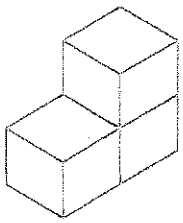
SA = 2·4·8 + 2·4·3 + 2·3·8
= 64 + 24 + 48 = 136 cm²

overlap: 2(8×4) = 64 cm²

392
+ 136
− 64
464 cm²

1.) Determine the surface area of the composite of cubes. Each cube has sides of 1 unit.

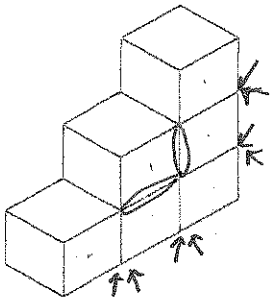
a)



SA of 1 cube = $6(1^2)$
= 6
× 3 cubes
18 − 4 = 14
(overlap)

14 square units

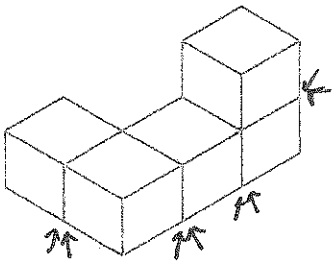
b)



SA = $6(1^2)$
= 6
× 6 cubes
36 − 12 = 24

24 square units

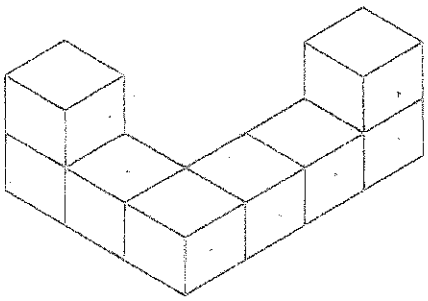
c)



SA = 6
× 5 cubes
30 − 8 =

22 square units

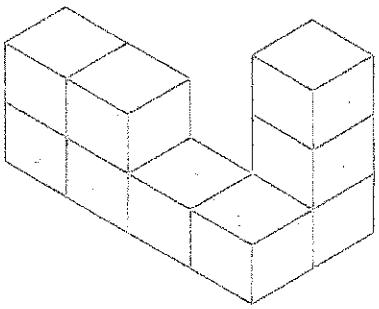
d)



SA = 6
× 8 cubes
48 − 14 =

34 square units

e)



SA = 6
× 9 cubes
54 − 18 =

36 square units

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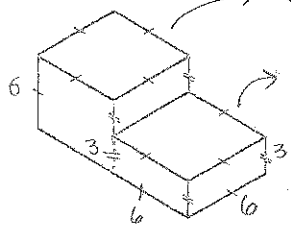
2.) Determine the surface area of the composite figure. (All measurements are in centimeters)

a)



$SA = 6a^2 \Rightarrow 6(6^2) = 6 \cdot 36 = 216$

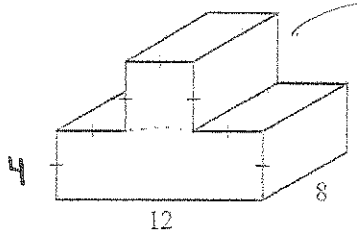
$SA = 2(3 \cdot 6 + 6 \cdot 6 + 6 \cdot 3)$
$= 2(18 + 36 + 18)$
$= 144$

overlap: $2(6 \times 3) = 36$

$216 + 144 - 36$

$324\ cm^2$

b)



$SA = 2(4 \cdot 8 + 4 \cdot 4 + 8 \cdot 4)$
$= 2(32 + 16 + 32) = 160$

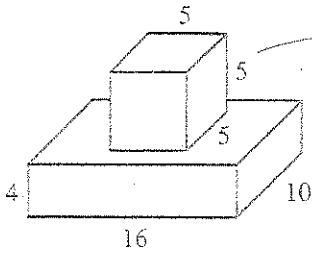
$SA = 2(12 \cdot 8 + 12 \cdot 4 + 8 \cdot 4)$
$= 2(96 + 48 + 32) = 352$

overlap: $2(8 \times 4) = 64$

$160 + 352 - 64$

$448\ cm^2$

c)



$SA = 6a^2 = 6(5^2) = 6 \cdot 25 = 150$

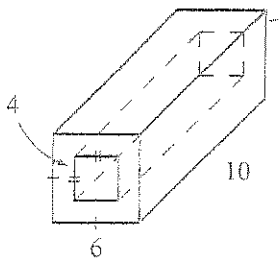
$SA = 2(16 \cdot 10 + 10 \cdot 4 + 16 \cdot 4)$
$= 2(160 + 40 + 64) = 528$

overlap: $2(5 \times 5) = 50$

$150 + 528 - 50$

$628\ cm^2$

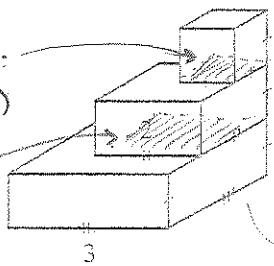
d)



$SA = 2(10 \cdot 6 + 6 \cdot 6 + 10 \cdot 6)$
$= 2(60 + 36 + 60) = 312$
$= 312 - 2\ \text{hollow faces} + \text{hollow tube}$
$= 312 - [2(4 \times 4)] + [4(4 \times 10)]$
$= 312 - 32 + 160$
$= 440$

$440\ cm^2$

e)



overlap:
$= 2(1 \times 1)$
$= 2$

overlap:
$= 2(2 \cdot 2)$
$= 2 \cdot 4$
$= 8$

$SA = 6a^2 = 6(1^2) = 6$

$SA = 2(2 \cdot 2 + 2 \cdot 1 + 2 \cdot 1)$
$= 2(4 + 2 + 2)$
$= 2(8)$
$= 16$

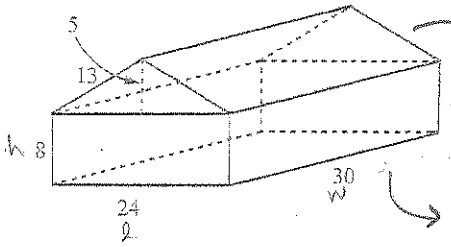
$SA = 2(3 \cdot 1 + 3 \cdot 1 + 3 \cdot 3)$
$= 2(3 + 3 + 9)$
$= 2(15)$
$= 30$

$6 + 16 + 30 - 10$

$42\ cm^2$

3.) Find the **surface area** of the following figures. All measurments are in centimetres. All prisms are right prisms. Round answers to one decimal place.

a)



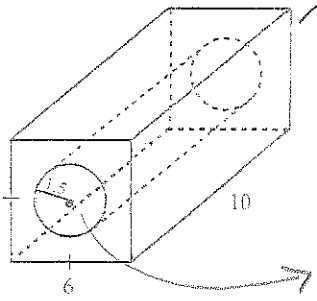
$SA = bh + 2ls + lb$
$= 24 \cdot 5 + 2 \cdot 30 \cdot 13 + 30 \cdot 24$
$= 120 + 780 + 720$
$= 1620$

$SA = 2wh + 2lw + 2lh$
$= 2 \cdot 30 \cdot 8 + 2 \cdot 24 \cdot 30 + 2 \cdot 24 \cdot 8$
$= 480 + 1440 + 384$
$= 2304$

overlap: $2(24 \times 30)$
$= 1440$

$1620 + 2304 - 1440$
$2484\ cm^2$

b)



$SA = 2(lw + wh + lh)$
$= 2(10 \cdot 6 + 6 \cdot 6 + 10 \cdot 6)$
$= 2(60 + 36 + 60)$
$= 312$

$SA = 2\pi r^2 + 2\pi rh$
$= 2\pi(1.5^2) + 2\pi \cdot 1.5 \cdot 10$
$= 14.14 + 94.24$
$= 94.24$

$312 + 94.24 - 14.14$
$392.1\ cm^2$

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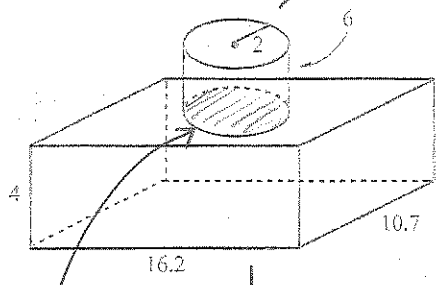
c)



$SA = 2\pi r^2 + 2\pi rh$

$= 2\pi 2^2 + 2\pi \cdot 2 \cdot 6$

$= 2\pi 4 + 2\pi 12$

$= 8\pi + 24\pi$

$= 32\pi$

$= 100.5309...$

overlap:

$= 2(\pi r^2)$

$= 2(\pi \cdot 2^2)$

$= 2(4\pi)$

$= 25.1327$

$SA = 2(4 \cdot 16.2 + 10.7 \cdot 16.2 + 4 \cdot 10.7)$

$= 2(64.8 + 173.34 + 42.8$

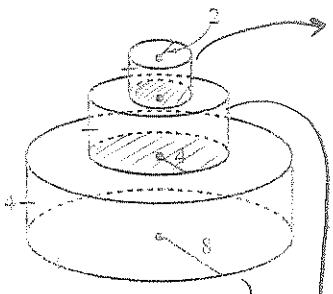
$= 2(280.94)$

$= 561.88$

100.5309...
561.88
− 25.1327...

637.25 cm²

d)



overlap:

25.1327...
+100.5309...
125.6636...

$SA = 2\pi r^2 + 2\pi rh$

$= 2\pi 2^2 + 2\pi \cdot 2 \cdot 4$

$= 8\pi + 16\pi$

$= 25.1327 + 50.26548...$

$= 75.3982...$

$SA = 2\pi 4^2 + 2\pi \cdot 4 \cdot 4$

$= 32\pi + 32\pi$

$= 100.5309... + 100.5309...$

$= 201.0619...$

$SA = 2\pi 8^2 + 2\pi \cdot 8 \cdot 4$

$= 128\pi + 64\pi$

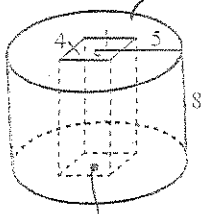
$= 402.1238... + 201.0619...$

$= 603.185...$

75.3982...
+201.0619...
+603.185...
−125.6636...

754 cm²

e)



$SA = 2\pi r^2 + 2\pi rh$

$= 2\pi 5^2 + 2\pi \cdot 5 \cdot 8$

$= 50\pi + 80\pi$

$= 130\pi$

$= 408.407...$

$SA = 2(lw + lh + wh)$

$= 2(8 \cdot 4 + 8 \cdot 4 + 4 \cdot 4)$

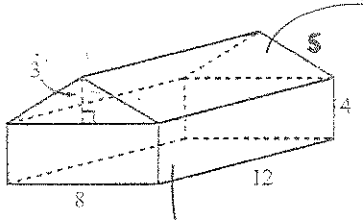
$= 2(32 + 32 + 16)$

$= 64 + 64 + 32$

$= 128$

408.407...
+ 128
− 32
504.4 cm²

f)



$SA = bh + 2ls + lw$

$= 8 \cdot 3 + 2 \cdot 12 \cdot 5 + 12 \cdot 8$

$= 24 + 120 + 96$

$= 144$

144
+ 256
400 cm²

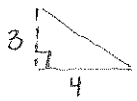
$SA = 2lw + 2lh + 2hw$

$= 1 \cdot 12 \cdot 8 + 2 \cdot 12 \cdot 4 + 2 \cdot 4 \cdot 8$

$= 96 + 96 + 64$

$= 256$

use pythagorean thearm:



$3^2 + 4^2 = c^2$

$9 + 16 = c^2$

$25 = c^2$

$5 = c$

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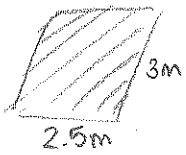
4) Ann wants to wallpaper the walls of her bedroom. The rectangular room is 12 ft. by 15 ft. with height of the wall 8 ft. high. If a roll of wallpaper is 3 ft. wide and 50ft. long, how many rolls of wallpaper are needed? (*can't buy part of a roll, and ignore doors and windows*)

4 walls only ⇒ SA = 2(8×12) + 2(15·8)
= 192 + 240
= 432 ft.

1 roll = 3 × 50 = 150 × 3 rolls = 450 ft.

≈ 3 rolls

5) Jessica wants to tile the kitchen floor with tiles that are 20 *cm* square. If the kitchen measures 2.5 *m* by 3 *m*, how many tiles are needed if 10% is added for waste?



2.5 × 3 = 7.5m²

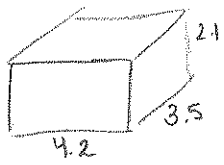
20cm → 0.2m → 0.2 × 0.2
= 0.04m²

100%
+10%
110% ÷ 100% = 1.1

7.5 m² ÷ 0.04m² = 187.5 tiles × 1.1 = 206.25

≈ 207 tiles

6) Andy has a contract to paint the walls and ceiling of 30 motel rooms each measuring 3.5 *m* by 4.2 *m* with height of 2.1 *m*. If a 4-litre pail of paint covers 40 m^2 and costs $18.95, what is the cost of paint used?



SA = 1(3.5·4.2) + 2(4.2·2.1) + 2(2.1·3.5)
= 14.7 + 17.64 + 14.7
= 47.04 × 30 motel rooms = 1411.2 m² / 40 m² = 35.28

× 36 pails
× $18.95
$682.50

$682.50

7) What happens to surface area if you:

a) Double each side of a cube?

x = edge of a cube

SA = 6x² ⇒ doubled ⇒ 2x ⇒ 6(2x)² = 6(4x²)
= 24x²

becomes 4x larger

b) Triple each side of a cube?

SA = 3x ⇒ 6(3x)² = 6(9x) = 54x

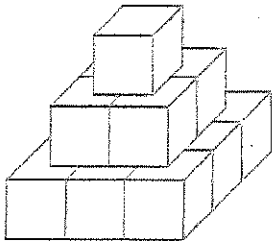
becomes 9x larger

c) Leave one side the same length, double another side and triple the third side?

SA would double, then be ↑ by a factor of 2lh + 3wh

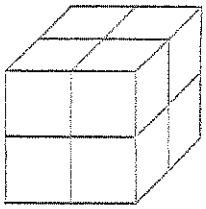
$3\frac{2}{3}$ times as large.

8) If you have [91] blocks and build a pyramid in the same pattern as the diagram shown, how many blocks are on the bottom layer?



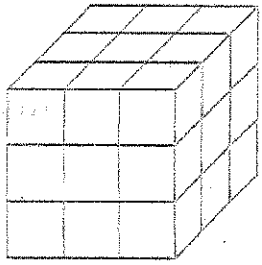
36

9) In the following diagram how many pieces have three sides showing?



8

10) In the following diagram how many pieces have:



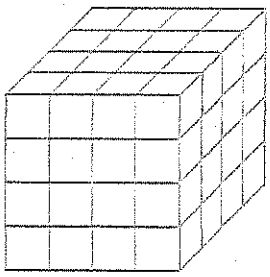
a) Three sides showing? 8

b) Two sides showing? 12

c) One side showing? 6

d) Zero sides showing? 1

11) In the following diagram how many pieces have:



a) Three sides showing? 8

b) Two sides showing? 24

c) One side showing? 16

d) Zero sides showing? 4