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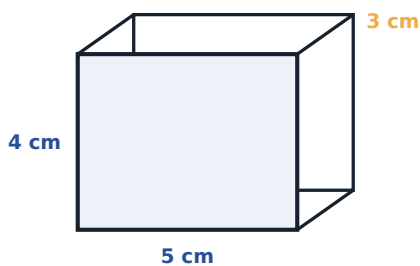
Date _____

15.6 Surface area, nets and views — worked answers

Use knowledge of area to calculate the surface area of cubes and cuboids, work with their nets, and represent the front, side and top views of a 3D shape. · 71 questions

A · Fluency — Surface areas, faces, edges and views.

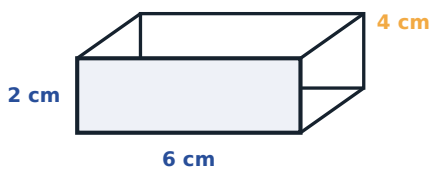
- 1 Find the **surface area** of this cuboid, in square centimetres.



Answer: 94

Six faces in three matching pairs. $5 \times 3 = 15$, $5 \times 4 = 20$ and $3 \times 4 = 12$. Adding those gives $15 + 20 + 12 = 47$, and doubling for the pairs gives $47 \times 2 = 94 \text{ cm}^2$.

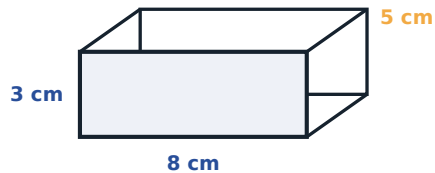
- 2 Find the **surface area** of this cuboid, in square centimetres.



Answer: 88

Six faces in three matching pairs. $6 \times 4 = 24$, $6 \times 2 = 12$ and $4 \times 2 = 8$. Adding those gives $24 + 12 + 8 = 44$, and doubling for the pairs gives $44 \times 2 = 88 \text{ cm}^2$.

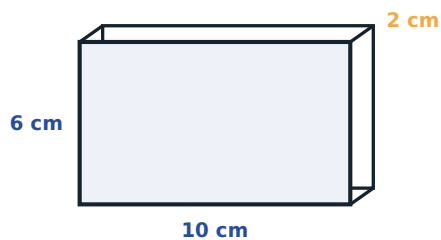
- 3 Find the **surface area** of this cuboid, in square centimetres.



Answer: 158

Six faces in three matching pairs. $8 \times 5 = 40$, $8 \times 3 = 24$ and $5 \times 3 = 15$. Adding those gives $40 + 24 + 15 = 79$, and doubling for the pairs gives $79 \times 2 = 158 \text{ cm}^2$.

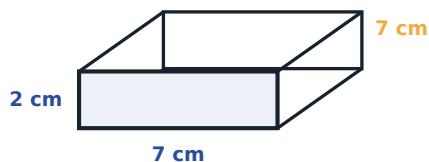
- 4 Find the **surface area** of this cuboid, in square centimetres.



Answer: 184

Six faces in three matching pairs. $10 \times 2 = 20$, $10 \times 6 = 60$ and $2 \times 6 = 12$. Adding those gives $20 + 60 + 12 = 92$, and doubling for the pairs gives $92 \times 2 = 184 \text{ cm}^2$.

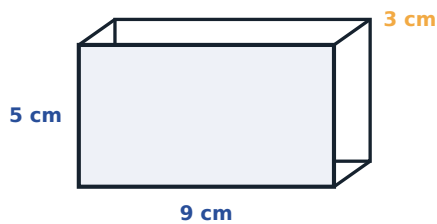
- 5 Find the **surface area** of this cuboid, in square centimetres.



Answer: 154

Six faces in three matching pairs. $7 \times 7 = 49$, $7 \times 2 = 14$ and $7 \times 2 = 14$. Adding those gives $49 + 14 + 14 = 77$, and doubling for the pairs gives $77 \times 2 = 154 \text{ cm}^2$.

- 6 Find the **surface area** of this cuboid, in square centimetres.



Answer: 174

Six faces in three matching pairs. $9 \times 3 = 27$, $9 \times 5 = 45$ and $3 \times 5 = 15$. Adding those gives $27 + 45 + 15 = 87$, and doubling for the pairs gives $87 \times 2 = 174 \text{ cm}^2$.

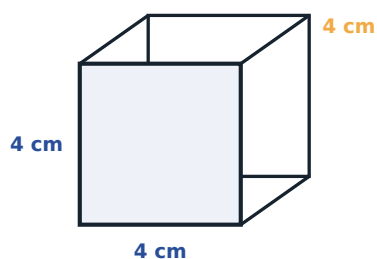
- 7 Find the **surface area** of this cuboid, in square centimetres.



Answer: 192

Six faces in three matching pairs. $12 \times 4 = 48$, $12 \times 3 = 36$ and $4 \times 3 = 12$. Adding those gives $48 + 36 + 12 = 96$, and doubling for the pairs gives $96 \times 2 = 192 \text{ cm}^2$.

- 8 Find the **surface area** of this cuboid, in square centimetres.



Answer: 96

Six faces in three matching pairs. $4 \times 4 = 16$, $4 \times 4 = 16$ and $4 \times 4 = 16$. Adding those gives $16 + 16 + 16 = 48$, and doubling for the pairs gives $48 \times 2 = 96 \text{ cm}^2$.

- 9 A cube has edges of 2 cm. What is its surface area, in square centimetres?

Answer: 24

Six identical square faces, each $2 \times 2 = 4 \text{ cm}^2$: $6 \times 4 = 24 \text{ cm}^2$.

- 10 A cube has edges of 3 cm. What is its surface area, in square centimetres?

Answer: 54

Six identical square faces, each $3 \times 3 = 9 \text{ cm}^2$: $6 \times 9 = 54 \text{ cm}^2$.

- 11 A cube has edges of 4 cm. What is its surface area, in square centimetres?

Answer: 96

Six identical square faces, each $4 \times 4 = 16 \text{ cm}^2$: $6 \times 16 = 96 \text{ cm}^2$.

- 12 A cube has edges of 5 cm. What is its surface area, in square centimetres?

Answer: 150

Six identical square faces, each $5 \times 5 = 25 \text{ cm}^2$: $6 \times 25 = 150 \text{ cm}^2$.

- 13 A cube has edges of 6 cm. What is its surface area, in square centimetres?

Answer: 216

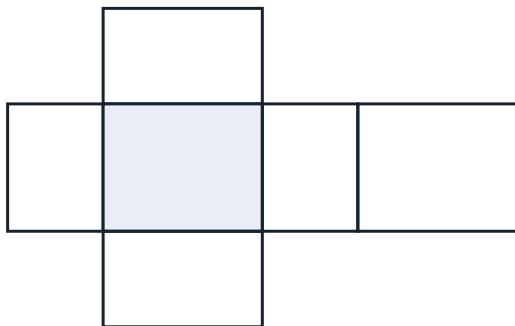
Six identical square faces, each $6 \times 6 = 36 \text{ cm}^2$: $6 \times 36 = 216 \text{ cm}^2$.

- 14 A cube has edges of 10 cm. What is its surface area, in square centimetres?

Answer: 600

Six identical square faces, each $10 \times 10 = 100 \text{ cm}^2$: $6 \times 100 = 600 \text{ cm}^2$.

- 15 This is the net of a 5 cm by 3 cm by 4 cm cuboid. What is the total area of the six rectangles, in square centimetres?

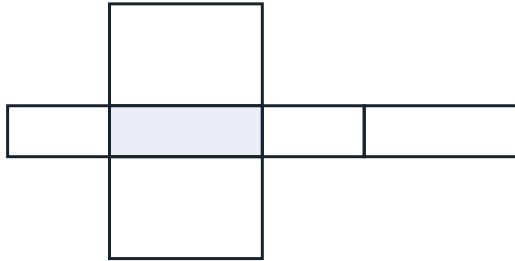


net of a 5 × 3 × 4 cm cuboid

Answer: 94

The net is the surface area laid out flat, so nothing can be missed. Two rectangles of $5 \times 3 = 15$, two of $5 \times 4 = 20$ and two of $3 \times 4 = 12$: $47 \times 2 = 94 \text{ cm}^2$.

- 16** This is the net of a 6 cm by 4 cm by 2 cm cuboid. What is the total area of the six rectangles, in square centimetres?

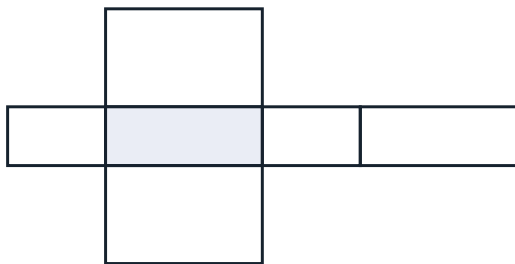


net of a $6 \times 4 \times 2$ cm cuboid

Answer: 88

The net is the surface area laid out flat, so nothing can be missed. Two rectangles of $6 \times 4 = 24$, two of $6 \times 2 = 12$ and two of $4 \times 2 = 8$: $44 \times 2 = 88 \text{ cm}^2$.

- 17** This is the net of a 8 cm by 5 cm by 3 cm cuboid. What is the total area of the six rectangles, in square centimetres?

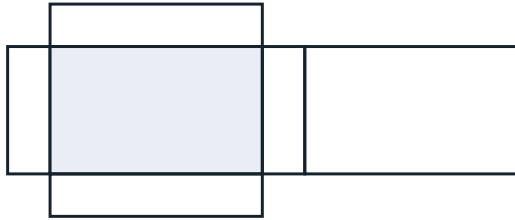


net of a $8 \times 5 \times 3$ cm cuboid

Answer: 158

The net is the surface area laid out flat, so nothing can be missed. Two rectangles of $8 \times 5 = 40$, two of $8 \times 3 = 24$ and two of $5 \times 3 = 15$: $79 \times 2 = 158 \text{ cm}^2$.

- 18** This is the net of a 10 cm by 2 cm by 6 cm cuboid. What is the total area of the six rectangles, in square centimetres?

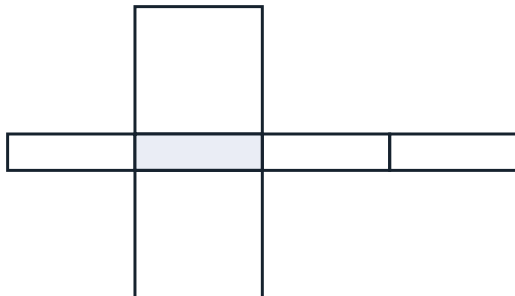


net of a $10 \times 2 \times 6$ cm cuboid

Answer: 184

The net is the surface area laid out flat, so nothing can be missed. Two rectangles of $10 \times 2 = 20$, two of $10 \times 6 = 60$ and two of $2 \times 6 = 12$: $92 \times 2 = 184 \text{ cm}^2$.

- 19** This is the net of a 7 cm by 7 cm by 2 cm cuboid. What is the total area of the six rectangles, in square centimetres?

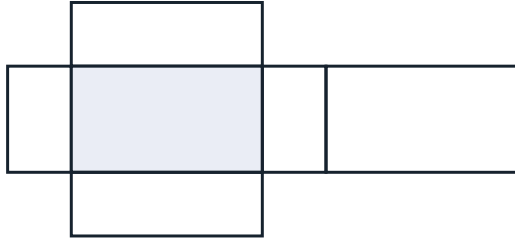


net of a $7 \times 7 \times 2$ cm cuboid

Answer: 154

The net is the surface area laid out flat, so nothing can be missed. Two rectangles of $7 \times 7 = 49$, two of $7 \times 2 = 14$ and two of $7 \times 2 = 14$: $77 \times 2 = 154 \text{ cm}^2$.

- 20** This is the net of a 9 cm by 3 cm by 5 cm cuboid. What is the total area of the six rectangles, in square centimetres?

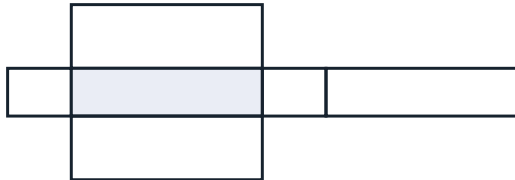


net of a $9 \times 3 \times 5$ cm cuboid

Answer: 174

The net is the surface area laid out flat, so nothing can be missed. Two rectangles of $9 \times 3 = 27$, two of $9 \times 5 = 45$ and two of $3 \times 5 = 15$: $87 \times 2 = 174 \text{ cm}^2$.

- 21** This is the net of a 12 cm by 4 cm by 3 cm cuboid. What is the total area of the six rectangles, in square centimetres?

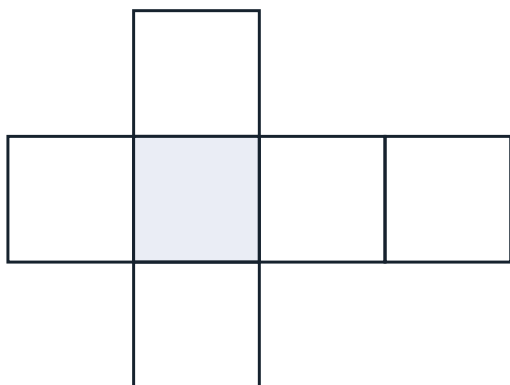


net of a $12 \times 4 \times 3$ cm cuboid

Answer: 192

The net is the surface area laid out flat, so nothing can be missed. Two rectangles of $12 \times 4 = 48$, two of $12 \times 3 = 36$ and two of $4 \times 3 = 12$: $96 \times 2 = 192 \text{ cm}^2$.

- 22** This is the net of a 4 cm by 4 cm by 4 cm cuboid. What is the total area of the six rectangles, in square centimetres?



net of a $4 \times 4 \times 4$ cm cuboid

Answer: 96

The net is the surface area laid out flat, so nothing can be missed. Two rectangles of $4 \times 4 = 16$, two of $4 \times 4 = 16$ and two of $4 \times 4 = 16$: $48 \times 2 = 96 \text{ cm}^2$.

- 23** A cuboid is 5 cm by 3 cm by 4 cm. How many **edges** does it have?

Answer: 12

Every cuboid has 12 edges: 4 of each of the three lengths. Their total is $4 \times (5 + 3 + 4) = 48 \text{ cm}$.

- 24** A cuboid is 6 cm by 4 cm by 2 cm. How many **edges** does it have?

Answer: 12

Every cuboid has 12 edges: 4 of each of the three lengths. Their total is $4 \times (6 + 4 + 2) = 48 \text{ cm}$.

- 25** A cuboid is 8 cm by 5 cm by 3 cm. How many **edges** does it have?

Answer: 12

Every cuboid has 12 edges: 4 of each of the three lengths. Their total is $4 \times (8 + 5 + 3) = 64 \text{ cm}$.

- 26** A cuboid is 10 cm by 2 cm by 6 cm. How many **edges** does it have?

Answer: 12

Every cuboid has 12 edges: 4 of each of the three lengths. Their total is $4 \times (10 + 2 + 6) = 72 \text{ cm}$.

- 27** A cuboid is 7 cm by 7 cm by 2 cm. How many **edges** does it have?

Answer: 12

Every cuboid has 12 edges: 4 of each of the three lengths. Their total is $4 \times (7 + 7 + 2) = 64 \text{ cm}$.

- 28** A cuboid is 9 cm by 3 cm by 5 cm. How many **edges** does it have?

Answer: 12

Every cuboid has 12 edges: 4 of each of the three lengths. Their total is $4 \times (9 + 3 + 5) = 68 \text{ cm}$.

- 29** A cuboid is 5 cm by 3 cm by 4 cm. What is the total length of all its edges, in centimetres?

Answer: 48

There are 4 edges of each length: $4 \times (5 + 3 + 4) = 48 \text{ cm}$.

- 30** A cuboid is 6 cm by 4 cm by 2 cm. What is the total length of all its edges, in centimetres?

Answer: 48

There are 4 edges of each length: $4 \times (6 + 4 + 2) = 48 \text{ cm}$.

- 31** A cuboid is 8 cm by 5 cm by 3 cm. What is the total length of all its edges, in centimetres?

Answer: 64

There are 4 edges of each length: $4 \times (8 + 5 + 3) = 64$ cm.

- 32** A cuboid is 10 cm by 2 cm by 6 cm. What is the total length of all its edges, in centimetres?

Answer: 72

There are 4 edges of each length: $4 \times (10 + 2 + 6) = 72$ cm.

- 33** A cuboid is 7 cm by 7 cm by 2 cm. What is the total length of all its edges, in centimetres?

Answer: 64

There are 4 edges of each length: $4 \times (7 + 7 + 2) = 64$ cm.

- 34** A cuboid is 9 cm by 3 cm by 5 cm. What is the total length of all its edges, in centimetres?

Answer: 68

There are 4 edges of each length: $4 \times (9 + 3 + 5) = 68$ cm.

- 35** A cuboid is 5 cm long, 3 cm deep and 4 cm tall. What is the area of its **front view**, in square centimetres?

Answer: 20

The front view is a rectangle 5 cm by 4 cm: $5 \times 4 = 20$ cm².

- 36** A cuboid is 5 cm long, 3 cm deep and 4 cm tall. What is the area of its **side view**, in square centimetres?

Answer: 12

The side view is a rectangle 3 cm by 4 cm: $3 \times 4 = 12$ cm².

- 37** A cuboid is 5 cm long, 3 cm deep and 4 cm tall. What is the area of its **top view**, in square centimetres?

Answer: 15

The top view is a rectangle 5 cm by 3 cm: $5 \times 3 = 15$ cm².

- 38** A cuboid is 6 cm long, 4 cm deep and 2 cm tall. What is the area of its **front view**, in square centimetres?

Answer: 12

The front view is a rectangle 6 cm by 2 cm: $6 \times 2 = 12$ cm².

- 39** A cuboid is 6 cm long, 4 cm deep and 2 cm tall. What is the area of its **side view**, in square centimetres?

Answer: 8

The side view is a rectangle 4 cm by 2 cm: $4 \times 2 = 8$ cm².

- 40** A cuboid is 6 cm long, 4 cm deep and 2 cm tall. What is the area of its **top view**, in square centimetres?

Answer: 24

The top view is a rectangle 6 cm by 4 cm: $6 \times 4 = 24$ cm².

- 41** A cuboid is 8 cm long, 5 cm deep and 3 cm tall. What is the area of its **front view**, in square centimetres?

Answer: 24

The front view is a rectangle 8 cm by 3 cm: $8 \times 3 = 24$ cm².

- 42** A cuboid is 8 cm long, 5 cm deep and 3 cm tall. What is the area of its **side view**, in square centimetres?
Answer: 15
The side view is a rectangle 5 cm by 3 cm: $5 \times 3 = 15 \text{ cm}^2$.
- 43** A cuboid is 8 cm long, 5 cm deep and 3 cm tall. What is the area of its **top view**, in square centimetres?
Answer: 40
The top view is a rectangle 8 cm by 5 cm: $8 \times 5 = 40 \text{ cm}^2$.
- 44** A cuboid is 10 cm long, 2 cm deep and 6 cm tall. What is the area of its **front view**, in square centimetres?
Answer: 60
The front view is a rectangle 10 cm by 6 cm: $10 \times 6 = 60 \text{ cm}^2$.
- 45** A cuboid is 10 cm long, 2 cm deep and 6 cm tall. What is the area of its **side view**, in square centimetres?
Answer: 12
The side view is a rectangle 2 cm by 6 cm: $2 \times 6 = 12 \text{ cm}^2$.
- 46** A cuboid is 10 cm long, 2 cm deep and 6 cm tall. What is the area of its **top view**, in square centimetres?
Answer: 20
The top view is a rectangle 10 cm by 2 cm: $10 \times 2 = 20 \text{ cm}^2$.

B · Reasoning — Why the faces pair up, and why the net helps.

- 47** What is the surface area of a solid?
- ☐ The space inside it
 - ☐ The total area of all its faces
 - ☐ The length of its edges
 - ☐ The area of its base
- Answer: The total area of all its faces**
It is what you would need to wrap it, or paint it.
- 48** How many faces has a cuboid?
- ☐ 4
 - ☐ 6
 - ☐ 8
 - ☐ 12
- Answer: 6**
Three matching pairs: front and back, left and right, top and bottom.
- 49** The surface area of a cuboid is ...
- ☐ $l \times w \times h$
 - ☐ $2(lw + lh + wh)$
 - ☐ $4(l + w + h)$
 - ☐ $6l^2$
- Answer: $2(lw + lh + wh)$**
One area for each pair of faces, then doubled.

50 The surface area of a cube of edge s is ...

- ☐ s^3
- ☐ $6s^2$
- ☐ $4s$
- ☐ $12s$

Answer: $6s^2$

Six identical square faces.

51 Surface area is measured in ...

- ☐ cm
- ☐ cm^2
- ☐ cm^3
- ☐ litres

Answer: cm^2

It is a total of areas, so it is still an area.

52 Why does the net help with surface area?

- ☐ It looks nice
- ☐ It lays all six faces out flat, so none is missed
- ☐ It shows the volume
- ☐ It does not help

Answer: It lays all six faces out flat, so none is missed

Forgetting a hidden face is the standard error.

53 Do two cuboids with the same volume have the same surface area?

- ☐ Yes
- ☐ No

Answer: No

A $1 \times 1 \times 8$ and a $2 \times 2 \times 2$ both hold 8 cm^3 , but their surface areas are 34 cm^2 and 24 cm^2 . The cube is the most economical box.

54 The **front view** of a solid is ...

- ☐ what you see from above
- ☐ what you see looking straight at it from the front
- ☐ the net
- ☐ the base

Answer: what you see looking straight at it from the front

A flat drawing with no perspective and no hidden edges.

55 How many edges and vertices has a cuboid?

- ☐ 8 edges, 12 vertices
- ☐ 12 edges, 8 vertices
- ☐ 6 edges, 8 vertices
- ☐ 12 edges, 6 vertices

Answer: 12 edges, 8 vertices

Four edges of each of the three lengths, and one corner at each of the eight combinations.

- 56** A cube is painted and cut into unit cubes. Which cubes have exactly three painted faces?
- ☐ the middle ones
 - ☐ the corner ones
 - ☐ the edge ones
 - ☐ none

Answer: the corner ones

A corner touches three outside faces — and a cube has eight corners.

C · Challenge — Working backwards, open boxes and comparisons.

- 57** A cuboid is 6 cm by 4 cm by 5 cm. What is its surface area, in square centimetres?

Answer: 148

$6 \times 4 = 24$, $6 \times 5 = 30$ and $4 \times 5 = 20$. Adding gives $24 + 30 + 20 = 74$, and doubling gives $74 \times 2 = 148 \text{ cm}^2$.

- 58** A cube has surface area 150 cm^2 . What is the length of one edge, in centimetres?

Answer: 5

Each face is $150 \div 6 = 25 \text{ cm}^2$, and the edge is the square root of 25, which is 5 cm.

- 59** A cube has surface area 96 cm^2 . What is its volume, in cubic centimetres?

Answer: 64

Each face is $96 \div 6 = 16 \text{ cm}^2$, so the edge is 4 cm and the volume is $4 \times 4 \times 4 = 64 \text{ cm}^3$.

- 60** A box 10 cm by 10 cm by 10 cm is to be wrapped. What area of paper is needed, in square centimetres, ignoring overlaps?

Answer: 600

$6 \times 10 \times 10 = 600 \text{ cm}^2$.

- 61** A 1 cm by 1 cm by 8 cm rod and a cube of edge 2 cm hold the same volume. How much larger, in square centimetres, is the surface area of the rod?

Answer: 10

Both have volume 8 cm^3 : $1 \times 1 \times 8 = 8$ and $2 \times 2 \times 2 = 8$. The rod's surface area is $2 \times (1 + 8 + 8) = 34 \text{ cm}^2$ and the cube's is $6 \times 4 = 24 \text{ cm}^2$, so the rod needs $34 - 24 = 10 \text{ cm}^2$ more. Of all the boxes holding a given volume, the cube uses the least material.

- 62** An open-topped box is 12 cm long, 8 cm deep and 5 cm tall. What is the area of card needed, in square centimetres?

Answer: 296

A closed box would be $2 \times (96 + 60 + 40) = 392 \text{ cm}^2$. Take off the missing top, which is $12 \times 8 = 96 \text{ cm}^2$: $392 - 96 = 296 \text{ cm}^2$.

- 63** A cuboid has a square base of side 3 cm and height 7 cm. What is its surface area, in square centimetres?

Answer: 102

The two square ends are $3 \times 3 = 9 \text{ cm}^2$ each, and the four side faces are $3 \times 7 = 21 \text{ cm}^2$ each. So $2 \times 9 + 4 \times 21 = 18 + 84 = 102 \text{ cm}^2$.

D · Word problems — Card, walls, pools and wrapping paper.

- 64** A box is 20 cm by 10 cm by 5 cm. What area of card is needed to make it, in square centimetres?

Answer: 700

$20 \times 10 = 200$, $20 \times 5 = 100$ and $10 \times 5 = 50$. Adding gives $200 + 100 + 50 = 350$, and doubling gives $350 \times 2 = 700 \text{ cm}^2$.

- 65** A room is 5 m by 4 m by 3 m high. What is the total area of the four walls, in square metres?

Answer: 54

Two walls are $5 \times 3 = 15 \text{ m}^2$ and two are $4 \times 3 = 12 \text{ m}^2$, so $2 \times 15 + 2 \times 12 = 30 + 24 = 54 \text{ m}^2$. The floor and ceiling are not walls.

- 66** A cube-shaped die has edges of 2 cm. What is its surface area, in square centimetres?

Answer: 24

$6 \times 2 \times 2 = 24 \text{ cm}^2$.

- 67** A swimming pool 25 m by 10 m and 2 m deep is tiled on the bottom and the four sides. What area is tiled, in square metres?

Answer: 390

The bottom is $25 \times 10 = 250 \text{ m}^2$. The two long sides are $25 \times 2 = 50 \text{ m}^2$ each and the two short ones $10 \times 2 = 20 \text{ m}^2$ each, so $2 \times 50 + 2 \times 20 = 140 \text{ m}^2$. Total $250 + 140 = 390 \text{ m}^2$.

- 68** A shipping container is 12 m by 2 m by 2 m. What is its surface area, in square metres?

Answer: 104

$12 \times 2 = 24$, $12 \times 2 = 24$ and $2 \times 2 = 4$. Adding gives $24 + 24 + 4 = 52$, and doubling gives $52 \times 2 = 104 \text{ m}^2$.

- 69** Paint covers 8 m^2 per litre. How many litres are needed for the four walls of a room 6 m by 4 m by 3 m high?

Answer: 7.5

Two walls are $6 \times 3 = 18 \text{ m}^2$ and two are $4 \times 3 = 12 \text{ m}^2$, so $2 \times 18 + 2 \times 12 = 36 + 24 = 60 \text{ m}^2$. Then $60 \div 8 = 7.5$ litres.

- 70** A gift box is a cube of edge 15 cm. What area of wrapping paper covers it exactly, in square centimetres?

Answer: 1350

$6 \times 15 \times 15 = 1350 \text{ cm}^2$.

- 71** A water tank is 2 m long, 1 m deep and 1 m tall, open at the top. What area of metal is needed, in square metres?

Answer: 8

A closed tank would be $2 \times (2 + 2 + 1) = 10 \text{ m}^2$. Take off the open top, which is $2 \times 1 = 2 \text{ m}^2$: $10 - 2 = 8 \text{ m}^2$.