2 - 1 Volume

How to Express the Amount of Space

Instruction How to compare the amount of space

Overlap
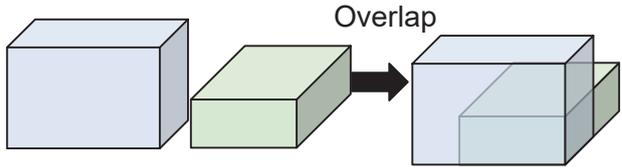
Which cuboid is larger?

Compare them using 1 cm cubic blocks. It is the similar way to calculate the "Area" as we learned in the previous grades.
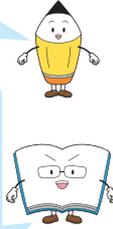
Example Find the number of blocks with 1 cm sides in the following figures below.

①

| 6 | blocks

②

| 4 | blocks

③
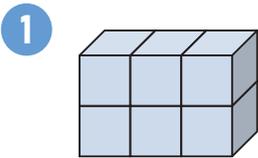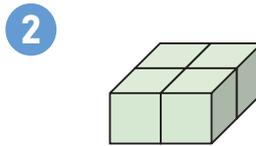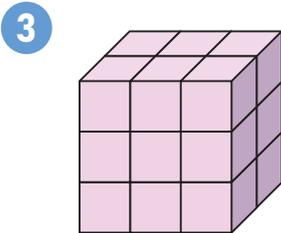
| 18 | blocks

There are 6 blocks with 3 layers.
2 blocks in length and 3 blocks in width.

Find the number of blocks with 1 cm sides in the following figures below.

①

| | blocks

②

| | blocks

③

| | blocks

④
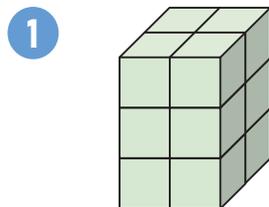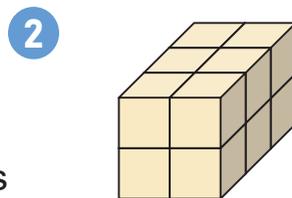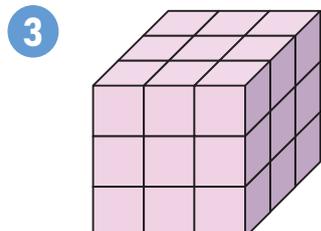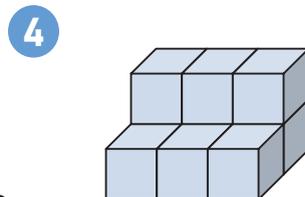
| | blocks

2 - 2 Volume

Volume of Cuboids and Cubes (1)

Instruction Volume

- The size of a solid is called its "**volume**".
- The volume of a cube with sides of 1 cm is called 1 **cubic centimeter**, and it is written as 1 **cm³**.
- "Cubic centimeter" is a unit of volume.

1 cm³
1 cm
1 cm
1 cm
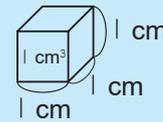
Example 1 If you stack 4 layers of the following blocks, what is the volume? Fill in the blanks.
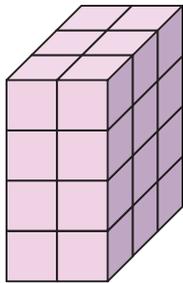
$$\boxed{3} \times \boxed{2} \times \boxed{4} = \boxed{24} \text{ cm}^3$$

| Number for length | Number for width | Number for height |

1 Find the volume.

1 When you stack 3 layers of the following blocks.

$$\boxed{} \times \boxed{} \times \boxed{} = \boxed{} \text{ cm}^3$$
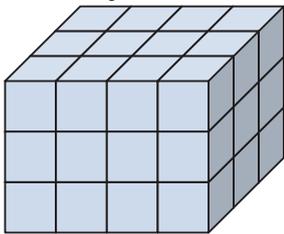
| Number for length | Number for width | Number for height |

2 Find the volume when you stack 5 layers of the following blocks.

$$\boxed{} \times \boxed{} \times \boxed{} = \boxed{} \text{ cm}^3$$
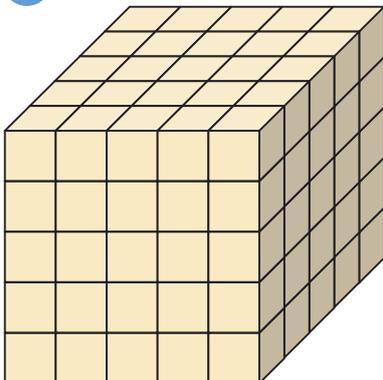
| Number for length | Number for width | Number for height |

Instruction How to Calculate Volume

(Volume of Cuboid) = (Length) × (Width) × (Height)

(Volume of Cube) = (Length of Side) × (Length of Side) × (Length of Side)

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2 - 3　Volume

Volume of Cuboids and Cubes (2)

Example 1　Find the volume of the following figure

3 cm
4 cm
5 cm
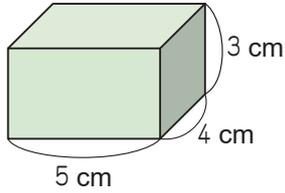
Math sentence　　$5 \times 4 \times 3 = 60$

Answer　　60 cm^3

1　Find the volume of the following figures.
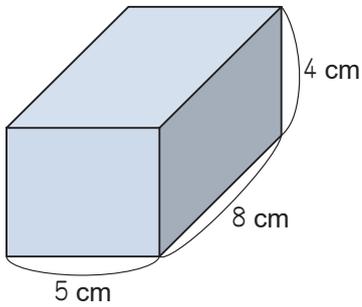
1

4 cm
8 cm
5 cm

Math sentence

Answer _____

2

4 cm
4 cm
4 cm

Math sentence

Answer _____

3

6 cm
4 cm
2.5 cm

Math sentence

Answer _____

4

3 cm
5 cm
6 cm
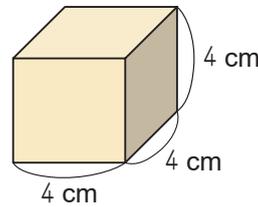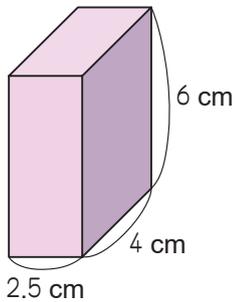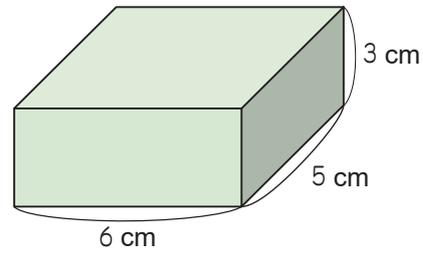
Math sentence

Answer _____

Example 2　The volume of the following cuboid is 150 cm^3, the length and the width of the cuboid are 6 cm and 5 cm.

□ cm
5 cm
6 cm
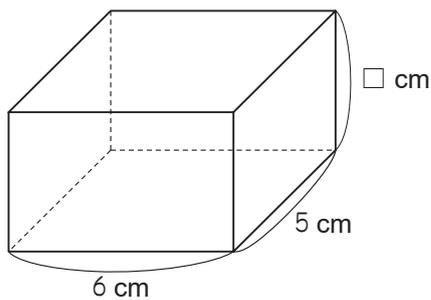
1　Letting the height be □ cm, make a math sentence to find the volume.

(Length) × (Width) × (Height) = (Volume)

Math sentence
$$6 \times 5 \times \square = 150$$
$$30 \times \square = 150$$

2 Find the height.
Since $30 \times \square = 150$, dividing 150 by 30 to find the value of $\square$.

Math sentence

$$30 \times \square = 150$$
$$\square = 150 \div 30$$
$$= 5$$

Answer ___5 cm___

2 The volume of the following cuboid is 36 cm^3, the length and the width of the cuboid are 3 cm and 2 cm.

1 Letting the height be $\square$ cm, make a math sentence to find the volume.

Math sentence

3 cm
2 cm
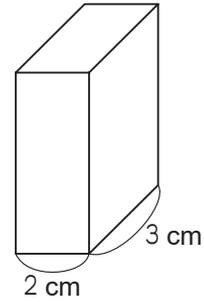
2 Find the height

Math sentence

Answer _____

Example 3 Find the volume of the cuboid that can be assembled with the following net.

1 cm

3 cm

4 cm
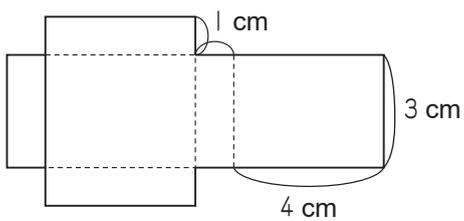
Math sentence $\quad 4 \times 3 \times 1 = 12$

Answer $\quad 12 \text{ cm}^3$

3 Find the volume of the cuboid that can be assembled with the following net.
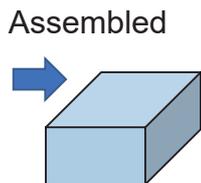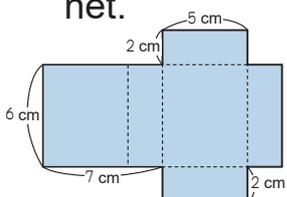
5 cm
2 cm
6 cm
7 cm
2 cm

Assembled

1 What is the dimension of the cuboid?

Length: _____ cm   Width: _____ cm

Height: _____ cm

2 Find the volume of the cuboid

Math sentence

Answer _____

11

2 - 4 Volume

Ideas for Finding Volume

Example Find the volume of the figure below.

4 cm
8 cm
6 cm
8 cm 5 cm
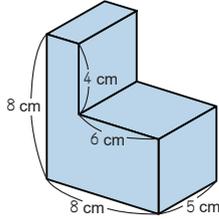
> How can we think about the volume of this kind of solid figure?

> How about dividing the figure? Let's think.

Idea 1

1. Divide a given figure into two cuboids and calculate.	2. Sum up the two volumes and find the total volume.
5 cm 2 cm A 8 cm 6 cm 5 cm 4 cm B Cuboid A $5 \times 2 \times 8 = 80$ Cuboid B $5 \times 6 \times 4 = 120$	$80 + 120 = 200$ <u>200 cm^3</u>
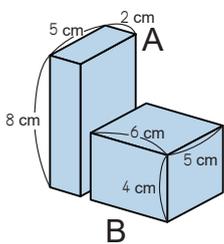
Idea 2

1. The given figure is obtained by subtracting the part of the dotted line from the large cuboid.	2. Calculate the volumes separately.
4 cm 8 cm 6 cm 8 cm 5 cm	Cuboid A $5 \times 8 \times 8 = 320$ 8 cm B 4 cm A 8 cm 5 cm 6 cm 5 cm Cuboid B $5 \times 6 \times 4 = 120$

3. Subtract the dotted line from the larger one.

$$320 - 120 = 200 \quad \underline{200 \text{ cm}^3}$$

Alternatively, given the height of the solid figure is 8 cm, I wonder we could cut and paste as follows and find the volume.

4 cm
4 cm

Cut and paste ➡

4 cm
5 cm
2 cm 8 cm
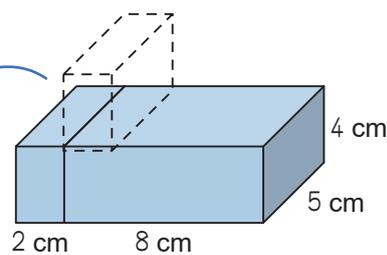
<u>Math sentence</u> $(2 + 8) \times 5 \times 4 = 200$

<u>Answer</u> <u>200 cm^3</u>

1 Find the volume of the following figure by using the following ways.
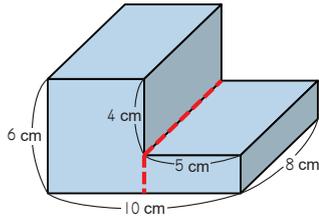
① By dividing the figure into two cuboids as follows.
Calculate the volumes separately.
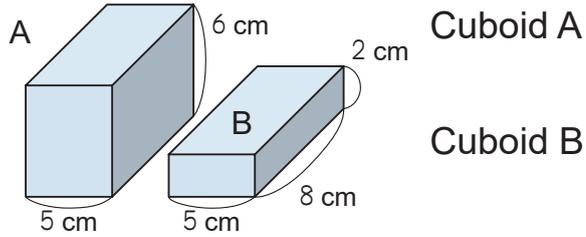
Cuboid A

Cuboid B

Math
sentence

Answer _____

② By subtracting a part from the whole.

1. Calculate the volumes separately.	2. Subtract cuboid D from cuboid C
Cuboid C Cuboid D	Math sentence Answer _____

③ By cutting the figure and paste to make a cuboid.

Cut and paste

Math sentence

Answer _____

13
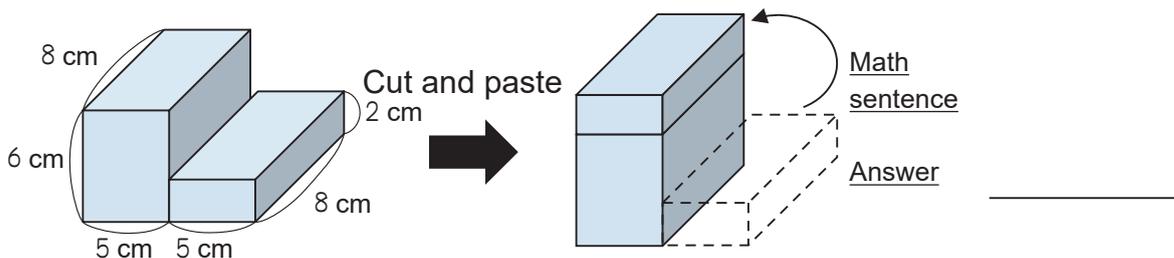
2 - 5   Volume

Various Units of Volume and Capacity (1)

Example 1   Answer the following questions.

1 Find the volume of the cuboid on the right.

Math sentence $3 × 2 × 2 = 12$

Answer $12 m^3$
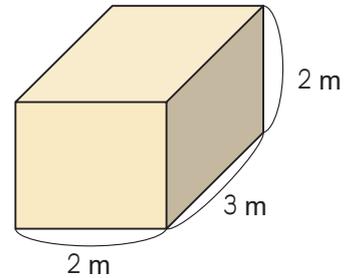
2 How many cm^3 is $1 m^3$?

$1 m = 100 cm$

$$\underset{\text{Length}}{100} × \underset{\text{Width}}{100} × \underset{\text{Height}}{100} = 1000000 \ cm^3$$
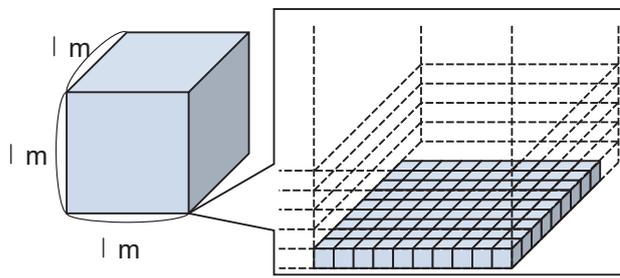
- The volume of a cube with sides of 1 m is called 1 cubic meter, and it is written as $1 m^3$.
- "Cubic meter" is a unit of volume.
- $1 m^3 = 1000000 cm^3$

---

1 Find the volume of the following figures.

1

5 m
5 m
5 m

Math sentence

Answer _____

2

3 m
0.5 m
0.5 m
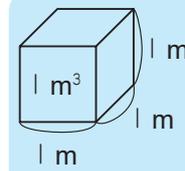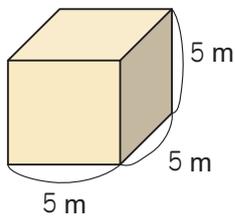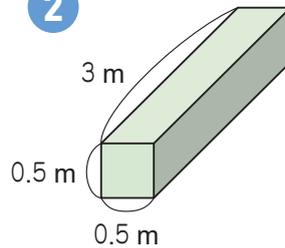
Math sentence

Answer _____

2 How many cm^3 is $24 m^3$?

Math sentence

Answer _____

14

Example 2 There is a container with the shape of a cuboid that is made of 1 cm thick wood as shown on the right.

1 Fill in the blanks with numbers.

Since the container is made of 1 cm thick wood, the size of the inside container is as follows:

Length: $\boxed{7} - 2 = \boxed{5}$

In length, the edge of the container has 2, so subtract 2 cm.

Width: $\boxed{7} - \boxed{2} = \boxed{5}$

Height: $\boxed{5} - 1 = \boxed{4}$

1 cm

5 cm

7 cm   7 cm
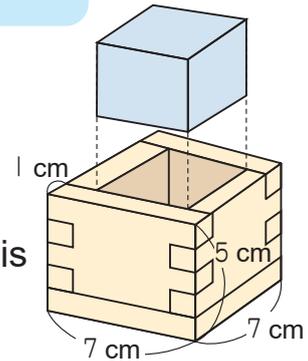
2 How many cm^3 is the volume of water that fills this container?

Math sentence $5 \times 5 \times 4 = 100$ Answer 100 cm^3

- The inside length, width, and height of the container are called the inside measures. The inside height is also called the depth.
- The size of a container is measured by the volume of water that it can hold. This volume is the capacity of the container.

3 Fill in the blank with a word or numbers.

When water is put into a container such as a cup or mass, the volume of water to be put is called $\boxed{}$.

4 Answer the following questions.
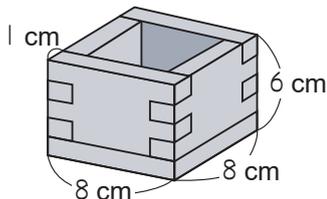
1 cm

6 cm

8 cm   8 cm

1 What is the dimension of the inside measures?

Length: $\boxed{}$ cm   Width: $\boxed{}$ cm

Depth: $\boxed{}$ cm

2 How many cm^3 is the capacity of the container?

Math sentence

Answer   _____

15

2 - 6 Volume
Various Units of Volume and Capacity (2)

Example 1 There is a 1 L container whose inside length, width, and height has 10 cm. Find the capacity of the container.

Math sentence $10 \times 10 \times 10 = 1000$ Answer $\underline{1000 \text{ cm}^3}$
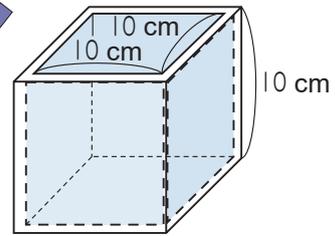
- $1 \text{ L} = 1000 \text{ cm}^3$
- $1 \text{ mL} = 1 \text{ cm}^3$

1 Find the capacity of the following containers. How much mL or L of water can hold?

1

12 cm
8 cm 6 cm

Math sentence

Answer _____

2

30 cm
40 cm
25 cm
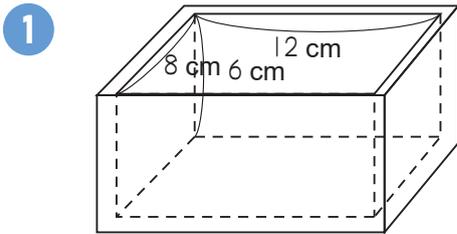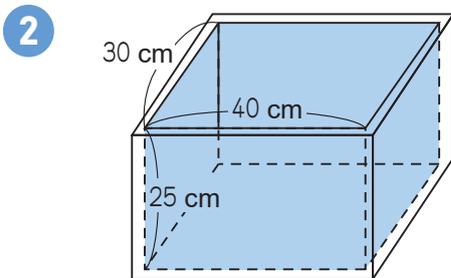
Math sentence

Answer _____

2 There is a container with the shape of a cuboid that is made of 2 cm thick wood as shown below. Answer the following questions.
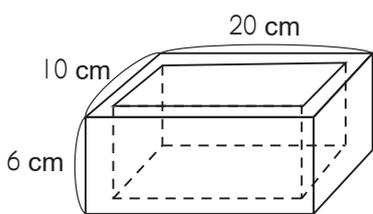
20 cm
10 cm
6 cm

1 What is the dimension of the inside measures?

Length: [   ] cm   Width: [   ] cm

Depth: [   ] cm

2 How many cm^3 is the capacity of the container?

Math sentence

Answer _____

3 How much mL or L of water can hold?

[   ]

Example 2   How many L is $1\ m^3$?

Since $1\ m = 100\ cm$,

$$1\ m^3 = 100 \times 100 \times 100 = 1000000\ cm^3$$

Since $1\ L = 1000\ cm^3$,

$$1000000 \div 1000 = 1000 \qquad \underline{\quad 1000\ L \quad}$$

$1000\ L = 1\ kL$

$1\ cm$	$10\ cm$	$1\ m$
$1\ cm^3$		$1\ m^3$
$1\ mL$	$1\ L$	$1\ kL$

---
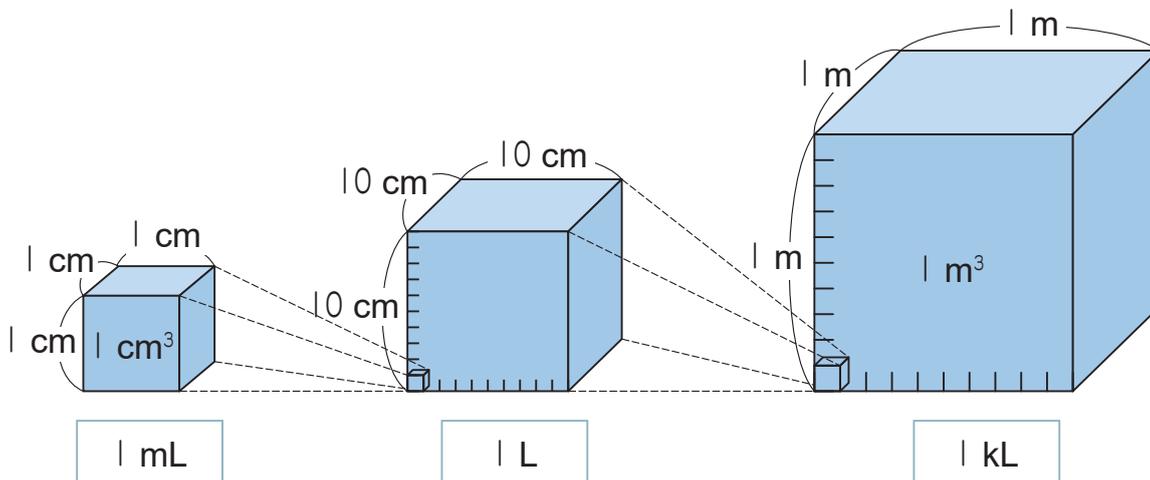
2   Fill in the blanks with numbers.

Length of side	$1\ cm$	$10\ cm$	$1\ m$
The area of the square	$1\ cm^2$	$100\ cm^2$	$1\ m^2$
The volume of the cube			$1\ m^3$
The capacity of the cube		$1\ L$	kL

When the length of a side is 10 times, the area makes (10×10) times, and the volume makes $(10 \times 10 \times 10)$ times.

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2 - 7 Volume
Finding the Approximate Volume and Capacity

Example 1 Find the approximate volume of the rock on the picture. The rock with length is 52 cm, width is 18 cm, and height is 21 cm. Let length be 50 cm, width and height be 20 cm and calculate.

20 cm
20 cm
100 cm
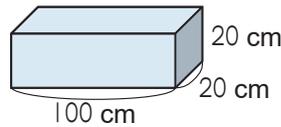
Math sentence $\quad 50 \times 20 \times 20 = 20000$

Answer $\quad$ 20000 cm^3

1 Find the approximate volume of the following sizes of figures.

A block with length is 9 cm, width is 11 cm, and height is 5 cm.
Let length and width be 10 cm and calculate.

Math sentence $\qquad$ Answer $\qquad\qquad$

Example 2 Find the approximate capacity of the bathtub to find out how much water it can store.

1 What shape does the container look like?

Cuboid
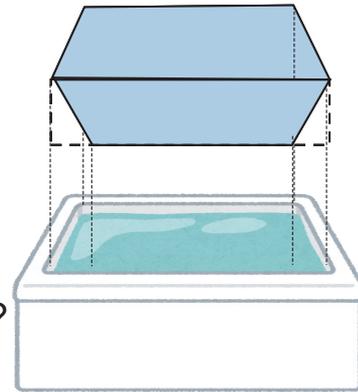
2 How many L of water can this container hold?

100 cm
80 cm
50 cm
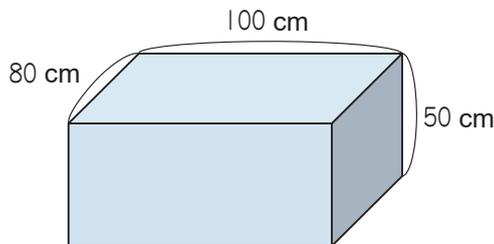
Math sentence $\quad 100 \times 80 \times 50 = 400000$

Since, 1 L $= 1000$ cm^3

400000 cm$^3 = 400$ L

Answer $\qquad$ 400 L

You can calculate the volume by approximating the objects into the figures you have learned so far.

18

2 Approximate the volume of the container to know how much it can store.

① What shape does the container look like?
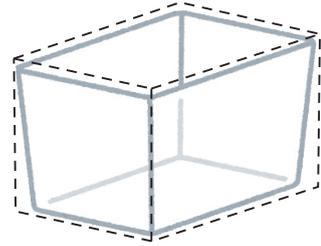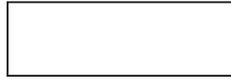
② Consider the container has the following dimensions. How many cm^3 is it?

30 cm
60 cm
30 cm
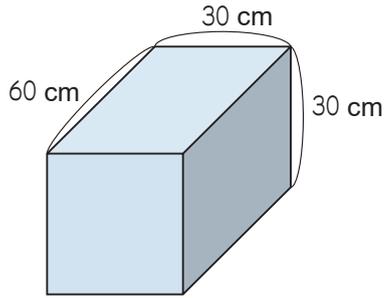
Math sentence

Answer _____

3 Approximate the volume of the container to know how much water it can store.

① What shape does the container look like?
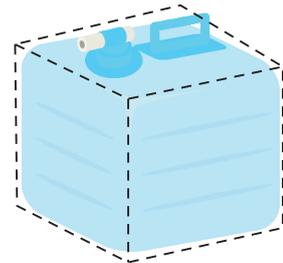
② Consider the container has the following dimensions. Approximate how many L it can store?

30 cm
30 cm
30 cm
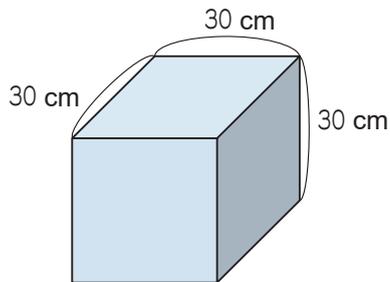
Math sentence

Answer _____

4 Approximate the volume of the following objects.

① A loaf of bread

20 cm
12 cm
12 cm
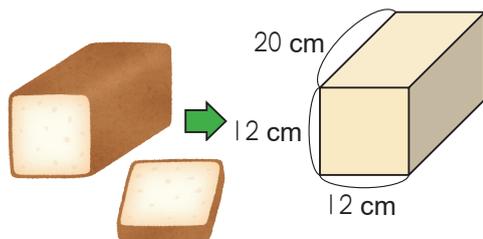
Math sentence

Answer _____

② A milk carton

MILK

20 cm
7 cm
7 cm

Math sentence

Answer _____

19
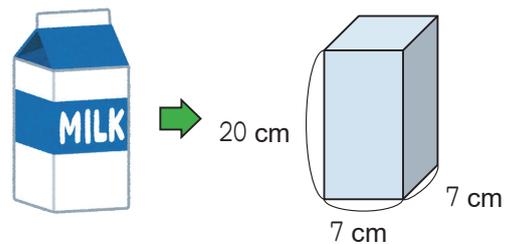
2 - 8　Volume

Review

1 Find the number of blocks with 1 cm sides in the following figures below.

1

blocks

2

blocks

2 Find the volume of the following figures.

1

2 cm
5 cm
7 cm

Math sentence

Answer _____

2

3 cm
3 cm
3 cm

Math sentence

Answer _____

3

3 m
8 m
2 m

Math sentence

Answer _____

4

0.7 m
0.7 m
10 m
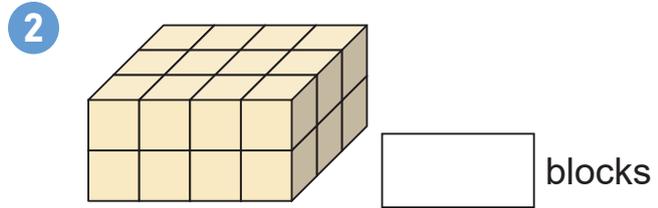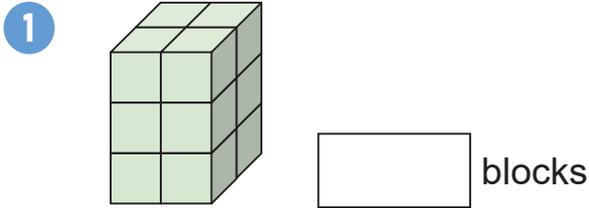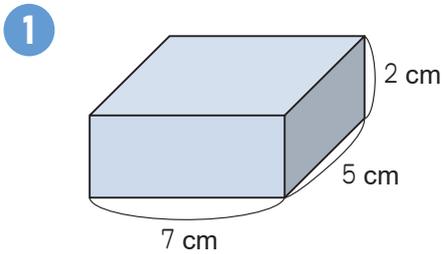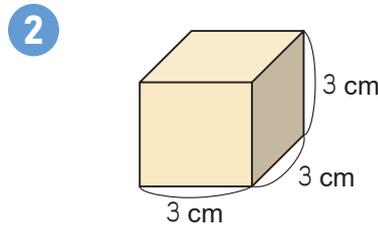
Math sentence

Answer _____

3 Find the volume of the cuboid that can be assembled with the following net.

5 cm
2 cm
2 cm
7 cm
5 cm
2 cm
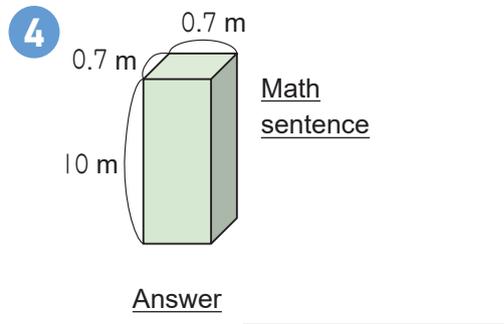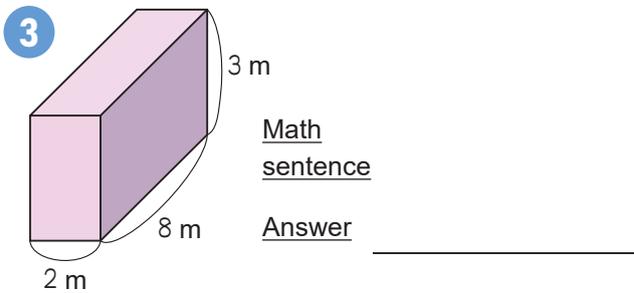
Assembled

1 What is the dimension of the cuboid?

Length: [ ] cm　Width: [ ] cm

Height: [ ] cm

2 Find the volume of the cuboid

Math sentence

Answer _____

4 Find the volume of the following figure by dividing the figure into two cuboids.

4 cm
10 cm
15 cm
5 cm
4 cm
10 cm
8 cm

1. Divide a given figure into two cuboids.	2. Calculate the volumes separately.
4 cm 10 cm 15 cm 5 cm 4 cm 10 cm 8 cm	Cuboid A Cuboid B A B
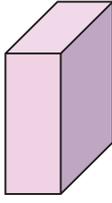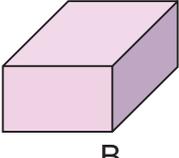
Math
sentence

Answer _____

5 Answer the following questions.

120 cm
80 cm
60 cm

1 What is the dimension of the inside measures?

Length: [ ] cm   Width: [ ] cm

Depth: [ ] cm

2 How many cm^3 is the capacity of the container?

Math
sentence

Answer _____

3 How many L of water can hold this container?

[ ]

1000 cm^3 = 1 L

4 If you use a 20 L container, how many times you should fetch water to fill the container?

Math
sentence

Answer _____

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