Volume

Volume

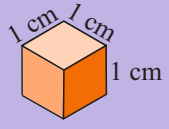
The amount of space occupied by a three-dimensional solid object is called its ***volume***.

Common units of volume are:
- cubic millimetres (mm^3)
- cubic centimetres (cm^3)
- litres
- cubic metres (m^3)

The unit used would depend on the size of the volume.

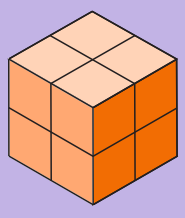
1 mm^3 is the volume of a cube with side lengths of 1 mm.
1 cm^3 is the volume of a cube with side lengths of 1 cm.
1 litre is the volume of a cube with side lengths of 10 cm.
1 m^3 is the volume of a cube with side lengths of 1 m.

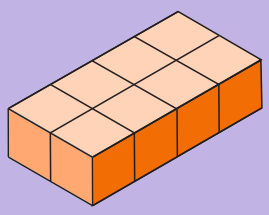
This cube has a volume of 1 cm^3.

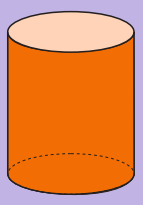


But many shapes would have the same volume.

Examples All the objects below have a volume of 8 cm^3.





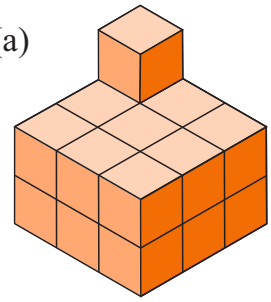


Rectangular Prisms

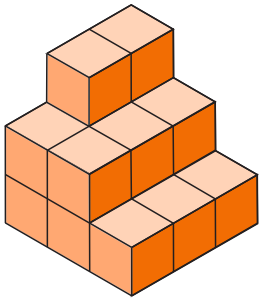
EXERCISE 18A

1. How many small cubes are in each of the following objects?

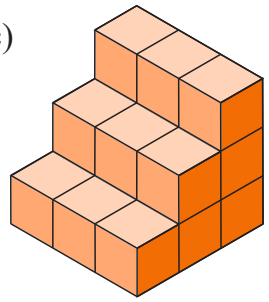
(a)



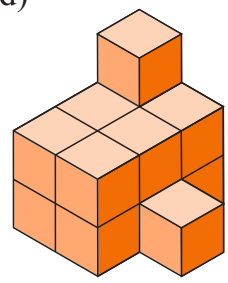
(b)



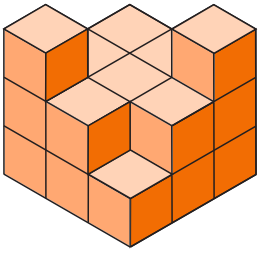
(c)



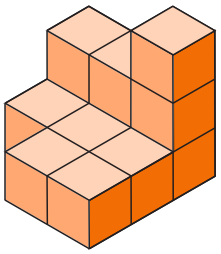
(d)



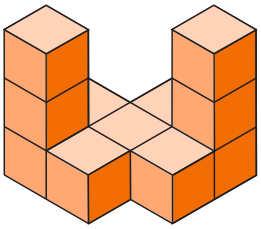
(e)



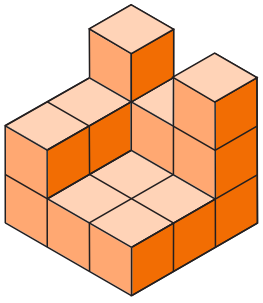
(f)



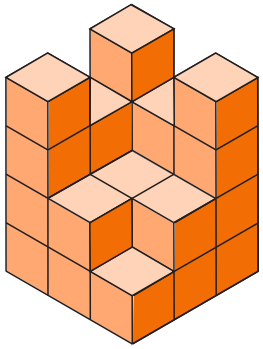
(g)



(h)



(i)



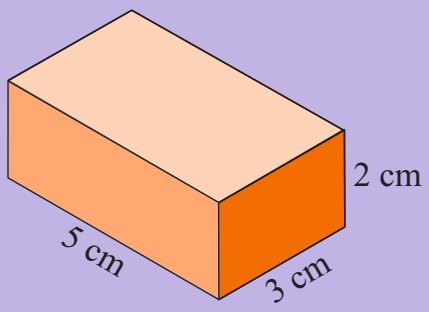
2. If each of the small cubes in the objects in question 1 have a volume of 1 cm^3, state the volume of each object.

A ***rectangular prism*** is a three-dimensional object that has rectangles on all three faces.

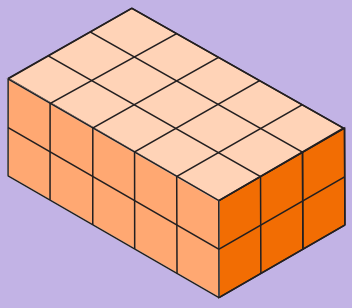
Example

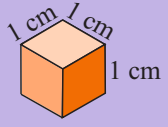
The rectangular prism shown here has the following dimensions:

length = 5 cm
width = 3 cm
height = 2 cm



Its volume can be found by seeing how many one centimetre cubes would be needed to make this object.



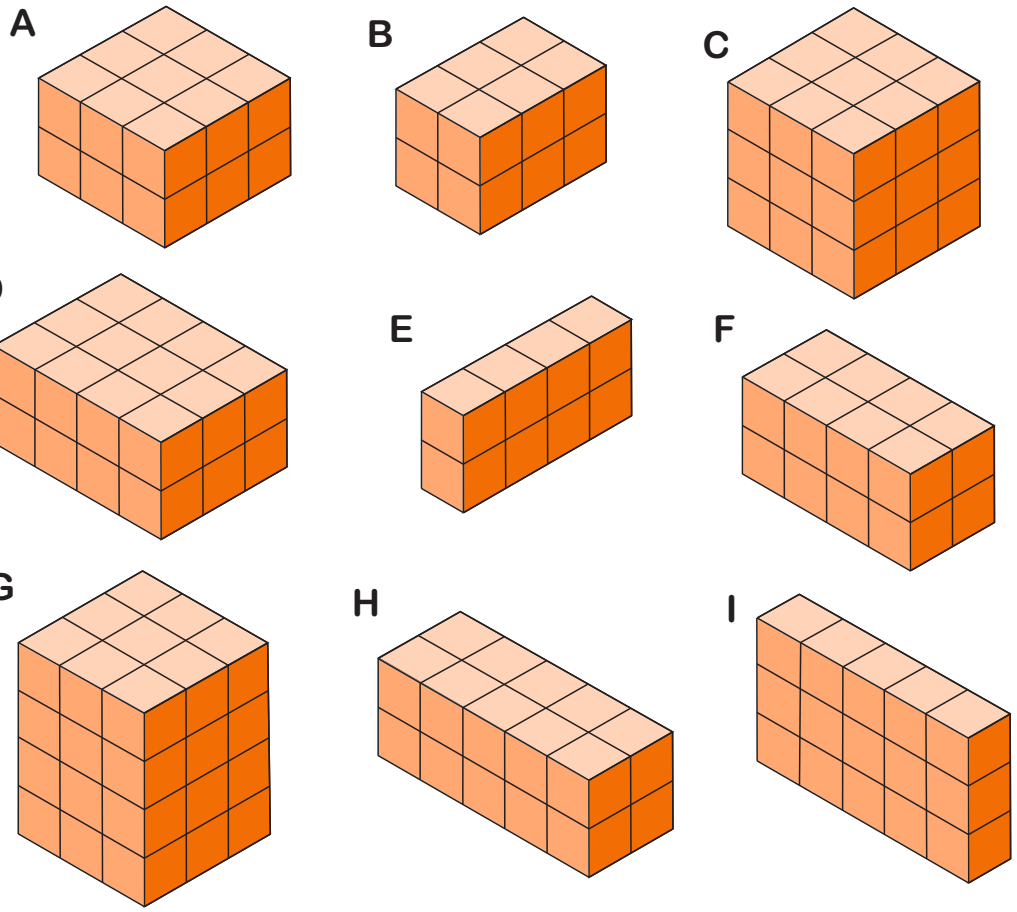


It would take 30 one centimetre cubes to make this object.
Each one centimetre cube has a volume of one cubic centimetre (1 cm^3).

Volume **= 30 cm^3**

3. Copy the table below into your books.
Complete it by filling in the side lengths and the volume of each of the objects shown below.
Each of the small cubes in the rectangular prisms is one cubic centimetre (1 cm^3).

Object	Length (cm)	Width (cm)	Height (cm)	Volume (cm^3)
A	3	3	2	18
B				
C				
D				
E				
F				
G				
H				
I				



4. (a) Using the answers from question 3 as examples describe how the volume of a rectangular prism can be found.

(b) Complete the following rule by placing the correct arithmetic operations $+$, $-$, $\div$ or $\times$ in the boxes.

Volume = length ☐ width ☐ height

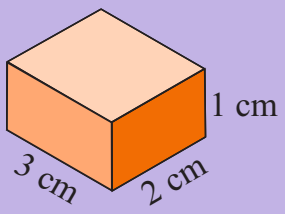
5. Find the volume of each of the rectangular prisms below.

Example

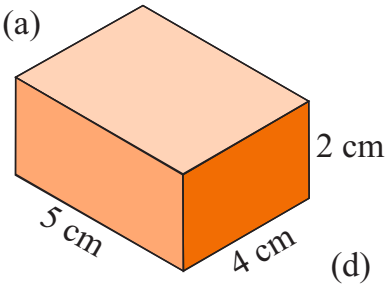
Volume = length × width × height

= 3 × 2 × 1

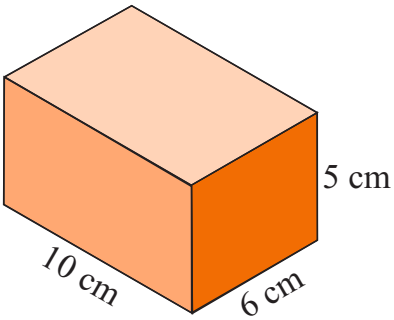
= **6 cm^3**



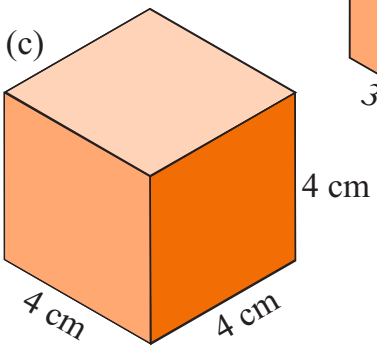
(a)



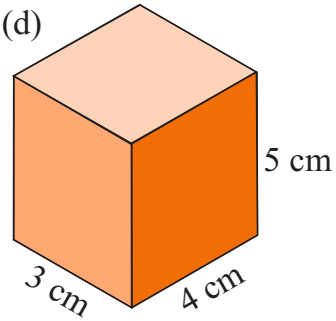
(b)



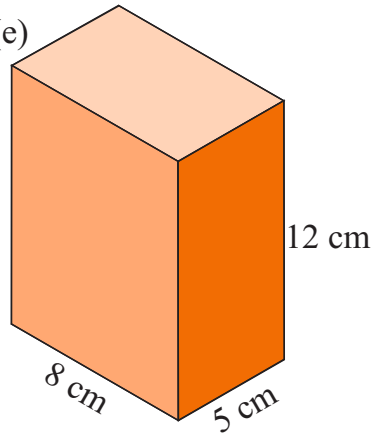
(c)



(d)



(e)



6. Find the volume of the rectangular prisms with the dimensions shown in the table below.

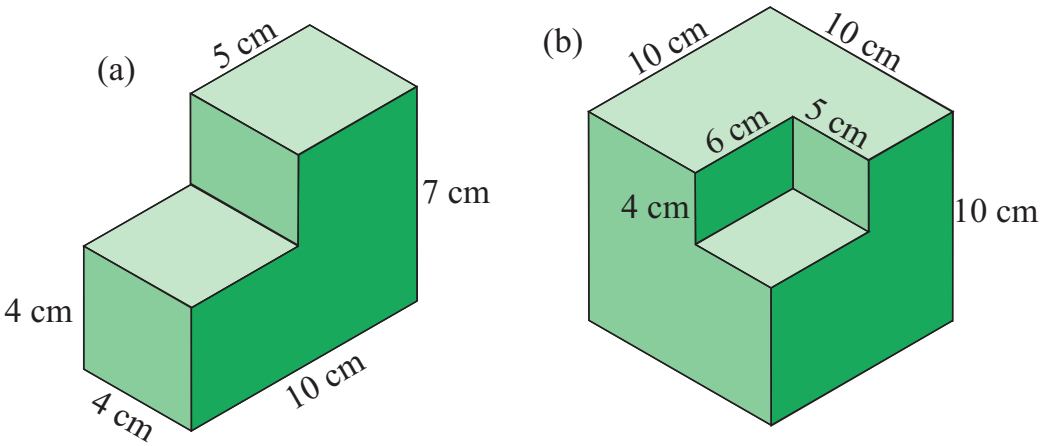
	Length (cm)	Width (cm)	Height (cm)
(a)	3	5	2
(b)	10	10	4
(c)	12	5	2
(d)	20	30	10
(e)	8	9	6

7. Find the volume of a cube with side length 10 cm.

8. (a) List the dimensions of all the different rectangular prisms that could be formed using 24 one cubic centimetre cubes.
(b) Find the height of a rectangular prism formed using 24 one cubic centimetre cubes that has a length and width of 2 cm.
(c) State the dimensions of a rectangular prism formed using 24 one centimetre cubes that has a length which is 1 cm longer than its width and 2 cm longer than its height.

9. A rectangular prism has a volume of 100 cm^3. Its height is 1 cm less than its length and its width is equal to its length.
Find its height if all the dimensions are whole numbers.

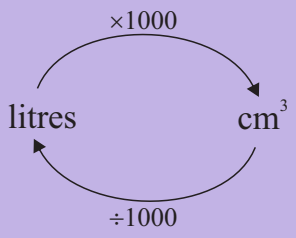
10. Find the volume of the following objects.



Litres

EXERCISE 18B

1 litre = 1000 cm^3



Remember -
When ***multiplying*** by 1000 move the decimal point 3 places to the ***right***.
When ***dividing*** by 1000 move the decimal point 3 places to the ***left***.
Add zeros where necessary.

1. Convert the following volumes to litres.

Examples

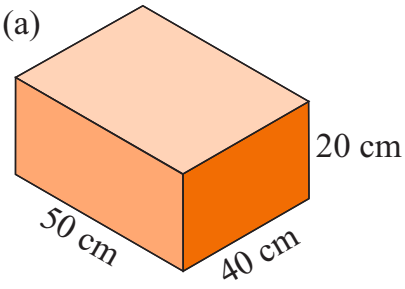
1. 3000 cm^3
= 3000 ÷ 1000
= 3000.
= **3 litres**

2. 28.5 cm^3
= 28.5 ÷ 1000
= .0285
= **0.0285 litres**

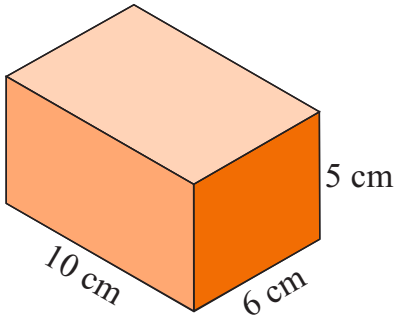
(a) 8000 cm^3 (b) 12 000 cm^3 (c) 200 000 cm^3
(d) 500 cm^3 (e) 9600 cm^3 (f) 35 700 cm^3
(g) 410 cm^3 (h) 20 cm^3 (i) 85 cm^3
(j) 3976.5 cm^3 (k) 13.4 cm^3 (l) 258.7 cm^3
(m) 1 cm^3 (n) 8.5 cm^3 (o) 0.7 cm^3

2. Find the volume (in litres) of the following rectangular prisms.

(a)



(b)



3. Declan made a go-cart and used a petrol tank that was in the shape of a rectangular prism with dimensions 20 cm × 10 cm × 10 cm.
(a) How many litres of petrol will the tank hold?
(b) Declan's go-cart will travel 5 km per litre of petrol. How far will the go-cart travel on a full tank of petrol?

4. Convert the following volumes to cubic centimetres.

Examples

1. 5 litres
$= 5 \times 1000$
$= 5.$
$= \mathbf{5000\ cm^3}$

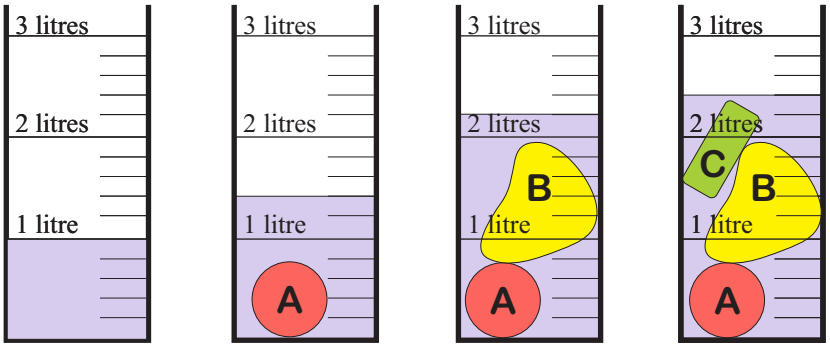
2. 0.6875 litres
$= 0.6875 \times 1000$
$= 0.6875$
$= \mathbf{687.5\ cm^3}$

(a) 2 litres
(b) 7 litres
(c) 13 litres
(d) 80 litres
(e) 4.1 litres
(f) 7.15 litres
(g) 12.685 litres
(h) 10.08 litres
(i) 5.5555 litres
(j) 0.9 litres
(k) 0.6752 litres
(l) 5.0008 litres
(m) 0.0052 litres
(n) 0.01 litres
(o) 0.00007 litres

5. How many 200 cm^3 glasses could be filled from a 2 litre bottle?

6. A container in the shape of a rectangular prism holds half a litre of drink. The base of the container is a square with side length 5 cm. What is the height of the drink container?

7.



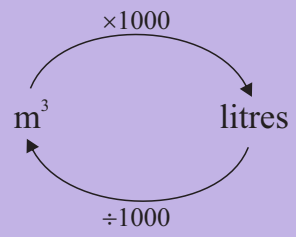
A glass cylinder with volume markings on the side, as shown above, has an amount of water in it. Three objects, A, B and C, are dropped into the cylinder and the volume recorded after each one is dropped in.

(a) What volume of water was in the cylinder before the objects were dropped in?

(b) What is the volume (in cm^3) of each of the objects?

8. A fish tank has the dimensions of 50 cm long, 30 cm wide and 40 cm deep. How many 10 litre buckets filled with water will it take to fill the fish tank?

9. Convert the following volumes to litres.



Remember -
When ***multiplying*** by 1000 move the decimal point 3 places to the ***right***.
When ***dividing*** by 1000 move the decimal point 3 places to the ***left***.
Add zeros where necessary.

(a) 4 m^3 (b) 12 m^3 (c) 50 m^3 (d) 0.5 m^3
(e) 1.2 m^3 (f) 0.01 m^3 (g) 5.08 m^3 (h) 6.9875 m^3

10. Find the volume (in litres) of rectangular prisms with the following dimensions.

(a) 2 m × 3 m × 1 m
(b) 2 m × 2 m × 2 m
(c) 3 m × 4 m × 5 m
(d) 4 m × 5 m × 0.5 m
(e) 2 m × 1 m × 1.6 m
(f) 2.4 m × 3 m × 1.5 m
(g) 0.8 m × 0.6 m × 1 m
(h) 1.2 m × 0.5 m × 0.9 m
(i) 2 m × 100 cm × 50 cm
(j) 1 m × 80 cm × 70 cm
(k) 180 cm × 150 cm × 20 cm
(l) 200 cm × 250 cm × 30 cm

11. (a) A container for transporting goods by ship was 6 metres long, 3 metres wide and 2.5 metres high.
What is the capacity of the container in: (i) m^3 (ii) litres
(b) Another container was in the shape of a cube and had a capacity of 27 000 litres. Find the side length (in metres) of the container.

12. A drinking water trough for horses was 2 metres long, 1 metre wide and 50 centimetres deep.
(a) How many litres of water does the trough hold?
(b) The trough is filled using a hose. The water flows from the hose at the rate of 100 litres per minute. How long would it take to fill the trough using this hose?
(c) There are 5 horses using the drinking trough and each horse drinks about 40 litres of water a day.
For how many days would this trough supply drinking water for the 5 horses?

PROBLEM SOLVING

1. A tray is to be made to hold 30 children's blocks. The blocks are cubes with side length 6 cm. The tray is to be as close to square shaped as possible. The blocks are to be two deep in the tray.
Find the dimensions of the tray.

2. Explain how a 9 litre and 4 litre container can be used to measure the following volumes.
(a) 3 litres (b) 5 litres (c) 6 litres (d) 7 litres

Example **1 litre** can be obtained by following these steps:
- fill the 9 litre container
- fill the 4 litre container from the 9 litre container
- empty the 4 litre container
- fill the 4 litre container from the 9 litre again
- there is 1 litre remaining in the 9 litre container

PUZZLE

Change EMPTY into LITRE by changing one letter at a time and rearranging the letters to form a new word. A clue for each word is given.

E	M	P	T	Y
L	I	T	R	E

Uses a keyboard

Paces

Used at the end of sentences - full ___

Tennis, hockey, football, netball, cricket, etc.

Used to catch animals

Birthday, New Year's Eve, etc.

Thick at one end and thin at the other end

King of Macedonia (356-323 BC) Alexander the __

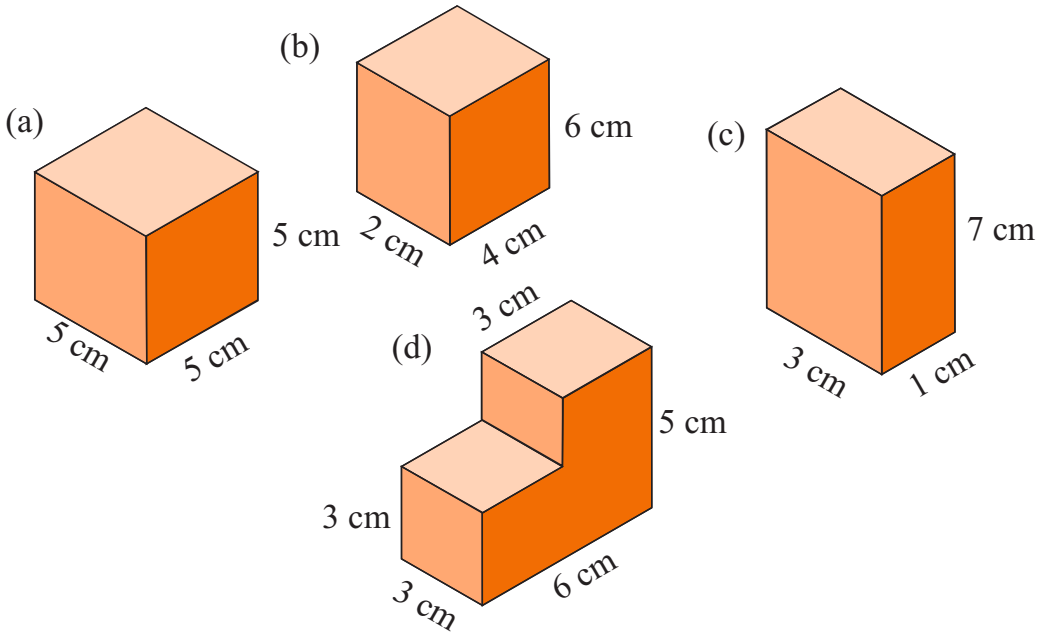
One of the felines

The square root of sixty-four

Often misspelt THERE

CHAPTER REVIEW

1. Find the volume (in cm^3) of the rectangular prisms below.



2. Find the volume (in litres) of the rectangular prisms with the following dimensions.

(a) 4 m × 1 m × 1 m
(b) 3 m × 2 m × 3 m
(c) 1 m × 2 m × 5 m
(d) 2 m × 5 m × 0.5 m
(e) 2 m × 2 m × 2.5 m
(f) 0.4 m × 3 m × 1.5 m
(g) 80 cm × 30 cm × 10 cm
(h) 20 cm × 50 cm × 16 cm
(i) 20 cm × 10 cm × 5 cm
(j) 30 cm × 80 cm × 20 cm
(k) 180 cm × 150 cm × 20 cm
(l) 200 cm × 250 cm × 30 cm

3. A rectangular prism has a volume of 12 cm^3. How high is the prism if it is 3 cm long and 2 cm wide?

4. A rectangular prism is made using cubes of side length 1 cm. The prism is 4 cm long, 4 cm wide and 2 cm high. If all the centimetre cubes are removed and stacked, one on top of the other, find the height of the stack?

5. How many litres of petrol would be in a tank that is 25 cm long, 30 cm wide and 24 cm high?