KING EDWARD VI
HANDSWORTH GRAMMAR
SCHOOL FOR BOYS

KING EDWARD VI
ACADEMY TRUST
BIRMINGHAM

Year 11

2026 Mathematics 2027

Unit 22 Booklet – Part 1

HGS Maths

Tasks

Dr Frost Course

Name: _____

Class: _____

KING EDWARD VI
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SCHOOL FOR BOYS

KING EDWARD VI
ACADEMY TRUST
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Year 11

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Unit 22 Booklet – Part 2

HGS Maths

Tasks

Dr Frost Course

Name: _____

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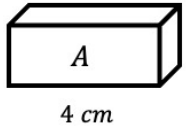
Contents

1 Similarity with Area and Volume
2 Arcs, Sectors and Segments
3 Volume and Surface Area of Non-Prisms
4 Bearings

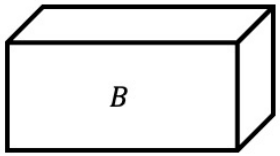
1 Similarity with Area and Volume

Worked Example

Cuboids A and B are similar.



4 cm



8 cm

Write down the scale factor for:

Length $A \rightarrow B$

Length $B \rightarrow A$

Surface Area $A \rightarrow B$

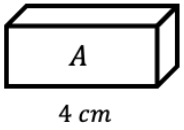
Surface Area $B \rightarrow A$

Volume $A \rightarrow B$

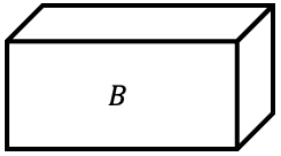
Volume $B \rightarrow A$

Your Turn

Cuboids A and B are similar.



4 cm



12 cm

Write down the scale factor for:

Length $A \rightarrow B$

Length $B \rightarrow A$

Surface Area $A \rightarrow B$

Surface Area $B \rightarrow A$

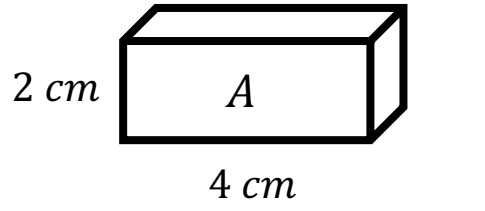
Volume $A \rightarrow B$

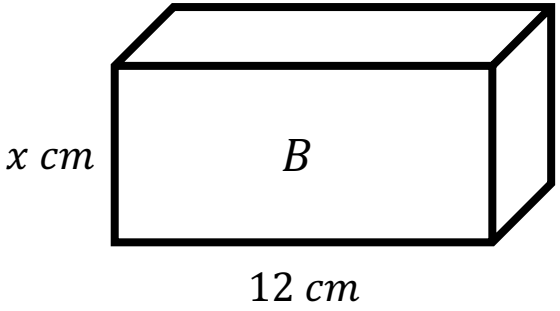
Volume $B \rightarrow A$

Dr Frost 324a and 324d

Worked Example

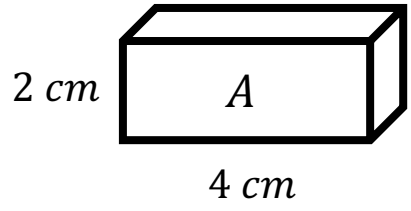
Cuboids A and B are similar.
Find x.

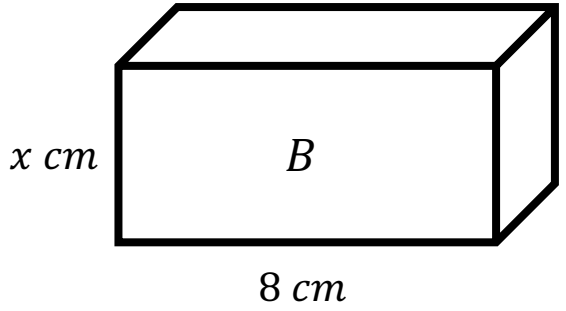




Your Turn

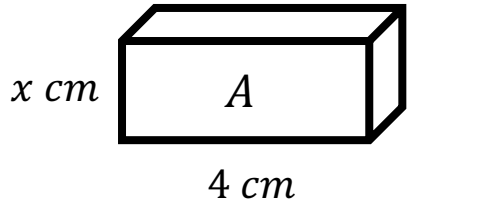
Cuboids A and B are similar.
Find x.

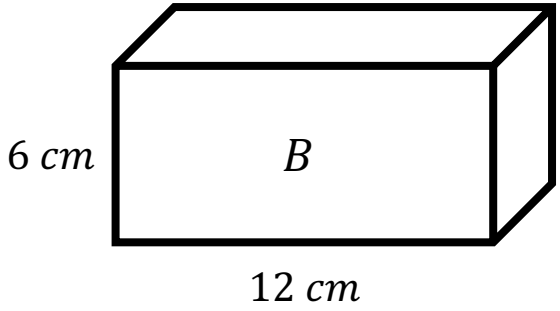




Worked Example

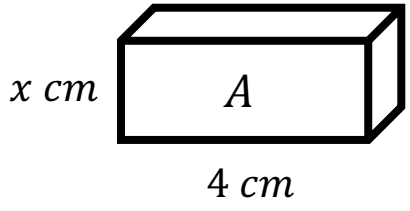
Cuboids A and B are similar.
Find x.

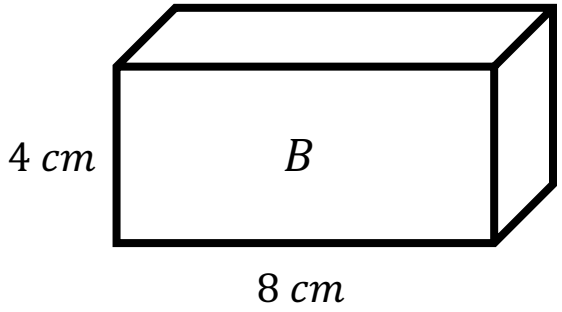




Your Turn

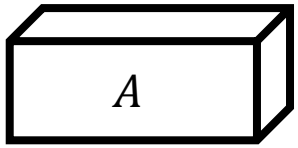
Cuboids A and B are similar.
Find x.



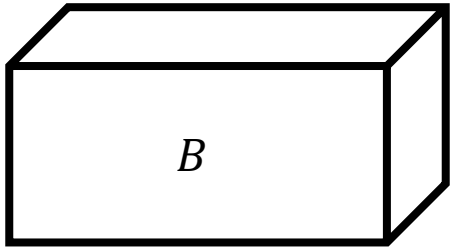


Worked Example

Cuboids A and B are similar.
The surface area of cuboid A is $72\ cm^2$. What is the surface area of cuboid B?



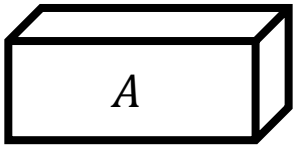
$4\ cm$



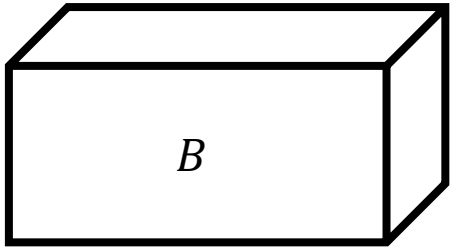
$12\ cm$

Your Turn

Cuboids A and B are similar.
The surface area of cuboid A is $72\ cm^2$. What is the surface area of cuboid B?



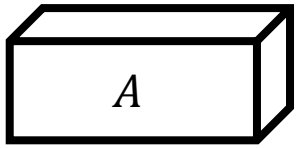
$4\ cm$



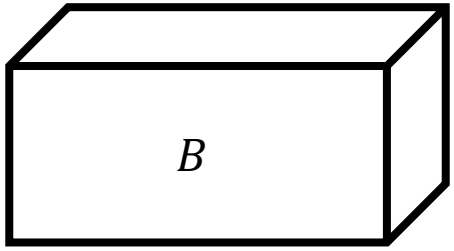
$8\ cm$

Worked Example

Cuboids A and B are similar.
The surface area of cuboid B is $72\ cm^2$. What is the surface area of cuboid A?



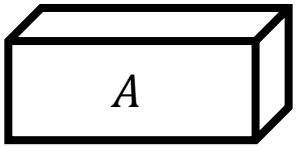
$4\ cm$



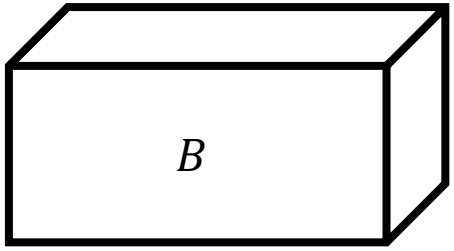
$12\ cm$

Your Turn

Cuboids A and B are similar.
The surface area of cuboid B is $72\ cm^2$. What is the surface area of cuboid A?



$4\ cm$

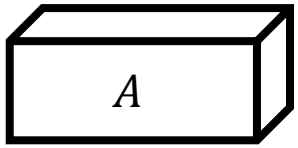


$8\ cm$

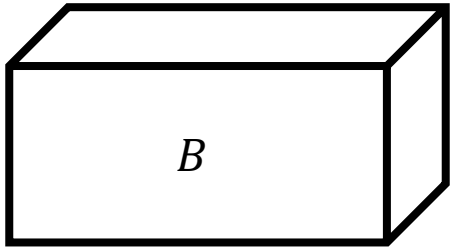
Dr Frost 324b and 324c

Worked Example

Cuboids A and B are similar.
The volume of cuboid A is $432\ cm^3$. What is volume of cuboid B?



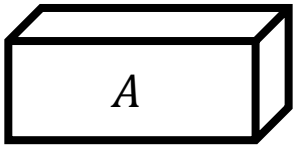
$4\ cm$



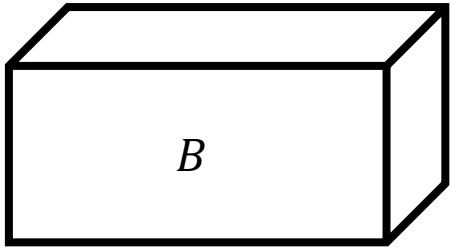
$12\ cm$

Your Turn

Cuboids A and B are similar.
The volume of cuboid A is $432\ cm^3$. What is volume of cuboid B?



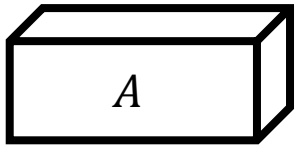
$4\ cm$



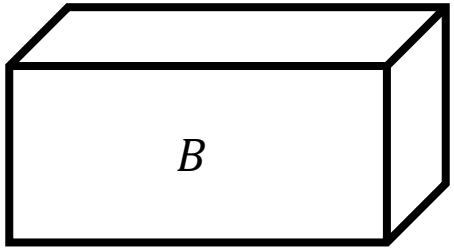
$8\ cm$

Worked Example

Cuboids A and B are similar.
The volume of cuboid B is $432\ cm^3$. What is volume of cuboid A?



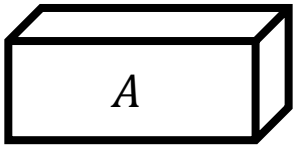
$4\ cm$



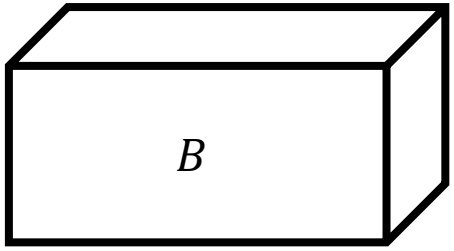
$12\ cm$

Your Turn

Cuboids A and B are similar.
The volume of cuboid B is $432\ cm^3$. What is volume of cuboid A?



$4\ cm$

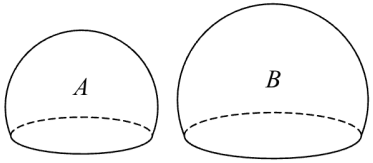


$8\ cm$

Dr Frost 324e and 324f

Worked Example

A and B are two solid shapes that are mathematically similar.

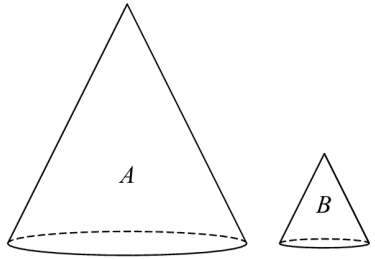


The volume of A is 14.08 cm^3
The volume of B is 27.5 cm^3
The surface area of A is 16 cm^2

Find the surface area of B

Your Turn

A and B are two solid shapes that are mathematically similar.

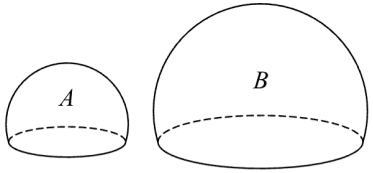


The volume of A is 373.76 cm^3
The volume of B is 19.71 cm^3
The surface area of A is 89.6 cm^2

Find the surface area of B

Worked Example

A and B are two solid shapes that are mathematically similar.

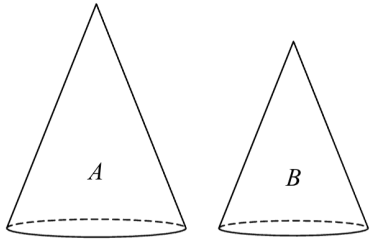


The surface area of A is 64 cm^2
The surface area of B is 196 cm^2
The volume of B is 583.1 cm^3

Find the volume of A

Your Turn

A and B are two solid shapes that are mathematically similar.



The surface area of A is 104.4 cm^2
The surface area of B is 72.5 cm^2
The volume of A is 367.2 cm^3

Find the volume of B

Worked Example	Your Turn
A and B are mathematically similar solids. The surface area of A is $100\ cm^2$. The surface area of B is $64\ cm^2$. Work out the ratio of the volume of A to the volume of B.	A and B are mathematically similar solids. The surface area of A is $120\ cm^2$. The surface area of B is $480\ cm^2$. Work out the ratio of the volume of A to the volume of B.

Worked Example	Your Turn
A and B are mathematically similar solids. The volume of A is $500\ cm^3$. The volume of B is $256\ cm^3$. Work out the ratio of the surface area of A to the surface area of B.	A and B are mathematically similar solids. The volume of A is $120\ cm^3$. The volume of B is $960\ cm^3$. Work out the ratio of the surface area of A to the surface area of B.

Fill in the Gaps

	Length	Area	Volume
Scale Factor	2	4	8
Shape A	5 cm	30 cm^2	100 cm^3
Shape B	10 cm	120 cm^2	

	Length	Area	Volume
Scale Factor	3	9	27
Shape A	4 cm	16 cm^2	50 cm^3
Shape B	12 cm		

	Length	Area	Volume
Scale Factor	2		
Shape A	15 mm	35 mm^2	64 mm^3
Shape B	30 mm		

	Length	Area	Volume
Scale Factor			
Shape A	2 m	1.5 m^2	16 m^3
Shape B	5 m		

	Length	Area	Volume
Scale Factor			
Shape A	4 cm		
Shape B	12 cm	72 cm^2	540 cm^3

	Length	Area	Volume
Scale Factor			
Shape A	2.4 m		
Shape B	1.2 m	4 m^2	5.6 m^3

	Length	Area	Volume
Scale Factor	1.5		
Shape A			
Shape B	7.5 cm	45 cm^2	202.5 cm^3

	Length	Area	Volume
Scale Factor	$\frac{4}{3}$		
Shape A	1.8 cm		54 cm^3
Shape B		80 cm^2	

	Length	Area	Volume
Scale Factor		4	8
Shape A	3 cm	10 cm^2	25 cm^3
Shape B			

	Length	Area	Volume
Scale Factor		9	
Shape A	4 cm	20 cm^2	70 cm^3
Shape B			

	Length	Area	Volume
Scale Factor			125
Shape A	0.5 m	2 m^2	5 m^3
Shape B			

	Length	Area	Volume
Scale Factor			
Shape A	4.5 mm	20 mm^2	35 mm^3
Shape B		180 mm^2	

	Length	Area	Volume
Scale Factor			
Shape A	2.5 cm	8 cm^2	20 cm^3
Shape B			67.5 cm^3

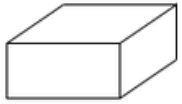
	Length	Area	Volume
Scale Factor			
Shape A	0.6 m	2.8 m^2	
Shape B		0.7 m^2	1.4 m^2

	Length	Area	Volume
Scale Factor			
Shape A		1.8 cm^2	
Shape B	2 cm	5 cm^2	25 cm^3

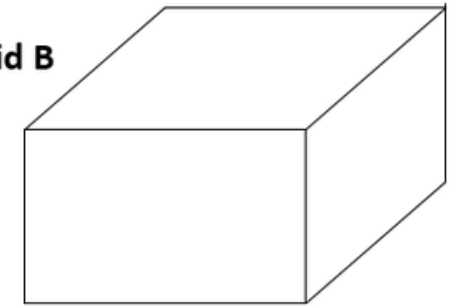
	Length	Area	Volume
Scale Factor			
Shape A	7.5 cm		135 cm^3
Shape B		22 cm^2	40 cm^3

Fill in the Gaps

Cuboid A



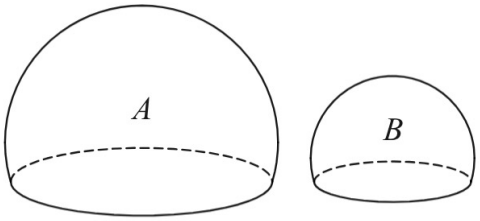
Cuboid B



Height of A (cm)	Height of B (cm)	Surface area of A (cm^2)	Surface area of B (cm^2)	Volume of A (cm^3)	Volume of B (cm^3)
15	45	120		60	
90	180	2000			12000
2	20		700		12000
18		70	1750	32	
	10	4.3	68.8	7.2	
6.8		12.5		6.6	178.2
	45		125	42	656.25
	11.36	15.2		54	221.184

Worked Example

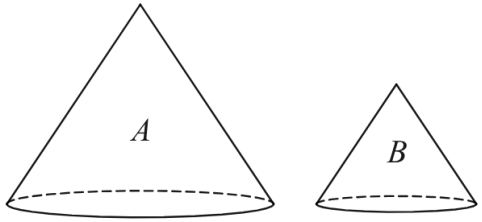
A and B are two solid shapes that are mathematically similar.
The shapes are made from the same material.



The total surface area of shape A is 62.5 cm^2.
The total surface area of shape B is 22.5 cm^2.
The mass of A is 375 g. Find the mass of B.

Your Turn

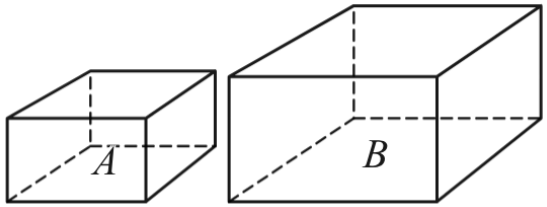
A and B are two solid cones that are mathematically similar.
The cones are made from the same material.



The total surface area of shape A is 75 cm^2.
The total surface area of shape B is 27 cm^2.
The mass of B is 81 g. Find the mass of A.

Worked Example

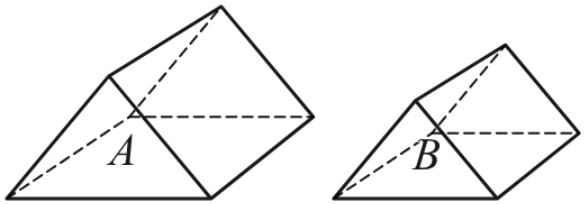
A and B are two solid cuboids that are mathematically similar.
The surface area scale factor from A to B is 2.25



Find the ratio of the volume of cuboid A to the volume of cuboid B

Your Turn

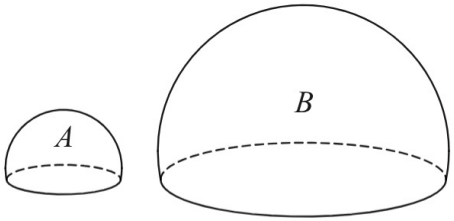
A and B are two solid prisms that are mathematically similar.
The surface area scale factor from A to B is 0.64



Find the ratio of the volume of prism A to the volume of prism B

Worked Example

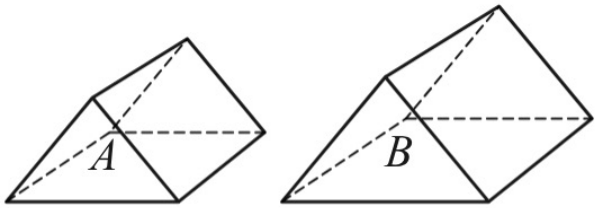
Shapes A and B are similar.



The volume of B is 1462.5% greater than the volume of A. Find the percentage increase from the surface area of shape A to the surface area of shape B.

Your Turn

Prisms A and B are similar.



The surface area of B is 44% greater than the surface area of A. Find the percentage increase from the volume of prism A to the volume of prism B.

Worked Example	Your Turn
The surface area of two mathematically similar solids are in the ratio $16:49$. The volume of the smaller solid is $128\ cm^3$. Work out the volume of the larger solid.	The surface area of two mathematically similar solids are in the ratio $9:25$. The volume area of the smaller solid is $108\ cm^3$. Work out the volume of the larger solid.

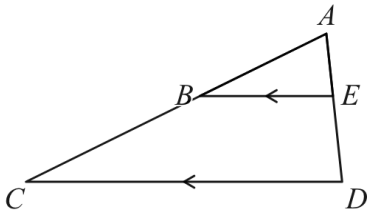
Worked Example	Your Turn
The volume of two mathematically similar solids are in the ratio $64: 343$. The surface area of the smaller solid is $32\ cm^2$. Work out the surface area of the larger solid.	The volume of two mathematically similar solids are in the ratio $27: 125$. The surface area of the smaller solid is $36\ cm^2$. Work out the surface area of the larger solid.

Worked Example	Your Turn
a) The scale of a map is $1 : 3000000$ On the map, the area of Toonhill Valley is 6.4 cm^2. Calculate the actual area of Toonhill Valley. Give your answer in square kilometres. b) The scale of a map is $1 : 400000$ The area of Lake Troycou is 646.4 km^2. Calculate the area of Lake Troycou on the map in cm^2.	a) The scale of a map is $1 : 70000$ On the map, the area of Fort Prisetomb is 50.6 cm^2. Calculate the actual area of Fort Prisetomb. Give your answer in square kilometres. b) The scale of a map is $1 : 60000$ The area of Saint Ralhay is 10.8 km^2. Calculate the area of Saint Ralhay on the map in cm^2.

Dr Frost 324m and 324n

Worked Example

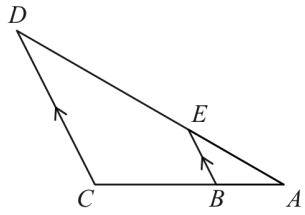
In the diagram ABC and AED are straight lines and BE is parallel to CD.



The length AB is 20 cm and the length BC is 27.5 cm.
The area of triangle ABE is 83.2 cm^2.
Work out the area of triangle ACD.

Your Turn

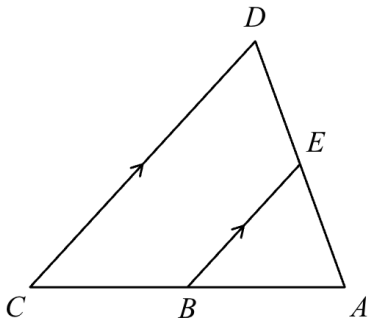
In the diagram ABC and AED are straight lines and BE is parallel to CD.



The length AB is 10.5 cm and the length BC is 18.9 cm.
The area of triangle ABE is 45 cm^2.
Work out the area of triangle ACD.

Worked Example

In the diagram ABC and AED are straight lines and BE is parallel to CD

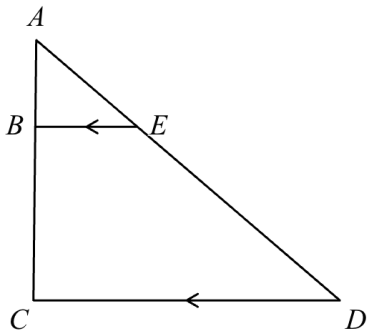


The length BE is 8 cm and the length CD is 16 cm
The area of triangle ABE is x cm^2
The area of quadrilateral $BCDE$ is y cm^2

Find an expression for y in terms of x

Your Turn

In the diagram ABC and AED are straight lines and BE is parallel to CD

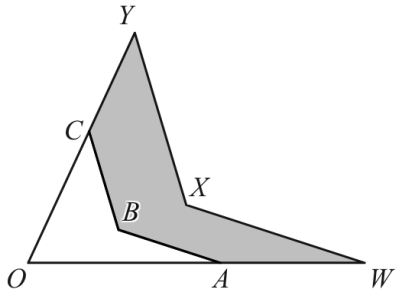


The length AB is 8.5 cm and the length BC is 17 cm
The area of triangle ABE is x cm^2
The area of quadrilateral $BCDE$ is y cm^2

Find an expression for x in terms of y

Worked Example

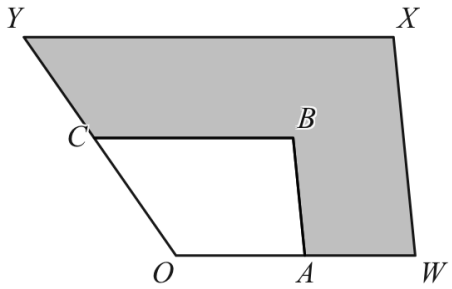
The diagram shows two similar quadrilaterals $OABC$ and $OWXY$.



The length of AB is 4 cm and the length of WX is 7 cm.
The area of quadrilateral $OABC$ is 9.6 cm^2.
Find the shaded area.

Your Turn

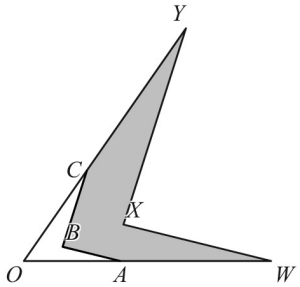
The diagram shows two similar trapeziums $OABC$ and $OWXY$.



The length of OA is 7 cm and the length of AW is 6 cm.
The area of trapezium $OABC$ is 27.44 cm^2.
Find the shaded area.

Worked Example

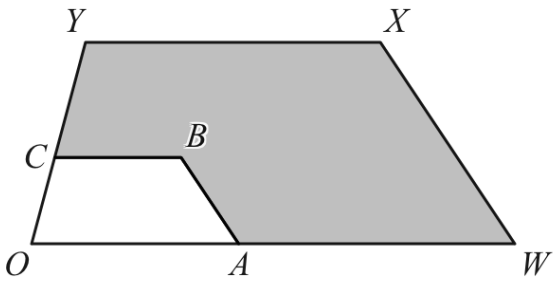
The diagram shows two similar quadrilaterals $OABC$ and $OWXY$.



The length of AB is 7 cm and the length of WX is 18 cm.
The area of quadrilateral $OWXY$ is 324 cm².
Find the shaded area.

Your Turn

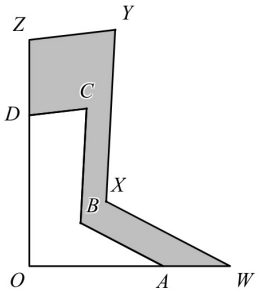
The diagram shows two similar trapeziums $OABC$ and $OWXY$.



The length of OA is 6 cm and the length of AW is 8 cm.
The area of trapezium $OWXY$ is 235.2 cm².
Find the shaded area.

Worked Example

The diagram shows two similar pentagons $OABCD$ and $OWXYZ$

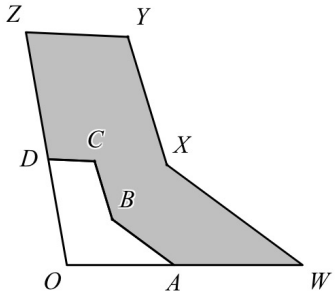


The length of OA is 8 cm and the length of AW is 4 cm
The shaded area is 176 cm^2

Find the area of pentagon $OWXYZ$

Your Turn

The diagram shows two similar pentagons $OABCD$ and $OWXYZ$



The length of OA is 5 cm and the length of AW is 6 cm
The shaded area is 192 cm^2

Find the area of pentagon $OABCD$

Extra Notes

2 Arcs, Sectors and Segments

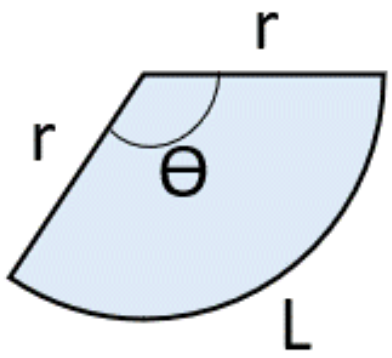
Arc Length and Perimeter of Sectors and Segments

Arc Length of a Sector $= \frac{\text{Angle}}{360} \times \pi \times \text{Diameter}$

$$L = \frac{\theta}{360} \times \pi d$$

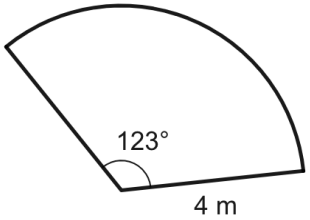
Perimeter of a Sector $= \frac{\text{Angle}}{360} \times \pi \times \text{Diameter} + 2 \times \text{Radius}$

$$P = \frac{\theta}{360} \times \pi d + 2r$$



Worked Example

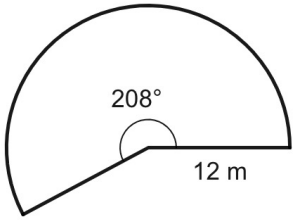
Find the arc length of the sector.



Give your answer correct to 1 decimal place.

Your Turn

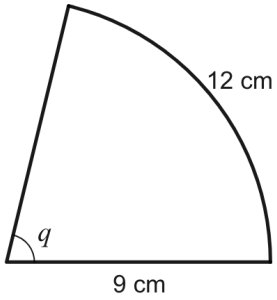
Find the arc length of the sector.



Give your answer correct to 1 decimal place.

Worked Example

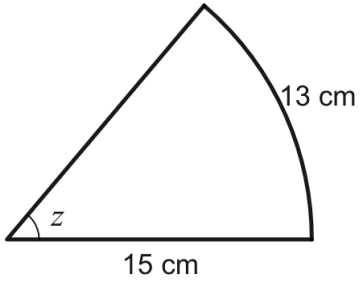
Given that the arc length of sector below is 12 cm, work out its angle, marked q on the diagram.



Give your answer correct to 1 decimal place.

Your Turn

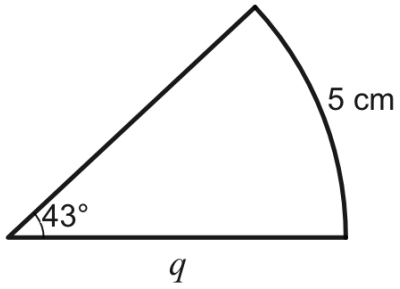
Given that the arc length of sector below is 13 cm, work out its angle, marked z on the diagram.



Give your answer correct to 1 decimal place.

Worked Example

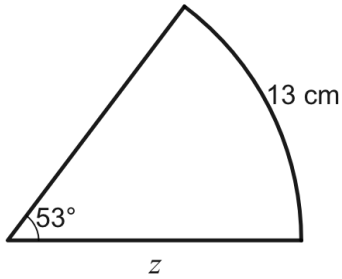
Given that the arc length of sector below is 5 cm, work out its radius, marked q on the diagram.



Give your answer correct to 1 decimal place.

Your Turn

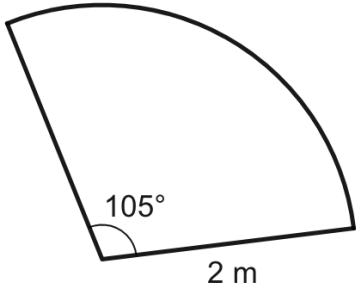
Given that the arc length of sector below is 13 cm, work out its radius, marked z on the diagram.



Give your answer correct to 1 decimal place.

Worked Example

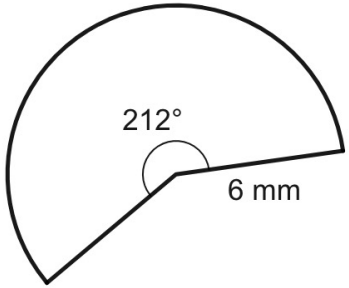
Work out the perimeter of the sector.



Give your answer correct to 1 decimal place.

Your Turn

Work out the perimeter of the sector.

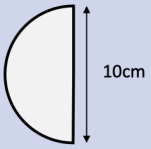
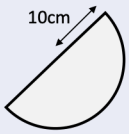


Give your answer correct to 1 decimal place.

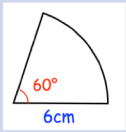
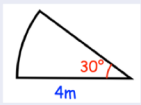
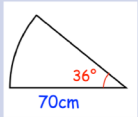
Fill in the Gaps

Radius	Angle	Arc Length	Perimeter
$8\ cm$	90°	$\frac{90}{360} \times \pi \times 2 \times 8 = 12.6\ cm$	$28.6\ cm$
$7\ cm$	45°	$\frac{45}{360} \times \pi \times 2 \times 7 = 5.5\ cm$	
$15\ mm$	60°	$\frac{60}{360} \times \pi \times 2 \times 15 = 15.7\ mm$	
$4\ cm$	75°		
$1.8\ m$	130°		
$82\ mm$	335°		
$11\ cm$	275°		
$9\ mm$	32°		
$10\ cm$		$\frac{\square}{360} \times \pi \times 2 \times 10 = 13.96\ cm$	
$25\ mm$		$\frac{\square}{360} \times \pi \times 2 \times 25 = 93.81\ mm$	
$2\ m$		$\frac{\square}{360} \times \pi \times 2 \times 2 = \square\ m$	$5.05\ m$
$8.9\ cm$		$\frac{\square}{360} \times \pi \times 2 \times 8.9 = \square\ cm$	$35.2\ m$
		$\frac{\square}{360} \times \pi \times 2 \times \square = 4.61\ cm$	$15.61\ cm$
		$\frac{\square}{360} \times \pi \times 2 \times \square = 55.29\ mm$	$99.29\ mm$

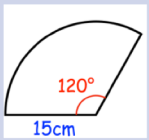
Fill in the Gaps

Sector.	Radius.	Diameter.	Fraction of the whole circle.	Arc length.	Length of straight sides.	Perimeter in terms of pi.	Perimeter to 1 decimal place.
	$5cm$	$10cm$	$\frac{1}{2}$	$5\pi = 15.7cm$	$10cm$	$(5\pi + 10)\ cm$	$25.7cm$
							
							

Sector.	Radius.	Diameter.	Fraction of the whole circle.	Arc length.	Length of straight sides.	Perimeter in terms of pi.	Perimeter to 1 decimal place.
							
		$4cm$	$\frac{1}{4}$				
	$3cm$		$\frac{1}{2}$				

Sector.	Radius.	Diameter.	Fraction of the whole circle.	Arc length.	Length of straight sides.	Perimeter in terms of pi.	Perimeter to 1 decimal place.
							
							
							

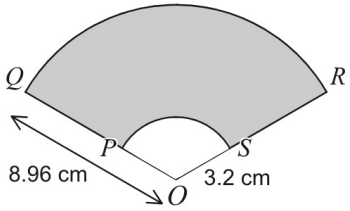
Fill in the Gaps

Sector.	Radius.	Diameter.	Fraction of the whole circle.	Arc length.	Length of straight sides.	Perimeter in terms of pi.	Perimeter to 1 decimal place.
							
		$10cm$	$\frac{1}{3}$				
	$10cm$		$\frac{1}{8}$				

Sector.	Radius.	Diameter.	Fraction of the whole circle.	Arc length.	Length of straight sides.	Perimeter in terms of pi.	Perimeter to 1 decimal place.
			$\frac{1}{2}$		$7cm$		
			$\frac{1}{3}$			$(4\pi + 12)\ cm$	
			$\frac{1}{10}$		$40cm$		$46.3cm$

Worked Example

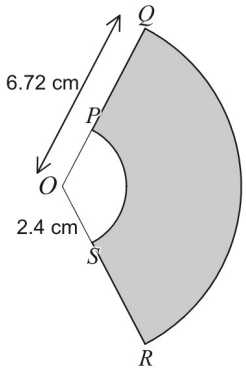
A shape is formed from the sectors of two circles with centre O.
OPQ and OSR are straight lines.



The length of OS is 3.2 cm.
The length of OQ is 8.96 cm.
Angle POS is $120°$.
Calculate the perimeter of the shaded region.
Give your answer to 1 decimal place.

Your Turn

A shape is formed from the sectors of two circles with centre O.
OPQ and OSR are straight lines.

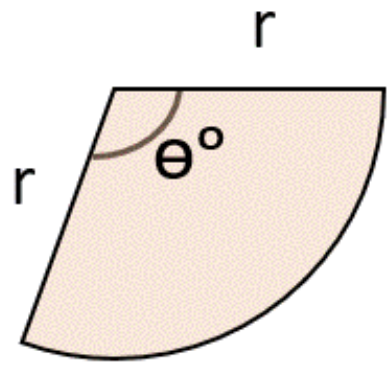


The length of OS is 2.4 cm.
The length of OQ is 6.72 cm.
Angle POS is $125°$.
Calculate the perimeter of the shaded region.
Give your answer to 1 decimal place.

Area of Sectors and Segments

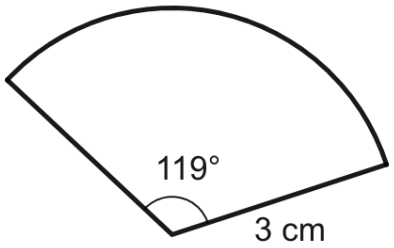
$$\text{Area of a Sector} = \frac{\text{Angle}}{360} \times \pi \times \text{Radius}^2$$

$$\mathbf{A = \frac{\theta}{360} \times \pi r^2}$$



Worked Example

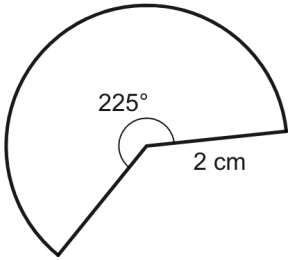
Find the area of the sector.



Give your answer correct to 1 decimal place.

Your Turn

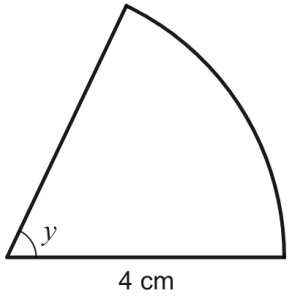
Find the area of the sector.



Give your answer correct to 1 decimal place.

Worked Example

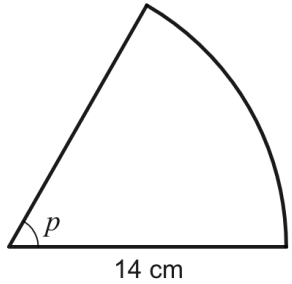
Given that the area of sector below is 9 cm^2, work out its angle, marked y on the diagram.



Give your answer correct to 1 decimal place.

Your Turn

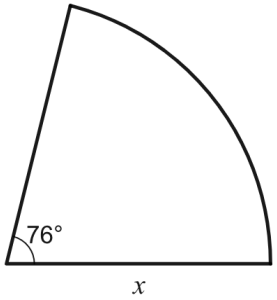
Given that the area of sector below is 103 cm^2, work out its angle, marked p on the diagram.



Give your answer correct to 1 decimal place.

Worked Example

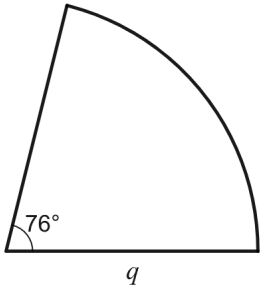
Given that the area of sector below is 17 cm^2, work out its radius, marked x on the diagram.



Give your answer correct to 1 decimal place.

Your Turn

Given that the area of sector below is 97 cm^2, work out its radius, marked q on the diagram.



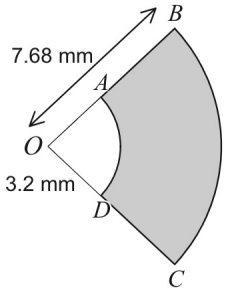
Give your answer correct to 1 decimal place.

Fill in the Gaps

Radius	Angle	Fraction	Area
$8\ cm$	90°	$\frac{90}{360}=\frac{1}{4}$	$\frac{90}{360}\times\pi\times 8^2=50.3\ cm^2$
$7\ cm$	45°	$\frac{45}{360}=\frac{1}{8}$	
$15\ mm$	60°		
$4\ cm$	75°		
$1.8\ m$	130°		
$82\ mm$	335°		
$11\ cm$	275°		
$9\ mm$		$\frac{\square}{360}=\frac{5}{36}$	
$10\ cm$		$\frac{\square}{360}=\frac{7}{9}$	
$25\ mm$			$\frac{\square}{360}\times\pi\times 25^2=327.2\ mm^2$
$2\ m$			$\frac{\square}{360}\times\pi\times 2^2=4.712\ m^2$
	35°		$\frac{35}{360}\times\pi\times\square^2=2.75\ cm^2$
	315°		$\frac{315}{360}\times\pi\times\square^2=464.6\ mm^2$
	58°		$\frac{58}{360}\times\pi\times\square^2=50.61\ cm^2$

Worked Example

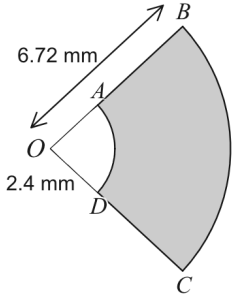
A metal component for a machine is formed from the sectors of two circles with centre O. The area of sector OAD is 7.7 mm^2.



OAB and ODC are straight lines.
The length of OD is 3.2 mm.
The length of OB is 7.68 mm.
Calculate the area of the shaded region.

Your Turn

A metal component for a machine is formed from the sectors of two circles with centre O. The area of sector OAD is 4.3 mm^2.

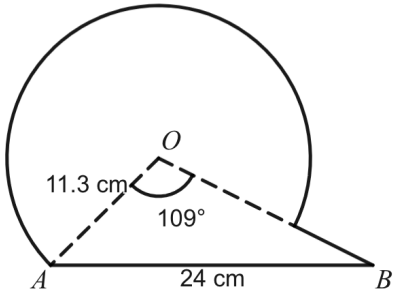


OAB and ODC are straight lines.
The length of OD is 2.4 mm.
The length of OB is 6.72 mm.
Calculate the area of the shaded region.

Dr Frost 319d

Worked Example

A shape is made from triangle AOB and a sector of a circle, centre O and radius OA

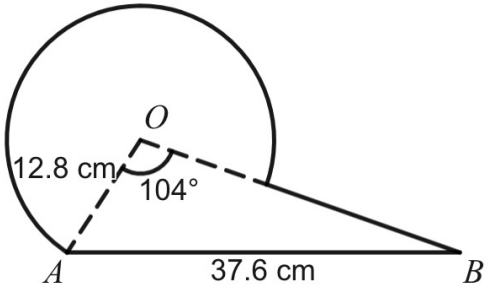


angle $AOB = 109°$
$OA = 11.3$ cm
$AB = 24$ cm

Work out the area of the shape.
Give your answer correct to 3 significant figures.

Your Turn

A shape is made from triangle AOB and a sector of a circle, centre O and radius OA

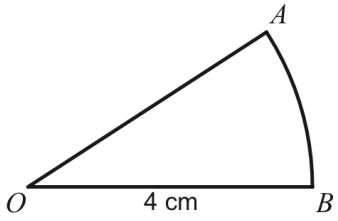


angle $AOB = 104°$
$OA = 12.8$ cm
$AB = 37.6$ cm

Work out the area of the shape.
Give your answer correct to 3 significant figures.

Worked Example

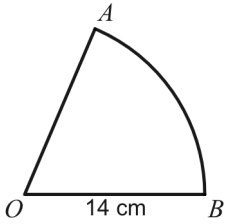
AOB is a sector of a circle, centre O and radius 4 cm.



The perimeter of the sector is 10 cm.
Work out the area of the sector.

Your Turn

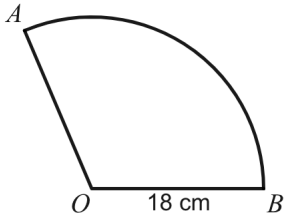
AOB is a sector of a circle, centre O and radius 14 cm.



The perimeter of the sector is 44 cm.
Work out the area of the sector.

Worked Example

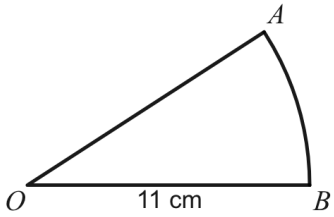
AOB is a sector of a circle, centre O and radius 18 cm.



The area of the sector is 320 cm^2.
Work out the perimeter of the sector.
Give your answer correct to 2 decimal places.

Your Turn

AOB is a sector of a circle, centre O and radius 11 cm.



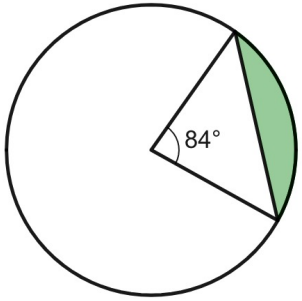
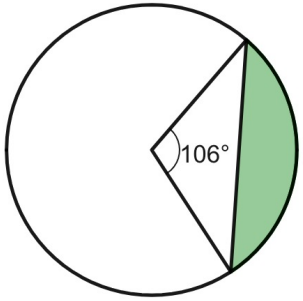
The area of the sector is 35 cm^2.
Work out the perimeter of the sector.
Give your answer correct to 2 decimal places.

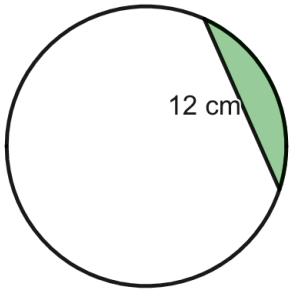
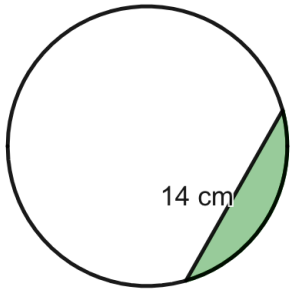
Fill in the Gaps

	Sketch	Radius	Angle	$\frac{Angle}{360}$ (simplified)	Circumference of whole circle	Arc length	Area of whole circle	Area of shaded sector
1		6	180^o	$\frac{1}{2}$	12π	6π		
2								
3			45^o		12π			
4		6		$\frac{3}{4}$				
5		6				2π		

Fill in the Gaps

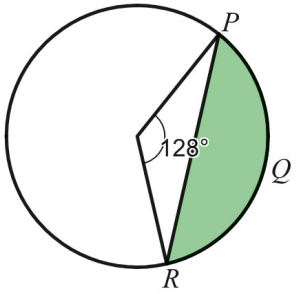
	Sketch	*Radius*	*Angle*	$\frac{Angle}{360}$ *(simplified)*	*Circumference of whole circle*	*Arc length*	*Area of whole circle*	*Area of shaded sector*
6							36π	12π
7			330^o		12π			
8			330^o		24π			
9					24π	2π		
10						6π		36π

Worked Example	Your Turn
The radius of the circle is 6 cm.  Find the area of the shaded region.	The radius of the circle is 15 cm.  Find the area of the shaded region.

Worked Example	Your Turn
The radius of the circle is 9 cm.  Find the area of the shaded region.	The radius of the circle is 10 cm.  Find the area of the shaded region.

Worked Example

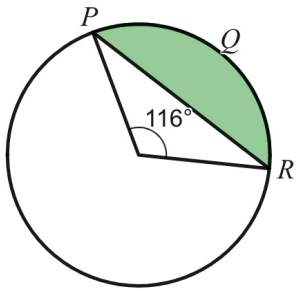
The area of the shaded region is 289 cm^2.



Find the length of the arc PQR.

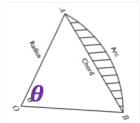
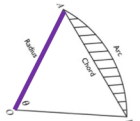
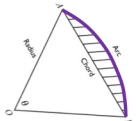
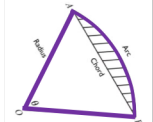
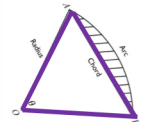
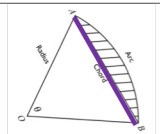
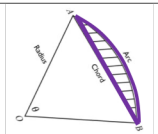
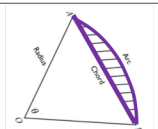
Your Turn

The area of the shaded region is 225 cm^2.

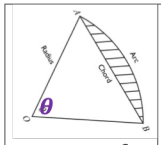
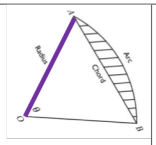
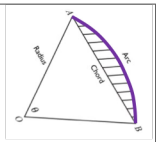
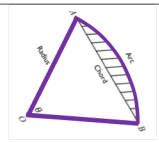
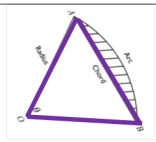
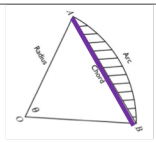
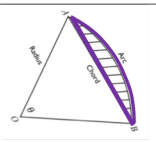
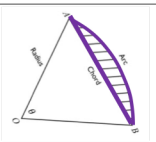


Find the length of the arc PQR.

Fill in the Gaps

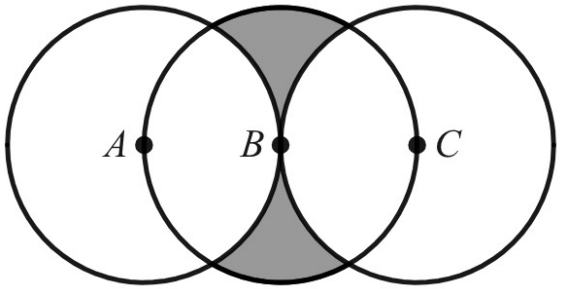
 Angle θ^c	 Radius $r\ cm$	 Arc Length	 Area of Sector	 Area of Triangle	 Length of Chord	 Area of Segment	 Perimeter of Segment
$\theta = 1.5^c$	$r = 10cm$	**Arc Length** $= r\theta$ $\rightarrow (10)(1.5)$ $= 15cm$	**Sector Area** $= \frac{1}{2}r^2\theta$ $\rightarrow \frac{1}{2}(10)^2(1.5)$ $= 75cm^2$	**Triangle Area** $= \frac{1}{2}ab\sin C$ $\rightarrow \frac{1}{2}(10)(10)\sin(1.5)$ $= 49.87cm^2$	**Cosine Rule** $a^2 = b^2 + c^2 - 2bc\cos A$ $a^2 = 10^2 + 10^2 - 2(10)(10)\cos(1.5)$ $a^2 = 185.853\ldots$ $a = 13.63cm$	Area = Sector – Triangle $\rightarrow 75 - 49.87$ $= 25.13cm^2$	Perimeter = Chord + Arc $\rightarrow 13.63 + 15$ $= 28.63cm$
1) 0.8^c	$7cm$						
2)	$20cm$	$60cm$					
3) 1.2^c			$21.6cm^2$				
4)		$6\pi\ cm$	$72\pi\ cm^2$				

Fill in the Gaps

 Angle θ^c	 Radius $r\ cm$	 Arc Length	 Area of Sector	 Area of Triangle	 Length of Chord	 Area of Segment	 Perimeter of Segment
$\theta = 1.5^c$	$r = 10cm$	**Arc Length** $= r\theta$ $\rightarrow (10)(1.5)$ $= 15cm$	**Sector Area** $= \frac{1}{2}r^2\theta$ $\rightarrow \frac{1}{2}(10)^2(1.5)$ $= 75cm^2$	**Triangle Area** $= \frac{1}{2}ab\sin C$ $\rightarrow \frac{1}{2}(10)(10)\sin(1.5)$ $= 49.87cm^2$	**Cosine Rule** $a^2 = b^2 + c^2 - 2bc\cos A$ $a^2 = 10^2 + 10^2 - 2(10)(10)\cos(1.5)$ $a^2 = 185.853\ldots$ $a = 13.63cm$	Area = Sector – Triangle $\rightarrow 75 - 49.87$ $= 25.13cm^2$	Perimeter = Chord + Arc $\rightarrow 13.63 + 15$ $= 28.63cm$
5)	$8cm$				$8cm$		
6)	$15cm$			$94.67cm^2$			
7)	$11cm$				$5.694cm$		
8) 2^c						$6.681cm^2$	

Worked Example

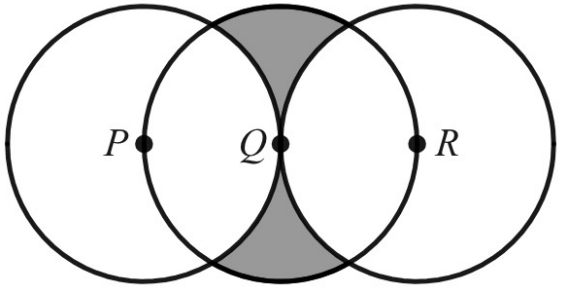
The diagram shows three circles, each of radius 9 cm.
The centres of the circles are A, B and C such that ABC is a straight line and $AB = BC = 9$ cm.



Work out the total area of the two shaded regions.
Give your answer in terms of π.

Your Turn

The diagram shows three circles, each of radius 6 cm.
The centres of the circles are P, Q and R such that PQR is a straight line and $PQ = QR = 6$ cm.



Work out the total area of the two shaded regions.
Give your answer in terms of π.

Dr Frost 467r

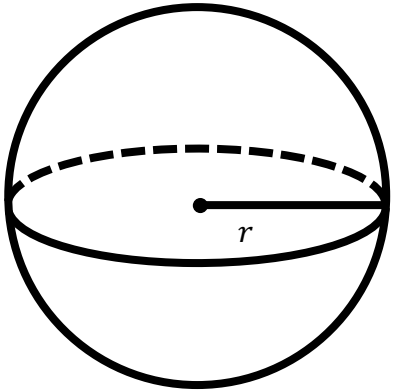
Extra Notes

3 Volume and Surface Area of Non-Prisms

Volume of Spheres

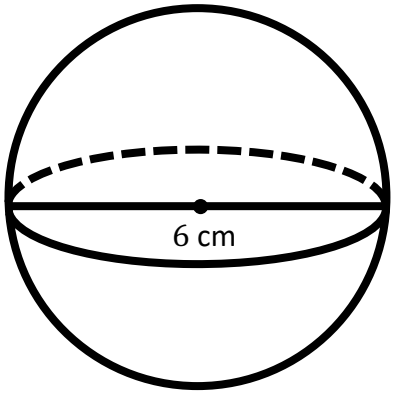
$$\text{Volume of Sphere} = \frac{4}{3} \times \pi \times \text{Radius}^3$$

$$V = \frac{4}{3}\pi r^3$$



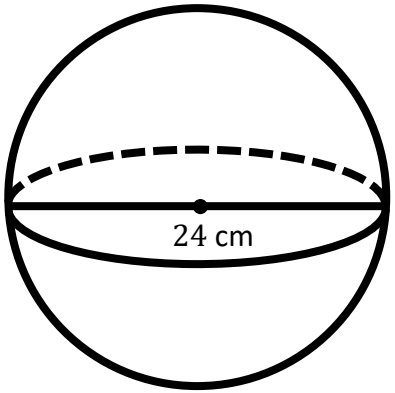
Worked Example

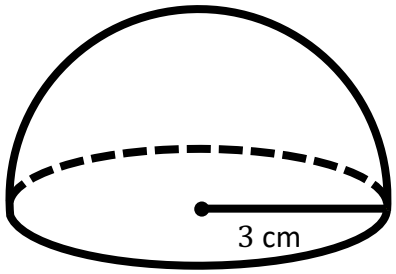
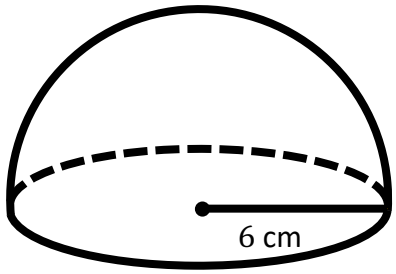
Calculate the volume of the following sphere. Give your answer in terms of π and to 1 decimal place.



Your Turn

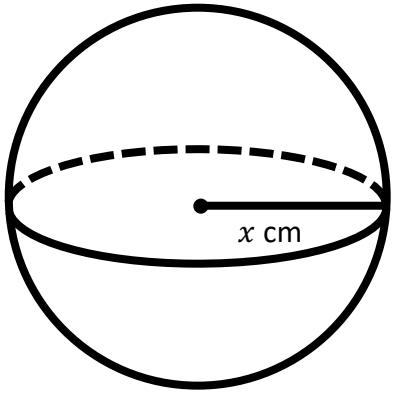
Calculate the volume of the following sphere. Give your answer in terms of π and to 1 decimal place.



Worked Example	Your Turn
Calculate the volume of the following hemisphere. Give your answer in terms of π and to 1 decimal place.  	Calculate the volume of the following hemisphere. Give your answer in terms of π and to 1 decimal place. 

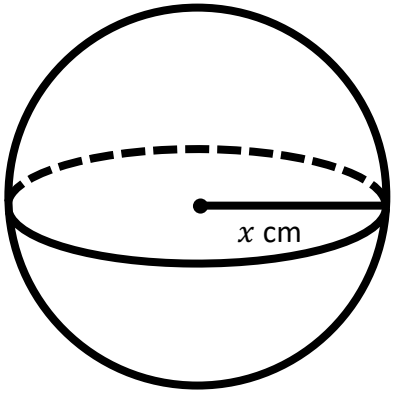
Worked Example

Find the radius, x, given that the volume of the following sphere is $113.1\ cm^3$. Give your answer to 1 decimal place.



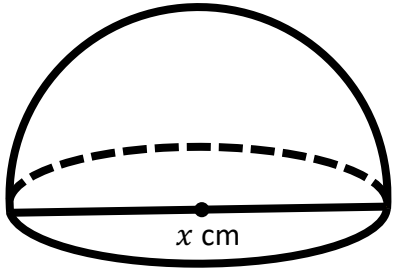
Your Turn

Find the radius, x, given that the volume of the following sphere is $904.8\ cm^3$. Give your answer to 1 decimal place.



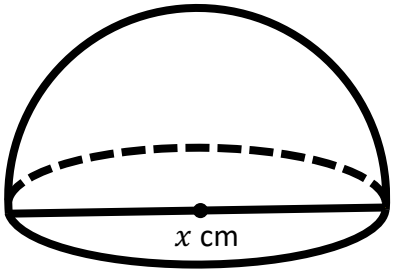
Worked Example

Find the diameter, x, given that the volume of the following hemisphere is $56.5\ cm^3$. Give your answer to 1 decimal place.



Your Turn

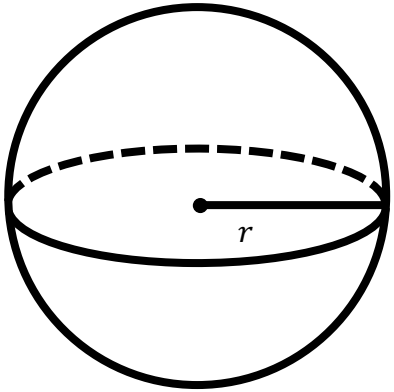
Find the diameter, x, given that the volume of the following hemisphere is $452.4\ cm^3$. Give your answer to 1 decimal place.



Surface Area of Spheres

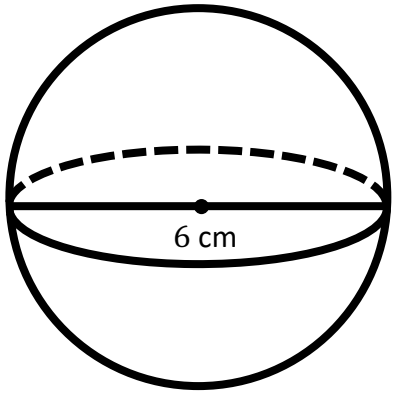
Surface Area of Sphere $= 4 \times \pi \times \text{Radius}^2$

$SA = 4\pi r^2$



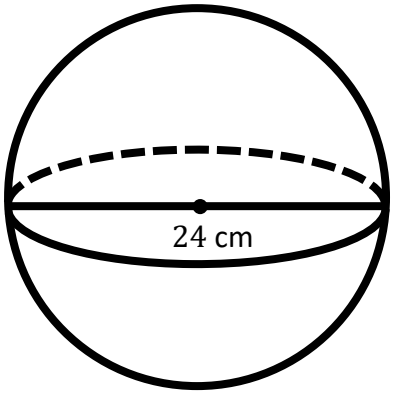
Worked Example

Calculate the surface area of the following sphere. Give your answer in terms of π and to 1 decimal place.



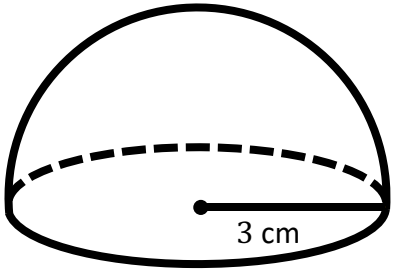
Your Turn

Calculate the surface area of the following sphere. Give your answer in terms of π and to 1 decimal place.



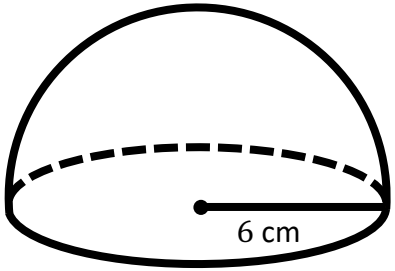
Worked Example

Calculate the total surface area of the following hemisphere.
Give your answer in terms of π and to 1 decimal place.



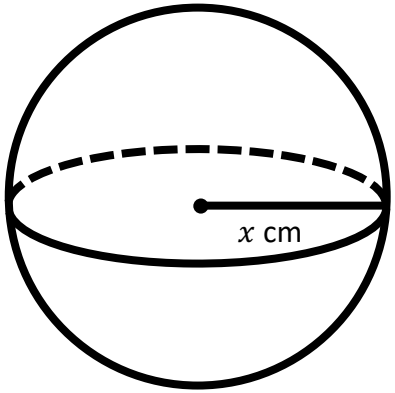
Your Turn

Calculate the total surface area of the following hemisphere.
Give your answer in terms of π and to 1 decimal place.



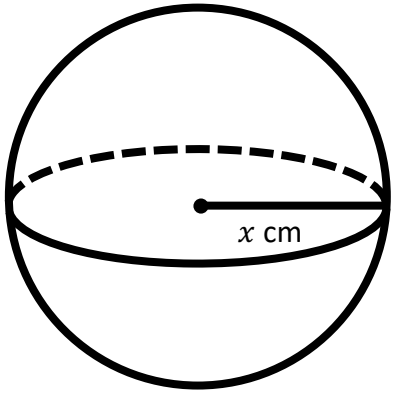
Worked Example

Find the radius, x, given that the surface area of the following sphere is $113.1\ cm^2$. Give your answer to 1 decimal place.



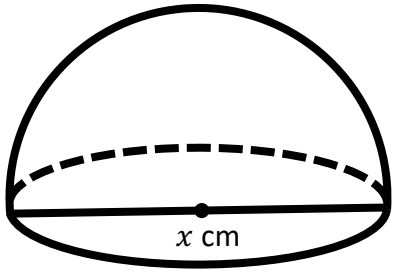
Your Turn

Find the radius, x, given that the surface area of the following sphere is $452.4\ cm^2$. Give your answer to 1 decimal place.



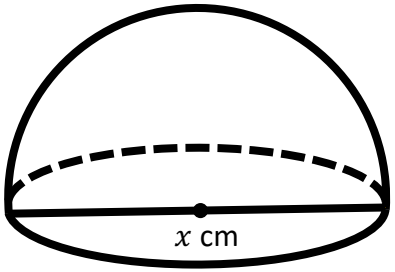
Worked Example

Find the diameter, x, given that the total surface area of the following hemisphere is $84.8\ cm^2$. Give your answer to 1 decimal place.



Your Turn

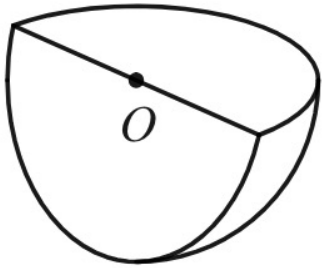
Find the diameter, x, given that the total surface area of the following hemisphere is $500\ cm^2$. Give your answer to 1 decimal place.



Worked Example	Your Turn
a) A sphere has a surface area of $36\pi\ cm^2$. Work out the volume of the sphere. Give your answer in terms of π and to 1 decimal place. b) A sphere has a volume of $36\pi\ cm^3$. Work out the surface area of the sphere. Give your answer in terms of π and to 1 decimal place.	a) A sphere has a surface area of $144\pi\ cm^2$. Work out the volume of the sphere. Give your answer in terms of π and to 1 decimal place. b) A sphere has a volume of $288\pi\ cm^3$. Work out the surface area of the sphere. Give your answer in terms of π and to 1 decimal place.

Worked Example

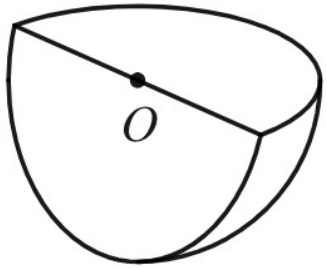
The diagram shows a solid quarter sphere, centre O.



The volume of the solid is 9750 cm^3.
Work out the surface area of the solid.
Give your answer to 1 decimal place.

Your Turn

The diagram shows a solid quarter sphere, centre O.

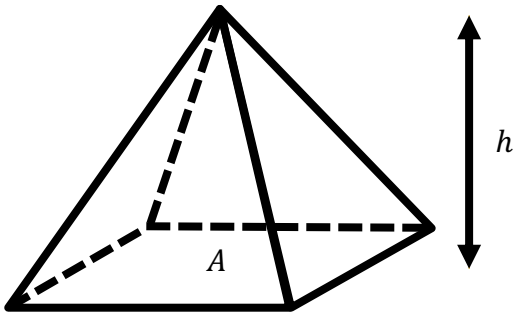


The volume of the solid is 3500 cm^3.
Work out the surface area of the solid.
Give your answer to 1 decimal place.

Volume of Pyramids

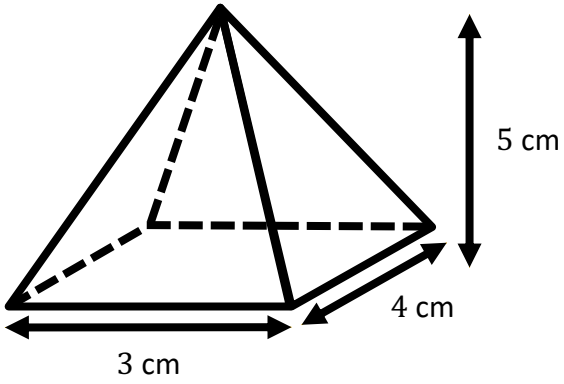
$$\text{Volume of Pyramid} = \frac{1}{3} \times \text{Area of Base} \times \text{Vertical Height}$$

$$V = \frac{1}{3}Ah$$



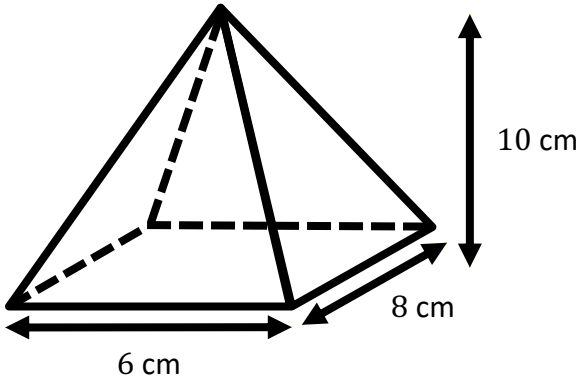
Worked Example

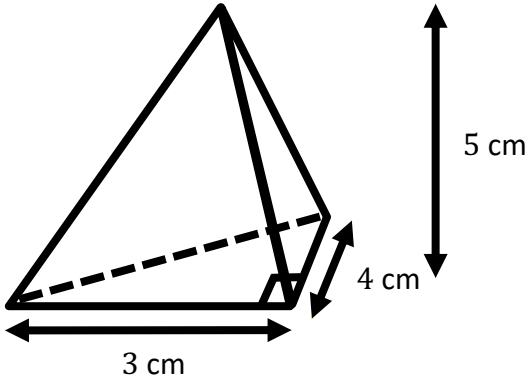
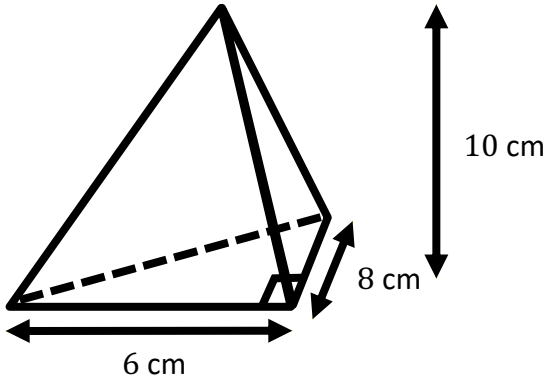
Calculate the volume of the following rectangular-based pyramid.



Your Turn

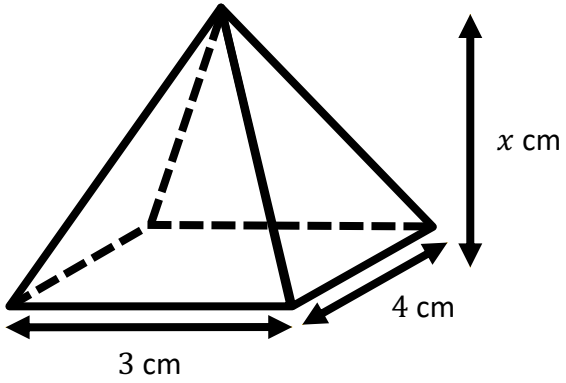
Calculate the volume of the following rectangular-based pyramid.



Worked Example	Your Turn
Calculate the volume of the following triangular-based pyramid.  	Calculate the volume of the following triangular-based pyramid. 

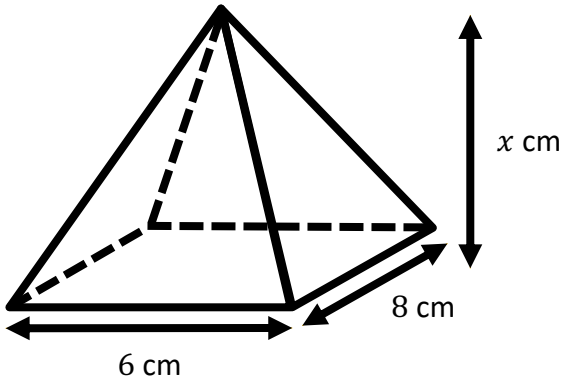
Worked Example

Find the height, x, given that the volume of the following rectangular-based pyramid is $20\ cm^3$.



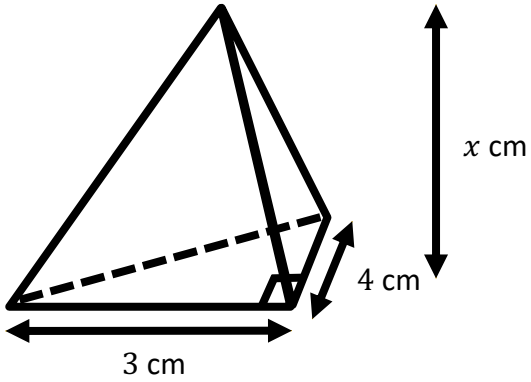
Your Turn

Find the height, x, given that the volume of the following rectangular-based pyramid is $160\ cm^3$.



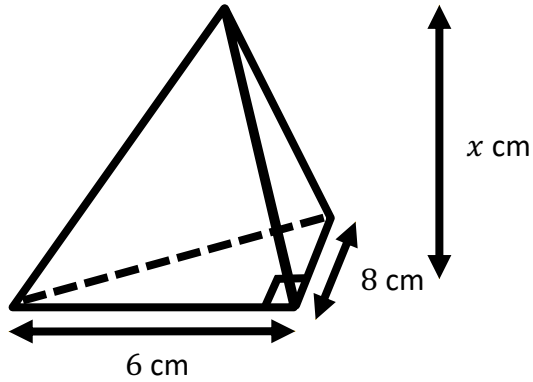
Worked Example

Find the height, x, given that the volume of the following triangular-based pyramid is $10\ cm^3$.



Your Turn

Find the height, x, given that the volume of the following triangular-based pyramid is $80\ cm^3$.

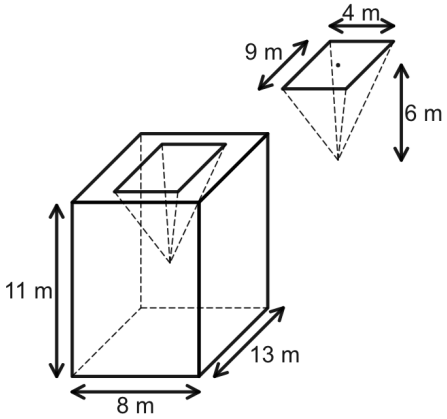


Worked Example

The diagram shows a compound solid comprising of a cuboid with a pyramidal indentation in the top.

The cuboid has length 8 m, width 13 m and height 11 m.

The rectangular based pyramid that has been removed has length 4 m, width 9 m and height 6 m as shown on the diagram.

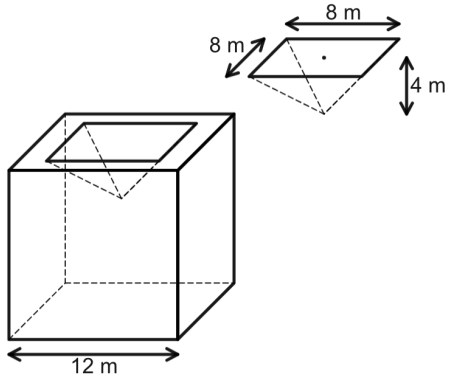


Calculate the volume of the remaining solid.
Give your answer in m^3 to the nearest integer.

Your Turn

The diagram shows a compound solid comprising of a cube with a pyramidal indentation in the top.

The cube has length 12 m.
The square based pyramid that has been removed has length and width of 8 m and a height 4 m as shown on the diagram.

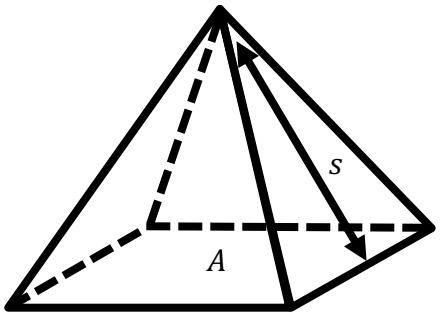


Calculate the volume of the remaining solid.
Give your answer in m^3 to the nearest integer.

Surface Area of Pyramids

$$\text{Total Surface Area of Pyramid} = \frac{1}{2} \times \text{Perimeter of Base} \times \text{Slant Height} + \text{Area of Base}$$

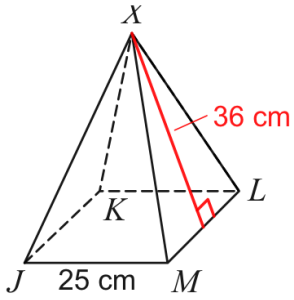
$$\text{TSA} = \frac{1}{2}\text{Ps} + \text{A}$$



Note: This formula only works for regular pyramids (e.g., pyramids with a square base). To find the surface area of other types of pyramids, you need to calculate the area of each face and the base separately, then add them together.

Worked Example

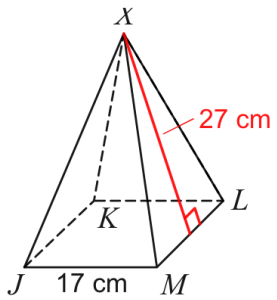
The diagram shows a square based pyramid $JKLMX$. The vertex, X, of the pyramid is directly above the centre of the square base.



The length of each side of the base is 25 cm. The distance from X to the midpoint of each of the sides of the base is 36 cm. Find the total surface area of the pyramid.

Your Turn

The diagram shows a square based pyramid $JKLMX$. The vertex, X, of the pyramid is directly above the centre of the square base.



The length of each side of the base is 17 cm. The distance from X to the midpoint of each of the sides of the base is 27 cm. Find the total surface area of the pyramid.

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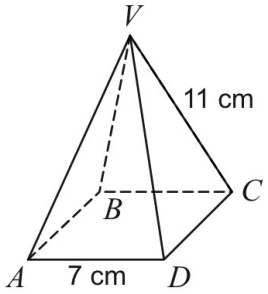
Worked Example

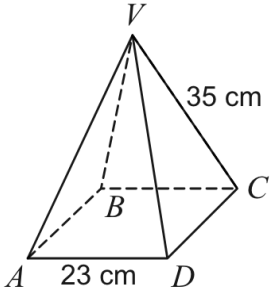
The diagram shows a square based pyramid $ABCDV$. The vertex, V, of the pyramid is directly above the centre of the square base.



The length of each side of the base is 7 cm. The length of each slanted edge is 11 cm. Find the total surface area of the pyramid. Give your answer to 1 decimal place.

Your Turn

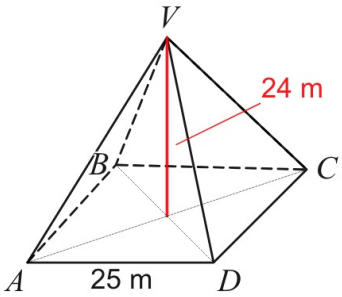
The diagram shows a square based pyramid $ABCDV$. The vertex, V, of the pyramid is directly above the centre of the square base.



The length of each side of the base is 23 cm. The length of each slanted edge is 35 cm. Find the total surface area of the pyramid. Give your answer to 1 decimal place.

Worked Example

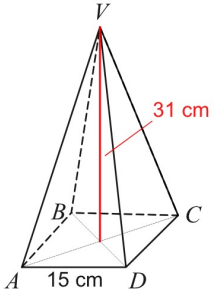
The diagram shows a square based pyramid $ABCDV$. The vertex, V, of the pyramid is directly above the centre of the square base.



The length of each side of the base is 25 m. The height of the pyramid is 24 m. Find the total surface area of the pyramid. Give your answer to 1 decimal place.

Your Turn

The diagram shows a square based pyramid $ABCDV$. The vertex, V, of the pyramid is directly above the centre of the square base.

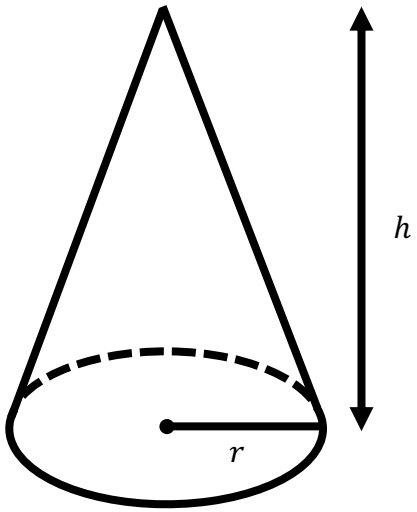


The length of each side of the base is 15 cm. The height of the pyramid is 31 cm. Find the total surface area of the pyramid. Give your answer to 1 decimal place.

Volume of Cones

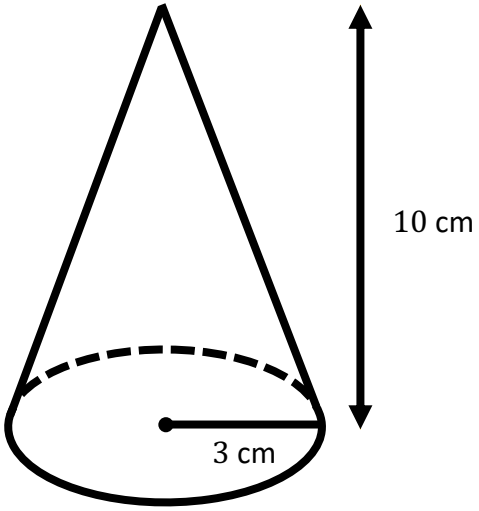
$$\text{Volume of Cone} = \frac{1}{3} \times \text{Area of Circle} \times \text{Height}$$

$$V = \frac{1}{3}\pi r^2 h$$



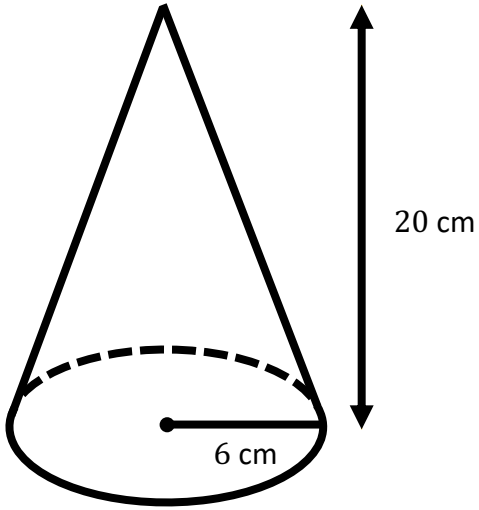
Worked Example

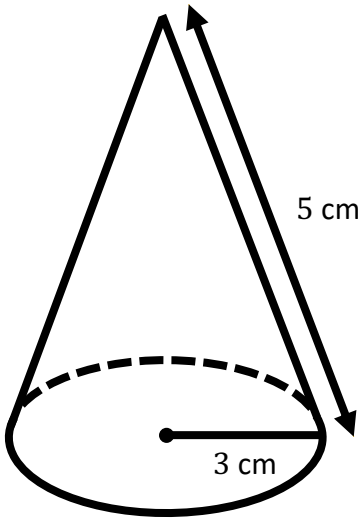
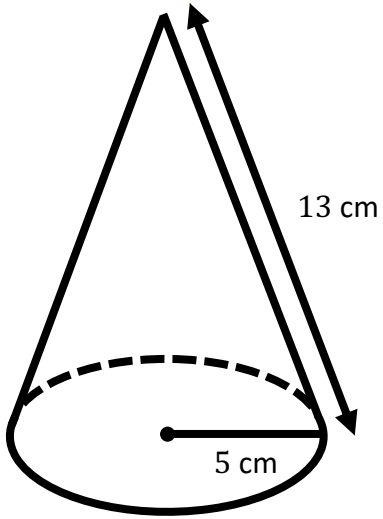
Calculate the volume of the following cone. Give your answer in terms of π and to 1 decimal place.



Your Turn

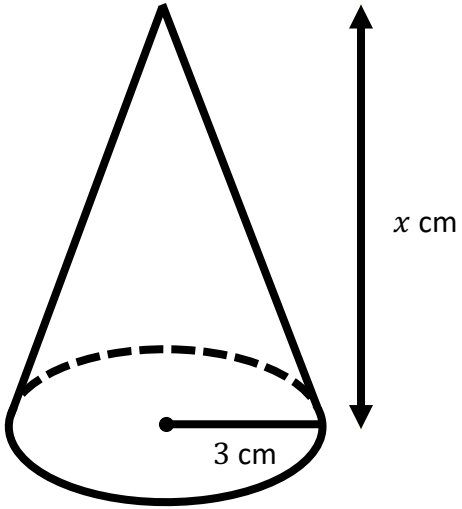
Calculate the volume of the following cone. Give your answer in terms of π and to 1 decimal place.



Worked Example	Your Turn
Calculate the volume of the following cone. Give your answer in terms of π and to 1 decimal place.  	Calculate the volume of the following cone. Give your answer in terms of π and to 1 decimal place. 

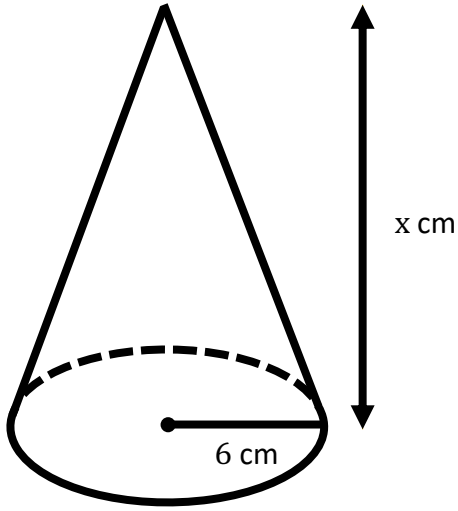
Worked Example

Find the height, x, given that the volume of the following cone is $94.2\ cm^3$. Give your answer to 1 decimal place.



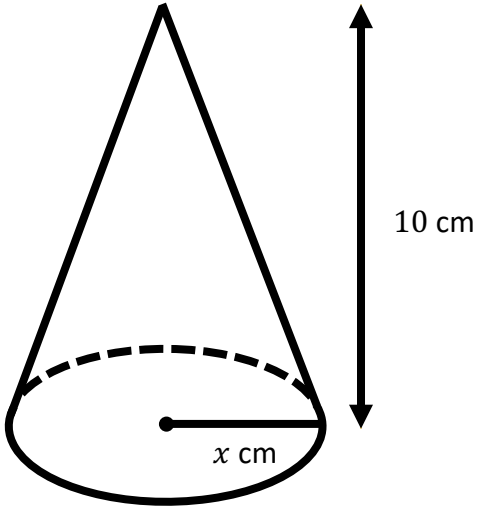
Your Turn

Find the height, x, given that the volume of the following cone is $754.0\ cm^3$. Give your answer to 1 decimal place.



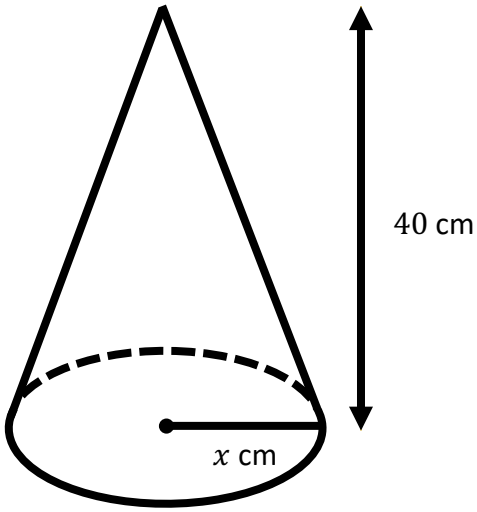
Worked Example

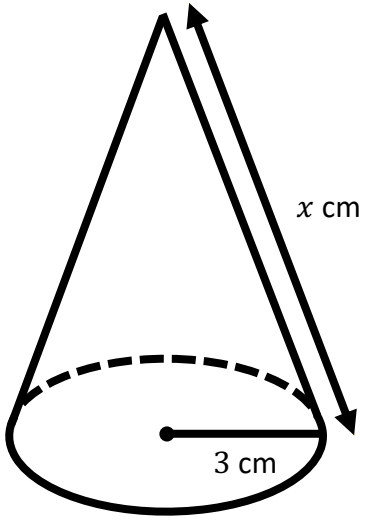
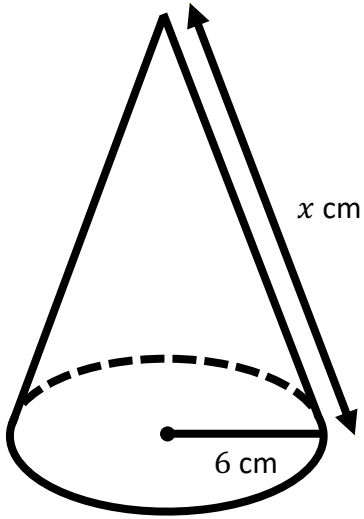
Find the radius, x, given that the volume of the following cone is $94.2\ cm^3$. Give your answer to 1 decimal place.

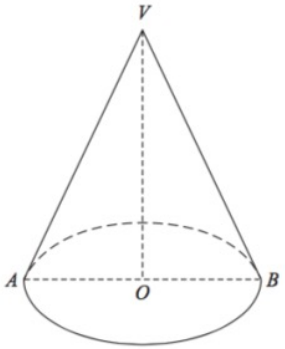
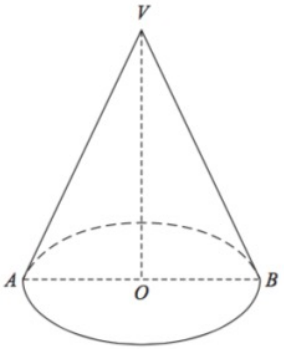


Your Turn

Find the radius, x, given that the volume of the following cone is $754.0\ cm^3$. Give your answer to 1 decimal place.

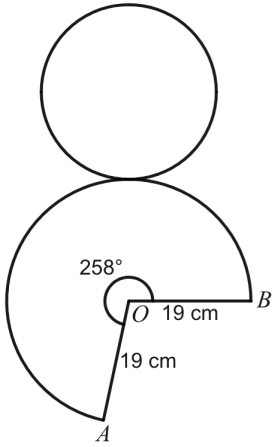


Worked Example	Your Turn
Find the slanted height, x, given that the volume of the following cone is $37.7\ cm^3$. Give your answer to 1 decimal place. 	Find the slanted height, x, given that the volume of the following cone is $500\ cm^3$. Give your answer to 1 decimal place. 

Worked Example	Your Turn
The diagram shows a solid cone. The base of the cone is a horizontal circle, centre O, with radius $9\ cm$. The curved surface area of the cone is $260\ cm^2$. Calculate the size of angle AVB.  	The diagram shows a solid cone. The base of the cone is a horizontal circle, centre O, with radius $4.5\ cm$. The curved surface area of the cone is $130\ cm^2$. Calculate the size of angle AVB. 

Worked Example

Here is the net of a cone.



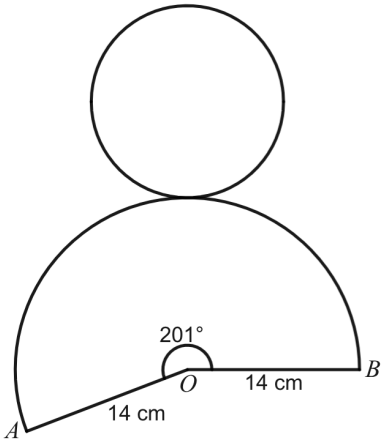
The net is formed from a sector of a circle, centre O, and radius 19 cm and an additional circle for the base.
Reflex angle $AOB = 258°$

The net makes a cone of slant height of 19 cm.

Calculate the volume of the cone.
Give your answer correct to 1 decimal place.

Your Turn

Here is the net of a cone.



The net is formed from a sector of a circle, centre O, and radius 14 cm and an additional circle for the base.
Reflex angle $AOB = 201°$

The net makes a cone of slant height of 14 cm.

Calculate the volume of the cone.
Give your answer correct to 1 decimal place.

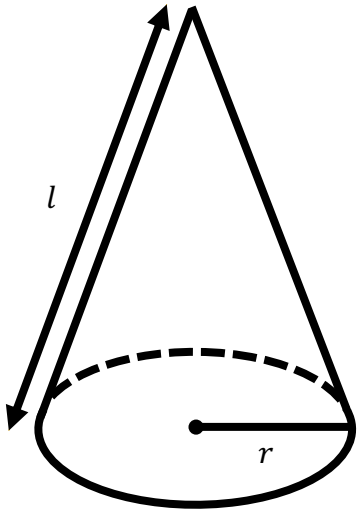
Surface Area of Cones

Curved Surface Area of Cone = π × Radius × Slanted Height

$CSA = \pi rl$

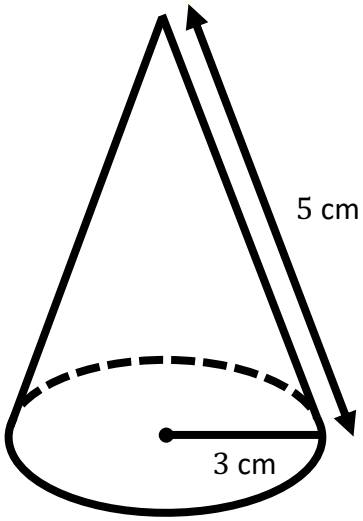
Total Surface Area of Cone = π × Radius × Slanted Height + π × Radius²

$TSA = \pi rl + \pi r^2$



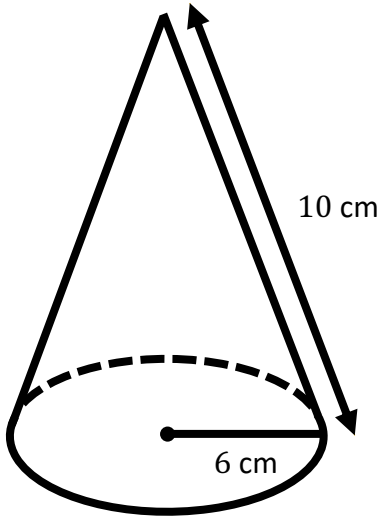
Worked Example

Calculate the total surface area of the following cone. Give your answer in terms of π and to 1 decimal place.



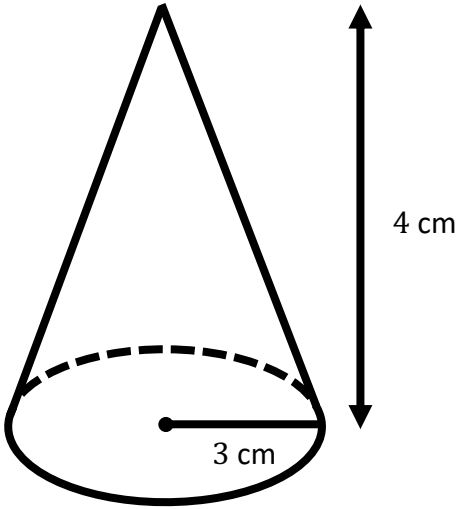
Your Turn

Calculate the total surface area of the following cone. Give your answer in terms of π and to 1 decimal place.



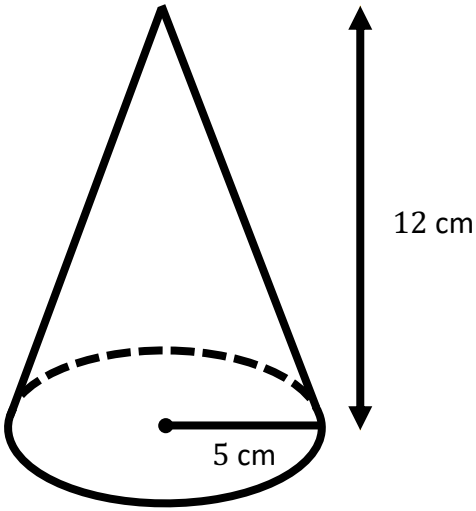
Worked Example

Calculate the total surface area of the following cone. Give your answer in terms of π and to 1 decimal place.



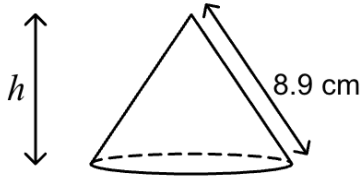
Your Turn

Calculate the total surface area of the following cone. Give your answer in terms of π and to 1 decimal place.



Worked Example

The diagram shows a cone of slant height 8.9 cm.

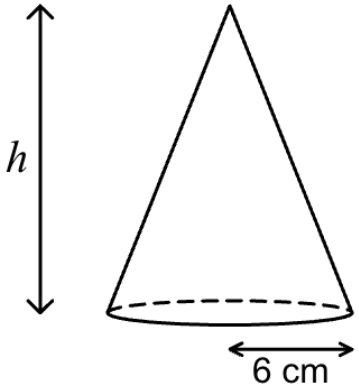


The curved surface area of the cone is 140 cm^2

Find the height, h, of the cone.
Give your answer to 1 decimal place.

Your Turn

The diagram shows a cone of radius 6 cm.

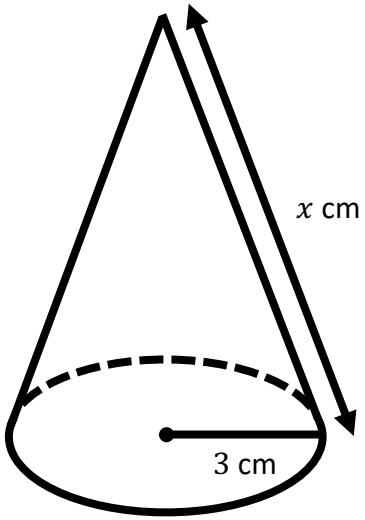


The curved surface area of the cone is 310 cm^2

Find the height, h, of the cone.
Give your answer to 1 decimal place.

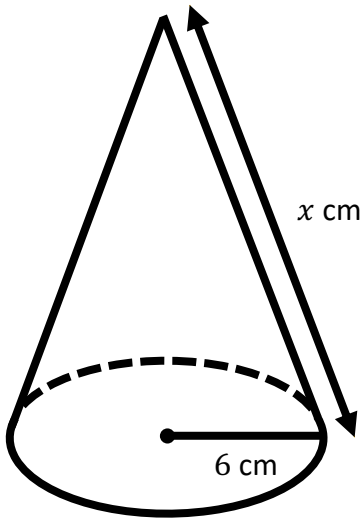
Worked Example

Find the slanted height, x, given that the total surface area of the following cone is $75.4\ cm^2$. Give your answer to 1 decimal place.



Your Turn

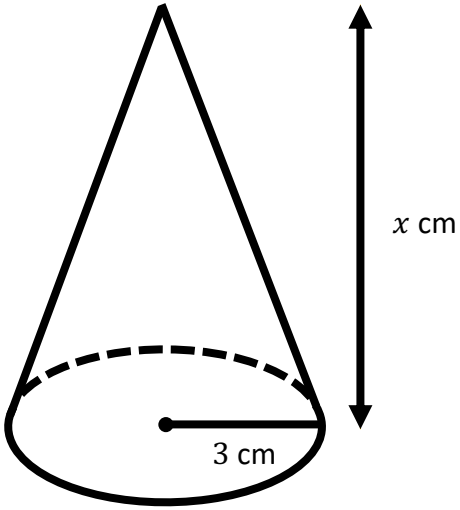
Find the slanted height, x, given that the total surface area of the following cone is $301.6\ cm^2$. Give your answer to 1 decimal place.



Dr Frost 406f

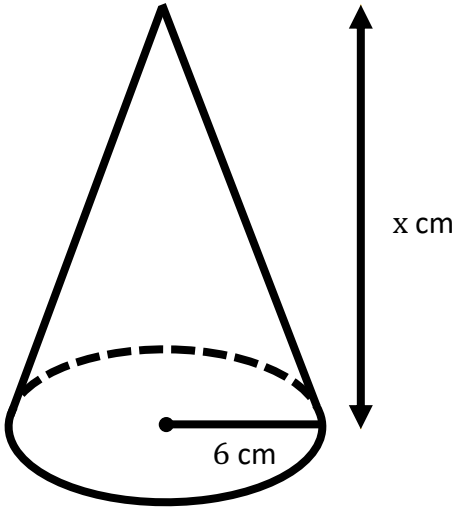
Worked Example

Find the perpendicular height, x, given that the total surface area of the following cone is $75.4\ cm^2$. Give your answer to 1 decimal place.



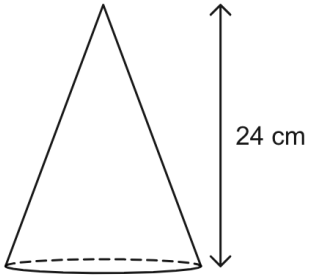
Your Turn

Find the perpendicular height, x, given that the total surface area of the following cone is $400\ cm^2$. Give your answer to 1 decimal place.



Worked Example

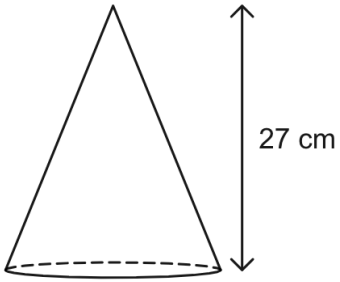
The diagram shows a cone with height 24 cm.



The volume of the cone is 2000 cm^3.
Find the total surface area of the cone.
Give your answer to one decimal place.

Your Turn

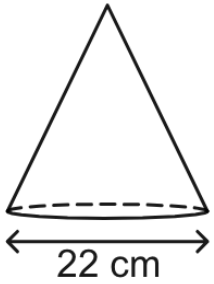
The diagram shows a cone with height 27 cm.



The volume of the cone is 3400 cm^3.
Find the total surface area of the cone.
Give your answer to one decimal place.

Worked Example

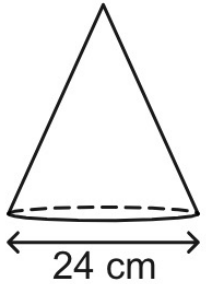
The diagram shows a cone with diameter 22 cm.



The total surface area of the cone is 1200 cm^2.
Find the volume of the cone.
Give your answer to one decimal place.

Your Turn

The diagram shows a cone with diameter 24 cm.



The total surface area of the cone is 1500 cm^2.
Find the volume of the cone.
Give your answer to one decimal place.

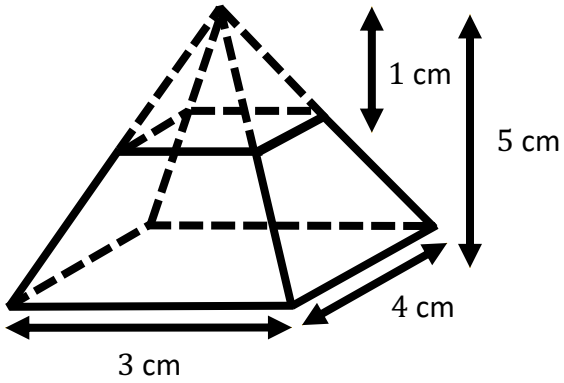
Fill in the Gaps

Radius r	Vertical Height h	Slanted Height l	Volume in terms of π	Volume to 3 s.f.	Curved Surface Area in terms of π	Total Surface Area in terms of π	Volume : Total Surface Area
$5\ cm$	$12\ cm$	$13\ cm$	$100\pi\ cm^3$			$90\pi\ cm^2$	$10 : 9$
$6\ cm$	$8\ cm$	$10\ cm$			$60\pi\ cm^2$		
	$30\ mm$	$34\ mm$		$8040\ mm^3$			
$0.7\ m$	$2.4\ m$						
$9\ cm$		$15\ cm$					
$2\ m$			$\frac{14}{5}\pi\ cm^3$				
		$20\ mm$			$240\pi\ mm^2$		
					$15\pi\ cm^2$	$24\pi\ cm^2$	
		$17\ cm$	$320\pi\ cm^3$				$8 : 5$

Volume of Frustums

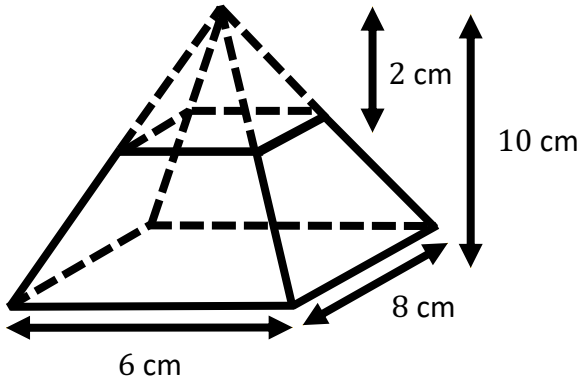
Worked Example

Calculate the volume of the following frustum.



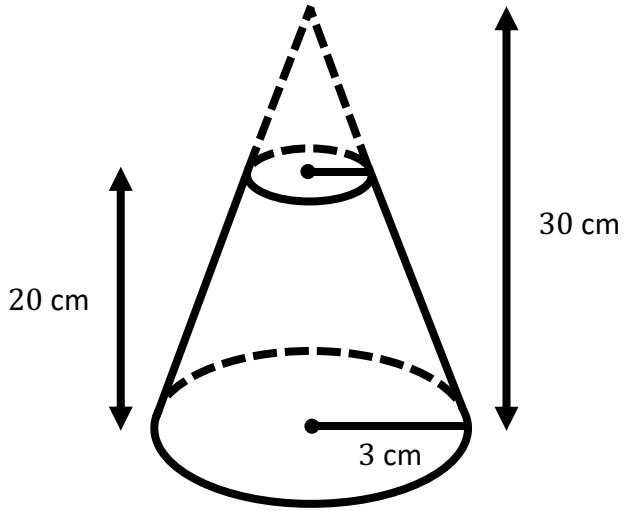
Your Turn

Calculate the volume of the following frustum.



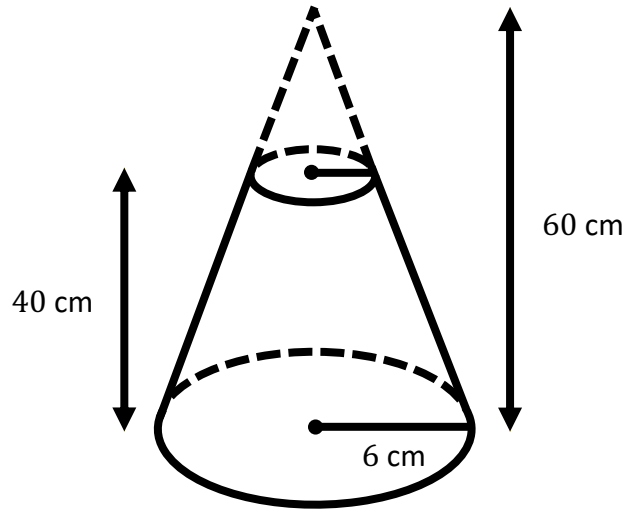
Worked Example

Calculate the volume of the following frustum. Give your answer in terms of π and to 1 decimal place.



Your Turn

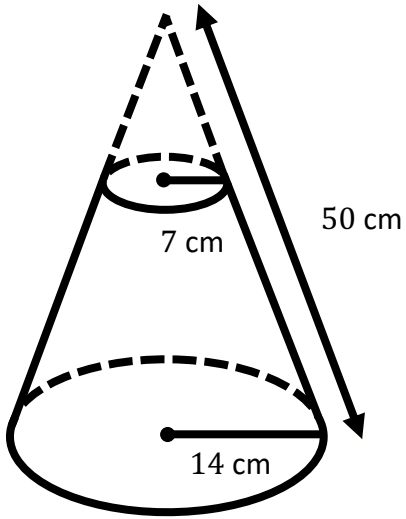
Calculate the volume of the following frustum. Give your answer in terms of π and to 1 decimal place.



Dr Frost 407c

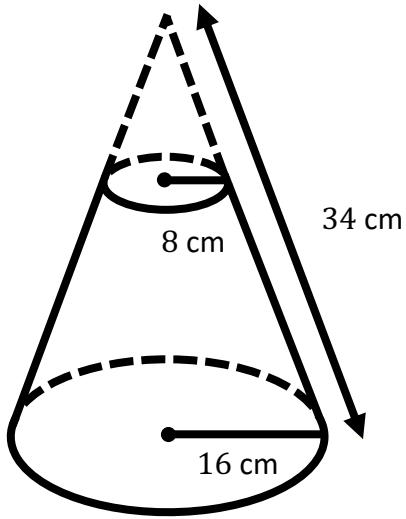
Worked Example

Calculate the volume of the following frustum. Give your answer in terms of π and to 1 decimal place.



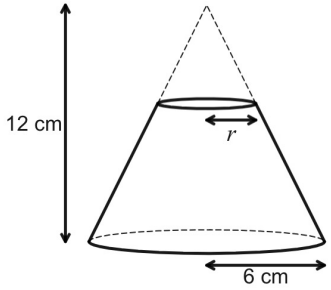
Your Turn

Calculate the volume of the following frustum. Give your answer in terms of π and to 1 decimal place.



Worked Example

A cone of radius r cm is removed from a cone of radius 6 cm and height 12 cm to give a frustum.

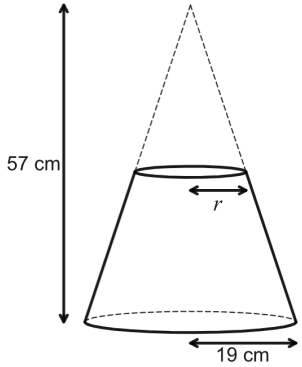


The volume of the frustum is 420 cm^3

Calculate the value of r
Give your answer correct to 1 decimal place

Your Turn

A cone of radius r cm is removed from a cone of radius 19 cm and height 57 cm to give a frustum.



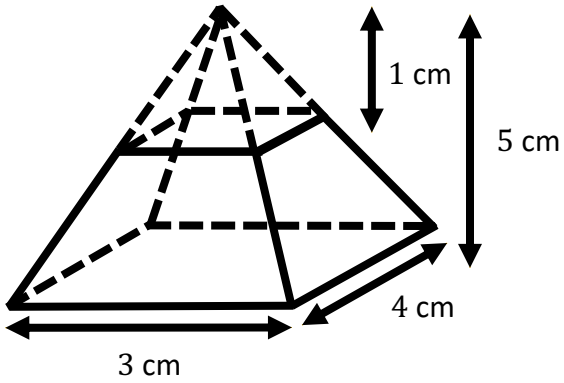
The volume of the frustum is 18407 cm^3

Calculate the value of r
Give your answer correct to 1 decimal place

Surface Area of Frustums

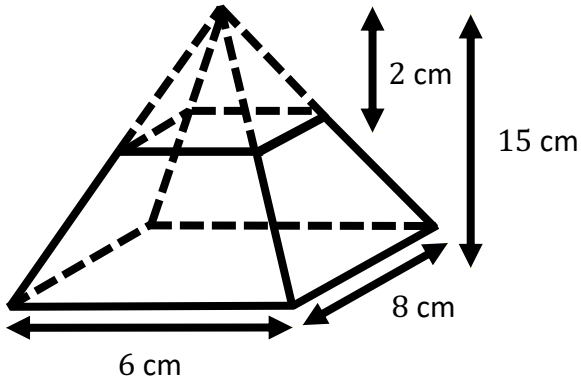
Worked Example

Calculate the total surface area of the following frustum.



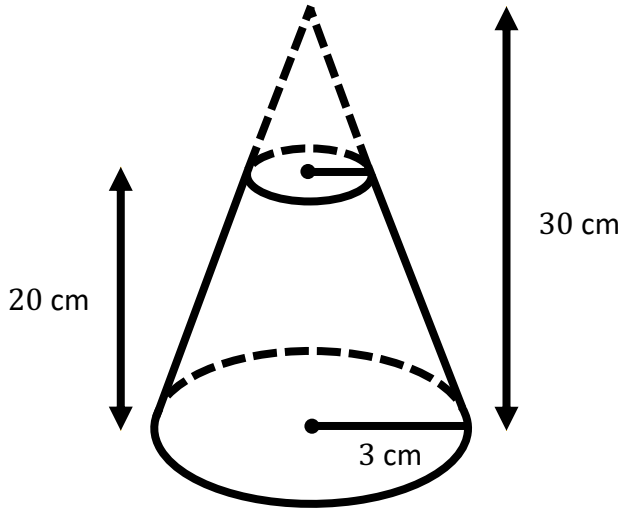
Your Turn

Calculate the total surface area of the following frustum.



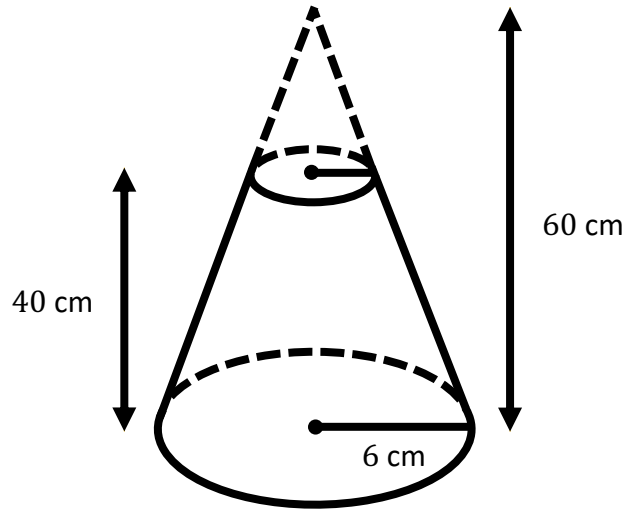
Worked Example

Calculate the total surface area of the following frustum. Give your answer in terms of π and to 1 decimal place.



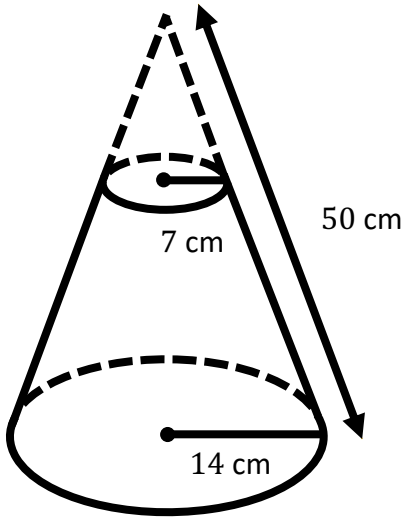
Your Turn

Calculate the total surface area of the following frustum. Give your answer in terms of π and to 1 decimal place.



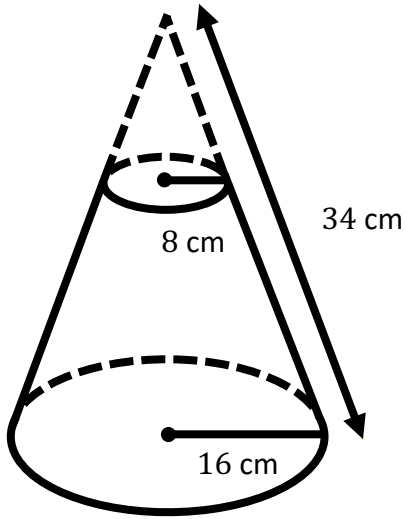
Worked Example

Calculate the total surface area of the following frustum. Give your answer in terms of π and to 1 decimal place.



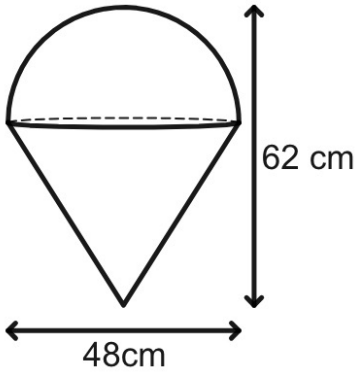
Your Turn

Calculate the total surface area of the following frustum. Give your answer in terms of π and to 1 decimal place.



Worked Example

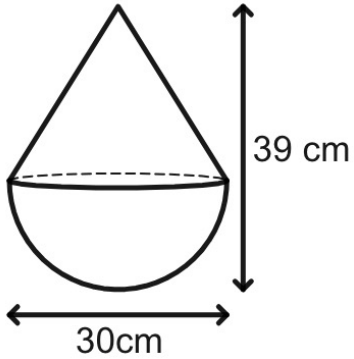
A child's toy is in the shape of a cone with a hemisphere on top, as shown below. The toy is 48 cm wide and 62 cm high.



Calculate the volume of the toy. Give your answer correct to two significant figures.

Your Turn

A child's toy is in the shape of a hemisphere with a cone on top, as shown below. The toy is 30 cm wide and 39 cm high.

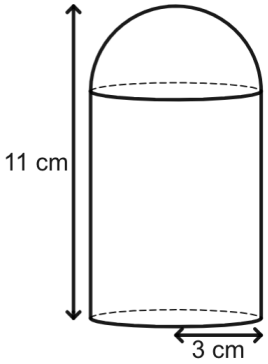


Calculate the volume of the toy. Give your answer correct to two significant figures.

Worked Example

The diagram shows a storage jar.

The storage jar consists of a cylinder with a hemisphere on top.



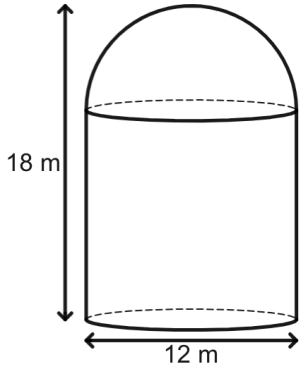
The height of the storage jar is 11 cm.
The radius is 3 cm.

Calculate the volume of the storage jar.
Give your answer in cm^3, in terms of π

Your Turn

The diagram shows an observatory.

The observatory consists of a cylinder with a hemisphere on top.

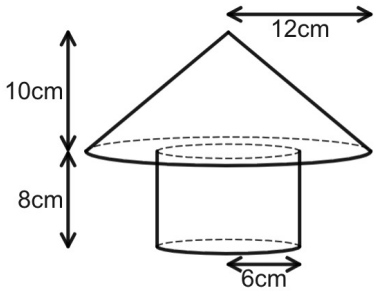


The height of the observatory is 18 m.
The radius is 12 m.

Calculate the volume of the observatory.
Give your answer in m^3, in terms of π

Worked Example

The diagram below shows a toy house made from a cylinder and a cone.

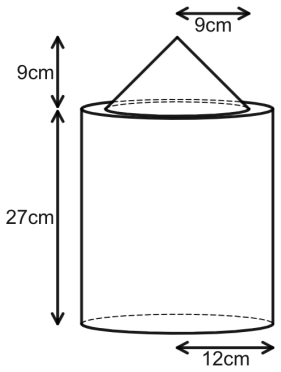


The cylinder has a height 8 cm and a radius 6 cm.
The cone has a height 10 cm and a radius 12 cm.

Calculate the volume of the house in cm^3.
Give your answer correct to 3 significant figures.

Your Turn

The diagram below shows a toy candle made from a cylinder and a cone.



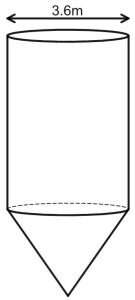
The cylinder has a height 27 cm and a radius 12 cm.

The cone has a height 9 cm and a radius 9 cm.

Calculate the volume of the candle in cm^3
Give your answer in terms of π

Worked Example

A water storage tank is constructed with a conical base and a cylindrical top section as shown in the diagram below.



The diameter of the top of the cone and the cylinder is 3.6 m.

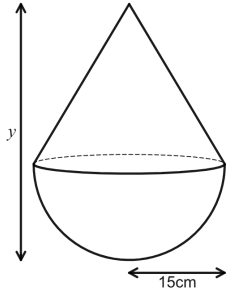
The total volume of the storage tank is 56 m^3

The height of the cylinder is two times the height of the cone.

Calculate the total height of storage tank.
Give your answer correct to 1 decimal place.

Your Turn

A buoy is constructed with a hemispherical base and a conical top section as shown in the diagram below.



The radius of the hemisphere and the base of the cone is 15 cm.

The total volume of the buoy is 4125π cm^3

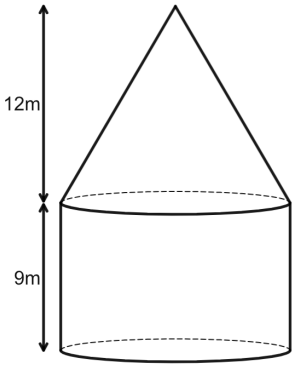
The total height of the buoy is y cm

Calculate the value of y

Dr Frost 407g

Worked Example

A solid shape is made from a cylinder and a cone.



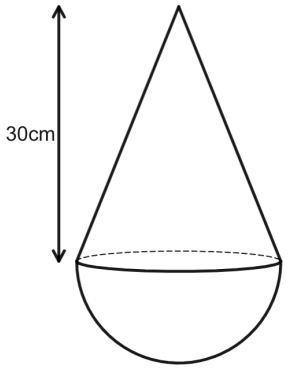
The cone exactly fits on top of the cylinder.
The cylinder has a height of 9 m.
The cone has a height of 12 m.

The volume of the cone is 196π m^3

Work out the total volume of the solid in m^3
Give your answer in terms of π

Your Turn

A solid shape is made from a cone and a hemisphere.



The radius of the hemisphere is equal to the radius of the base of the cone.

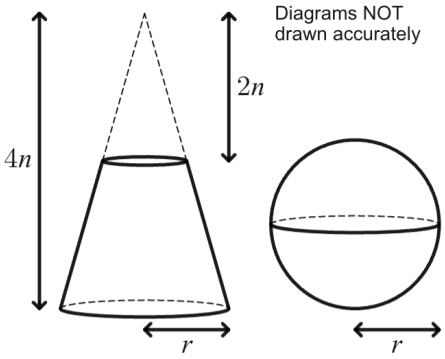
The cone has a height of 30 cm.

The volume of the hemisphere is 1152π cm^3

Work out the total volume of the solid in cm^3
Give your answer in terms of π

Worked Example

The diagram shows a frustum of a cone and a sphere. The frustum is made by removing a small cone from a large cone. The cones are similar.



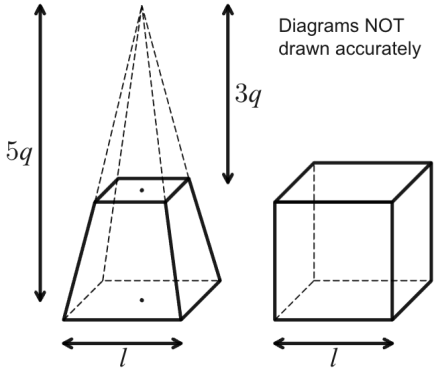
The height of the small cone is $2n$ cm.
The height of the large cone is $4n$ cm.
The radius of the base of the large cone is r cm.
The radius of the sphere is r cm.

Given that the volume of the frustum is equal to the volume of the sphere, find an expression for r in terms of n
Give your expression in its simplest form.

Your Turn

The diagram shows a frustum of a square based pyramid and a cube. The frustum is made by removing a small pyramid from a large pyramid. The pyramids are similar.

The apex of each pyramid is directly above the centre of the base.



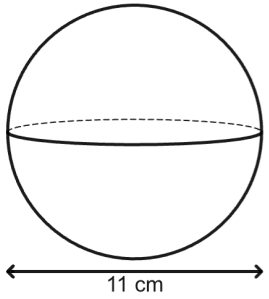
The height of the small pyramid is $3q$ cm.
The height of the large pyramid is $5q$ cm.
The length of the base of the large pyramid is l cm.
The length of the cube is l cm.

Given that the volume of the frustum is equal to the volume of the cube, find an expression for l in terms of q

Give your expression in its simplest form.

Worked Example

A solid sphere has a diameter of 11 cm

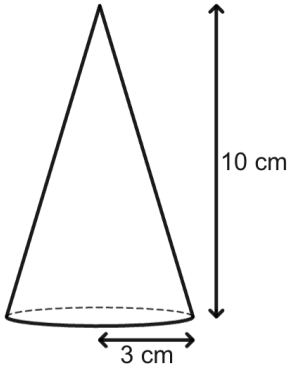


The sphere has a density of 0.4 g/cm^3

Calculate the mass of the sphere.
Give your answer in grams, correct to the nearest gram.

Your Turn

A solid cone has a radius of 3 cm and a height of 10 cm

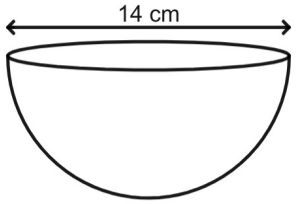


The cone has a mass of 235 grams.

Calculate the density of the cone.
Give your answer in g/cm^3, correct to 2 decimal places.

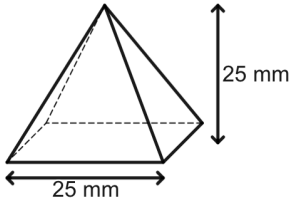
Worked Example

Kaitlyn has a hemispherical bowl filled with melted chocolate. The bowl has an internal diameter of 14 cm



The chocolate is poured into square-based pyramidal moulds to create chocolates with a height and base length of 25 mm

The chocolate must fill the pyramid-shaped moulds completely or they are rejected.



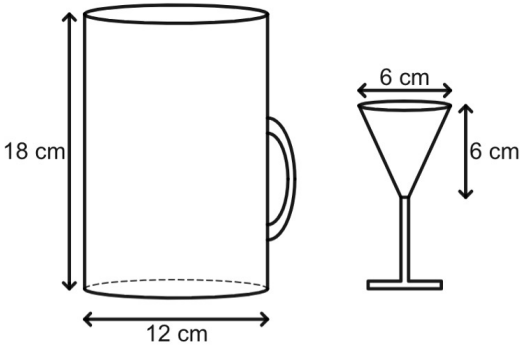
Calculate the number of chocolates that can be made from the bowl of melted chocolate.

Your Turn

Abdallah has a cylindrical jug filled with lemonade. The jug has an internal diameter of 12 cm and internal height of 18 cm

The lemonade is then poured into cone-shaped glasses with an internal diameter and bowl height of 6 cm

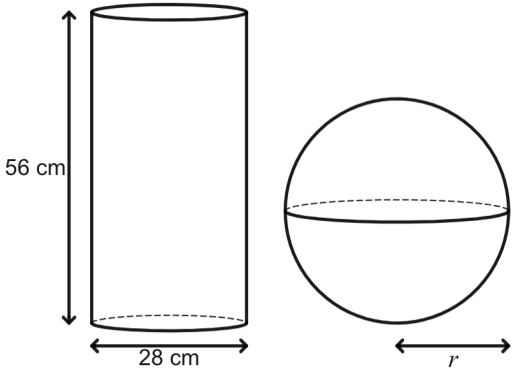
The lemonade fills the cone-shaped glasses completely.



Calculate the number of full glasses of lemonade that can be filled from the jug.

Worked Example

The diagram shows a cylinder and a sphere.



The cylinder has a diameter 28 cm and a height 56 cm
The cylinder and the sphere have the same volume.

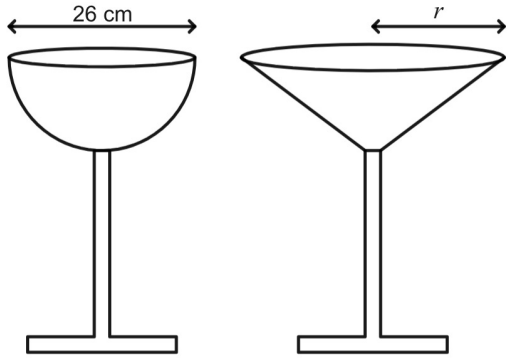
Work out the radius r of the sphere.
Give your answer in cm correct to 1 decimal place.

Your Turn

A hemispherical glass with a diameter of 26 cm is filled with lemonade.

The lemonade is then poured into a cone-shaped glass with the same height.

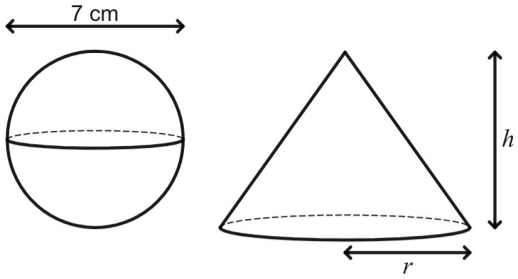
The lemonade fills the cone-shaped glass completely.



Calculate the radius r of the cone-shaped glass.
Give your answer in cm correct to 1 decimal place.

Worked Example

The diagram shows a sphere and a cone.



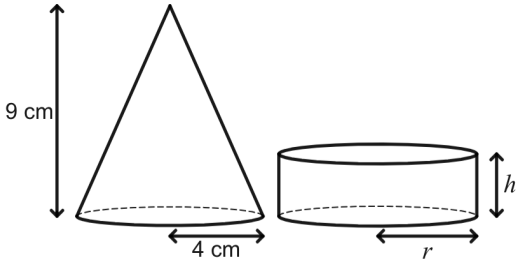
The sphere has a diameter 7 cm
The cone has a radius r cm and height h cm
The ratio $r : h$ is $5 : 7$

The volume of the cone is equal to the volume of the sphere.

Calculate the values of r and h
Give your answers in cm correct to 2 decimal places.

Your Turn

The diagram shows a cone and a cylinder.



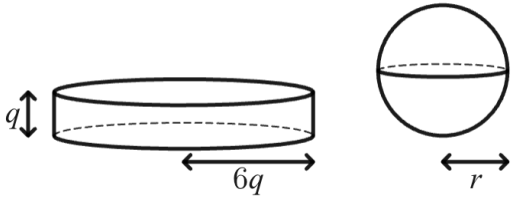
The cone has a radius 4 cm and height 9 cm
The cylinder has a radius r cm and height h cm
The ratio $r : h$ is $8 : 5$

The volume of the cylinder is equal to the volume of the cone.

Calculate the values of r and h
Give your answers in cm correct to 2 decimal places.

Worked Example

The diagram shows a solid metal cylinder and a sphere.



Diagrams NOT drawn accurately

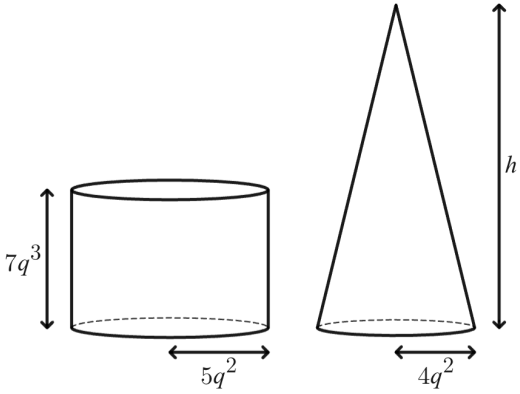
The cylinder has base radius $6q$ and height q

The cylinder is melted down and made into a sphere of radius r

Find an expression for r in terms of q
Give your answer in its simplest form.

Your Turn

The diagram shows a solid metal cylinder and a cone.



Diagrams NOT drawn accurately

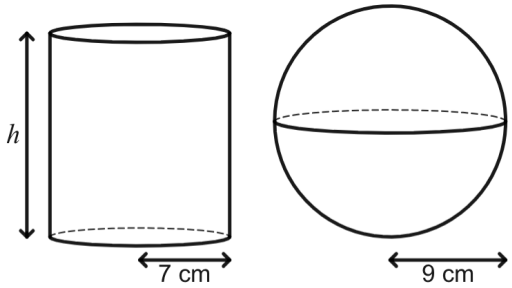
The cylinder has base radius $5q^2$ and height $7q^3$

The cylinder is melted down and made into a cone with radius $4q^2$

Find an expression for h in terms of q
Give your answer in its simplest form.

Worked Example

Shown below is a cylinder and a sphere.

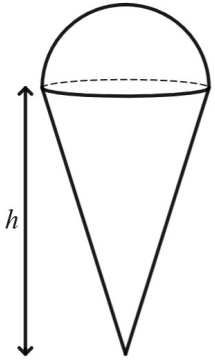


The ratio of the volume of the cylinder to the volume of the sphere is $4 : 5$

Calculate the height h of the cylinder.
Give your answer correct to 2 decimal places.

Your Turn

The diagram below shows an icecream made from a filled cone of internal radius 4.4 cm and height h topped with a hemisphere of icecream of the same radius.

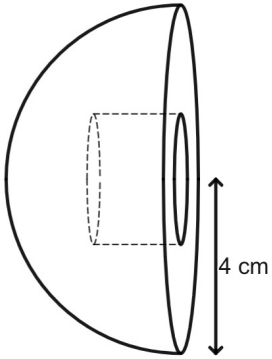


The ratio of the volume of the hemisphere to the volume of the cone is $5 : 8$

Calculate the height h of the cone.
Give your answer correct to 2 decimal places.

Worked Example

The diagram below shows a wooden end-piece for a curtain pole.
It is in the shape of a hemisphere with a radius of 4 cm.



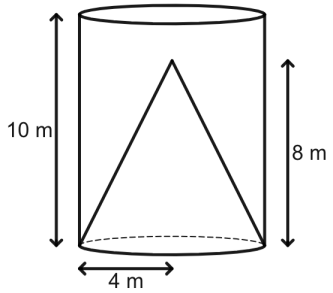
The curtain pole sits in a cylindrical hole that has been drilled into the end-piece.
The hole has a radius of 1.5 cm and depth 2 cm.

Calculate the volume of wood that remains.
Give your answer in cm^3 correct to the nearest integer.

Your Turn

A cylindrical tank with a radius of 4 metres and a height of 10 metres is partially filled with a conical heap of sand.

The cone has the same base radius of 4 metres and a height of 8 metres.

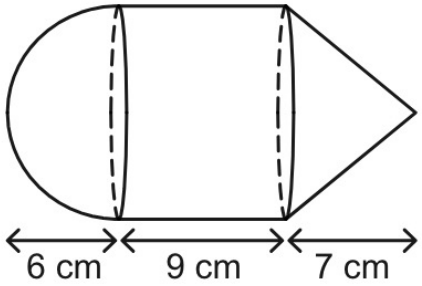


Calculate the volume of the space inside the cylindrical tank but outside the conical heap of sand.

Give your answer in m^3 correct to the nearest integer.

Worked Example

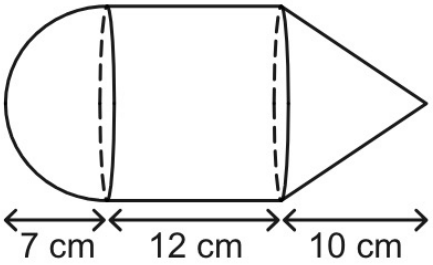
The diagram shows a solid formed from a hemisphere, a cylinder and a cone.



Find the total surface area of the solid.
Give your answer to one decimal place.

Your Turn

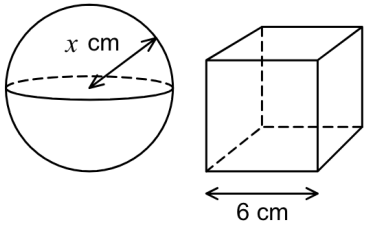
The diagram shows a solid formed from a hemisphere, a cylinder and a cone.



Find the total surface area of the solid.
Give your answer to one decimal place.

Worked Example

The diagram shows a solid sphere and a solid cube.

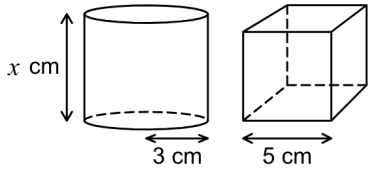


The sphere has radius x cm.
The cube has side length 6 cm.
The surface area of the sphere is equal to the surface area of the cube.

Find the value of x
Give your answer to 1 decimal place.

Your Turn

The diagram shows a solid cylinder and a solid cube.

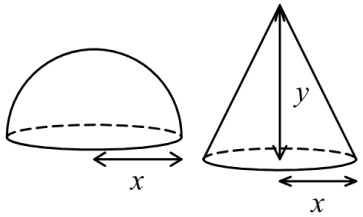


The cylinder has radius 3 cm and height x cm.
The cube has side length 5 cm.
The surface area of the cylinder is equal to the surface area of the cube.

Find the value of x
Give your answer to 1 decimal place.

Worked Example

The diagram shows a solid hemisphere and a solid cone.

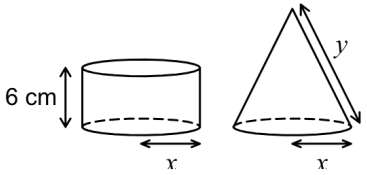


The hemisphere has radius x cm.
The cone has radius x cm and height y cm.
The surface area of the hemisphere is equal to the surface area of the cone.

Find an expression for y in terms of x

Your Turn

The diagram shows a solid cylinder and a solid cone.

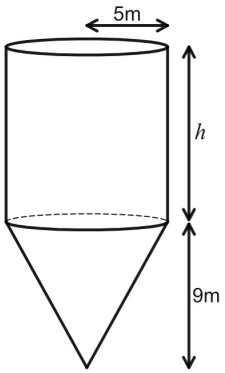


The cylinder has radius x cm and height 6 cm.
The cone has radius x cm and slant height y cm.
The surface area of the cylinder is equal to the surface area of the cone.

Find an expression for y in terms of x

Worked Example

The diagram shows a container for grain.



The container is a cylinder on top of a cone.
The cylinder has a radius of 5 m and a height of h m.
The cone has a base radius of 5 m and a vertical height of 9 m.

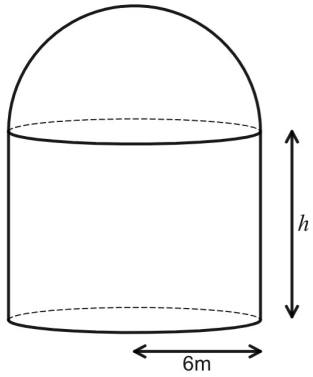
The container is initially empty.
The container is then filled with grain at a constant rate.

After 15 hours the depth of the grain is 15 m above the vertex of the cone.
After 23 hours the container is full of grain.

Work out the value of h

Your Turn

The diagram shows a water tank.



The container is a hemisphere on top of a cylinder.
The cylinder has a radius of 6 m and a height of h m.
The hemisphere has a base radius of 6 m.

The container is initially full.
The container is then emptied at a constant rate.

After 10 hours the height of the water has dropped by 12 m from the top of the hemisphere.
After 13 hours the container is empty of water.

Work out the value of h

Dr Frost 407k

Extra Notes

4 Bearings

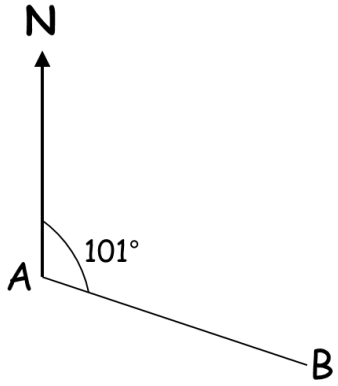
Can this be a Bearing?

040	Yes / No
90	Yes / No
90.5	Yes / No
158.50	Yes / No
58.5	Yes / No

Intelligent Practice

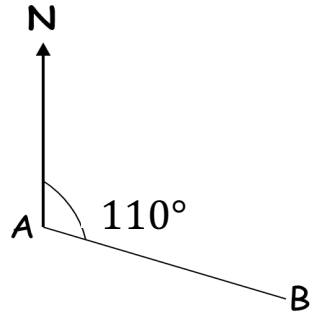
1) 045 Yes / No
2) 090 Yes / No
3) 45 Yes / No
4) 360 Yes / No
5) 361 Yes / No
6) 450 Yes / No
7) 30 Yes / No
8) 030 Yes / No
9) -145 Yes / No
10) 260 Yes / No
11) 365 Yes / No
12) 180 Yes / No
13) 27 Yes / No
14) -049 Yes / No
15) 049.5 Yes / No
16) 0180 Yes / No
17) 045 Yes / No
18) 145 Yes / No
19) -260 Yes / No
20) 0100 Yes / No
21) 80 Yes / No
22) 080 Yes / No
23) 0005 Yes / No
24) 000.5 Yes / No
25) 100.005 Yes / No

Worked Example



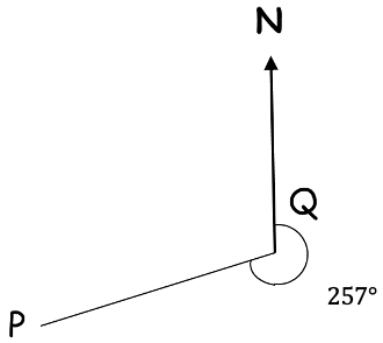
a) Find the bearing of B from A
b) Find the bearing of A from B

Your Turn



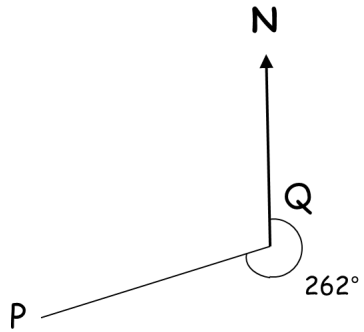
a) Find the bearing of B from A
b) Find the bearing of A from B

Worked Example



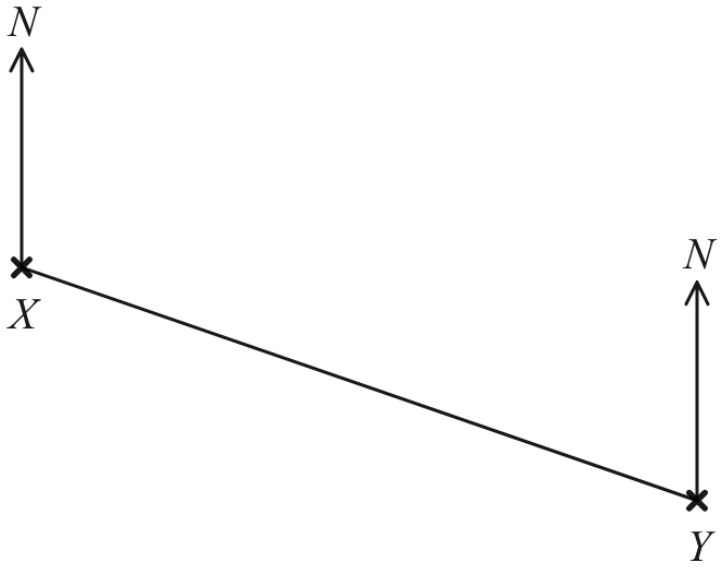
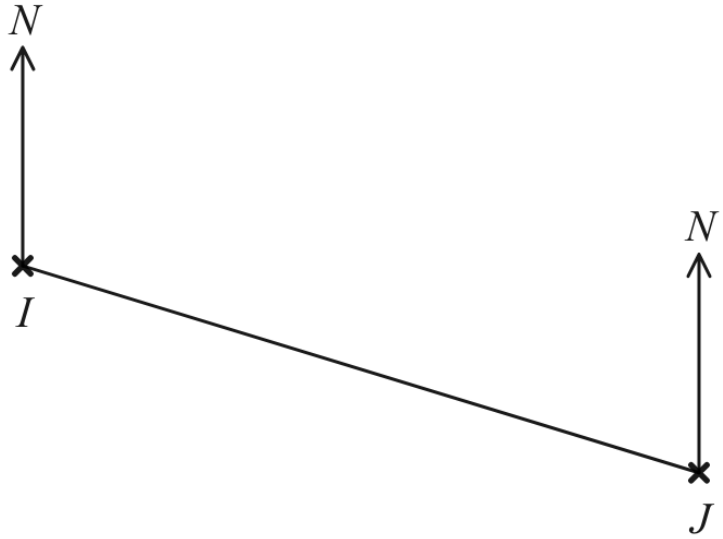
a) Find the bearing of P from Q
b) Find the bearing of Q from P

Your Turn



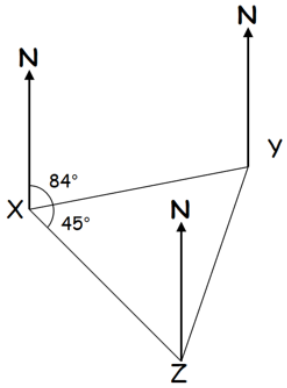
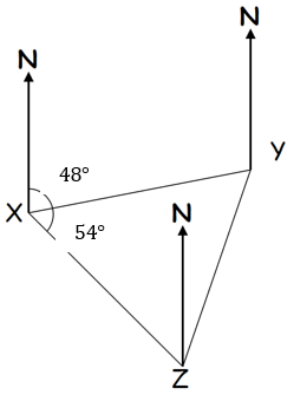
a) Find the bearing of P from Q
b) Find the bearing of Q from P

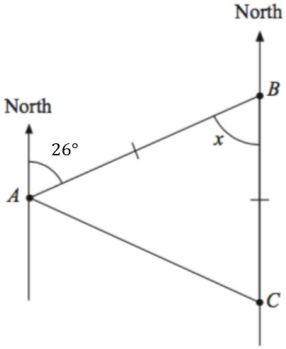
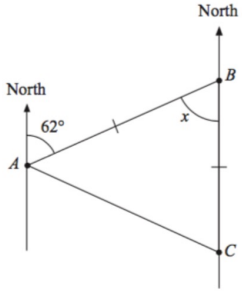
Dr Frost 264b and 264d

Worked Example	Your Turn
Measure the bearing of X from Y.  	Measure the bearing of I from J. 

Dr Frost 264c

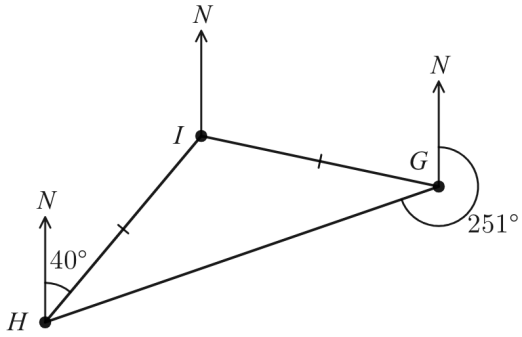
Worked Example	Your Turn
a) The bearing of B from A is $030°$. What is the bearing of A from B? b) The bearing of B from A is $130°$. What is the bearing of A from B? c) The bearing of B from A is $230°$. What is the bearing of A from B?	a) The bearing of B from A is $250°$. What is the bearing of A from B? b) The bearing of B from A is $050°$. What is the bearing of A from B? c) The bearing of B from A is $150°$. What is the bearing of A from B?

Worked Example	Your Turn
Find the bearing of:  Y from X X from Y Z from X X from Z	Find the bearing of:  Y from X X from Y Z from X X from Z

Worked Example	Your Turn
Calculate the bearing of C from A 	Calculate the bearing of C from A 

Worked Example

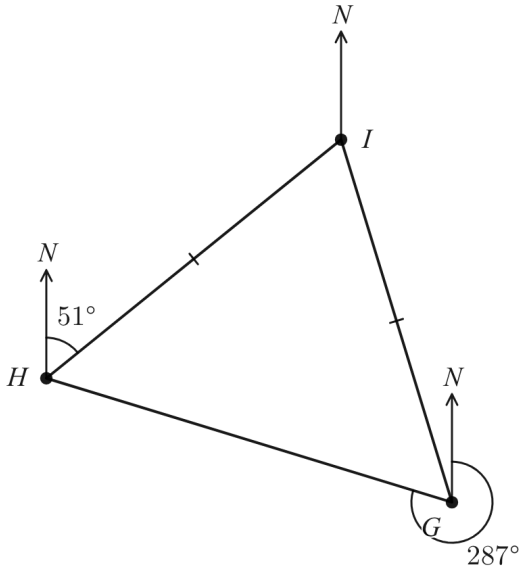
The diagram shows three points, G, H and I.
The bearing of H from G is $251°$.
The bearing of I from H is $040°$.
$HI = IG$



Find the bearing of I from G.

Your Turn

The diagram shows three points, G, H and I.
The bearing of I from H is $051°$.
The bearing of H from G is $287°$.
$HI = IG$



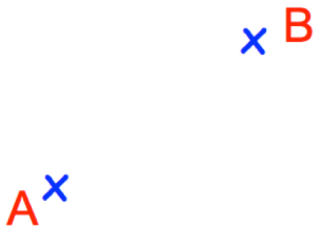
Find the bearing of I from G.

Question 1: Write down the bearing of B from A in each of the following.
Give each answer as a three figure bearing.

(a)

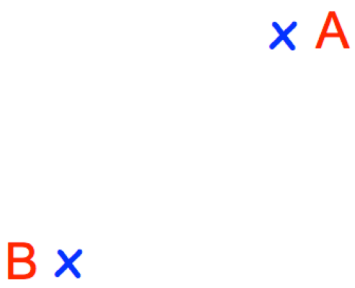
(b)

(c)



(d)

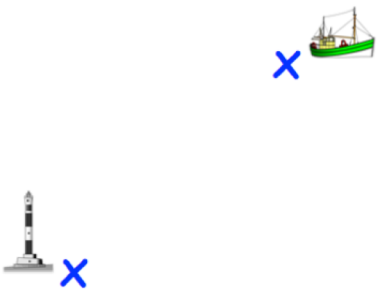
(e)



(f)

Question 2: Write down the bearing of the boat from the lighthouse in each of the following. Give each answer as a three figure bearing.

(a)

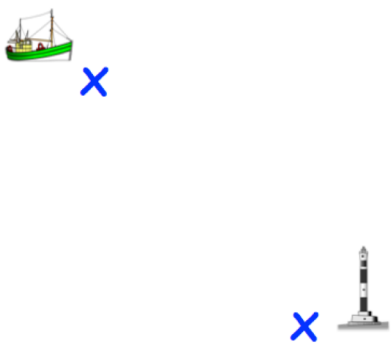


(b)

(c)

(d)

(e)



(f)

Question 3: There are eight airplanes in the airspace above a radar.
Put an x in the middle of your page to represent the radar.
Letting 1cm = 1mile, mark the position of each airplane.

(a) Airplane 1 is 6 miles from the radar on a bearing of 025°
(b) Airplane 2 is 4 miles from the radar on a bearing of 075°
(c) Airplane 3 is 5 miles from the radar on a bearing of 125°
(d) Airplane 4 is 8 miles from the radar on a bearing of 150°
(e) Airplane 5 is 4 miles from the radar on a bearing of 190°
(f) Airplane 6 is 3 miles from the radar on a bearing of 250°
(g) Airplane 7 is 6.5 miles from the radar on a bearing of 310°
(h) Airplane 8 is 9 miles from the radar on a bearing of 351°

Question 4: There are eight boats in the sea around an island.
Put an x in the middle of your page to represent the island.
Letting 1cm = 1km, mark the position of each boat.

(a) Boat 1 is 4 km from the island on a bearing of 080°
(b) Boat 2 is 3 km from the island on a bearing of 016°
(c) Boat 3 is 5 km from the island on a bearing of 111°
(d) Boat 4 is 5.5 km from the island on a bearing of 308°
(e) Boat 5 is 3.5 km from the island on a bearing of 055°
(f) Boat 6 is 6 km from the island on a bearing of 214°
(g) Boat 7 is 6 km from the island on a bearing of 199°
(h) Boat 8 is 5 km from the island on a bearing of 154°

Question 5: Give these directions of travel as three figure bearings

(a) North (b) South-east (c) West (d) North-east

(e) East (f) South-west (g) South (h) North-west

Question 6: A dolphin is on a bearing of 100° from the island.
The same dolphin is on a bearing of 015° from the lighthouse.
On a sketch of the diagram below, mark the location of the dolphin.

Question 7: A hot-air balloon is on a bearing of 140° from the radar A.
The same hot-air balloon is on a bearing of 065° from the radar B.
On a sketch of the diagram below, mark the location of the hot-air balloon.

Question 8: A UFO is on a bearing of 015° from the radar A.
The same UFO is on a bearing of 315° from the radar B.
On a sketch of the diagram below, mark the location of the UFO.

Question 9:

(a) The bearing of A from B is 025°, find the bearing of B from A.
(b) The bearing of A from B is 061°, find the bearing of B from A.
(c) The bearing of A from B is 098°, find the bearing of B from A.
(d) The bearing of A from B is 102°, find the bearing of B from A.
(e) The bearing of A from B is 193°, find the bearing of B from A.
(f) The bearing of A from B is 222°, find the bearing of B from A.
(g) The bearing of A from B is 315°, find the bearing of B from A.

Question 10: Make a copy of the diagram below into your book.

(a) Find the bearing of B from A.
(b) Find the bearing of A from B.

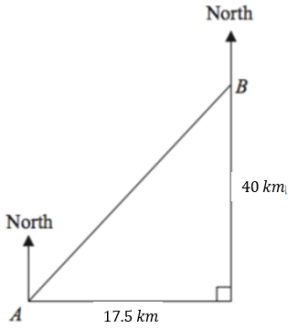
Use the scale 1cm represents 20miles.

(c) From your diagram, work out the real distance between A and B.

C is 140 miles from B on a bearing of 110°.

(d) On your diagram, mark C with a cross.

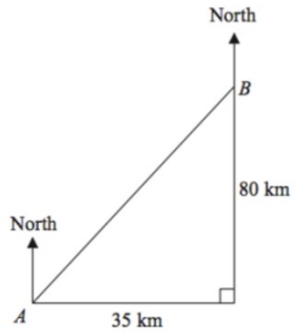
Worked Example



a) Work out the bearing of town A from town B

b) Work out the bearing of town B from town A

Your Turn

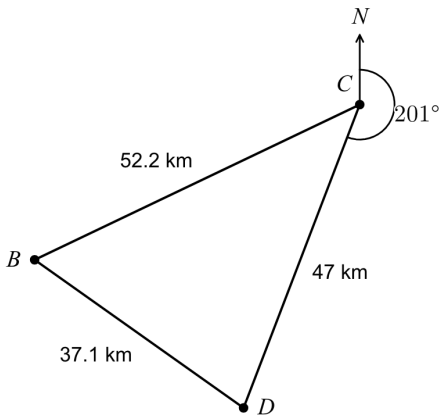


a) Work out the bearing of town A from town B

b) Work out the bearing of town B from town A

Worked Example

The diagram shows the position of three towns B, C and D



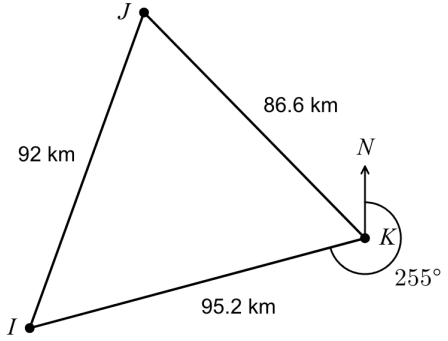
The distance between C and D is 47 km
The distance between C and B is 52.2 km
The distance between D and B is 37.1 km

The bearing of D from C is $201°$

Find the bearing of B from C
Give your answer correct to the nearest degree.

Your Turn

The diagram shows the position of three towns I, J and K



The distance between K and I is 95.2 km
The distance between K and J is 86.6 km
The distance between I and J is 92 km

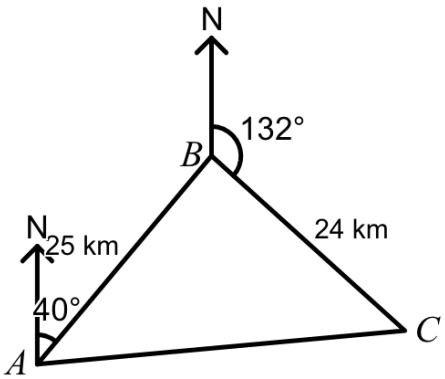
The bearing of I from K is $255°$

Find the bearing of J from K
Give your answer correct to the nearest degree.

Dr Frost 469a

Worked Example

In the diagram, the three towns Abbotsley, Bowden and Cowbridge are represented by the letters A, B and C

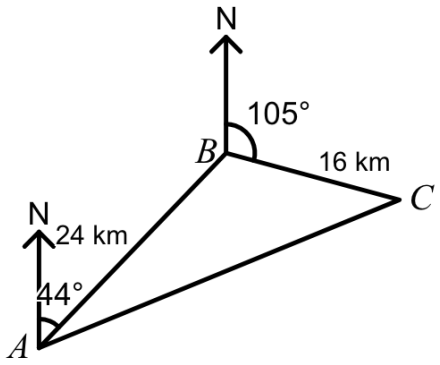


A plane flies from Abbotsley for 25 km on a bearing of $040°$ to Bowden.
It then flies from Bowden for 24 km on a bearing of $132°$ to Cowbridge.
The plane then returns directly to Abbotsley.

Find the total distance travelled by the plane.

Your Turn

In the diagram, the three towns Abercarn, Bagham and Caldmore are represented by the letters A, B and C



A helicopter flies from Abercarn for 24 km on a bearing of $044°$ to Bagham.
It then flies from Bagham for 16 km on a bearing of $105°$ to Caldmore.
The helicopter then returns directly to Abercarn.

Find the total distance travelled by the helicopter.

Dr Frost 469b

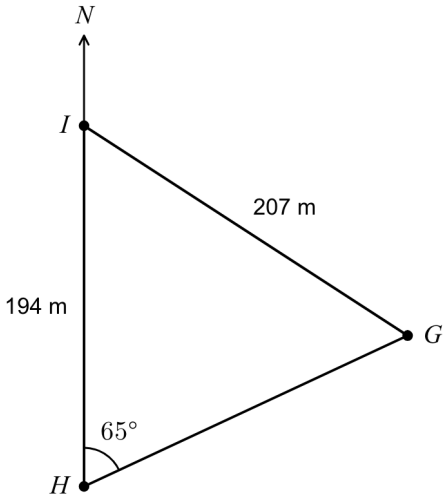
Worked Example

The diagram shows the position of three people G, H and I

I is due north of H

The bearing of G from H is $065°$
The distance between I and G is 207 m.
The distance between H and I is 194 m.

Calculate the bearing of G from I
Give your answer to the nearest degree.



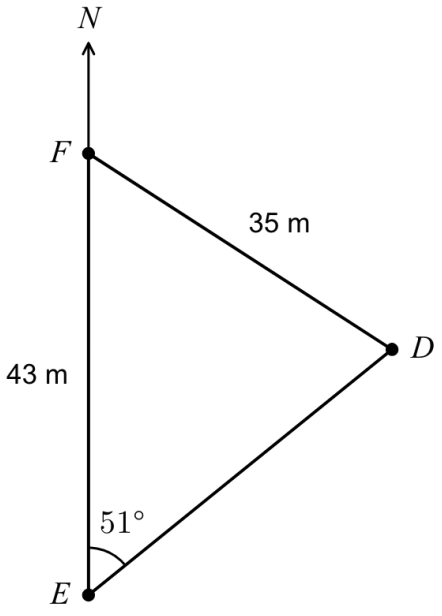
Your Turn

The diagram shows the position of three people D, E and F

F is due north of E

The bearing of D from E is $051°$
The distance between F and D is 35 m.
The distance between E and F is 43 m.

Calculate the bearing of D from F
Give your answer to the nearest degree.



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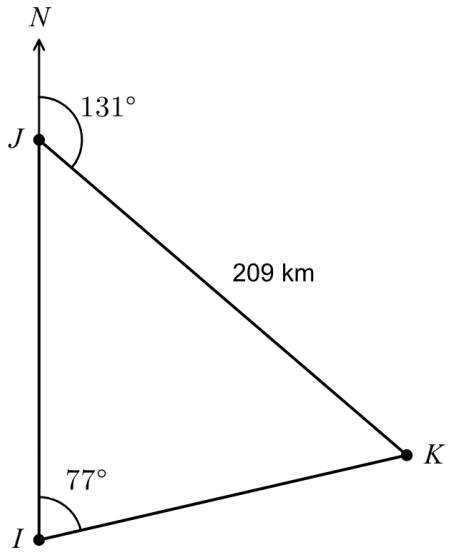
Worked Example

The diagram shows the position of three radio towers I, J and K

J is due north of I

The bearing of K from I is $77°$
The bearing of K from J is $131°$
The distance between J and K is 209 km.



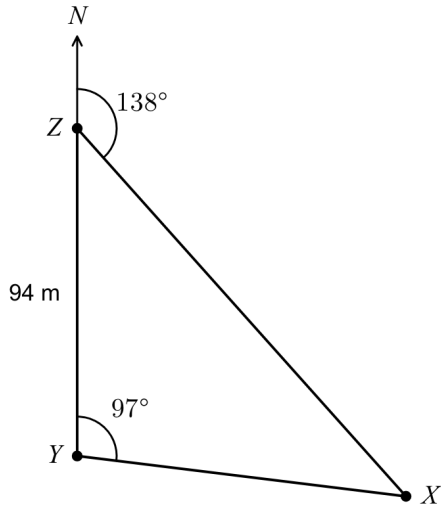
Find the distance between K and I
Give your answer correct to one decimal place.

Your Turn

The diagram shows the position of three radio towers X, Y and Z

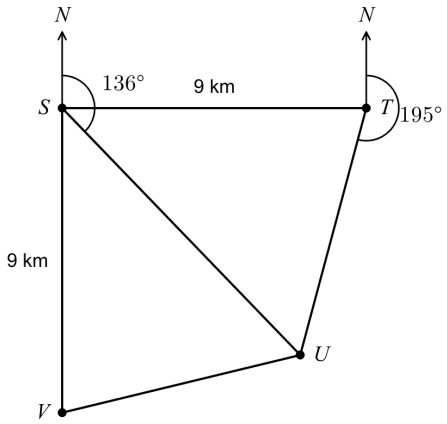
Z is due north of Y

The bearing of X from Y is $97°$
The bearing of X from Z is $138°$
The distance between Y and Z is 94 m.



Find the distance between X and Y
Give your answer correct to one decimal place.

Worked Example



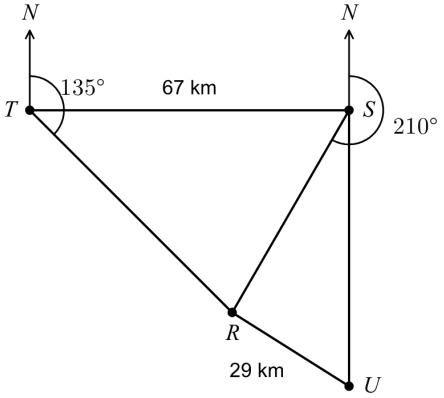
There is a lifeguard station at point S and at point T
T is 9 km due east of S

There is a lifeboat at point U
U is on a bearing of $136°$ from S
U is on a bearing of $195°$ from T

There is a yacht at point V
V is 9 km due south of S

Find the bearing of U from V
Give your answer correct to the nearest degree.

Your Turn

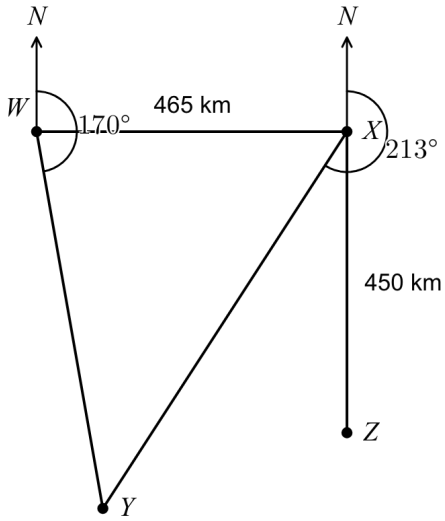


There are three towns at points S, T and R
T is 67 km due west of S
R is on a bearing of $210°$ from S
R is on a bearing of $135°$ from T

A hiker walks due south from S to point U, which is 29 km from R

Find the bearing of R from U
Give your answer correct to the nearest degree.

Worked Example

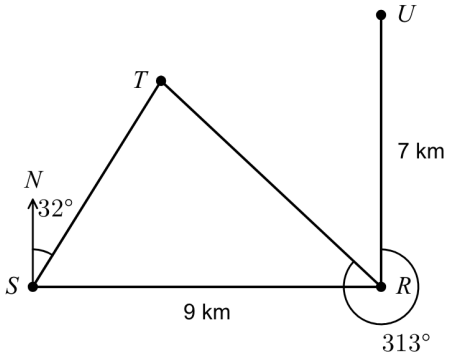


There are three airports at points X, W and Y
W is 465 km due west of X
Y is on a bearing of $213°$ from X
Y is on a bearing of $170°$ from W

A plane flies 450 km due south from X to point Z

Find the distance between Y and Z
Give your answer correct to one decimal place.

Your Turn



There is a coastguard station at point R and at point S
S is 9 km due west of R

There is a rowing boat at point T
T is on a bearing of $313°$ from R
T is on a bearing of $32°$ from S

There is a speedboat at point U
U is 7 km due north of R

Find the distance between T and U
Give your answer correct to one decimal place.

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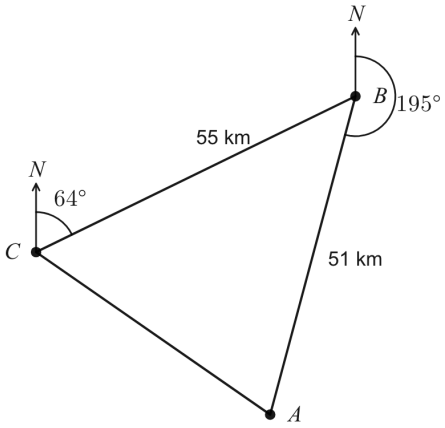
Worked Example

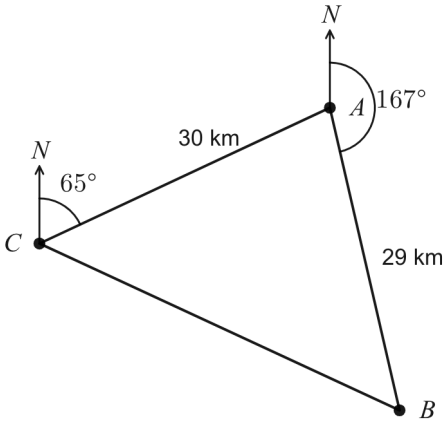
The diagram shows the position of three radio towers, A, B and C.
The bearing of A from B is $195°$.
The bearing of B from C is $64°$.
The distance between B and A is 51 km.
The distance between B and C is 55 km.



Calculate the area of triangle ABC.
Give your answer correct to 1 decimal place.

Your Turn

The diagram shows the position of three radio towers, A, B and C.
The bearing of B from A is $167°$.
The bearing of A from C is $65°$.
The distance between A and B is 29 km.
The distance between A and C is 30 km.



Calculate the area of triangle ABC.
Give your answer correct to 1 decimal place.

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Extra Notes