SUBJECT and GRADE	MATHEMATICAL LITERACY – GRADE 12	
TERM 2	*WEEK 5 AND 6*	
TOPIC	Surface Area and Volume	
AIMS OF LESSON	UNDERSTANDING: Measurement and specific any calculations involving Surface Area and Volume. Learners should be able to substitute in the formulae and interpret questions in this topic.	
RESOURCES	***Paper based resources***	***Digital resources***
	Please use the NOTES along with your textbook. Please check your textbook for the topic on Measurement covered for Term 2. It should start just after Maps and Plans.	*Please check the following resources:* ***YouTube videos on the following topics:*** Khan Academy - https://www.khanacademy.org/math/basic-geo/basic-geo-volume-sa *Mind the Gap* - https://www.google.com/search?q=mind+the+gap+mathematical+literacy+grade+12 *Via Afrika* - https://viaafrika.com/free-downloads/
INTRODUCTION	• *Learners should be able to understand basics of conversions and know how to substitute.* • *Learners should be able to visualize 3D shapes and understand the concept of an open and closed container and how it impacts on the formulae and calculations.*	
CONCEPTS AND SKILLS	• *See all the concepts on Surface Area and Volume listed in the notes.*	
ACTIVITIES/ASSESSMENT	• *The material consists of the lesson plan, with Notes and activities to work through.* • *There are 2 sections: Surface Area and Volume.* • *Read through the Notes related to the activity that you will be doing.* • *Break up the activities to be done over the week.*	
CONSOLIDATION	• *Supplement activities with activities in your textbook.* • *It is important to study previous papers to see questions that relates to the topic done now. By doing this, you will get a feeling of how questions could be posed in the end-of-year-examination.* • *Thank you for showing your first step of independent working. This will help a great deal if you start your Tertiary Education next year. Please consult with your class friends and continue to motivate each other.*	
VALUES	*The topic on measurement is important to do renovations at home. You might even end up doing construction work one day where you need to accurately measure and do budgeting and planning.*	

HOW TO DEAL WITH THIS TOPIC:	*Please try to do all activities without looking at the answers.* *What you as the learner need to be able to do:* • Understand and use formulae such as the following, where the dimensions and formulae are readily available: perimeters and areas of polygons, volume of right prisms, right circular cylinders, surface areas of right prisms and right circular cylinders. • Understand and use appropriate vocabulary, such as: equation, formulae, area, surface area, perimeter, radius, diameter, length, breadth, height, base, circumference, volume, circle, cylinder, polygons, right prisms, triangular, rectangular and square. • Read information directly from a table and use some given information and simple operations to complete a table of values. • Describe the relationship between input and output values in a table of data concerning space, shape and measurement. • Convert units of measurement between different scales and systems using conversion tables provided. • Converting to a smaller unit of length, time, weight, etc. • Converting to a bigger unit of length, time, weight, etc. • Converting units of area. • Converting units of volume.
RESOURCES	*Mind the Gap; Via Africa Study Guide; MATHEMATICAL LITERACY REVISION BOOKLET DBE; NSC Papers*

NOTES & EXAMPLES

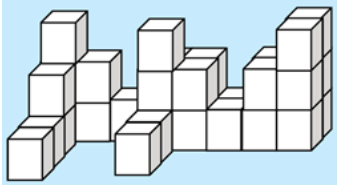
1. SURFACE AREA:

Activity 1:

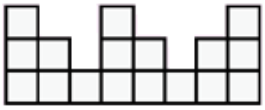
How to deal with surface area:

The first skill that you need to master, is to be able to visualize a 3D shape from all sides. The first activity addresses that.
You also need to look at substitution in the formula.
Your Surface Area formulae is generally very long, so accuracy is needed.
The correct application of BODMAS is also important.

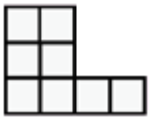
1. Study the following arrangement of blocks. Let us see it as a block of buildings in a city. Now test yourself by answering the following questions:



a) Write down the view shown by the following angle.



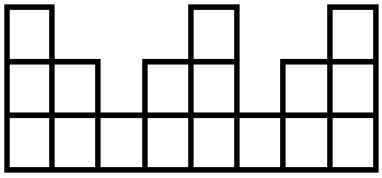
b) Write down the view shown by the following angle.



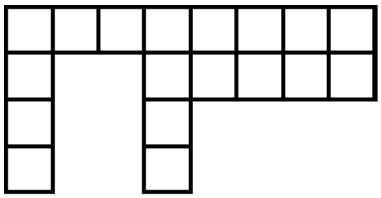
c) Draw the view from the back
d) Draw the top view

Solutions:

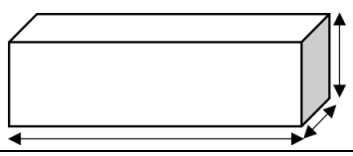
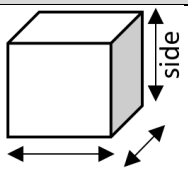
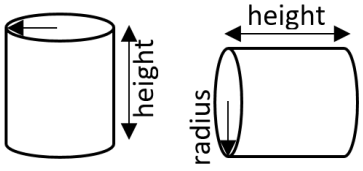
1. a) Front view
b) Left view
c)



d)



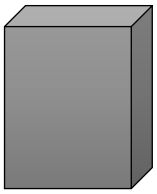
Formulae to calculate Surface Area:

Shape	Rectangular box	Cube	Cylinder
			

Formula	Surface Area = $2(l \times b) + 2(l \times h) + 2(b \times h)$, where l = length, b = breadth and h = height	Surface Area = 6(side × side)	Surface Area = $2\pi r^2 + 2\pi rh$ or $2\pi r(r + h)$

Example:

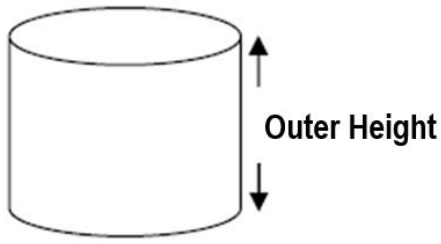
1 Mr Rampedi is working as an intern at Cover company in Durban. The company designs boxes and other containers for dairy products. He is required to work on a design for a juice carton, as shown in the diagram.

	
Picture of the dairy juice product containers.	Dimensions of juice carton are: length = 9cm; breadth = 0.06m; height = 19cm.

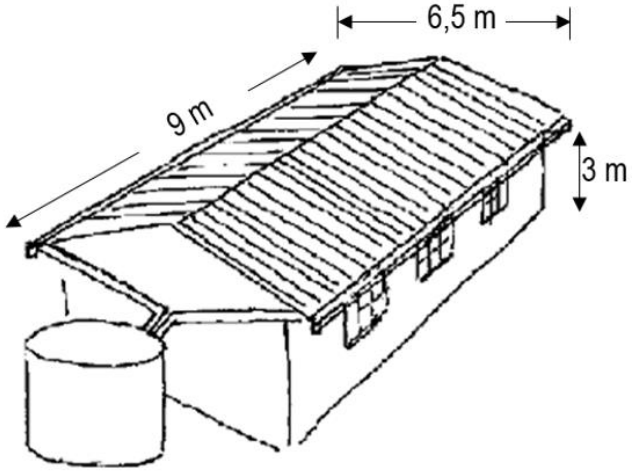
Note: The dimensions of the base are the same as the dimensions of the top (lid).
Area = Length x breadth

a) Determine how much cardboard (the surface area) is needed to make one juice carton in cm^2.

2. Jabu Ndou requires a cylindrical water tank to collect rainwater from his roof. This water will be used for irrigating his garden. The outside walls and roof of the rainwater tank need to be painted. The diameter of the tank is 1,8 m and the outer height of the tank is 2,34 m.



Cylindrical rainwater tank



a) Calculate the surface area of the cylindrical tank that will be painted using the formula: **Surface area of the tank = π × radius × (2× height + radius),** and using **π** = 3,142

b) If this is a 5500 liter tank, calculate, rounded to 2 decimal places, how much water will be in it if was filled to 1,2 m?

Solutions:

1. a) Sometimes they might not provide the formula for Surface Area, which is Surface Area = $2(l \times b) + 2(l \times h) + 2(b \times h)$, because ultimately it is the 6 sides of the box, which are areas of rectangles, that needs to be added. Look at how I took the different parts apart…
This juice carton consists of …

Full box		Front	Side	Top
	=		+ 	+ 
1 box	=	2 parts +	2 parts +	2 parts

- To start with, we need to first find out what unit your answer needs to be in… cm^2.
- So, we start by converting all units to cm, if needed.
- Then we start by calculating the different parts

Length = 9 cm
Breadth = 0,06 m (× 100) = 6 cm
Height = 19 cm
Area of fronts = (9 cm x 19 cm) x 2 parts = 342 cm^2
Area of sides = (6 cm x 19 cm) x 2 parts = 228 cm^2
Area of top & bottom = (6 cm x 9 cm) x 2 parts = 108 cm^2

Surface Area = 342 cm^2 + 228 cm^2 + 108 cm^2
= 678 cm^2

2. a) Radius = 1,8 m ÷ 2
= 0,9 m
Surface area of the tank = π × radius × (2× height + radius), and
= 3,142 × 0,9 m × (2 × 2,34 m + 0,9 m)
= 2,8278 × 5,58
= 15,779124 m^2

b) $\frac{1,2}{2,34} \times \frac{5500}{1}$

= 2820,51 liter

Exercises

1. Water is scarce in South Africa. The annual average rain fall is 446 mm. According to Statistics South Africa (www.statssa.gov.za), 88,6% of the South African population has access to drinking water.

The measurements of a water tank are given in metres. The water tank's radius is 14 m and its height is 10 m.

a) Explain the difference between diameter and radius

b) Determine the diameter of the water tank.

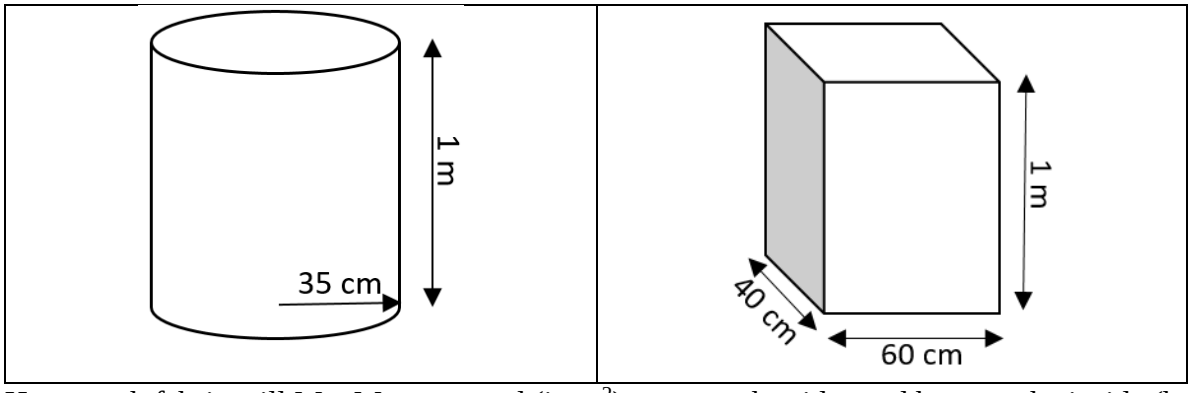
c) The lid of the water tank must be painted on the outside, in order for it to be clearly visible. Calculate the area of the lid (in m^2), if it has a radius of 14 m.
Use the formula: **Area = π × (radius)2 ,** where π = 3,14

d) A one-litre tin of paint covers an area of 15 m^2. Calculate the area that can be covered with 17 litres of paint.

e) The inside of the tank must be sealed with waterproof paint. The lid does not get waterproofed on the inside. Calculate the interior surface area (in m^2) using the following formula:
Inside area = (2 × π × r × h) + (π × r^2), where π = 3,142**,** r = radius and **h** = height / depth of the water tank

2. a) Mrs Mpanza runs a small business from her home. She buys different types of laundry baskets and covers the inside of the baskets with fabric. Then she resells them.

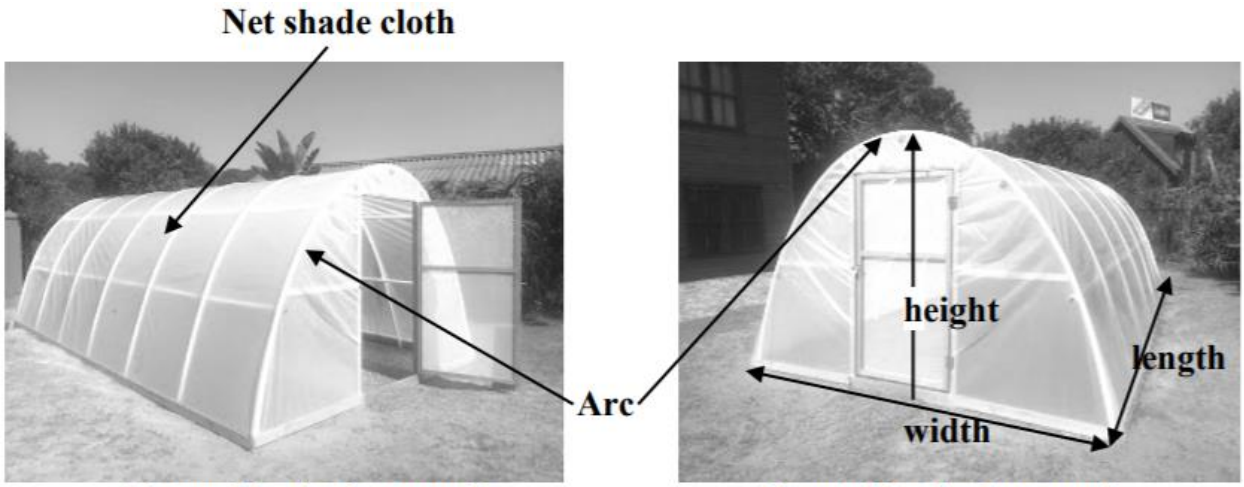
	
The dimensions are as follow:	



a) How much fabric will Mrs Mpanza need (in m^2) to cover the sides and base on the inside (but not the lid) of a rectangular laundry basket?
Use the following formulae: Surface area = (l × b) + 2 (l × h) + 2 (b × h)

b) Calculate the amount of fabric needed to cover the base and sides of the inside of the cylindrical laundry basket. Round off your answer to the nearest m^2.
Use the formula: Surface area = ($\pi \times r^2$) + ($2 \times \pi \times r \times h$), use $\pi = 3{,}142$

3. Marieka is building a vegetable shade tunnel in her yard to grow the vegetables she needs for her coffee shop. The vegetable shade tunnel is shown in the photographs below.



Vegetable shade tunnel with open door

Vegetable shade tunnel with closed door

The dimensions of the vegetable shade tunnel are as follows:
Length = 6,5 m; width = 4,4 m; maximum height = 2,2 m
The vegetable shade tunnel is exactly half of a cylinder.

a) Calculate the length of the arc of the vegetable tunnel. Give your answer correct to TWO decimal places.
Use the formula: **P = Length of arc = π × r,**
where $\pi = 3{,}142$; r = radius

b) Determine the minimum amount of net shade cloth required to cover the whole tunnel by calculating the surface area of the vegetable tunnel.
The following formula may be used:

Surface area = $\pi \times r^2 + P \times l$, where $\pi = 3,142$
r = radius
P = length of arc
l = length of vegetable shade tunnel

Solutions:			
1.	a)	Radius is half the diameter. OR Diameter is double the radius	
	b)	14 x 2 = 28 m	
	c)	Area = $\pi \times (\text{radius})^2$ $= 3,142 \times 14^2$ $= 615,83\ m^2$	
	d)	17×15 $= 255\ m^2$	
	e)	Interior surface area $= (2 \times \pi \times r \times h) + (\pi \times r^2)$ $= (2 \times 3,142 \times 14 \times 10) + (3,142 \times (14)^2)$ $= 879,76 + 615,83$ $= 1\ 495,59\ m^2$	
2	a)	Surface Area $= (0,6 \times 0,4) + 2(0,6 \times 1) + 2(0,4 \times 1)$ $= 2,24\ m^2$ $\approx 3\ m^2$	
	b)	35 cm = 0,35 Surface Area $= (3,142 \times 0,35^2) + (2 \times 3,142 \times 0,35 \times 1)$ $= 2,584\ m^2$ $\approx 3\ m^2$	
3.	a)	**P = Length of arc $= \pi \times r$,** $= 3,142 \times 2,2$ m $= 6,9124$ m	
	b)	**Surface area $= \pi \times r^2 + P \times l$** $= 3,142 \times (2,2\ m)^2 + 6,9124 \times 6,5$ m $= 15,20728 + 44,9306$ $= 60,13788\ m^2$	

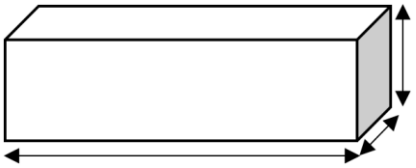
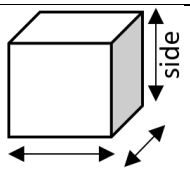
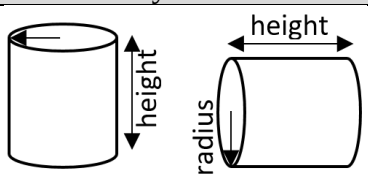
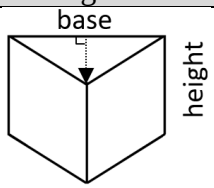
NOTES & EXAMPLES

2. VOLUME

As explained in the previous weeks, it is important to be able to visualize the different shapes in everyday objects. In this case we need to know which polygon is represented by which object. The formulae are generally provided, so the important thing here, is to be able to substitute values correctly into the formulae.

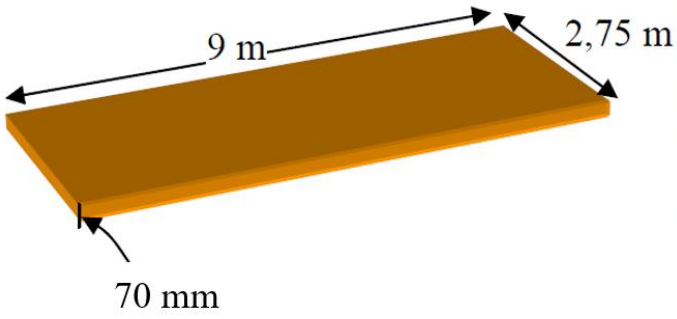
Formulae to calculate Volume:

Shape	Rectangular box	Cube

		
Formula	Volume = length × width × height	Volume = side × side × side / $(side)^3$
Shape	Cylinder	Triangular box
		
	Volume = π × $radius^2$ × height	Volume = ½ base × ⊥height × height

Worked Example:

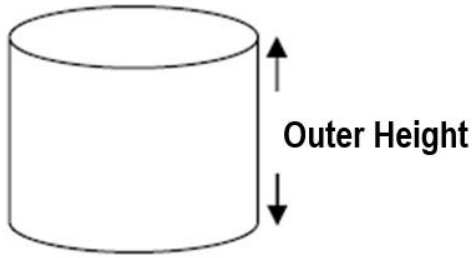
1. The rectangular long jump pit at the school is 2,75 m wide and 9 m long and is filled with sand.



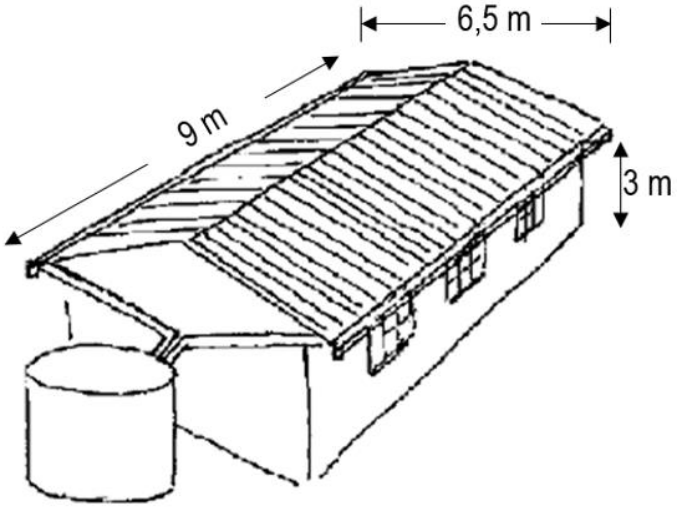
a) Calculate the volume of sand needed to fill the long jump pit to a depth of 70 mm. Give the answer rounded off to THREE decimal places.
Use the formula: **Volume = length × breadth × height**

b) Would you say that the sand used is enough to ensure that learners do not get hurt? Explain.

2. Jabu Ndou requires a cylindrical water tank to collect rainwater from his roof.
This water will be used for irrigating his garden.



Cylindrical rainwater tank



Jabu wants to know how much rainwater the tank can hold. The inner radius of the tank is 0,998 m and the inner height of the tank is 2,498 m.

a) Calculate the total volume, rounded off to THREE decimal places, of the water tank.
Use the formula:
Volume of a cylinder = $\pi \times$ **(radius)^2 × height**, and using $\pi = 3{,}142$ (3)

b) Determine the height, rounded off to THREE decimal places, of the water in the tank when it is 80% full. (2)

Solutions:

1. a) 70 mm = 0,07 m
Volume = length × breadth × height
= 2,75 × 9 × 0,07
= 1,7325 m^3

b) No, 70 mm is not even one third of a ruler, so learners would land on a very hard surface, that could result in injury.

2. a) **Volume of cylinder =** $\pi \times$ **(radius)^2 × hoogte**
= 3,142 × 0,998^2 × 2,498
= 7,812 m^3

b) $\frac{80}{100} \times \frac{2{,}498}{1}$
= 1,998 m

EXERCISES & ACTIVITIES

CALCULATING VOLUME:

Exercises:

1. A school builds a swimming pool with the following dimensions of: length = 15 m; depth = 1,3 m to the filling level, and width = 5 m.
(NOTE: 1 m^3 = 1 000 liter and 1 000 liter = 1 kl)

a) Calculate the volume of the swimming pool up to the level it is filled. (3)

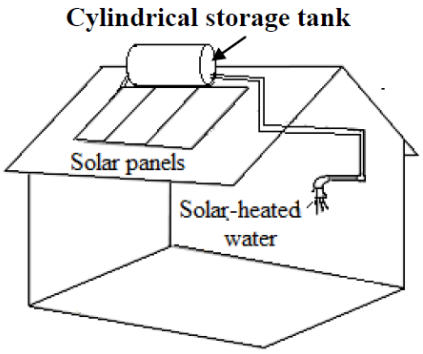
b) Convert this volume (i) to litres (ii) and kilolitres (4)

c) When the school fills the pool, they use a pump which pumps water at a rate of 2 liter per second. How long would it take to fill up the pool? Give your answer in hours and minutes. (6)

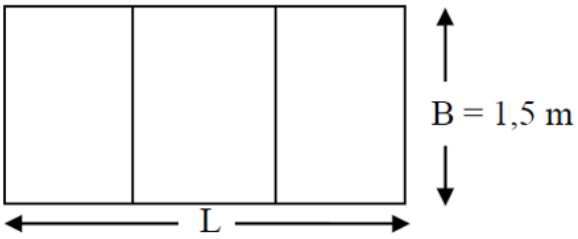
d) Water costs R8,64 per kiloliter. How much will it cost the school to fill up the pool? (2)

e) If after the children were splashing in the pool and the water level dropped to 1,24 meters, how much water, in liters, do they need to top it up with? (5)

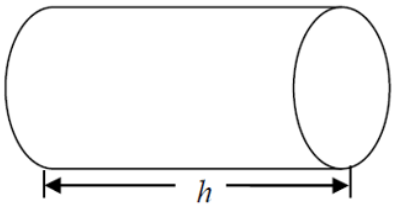
2. Mrs Ntanzi decides to install a solar geyser on the roof of her house, to reduce her electricity bill.
The solar geyser consists of rectangular solar panels and a cylindrical storage tank as shown in the diagrams.
The solar panels use sunlight to heat the water stored in the cylindrical tank. The heated water can then be used in the house.
There are altogether six people in Mrs Ntanzi's household.



Solar panels



Cylindrical hot water tank



You may use the following formulae:
Area of a rectangle = length × breadth

Volume of a cylinder = $\pi \times r^2 \times h$, where ***r*** = radius, ***h*** = height and using $\pi = 3,14$

a) Mrs Ntanzi was told that she needed solar panels with an area of 2 m² for the first two members in her household and thereafter an area of 0,7 m² for each additional member. Determine the total length (L) of the solar panels needed by Mrs Ntanzi if the breadth (B) is 1,5 m.

b) The cylindrical hot water tank on the roof has a volume of 150 ℓ and a height (h) of 1,2 m. Calculate (to the nearest cm) the length of the radius of the tank if 1 ℓ = 1 000 cm^3.

3. Wandile decides to grow his own vegetables. He makes a rectangular vegetable garden with length = 2,5 m and breadth = 1,5 m.

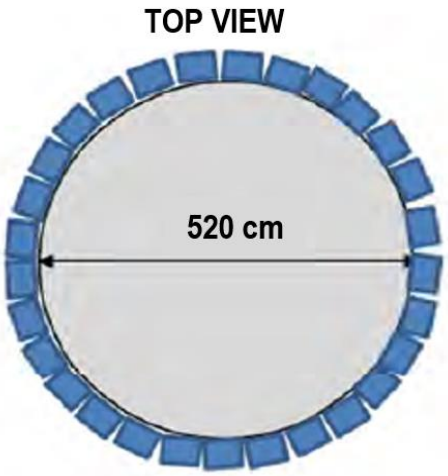
Shade-netting over the vegetable garden

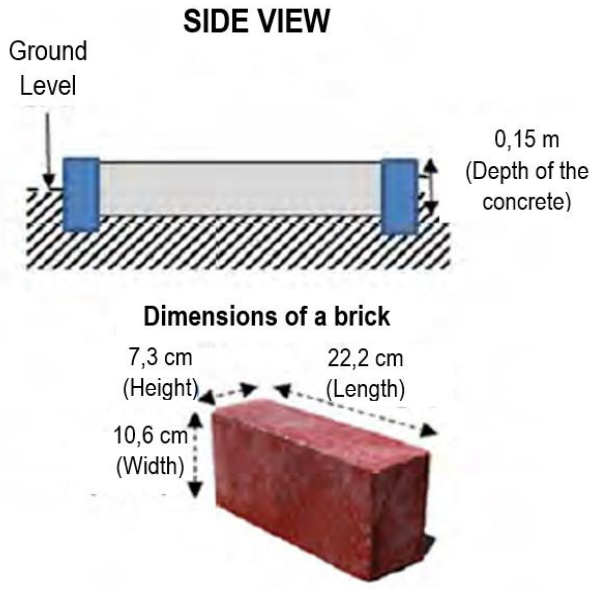
a) Wandile adds a 7,5 cm layer of compost to his vegetable garden. Calculate the volume of the compost added in cm.

Use the formula:
Volume of a rectangular prism = length × breadth × height

b) If the total volume of the compost and the soil layer is 843 750 cm^3, determine the height of the soil without the compost.

4. A circular concrete slab is planned for an outdoor picnic area. The circular concrete slab will be surrounded by bricks along the perimeter as follows: (NOTE: Drawings are NOT to scale)





a) Convert 520 cm to metres.

b) Use the following equation to calculate the volume of the concrete in the circular concrete slab. Answer in m^3. ($\pi = 3{,}142$)
Volume = $\pi \times \text{radius}^2 \times \text{height}$

c) Calculate the number of bricks you will need to fit next to each other, if it is placed side to side along the length of the brick.
You may use the following formula:
Perimeter = $2 \times \pi \times$ radius, where $\pi = 3{,}142$

	Solutions			
1.	a)	15 m × 5 m × 1,3 m = 97,5 m^3		(3)
	b)	(i) 97 500 liters (ii) 97,5 kl		(4)
		Time to fill up= $\frac{97500}{2}$ = 48750 seconds (÷60) = 812,5 minutes (÷60) = 13,54166667 hours ∴ 0,5416667 (×60) = 32,5 minutes So, the total time taken is 13 hr 32½ min	*ADDITIONAL NOTE: If they asked in hours, minutes and seconds…* ∴ 0,5 (×60) = 30 seconds So, the total time taken is 13 hr 32 min and 30 s	(6)
	d)	R8,64 × 97,5 kl = R842,40		(2)
	e)	1,3 m – 1,24 m = 0,06 m 15 m × 5 m × 0,06 m = 4,5 m^3 = 4500 liters		(5)
2.	a)	First two members will need an area of: 2 m^2 There are 4 other members who need: 4 x 0,7m = 2,8m^2 Total Area = 2m^2 + 2,8m^2 = 4,8m^2 Length= $\frac{\text{Area}}{\text{breadth}}$ Length= $\frac{4{,}8m^2}{1{,}5m}$ = 3,2m		

	b)	Volume of cylinder = $\pi \times r^2 \times$ height 150 ℓ = $3,14 \times r^2 \times 1,2$ m ✓SF ✓C 150 000 cm^3 = $3,14 \times r^2 \times 120$ cm ✓C $r^2 = \frac{150\ 000}{3,14 \times 120}$ cm^2 ✓CA = 398,089172 cm^2 r = 19,9521... cm ✓CA ≈ 20 cm ✓R	
3.	a)	2,5 m = 250 cm 1,5 m = 150 cm **Volume of a rectangular prism = length × breadth × height** = 250 cm × 150 cm × 7,5 cm = 281 250 cm^3	
	b)	**Volume of a rectangular prism = length × breadth × height** 843 750 cm^3 = 250 cm × 150 cm × height with compost $\frac{843\ 750}{37\ 500}$ =height with compost 22,5 cm = height with compost Therefore, height of soil = 22,5 cm – 7,5 **= 15 cm**	
4.	a)	520 cm = 5,2 m	
	b)	Vol = 3,142 x $(2,6\ m)^2$ x 0,15 m = 3,142 x (6,76 m^2) x 0,15 m **= 3,19 m^3**	
	c)	Perimeter = 2 × π × radius = 2 × 3,142 × 2,6 m **= 16,3384 m** 16,3384 m = 1633,84 cm Number of bricks = 1633,84 cm ÷ 10,6 cm **= 154 bricks**	