NASCA Quantitative Literacy Materials Draft 1

## Topic 2: Measurement

# Topic 2: MEASUREMENT

**Learning Outcomes:**

***By the end of this unit you should be able to:***

* Convert units of measurement (length, mass and time) within the metric system
* Convert units of measurement in context
* Convert between the metric and imperial systems
* Convert between degrees Fahrenheit to degrees Celsius using a given formula
* Do time calculations, both digital and analogue
* Calculate distance, time and average speed using a given formula

**Introduction**

Our introduction to measurement begins on the day we are born and continues for the rest of our lives. On the day we are born your length is measured, the size of your head (circumference) and you are weighed (mass). As you become more aware of yourself you learn “how old you are” (time). Eventually we learn to understand two-dimensional measurement (area) and three-dimensional (volume) measurement. How about how hot or cold (temperature) it is?

Measurements surround you on all sides and they matter! They are here for a reason. We measure and keep track of time every minute of the day, just to plan how when you want to watch your favourite your television shows. Measurements like weight, height, pulse and blood pressure tell a doctor a lot about your health. In the kitchen you cannot cook or bake without understanding measurements. Travelling on the road we need to keep within the speed limit, again with a need to understand speed, distance and time.

Using the correct measurement and checking and re-checking can benefit us in many areas of our life.

**Unit 1: Measurement of length and quantity.**

**Purpose:**

Measurement is an important part of people's lives. We measure quantity every day. A mother measures the Jungle Oats when she makes porridge in the morning. She measures out quantities of flour and sugar when making a cake. We also measure length and distance. We say it is about two kilometres to the station or bus stop. You need to know what time to leave and how fast you need to walk to make sure that you do not miss the train or bus.

**By the end of this unit you will be able to:**

1. Estimate measurements quite accurately
2. Measure accurately
3. Select appropriate units of measurement
4. Do simple calculations using standard measures?
5. Convert from one unit of measurement to another measure accurately.

Sometimes when you measure, you make an estimate which is a rough measurement. Write a list of the things you measure in your daily life and next to them, estimates.

How do we measure?

**Estimating in everyday life**

If you wanted to make a table, you could estimate the length by stretching out your arms. At the shop, the assistant could show you different lengths of wood like 1,5 metres; 1,8 metres and 2 metres. Knowing your estimate, you will be able to buy the correct length of wood.

***Now let us try estimating (on your own or with your friends)***

**Activity 1 : Estimation and actual measurement**

Here is a table for some your dimensions (measurements). Use the information on the left to complete the table**.**

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | Estimate | Actual measurement |
| 1 | Your own Height in m and cm |  |  |
| 2 | The length of the room |  |  |

1. **Height**

a) In the first column of the table write what you estimate your height to be.

b) Then measure your height as accurately as possible using metres and centimetres. Ask a friend to mark your height on a wall.

Enter this in the second column.

**Reflection:**

Describe how you estimated your height.

Did you perhaps use a ruler and check how many ruler lengths you are?

How close was your estimation to your actual height?

How can you improve your estimation?

|  |  |
| --- | --- |
|  | child's adult height predictor |

<http://www.momjunction.com/child-height-predictor/#gref>

2. **Length of a room.** This is the distance from the one wall of the longest side of a room to the other wall of the room.

a) Estimate your length of the room and record it.

b) Use a tape measure to measure from one end of the room to the other. Enter this in the second column.

c) Use this knowledge to estimate the length of the house

**Reflection:** How close was your estimation to the actual length of the room? Did you check that the tape measure started at zero? Did you measure from zero?

When will you find estimation useful in your everyday life? Can you identify three aspects in your life when you will need estimation?

**Standard units**

In the past many different units of measurement were used. At the time of Noah's Ark, they used cubits. More recently people used yards, feet and inches. In South Africa today we use the metric system (kilometres, metres, centimetres, etc.) developed in France many years ago. Some countries, however, such as North America and England, do not use the metric system. Some older people in South Africa may still use yards, feet and inches. Yards are a little less than a metre. There are three feet in a yard, and 12 inches in a foot.

**How long is a metre?** Scientists measured the distance from the Equator to the North Pole. They divided this distance into 10 000 units of 1km. Each of these was divided into metres.

A metre is divided into 100 parts called centimetres. Each centimetre is divided into 10 parts called millimetres. So, a metre is divided into 1 000 tiny parts called millimetres. 1 kilometre= 1 000 metres 1 metre = 100 cm = 1 000 mm 1 cm = 10 mm

To understand length, let us look at a standard ruler. The small marks on the ruler are mm and the bigger markings are cm.

Hence: 10 mm = **1 cm** and 100 cm = **1m** ; 1 000 m **= 1 km**; 1000 000 mm = **1 km**

Converting from a smaller to a bigger unit we divide.

Converting from a bigger to smaller unit we multiply.

To convert from **mm to cm** (divide by 10); but cm to m (multiply by 10)

x 1 000

x 10

x 100

|  |  |  |  |
| --- | --- | --- | --- |
| km | m | cm | Mm |

÷ 1 000

÷ 10

÷ 100

**Illustrative examples:**

**Example:** The length1 526 780 mm:

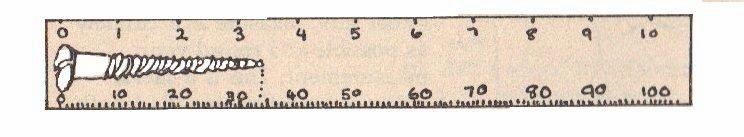
* In cm is 152 678 cm
* In m is 1 526,78 m
* In km is 1, 52678 km ≈ 1,53 km (rounded off to the nearest 2 decimal places)

**Example:** The distance 5,43 km

* In metres (m) is 5 430 m
* In centimetres (cm) is 543 000 cm
* In millimetres (mm) is 5 430 000 mm

**Measuring accurately**

Sometimes our measurements have to be very accurate. For example, window panes need to fit the frames exactly. Can you think of other situations where great accuracy is needed? Measuring in millimetres gives a high degree of accuracy. The width of your forefinger is about 20 mm. Look at this ruler. It is marked in cm and mm.

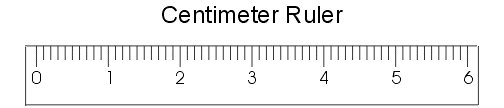
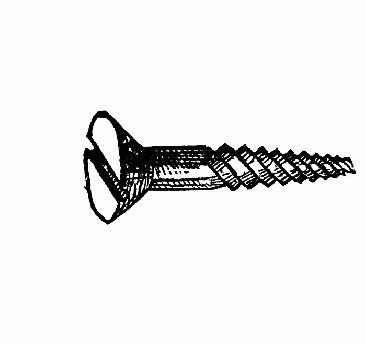


Look at the screw. It is longer than 3 cm and shorter than 4 cm. The screw is 34 mm long or 3,4 cm.

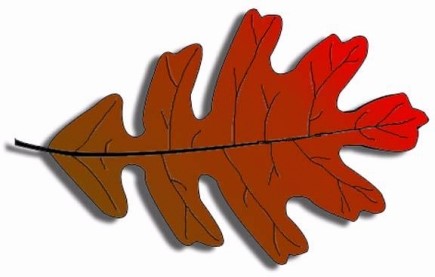
**Activity 2**

Write down the lengths of these objects first in centimetres then in millimetres.

NOTE: We measure from ZERO



|  |  |
| --- | --- |
|  |  |



|  |  |
| --- | --- |
|  |  |



1. Length of nail = … cm = … mm
2. Length of leaf = … cm = … mm
3. Length of pencil = … cm = … mm

***Answers on page 20***

**Reflection:** When we start measuring from zero ? What does that mean?

When we start measuring from a number other zero? What do we do?

What is the difference between estimation and accurate measurement?

One student wrote that the nail measured 3,2 cm. What error did he make?

***Answers to reflection on page 20***

**Quantity**

How do we measure quantity? When people first started to sell crops, they had to measure amounts. They did this by using special containers for each kind of grain. Corn was sold in a corn bushel. They also used special containers for the wine and ale they made. These containers were always the same size. In Africa beer was sold in calabashes. In Europe fruit was sold in a punnet. Strawberries are still sold in punnets. In Mesopotamia (now called Iraq), the traders had to measure their goods. They used talents (about 20 kilograms) to measure heavy things and shekels (about 100 grams) to measure smaller things. Many different units of measurement have been used throughout the world. In Britain they use pounds and stone.

**Standard units for mass and capacity**

Today the metric units of measurement are used universally. Quantity is sometimes measured by mass (what we commonly call weight) and sometimes by capacity. The standard measure for capacity is a litre. Scientists use cubic centimetres, but for our purposes we are going to look at litres for the measurement of capacity.

**How much is a litre?**

|  |  |
| --- | --- |
| Think of a litre of milk, or a litre of coke. You may buy half a litre of milk, which is 500 ml. When you buy a can of coke, this may be 340 ml, which is less than half a litre. |  |

**How much is a kilogram?**

A kilogram of potatoes is about 8 medium-sized potatoes.

Think about a kilogram of butter. In the supermarket there are big blocks (500 g) and smaller blocks (250 g) of butter.

|  |  |
| --- | --- |
| Two of these make a kilogram.  (Two 500g blocks) | Four of these make a kilogram.  (Four 250g blocks) |

**Activity 3 (Understanding measurement of mass and volume)**

Check if you have following items in your kitchen cupboards:

coffee 125 g or 250 g or 500 g

flour 1 kg or 500 g

tomato sauce 375 ml

lemonade 1 litre or 250 ml

long life milk 500 ml or 1 litre

honey 500 g

salt 500 g or 1 kg

|  |  |
| --- | --- |
| Mass can be measured on a kitchen scale. The scale is marked in grams and kilograms. |  |

Coffee, flour, honey and salt are all measured in units of mass; that is kilograms (kg) and grams (g). 1 kilogram = 1 000 grams

**Reflection:** Have you noticed that kilo– means one thousand? Hence to convert from a kilo-unit to a unit we multiply by 1 000. In the same way if we wan o convert from a unit to a kilo-unit we divide by 1 000.

**Converting between the metric and imperial systems**

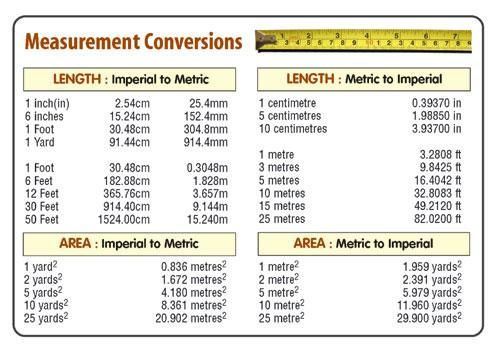
In South Africa we use the metric system, but in some other countries the imperial system is used. The Metric System uses the measuring units such as meters and grams and adds prefixes like kilo-, milli- and centi- to count orders of magnitude. The Imperial system measures in feet, inches and pounds.

In South Africa we sometimes import goods that are in Imperial units (example pounds and ounces). You must be able to convert within the same system and between the two systems.

The table below shows how imperial units relate to the metric units:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Distance (length)** | | **Mass** | | **Capacity (liquid volume)** | |
| **Imperial** | **Metric** | **Imperial** | **Metric** | **Imperial** | **Metric** |
| 1 mile (mi) | 1,6 km | 1 short ton (ST) | 907 kg | 1 gallon (gal) | 3,8 litre |
| 1 yard (yd) | 0,91 m | 1 pound (lb) | 453 g | 1 pint (pt) | 473 ml |
| 1 foot (ft) | 30 cm | 1 ounce (oz) | 28 g | 1 fluid ounce (floz) | 29,6 ml |
| 1 inch (in) | 2,54 cm |  |  |  |  |

To convert between Metric measure and Imperial measure, we can use the **table below:**

[*www.pinterest.com*](http://www.pinterest.com)

**Illustrative examples:**

Example: Do each of the following conversions:

1. 3 feet into cm.

2. 1,5 yard into metre

3. 2,5 metres into feet

**Step 1:** Identify the conversion factor

(feet to cm. 1 foot = 30,48 cm)

**Step 2:** Multiply the feet by the conversion factor

4. 15 cm into inches

Answers:

1. 3 feet = 3 × 30,48 cm = 91,44 cm

2. 1,5 yard = 1,5 × 91,44 cm = 137,16 cm = 1,3716 m

**For all conversions:**

**Step 1:** Identify the conversion factor

**Step 2:** Multiply by the conversion factor

3. 2,5 metres = 2,5 × 3,28 feet = 8,3 ft

4. 15 cm = (15 ÷ 2,54) inches = 5,91 inches

**Activity 4**

1. Convert:
2. A zip measuring 18 inches to cm
3. A case with length 55 cm to inches.
4. Ben jumped 7,3 m at a long jump pit. His school record for the long jump is 9 yards. Did he break the record?

**Reflection:** Did you know that the only way to check if he broke the record was to compare the quantities in the same unit? Hence, we need to convert the yards to metres OR the metres to yards.

***Answers on page 20***

**Convert between degrees Fahrenheit to degrees Celsius using a given formula**

|  |  |
| --- | --- |
| http://coolcosmos.ipac.caltech.edu/cosmic_classroom/light_lessons/thermal/images/thermeter.jpg | Many devices have been invented to accurately measure temperature. It all started with the establishment of a temperature scale. This scale transformed the measurement of temperature into meaningful numbers.  The Fahrenheit scale sets the freezing point of water at 32o and the boiling point at 212o  The Celsius scale sets the freezing temperature for water to be 0o and the boiling temperature 100o.  The relationships between the different temperature scales are:  oC = () ×(oF-32)  oF = () × oC+32  <http://coolcosmos.ipac.caltech.edu/> |

**Illustrative examples:**

Example 1: Convert each of the following temperatures to temperature in oC:

**For number 1:**

**Step 1:** Write down the formula to convert temperature in Fahrenheit to temperature in Celsius.

**Step 2:** Substitute into the formula.

**Step 3:** Use your calculator to calculate

(a) 212 oF

(b) 450 oF

(c) 1 650 oF

**Example 2:** Convert each of the following temperatures to temperature in oF

**For Number 2:**

**Step 1:** Write down the formula to convert temperature in Celsius to temperature in Fahrenheit.

**Step 2:** Substitute into the formula.

**Step 3:** Use your calculator to calculate

(a) 120 oC

(b) 250 oC

(c) – 5 oC

**Answers:** 1(a) 212oF = × (212o – 32o)=× 180 oC= 100 oC

1(b) 450oF = × (450o – 32o)=× 418 oC= 232,22 oC

1(c) 1 650 oF =× (1 650o – 32o)=× 1 618 oC= 1 078,67 oC

2(a) 120 oC= (× 120o + 32o)F = 248 oF

2(b) 250oC = (× 250o + 32o)F = 482 oF

2(c) – 5oC = (× –5o + 32o)F = 23 oF

**Activity 5**

1. The temperature in New York is 74oF. The temperature in Durban on the same day is 26 oC. Which city has the higher temperature?
2. Lydia uses a recipe to bake a cake at 180oC. Her stove is calibrated in oF. Convert the temperature to oF.

**Reflection:** To compare the temperature of the two cities the temperatures must be in the same unit. The formula to convert oC to oF can be simplified to:

Temperature in oF = (1,8 × Temp in oC + 32o). Hence convert the temperature in Durban to temperature in Fahrenheit.

***Answers on page 20***

## Time calculations, both digital and analogue

#### **Hours, minutes, and seconds**

Why are there 12 hours in a day? Why not 10? Or 20? This was chosen 4 000 years ago by the Babylonians. They divided each hour into 60 minutes and each minute into 60 seconds.

For Time conversions we need to **MEMORISE** the following:

60 seconds = 1 minute

60 minutes = 1 hour

24 hours = 1 day

7 days = 1 week

365 days = 1 year

366 days = 1 leap year (every year divisible by 4, e.g. 2016, 2020 etc)

12months = 1 year

1 decade = 10 years

1 century = 100 years

**Days in every month:**

|  |  |  |
| --- | --- | --- |
| Jan = 31 | Feb = 28 (29 in leap year) | Mar = 31 |
| Apr = 30 | May = 31 | June = 30 |
| July = 31 | Aug = 31 | Sep = 30 |
| Oct = 31 | Nov = 30 | Dec = 31 |

We can calculate elapsed time by subtraction; by counting or by using a calculator

|  |  |  |
| --- | --- | --- |
| **Illustrative Example** | **Time elapsed from 08:45 to 14:22 the same day** | **Time elapsed from 22:10 to 4:15 the following day** |
| **By subtraction** | 14h22min 13h82min  08h45min 08h45min  05h37min | 24h00 23h60min  22h10 23h60min  = 01h50min  Plus 04h15min  Total time elapsed → 5h 65 min  → 6h 5 min |
| **By counting** | From 08:45 to 09:00 → 0 h 15 min  From 09:00 to 14:22 →5 h 22 min  Total time elapsed → 05 h 37 min | From 22:10 to 23:00 → 0 h 50 min  From 23:00 to 24:00 → 1 h 00 min  From 24:00 to 04:15 → 4 h 15 min  Total time elapsed → 5 h 65 min  → 6 h 5 min |
| **With a calculator** | Use the °’ ‘’ key.  Key in:  14 °’ ‘’ 22 °’ ‘’ minus 8°’ ‘’ 45°’ ‘’ |  |

**Analogue time uses the face of the clock to indicate a time.**

Below is an illustration of the relationship between an analogue clock and the corresponding digital time.

****

But the analogue clock only shows a 12-hour day. Therefore each for the times above could also be:

**21:25 22:15 23:40**

When reading the analog clock, we need to know the meaning of some common words and phrases like: **o’clock**; Past; ; **quarter pass**; **half past**; **to**  ; **quarter to**

|  |  |  |
| --- | --- | --- |
| o’clock  Image result for analogue clock  12 o’clock | Past  https://mamontoff.files.wordpress.com/2012/02/clock-large.jpg  22 minutes past 8 | quarter pass  22 minutes past 8 |

|  |  |  |
| --- | --- | --- |
| half past  Image result for analogue clock  Half past ten | to    Ten **to** two | *Example: quarter to three*  Illustrate quarter to three below. |

**Activity 6**

### 1. Write these times using the 24 hour system. Use two figures for the hours and two figures for the minutes, for example, 7.30 a.m. would be 07h30.

### a) 6 a.m.

### b) 8.30 a.m.

### c) midday

### d) 5 p.m.

### e) 10.55 p.m.

### 2. Here is a section of the Cape town suburban line train timetable.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  | | --- | --- | --- | | **STATION** | **MORNING DEPARTURE TIME** | **EVENING DEPARTURE TIME** | | **Cape Town** | 06h38 | 17h07 | | **Woodstock** | 06h41 | 17h10 | | **Salt River** | 06h43 | 17h12 | | **Observatory** | 06h46 | 17h15 | | **Mowbray** | 06h48 | 17h17 | | **Rosebank** | 06h50 | 17h19 | | **Rondebosch** | 06h51 | ... doesn't stop | | **Claremont** | 06h54 | 17h24 | | **Wynberg** | 06h58 | 17h28 | | **Retreat** | 07h12 | 17h40 | | **Simonstown** | 07h41 | 18h08 | |

### 2.1 The train leaves Cape Town at 06h38.

### (a) How long does it take to get to Wynberg?

### (b) How long does it take to get to Simonstown?

### 2.2 In the evening the train leaves Cape Town at 17h07.

### (a) Is the journey to Wynberg longer or shorter in the evening?

### (b) By how much?

### (c) Is the journey to Simonstown longer or shorter in the evening?

**Reflection:** 2.1 (a)/(b) Check what time the train arrived in Wynburg/(Simonsown). Then subtract from that time, the time the train left Cape Town.

2.2 (a) Now apply the same principle to calculate the evening time. Now we compare the times to see if the evening journey is longer or shorter than the morning journey.

3. Ndu leaves home at half past twelve. She takes 2 hours to drive from home and do shopping, Half an hour to go to the Post Office and 20 minutes to fetch her children and drive home.

a) What is the total time taken to do these tasks?

b) What time does Ndu get back home?

c) How much time Ndu have for other activities at home before 17h00, when she must leave to go to evening class

**Reflection:** 3 (a) Remember that when we add time 60 minutes = 1 hour ; half an hour is 30 minutes.

3c To calculate the amount of time needed to do other chores is to subtract he time she gets back home from the time she needs to leave home (17h00)

***Answers on page 21***

**Distance, time and average speed calculations using a given formula**

|  |  |  |
| --- | --- | --- |
| In South Africa we have different speed limit for different areas. In residential areas the speed limit is 60 km per hour. This means that a car is allowed to travel a maximum of 60 km in an hour.  If an object is moving at varying speeds, then the relationship between speed, distance and time can only be used to calculate the average speed. |  | **FORMULA**  **Distance = speed × time**  **Time =**  Speed = |

**Illustrative examples:**

**Example 1:** Calculate the speed (in km per hour) of a car which travelled 50 km in 36 minutes

**Step 1:** Convert the time to hours by dividing the minutes taken by 60

**Step 2**: Use the formula for speed and substitute the distance in km and the time in hours.

**Step 3:** Use your calculator to simplify

**Answer:** Time =  h = 0,6 h

Speed = = km per hour = 83,33km per hour

**Example 2:** A train travels at an average speed of 45 km per hour for 3 hours 30 min. Calculate the distance travelled by the train.

**Step 1:** Convert the time to hours by dividing the 30 minutes taken by 60

**Step 2**: Use the formula for distance and substitute the speed in km per hour and the time in hours.

**Step 3:** Use your calculator to simplify.

**Answer:** Time = 3hours 30 min = 3,5 h

Distance = speed × time

= 45 km per hour × 3,5 hour

= 157,5 km

**Activity 7 (Distance speed and time calculations)**

Two school boys Rashid and Farouk take part in a fun 10 km run to raise awareness for Aids orphans. The race started at 07:15 at the local soccer grounds. Farouk gets a cramp in his leg and walks the last 1 km.

1. Rashid finished the race at 08:42. Calculate the speed per hour at which he was running.

2. Farouk finished the race at 08:56. He took 8 minutes to walk last 1 km of the race.

Determine his speed per hour for the first 9km of the run.

**Reflection:** To calculate

***Answers on page 21***

***Self-assessment checklist:***

Are you able to:

* estimate measurements quite accurately
* measure accurately.
* select appropriate units of measurement
* use standard measures in simple calculations
* convert from one unit of measurement to another
* convert temperature between Fahrenheit and Celsius (using a given formula)
* do Time calculation – digital and analogue
* calculate distance, speed and time – using a given formula

### **Practise Exercise 1: Analysing a recipe**

**Have you understood your reading. This activity is based on measurement and conversion.**

Nolwazi is baking Vanilla Cup-Cakes or the school fete. She uses the following ingredients.

|  |  |
| --- | --- |
| Ingredients*: (makes 16 cakes)* 1 ½ cups flour ¾ cup sugar 1 Tsp baking powder ½ tsp salt ½ cup milk ½ cup oil 2 eggs 1 tsp vanilla essence  Bake at 180 oC | vanilla-cupcakes1  ***Conversion Table***  5 mℓ = 1 teaspoon (tsp)  1 tablespoon (Tsp) = 12,5 mℓ  1 cup = 250 mℓ |

Study the above information and answer the questions that follow.

1.1 Write down the ratio of salt **:** baking powder in the form **1 : …**

1.2 Convert the amount of oil used to tablespoons.

1.3 Calculate how many mℓ of flour is need for 80 cup cakes

1.4 Calculate the total volume of liquid ingredients added to the cake mixture.

1.5 Determine how many teaspoons of vanilla essence Nolwazi will need to make 48 cup cakes.

1.6 The cup-cakes take 15 minutes to mix, are baked for 20 minutes and are cooled for 30 min and then iced. Nolwazi makes the icing while the cakes are baking. Nolwazi takes 10 minutes to ice the cakes. Nolwazi starts mixing the cakes at 09:15. At what time will she finish icing the cakes? (write the time in digital form and analogue form).

1.7 Convert the time that the cakes must bake at to oF

***Answers on page 21/22***

**Practise Exercise 2: Conversions and BMI**

Paul and Pauline are a set of twins. Paul’s height is 165 cm and Pauline’s 60 inches. The topic they currently discussing at school is Healthy Living. Study the information below and answer the questions that follow.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **bmi0001.jpg** | |  |  | | --- | --- | | **BMI range (kg/** | **Weight status** | | Less than 18,5 | underweight | | From 18,5 to 24,9 | normal weight | | From 25 to 30 | overweight | | More than 30 | obese | |

|  |  |  |
| --- | --- | --- |
| 2.1 | Convert Paul and Pauline’s height to metres | (4) |
| 2.2 | Determine between Paul and Pauline who has a higher Body mass index.  Use the formula BMI = | (4) |
| 2.3 | Determine Paul and Pauline’s weight status. | (2) |
| 2.4 | What advice would you give someone with a BMI reading of >30. | (2) |
| 2.5 | Paul’s friend Joshua is 5 feet and 1 inch tall. Convert this to metres. | (3) |
| 2.6 | Determine who is taller, Paul or Joshua. | (2) |
| 2.7 | Pauline’s cousin Jennifer stays 9,144 yards away from her. Convert this to metres. | (2) |

***Answers on page 22***

**Practise Exercise 3: Time and Graphs**

|  |  |
| --- | --- |
| Jane participated in a sponsored 20 km walk to raise funds for Aids orphans. The organiser encouraged the walkers to have a fifteen minute rest during the walk. The graph showing the distance covered by Jane against the time taken by her, is given below. |  |

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
| 3.1 | At what time did the walk start? |  | (1) |

|  |  |  |  |
| --- | --- | --- | --- |
| 3.2 | How many kilometres did Jane walk during the first hour? |  | (2) |

|  |  |  |  |
| --- | --- | --- | --- |
| 3.3 | How far had Jane walked by 10:00? |  | (2) |

|  |  |  |  |
| --- | --- | --- | --- |
| 3.4 | How long did Jane take to walk the first 9 km? |  | (2) |

|  |  |  |  |
| --- | --- | --- | --- |
| 3.5 | After how many hours of walking did Jane rest? |  | (2) |

|  |  |  |
| --- | --- | --- |
| 3.6 Give an estimate of the time at which Jane finished the walk. |  | (2) |
| |  | | --- | | **Summary Assessment** |  |  |  | | --- | --- | | 1. | Study the given information and answer the questions that follow. |  |  |  |  |  |  | | --- | --- | --- | --- | --- | |  | Butterfly buns  ***A picture of the cream buns*** | **For the buttercream:**   * 50 g butter, softened * 75 g icing sugar * 2 **tablespoons** strawberry jam * Icing sugar, for dusting   **Time**   * Prep time: 20 mins * Cooking time: 15 mins |  |  | |  |  | |  |  |  |  |  |  |  | | --- | --- | --- | --- | | 1.1 | Determine the total mass of butter needed for the ten buns. |  | (3) |  |  |  |  |  | | --- | --- | --- | --- | | 1.2 | If 1 teaspoon = 5 mℓ, write down the ratio of baking powder to milk, needed for the ten buns. |  | (3) |  |  |  |  |  | | --- | --- | --- | --- | | 1.3 | Write down the number of mℓ of strawberry jam needed for the ten buns. |  | (2) |  |  |  |  |  | | --- | --- | --- | --- | | 1.4 | If Saritha bought a 500 g packet of self-raising flour, how many buns would she be able to make. |  | (2) |  |  |  |  |  | | --- | --- | --- | --- | | 1.5 | Saritha started her preparation at 10:00. At what time did she finish making the buns? |  | (2) |  |  |  |  |  | | --- | --- | --- | --- | | 1.6 | Determine the number of eggs needed to make 50 buns. |  | (2) |  |  |  |  |  | | --- | --- | --- | --- | | 2 | The school decides to re-surface the hockey field. The contractor explains that the length of time required for the job will depend on the number of workers available. The graph below illustrates the relationship between time taken in days and number of workers needed. |  |  |  |  |  |  | | --- | --- | --- | | Use the graph to answer the following questions: |  |  |  |  |  |  |  | | --- | --- | --- | --- | | 2.1 | How many days would it take for 1 worker to complete the job? |  | (2) |  |  |  |  |  | | --- | --- | --- | --- | | 2.2 | Estimate the minimum number of days 6 workers would take to complete the job. |  | (2) |  |  |  |  |  | | --- | --- | --- | --- | | 2.3 | Calculate the minimum number of workers needed to complete the job in exactly 5 days |  | (2) | |  |  |  | **[20]** |   ***Answers on page 23*** | | |

**Solutions for Unit 1**

|  |  |
| --- | --- |
| **Activity 1** | |
| 1 | Your height … |
| 2 | Length of your room…. |

|  |  |
| --- | --- |
| **Activity 2** | |
| (a) | Length of nail = 1,2 cm = 12 mm |
| (b) | Length of leaf = 2,9 cm = 29 mm |
| (c) | Length of pencil = 3,9 cm = 39 mm |

|  |  |
| --- | --- |
| **Reflection** | |
| When we start measuring from zero ? | The end value is the answer |
| When we start measuring from a number other zero? | We subtract the end value from the start value to get the measurement |
| What is the difference between estimation and accurate measurement? | Estimation is an informed guess. Accurate measurement is found using a measuring instrument or by calculation. |

|  |
| --- |
| **Activity 3** |
| Answers dependent on student |

|  |  |
| --- | --- |
| **Activity 4** | |
| 1(a) | 18 inches = 18 × 2,54 cm = 45,72 cm |
| 1(b) | 55 cm = (55 ÷ 2,54) inches = 21,65 inches |
| 2 | 9 yards = 9 × 91,44 cm  = 822,96 cm  = 8,23 m  No he did not break the record. |

|  |  |
| --- | --- |
| **Activity 5** | |
| 1 | 74oF = (5 ÷ 9) × (74o – 32o) oC =23,3oC. Durban is hotter |
| 2 | 180oC = [(9 ÷ 5) × 180o + 32o] F = 356 oF |

|  |  |
| --- | --- |
| **Activity 6** | |
| 1(a) | 06:00 |
| 1(b) | 08:30 |
| 1(c) | 12:00 |
| 1(d) | 17:00 |
| 1(e) | 22:55 |
| 2.1(a) | 20 minutes |
| 2.1(b) | 1 hour 3 minutes or 63 minutes |
| 2.2(a) | Longer (takes 21 minutes) |
| 2.2(b) | 1 minute longer |
| 2.2.(c) | takes 1 hour 1 minute or 61 minutes. Shorter |
| 3(a) | 2 hours + 30 minutes + 20 minutes = 2 hours 50 minutes |
| 3(b) | 12:30 + 2 hours 50 minutes = 15:20 |
| 3(c) | 1 hour 40 minutes |

|  |  |
| --- | --- |
| **Activity 7 (Distance speed and time calculations)** | |
| 1 | 08:42-07:15=1 h 27 minutes  Speed=×60=6,90 km/h or |
| 2 | (08:56-8) -7:15 = 1 h 33 minutes  Speed=× 60 = 5,81 km/h or |

|  |  |
| --- | --- |
| **Practise Exercise 1: Analysing a recipe** | |
| 1.1 | salt : baking powder = ½ tsp : 1 Tsp  = 2,5 : 12,5  = 1 : 5 |
| 1.2 | ½ cup= 125mℓ = 10 Tsp |
| 1.3 | 1 ½ cups = 375 mℓ for 16 cup cakes  For 80 cup cakes we need = (80 ÷ 16 )×375 mℓ = 1 875 mℓ |
| 1.4 | liquid ingredients are milk, oil and vanilla essence  Volume = ½ cup +½ cup + 5 mℓ = 255mℓ |
| 1.5 | 48 cup cakes= 3×16  Amount of vanilla essence = 3 ×5 mℓ = 15mℓ |
| 1.6 | Total time taken = 15 min + 20 min + 30 min + 10min = 75 min = 1 h 15 min  She will end at 09:15 + 1 h 15 min = 10:30 or half past ten. |
| 1.7 | 180oC =(9 ÷ 5 × 180o + 32o)F = 356 oF = 360oF |

|  |  |
| --- | --- |
| **Practise Exercise 2: Conversions and BMI** | |
| 2.1 | Paul 165÷100 =1,65m  60×0,0254=1,52 m |
| 2.2 | Pauline:99×0,4536=44,91kg  =19,44  =20,57  Paul has a higher BMI |
| 2.3 | Both are normal weight. |
| 2.4 | Healthy eating plan and exercise |
| 2.5 | (0,3048×5) + 0.0254m=1,55m |
| 2.6 | Paul is taller at 1,65m than Joshua at 1,55m |
| 2.7 | 9,144x0,9144=8,36 m |

|  |  |
| --- | --- |
| **Practise Exercise 3: Time and graphs** | |
| 3.1 | 07:00 or 7:00a.m. |
| 3.2 | 6 km |
| 3.3 | 16,5 km |
| 3.4 | 12 km |
| 3.5 | 2 hours |

|  |  |  |
| --- | --- | --- |
| **Summary Assessment** | |  |
| **No** | **Solution** | **Explanation** |
| 1.1 | Mass = 100 g + 50 g  = 150 g (2) | 1M adding  1 A solution  Answer only: full marks |
| 1.2 | Amount of baking powder =  mℓ = 2,5 mℓ  Baking powder : milk  = 2,5 : 15  = 1 : 6 (3) | 1A dividing  1M writing as a ratio  1 CA solution  Answer only: full marks |
| 1.3 | Amount = 2 × 15 mℓ  = 30 mℓ (2) | 1M multiplying  1 A solution  Answer only: full marks |
| 1.4 | Number of buns =  × 10  = 50 (2) | 1 M dividing/multiplying  1 CA solution  Answer only: full marks |
| 1.5 | Time = 10:00 + 20 min + 15 min  = 10:35 (2) | 1M adding  1 A solution  Answer only: full marks |
| 1.6 | Number of eggs = × 2  = 10 (2) | 1 M dividing/multiplying  1 CA solution  Answer only: full marks |
| 2.1 | 20 (2) | 2A answer |
| 2.2 | accept any answer between three and four (2) | 2A answer |
| 2.3 | 4 (2) | 2A answer |

**Unit 2: Perimeter and surface area**

***By the end of this unit you should be able to:***

* Calculate lengths, distances and perimeters (circumference)
* Calculate areas of triangle, square, rectangle and circle including combinations of these shapes using given formulae

**Introduction**

All objects around us have a particular shape. We use shapes to describe objects. For example, a window may be rectangular, or a table may be rectangular. Mathematicians study the properties of shapes. These properties enable them to solve other mathematical problems. Let us look at some of these shapes.

**Types of shapes and their perimeters**

**Purpose:**

**Squares and rectangles**

|  |  |
| --- | --- |
| *Quadrilateral –*  *four-sided figure*  *Parallel lines are lines which do not meet and have a constant distance between them*  *A block indicates that an angle is a right-angle*  *The arrows indicate the lines are parallel* | A four-sided shape is known as a **quadrilateral.** We will study the square and the rectangle.  A **square** is a quadrilateral; with all four sides equal in length, all four angles equal to 90o and opposite sides parallel  Square  A quadrilateral with 2 pairs of parallel sides and opposite sides equal, with all of the angles right-angles is known as a **rectangle.** |

The measurement from one end to the other along the longest side of a rectangle is known as **length**. The measurement along the other side is known as the **width** (or breadth).

If you want to measure the distance around your rectangular plot, then you will measure the four sides of your plot.

length

length

width

width

|  |
| --- |
| PLOT |

You will measure the two lengths together with the two widths.

That is:

length + length + width + width = 2 lengths + 2 widths

= 2 × (length + width)

This measurement is called the perimeter:

**Perimeter of rectangle = 2(length + width)**

In a **squar**e the length = width, so we just talk about the side. If we want to measure the distance around a square computer screen, then we need only know the length of one side of square screen. We can then add the lengths of the four equal sides.

That is: side + side + side + side = 4 sides

**Perimeter of square = 4 × sides**

**Activity 1.1 (Perimeters of rectangles and squares)**

1. Write down the indicated measurements in the pictures below:
   1. Length of rectangular part of camera:

Breadth/width of rectangular part of camera:

4

cm

7

cm

**Reflection:** Length is the longer horizontal side. Width is the shorter (vertical) side

* 1. Write down the Length of computer screen and Width of computer screen:

Calculate the perimeter of computer screen:

30

cm

20

cm

**Reflection:** Length is the longer horizontal side. Width is the shorter (vertical) side. Hence write down the formula for perimeter and substitute the length and width into the formula.

* 1. Length of outer side of square photo frame. Length of inner side of square photo frame. Perimeter of outer part of photo frame. Perimeter of inner part of photo frame:

10

cm

8

cm

**Reflection**: Have you noticed, that the photo frame is a square? What does that mean? (Length = width). Hence we speak about the side of a square. Use the formula for the perimeter of a square and then substitute.

**(Solution on page 16)**

**Triangles**

If you want to measure the distance around a triangular sign-board, you will measure each of the three sides of the board.

side 1

side 2

side 3

SIGN

-

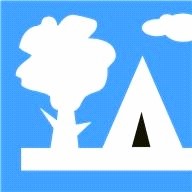
BOARD

You can then add the lengths of the three sides. That is: side 1 + side 2 + side 3

Remember that this measurement is known as the perimeter:

**Perimeter of any triangle = length of (side 1 + side 2 + side 3)**

**Activity 1.2 (Perimeter of a triangle)**



8 cm

10cm

(a)Find the perimeter of the front side of the picture

of the tent in the sketch alongside, where the

base = 8 cm and each slant height is 10 cm

**Reflection:** We need to add the three sides of the

triangular face. But are you aware that the two slant

height are the same. Now that you have identified the

three sides, you can add them up.

(b) Calculate the perimeter of the traffic sign with three equal sides.

**Reflection:** We need to add the three sides of the

triangular traffic sign. The sides are equal. Now we can add the three sides together. Do you know that you can now calculate the width of the stand?



50

cm

50

cm

20 cm

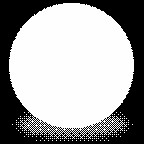
20 cm

100 cm

**(Solution on page 16)**

**Circles**

You will probably agree that circular shapes are as familiar to us as rectangles, squares and triangles.



**Parts of a circle**

It is difficult to draw a circle free-hand. In earlier times, and even today in some communities, circles were drawn using a length of string and a stick or writing instrument such as a pencil. Some communities still use this method when measuring out the floor for the construction of their houses. Today mathematicians use a pair of compasses to draw circles accurately.

|  |  |  |
| --- | --- | --- |
|  | O    **radius** | **diameter**    C    D  O  A circle with centre O and **diameter CD**. OC is a radius and so is OD.    **diameter = radius + radius** |

The radius (r) is the line drawn from the centre of the circle to the line around the outside of the circle. The line around the circle is called the circumference. The radius can be drawn anywhere from the centre to the circumference and it will still be the same length. Any straight line drawn from a point on the circumference through the centre to another point on the circumference is called the diameter (d). So the diameter is made up of two radii or we can say that diameter = radius + radius = 2 × radius.

The line around the outside of the circle is called the circumference. So the length of the circumference is the perimeter of the circle.

The circumference can be found by using a piece of string to measure around the circle, or by rolling the shape along a ruler. This approach can be awkward and not very accurate if we have to work with very small or very large circles.Mathematicians use a formula for calculating the circumference of a circle.Mathematicians discovered that a relationship existed between the circumference and diameter of a circle.

**Activity 1.3 to confirm the value of pi**

Complete and study the table below that presents the radius and circumferences of a number of circles:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Radius | Circumference | Diameter | Circumference ÷ diameter |
| 1 | 1 cm | 6,283 cm | 2 cm |  |
| 2 | 2 cm | 12,566 cm | 4 cm |  |
| 3 | 3 cm | 18,850 cm | 6 cm |  |
| 4 | 4 cm | 25,133 cm | 8 cm |  |
| 5 | 5 cm | 31,416 cm | 10 cm |  |
| 6 | 10 cm | 62,832 cm | 20 cm |  |
| 7 | 20 cm | 125,664 cm | 40 cm |  |
| 8 | 50 cm | 314,159 cm | 100 cm |  |

**(Solution on page 16)**

**Reflection:** Use your calculator to divide the circumference by the diameter. You should notice that the answers in the final column of the table are all approximately equal to 3,142 if we round off to 3 decimal places. Now we can approximate the value of pi and always use it as 3,142.

We do not know the exact value of this number as it is an irrational number in that it has no recurring decimal pattern and does not terminate. Because of the importance of this number in finding the circumference and area of a circle, it is given a symbol π (pi) which is a letter of the Greek alphabet.

You will see there is a π key on your calculator.

Hence the formula to calculate the perimeter (Circumference) of a circle is:

C= 2 × π × r **OR** C = π × D and using π = 3,142

**Activity 1.4 (Circumference of a circle)**

|  |  |
| --- | --- |
| a) The floor of a circular hut has a radius of  7m. What is the circumference of the floor  of the hut? Round off your answer to the  nearest metre.  **Reflection:** Have you noted that in this case the radius is given? Then you choose to use the formula that gives the circumference in terms of radius. Now substitute the radius and π = 3,142. Then use your calculator to calculate the circumference.  b) The diameter of the base of the roof of the  hut is 20 m. What is the circumference of  the base of the roof? Round off your  answer to the nearest metre.  **Reflection:** Have you noted that in this case the diameter is given? Then you choose to use the formula that gives the circumference in terms of the diameter. Now substitute the diameter and π = 3,142 into the formula. Then use your calculator to calculate the circumference. |  |

**(Solution on page 17)**

**Summary: Lengths, distances and perimeters**

A **perimeter** is a path that surrounds a [two-dimensional](https://en.wikipedia.org/wiki/Two-dimensional) [shape](https://en.wikipedia.org/wiki/Shape).

(*https://en.wikipedia.org/)*

|  |  |  |
| --- | --- | --- |
| **SHAPE** | **VARIABLES/Definitions** | **PERIMETER (P)** |
| **Square**  **s**  **s**  A four-sided figure with all four sides equal in length and all four angles 90o. | **Side (s)– measure of one side** | **P = 4 × s**  **OR**  **P = s + s + s + s** |
| **Rectangle**  ***ℓ***  ***b***  A four sided figure with all angles 90o and opposite sides equal. | **Length (*ℓ*)** – measure of the longer side.  **Breadth (*b*)** – measure of the shorter side.  (In calculations the length and breadth can be interchanged) | **P = 2 × (*ℓ*+ *b*)**  **OR**  **P = *ℓ*+ *b* + *ℓ*+ *b*** |
| **Triangle**  **s3**  **s2**  **s1 or b**  ***h***  A three-sided figure | **Three sides – s1; s2; s3 ..**  **Base (b)** the length of the side of a triangle from which the perpendicular height is drawn  Perpendicular height (h) the perpendicular drawn from the base to the apex of the triangle. | **P = s1 + s2 + s3** |
| **Circle**  ***r***  ***D***  A set of points equidistant from a centre. | **Circumference** (C) the outer edge of a circle  **Radius** (r) – measurement from the centre of the circle to the circumference  **Diameter** (D) – the length from one end of the circumference, through the centre to the other end. | **P = 2 × π × *r*2**  **whereπ = 3,14**  **P = π × D** |

**Areas of triangle, square, rectangle and circle including combinations of these shapes using given formulae**

If you want to paint the walls of your room, you will need to know the area of the walls.

Stand in one of the rooms in your house. Look at one of the walls. Estimate the area of the wall.

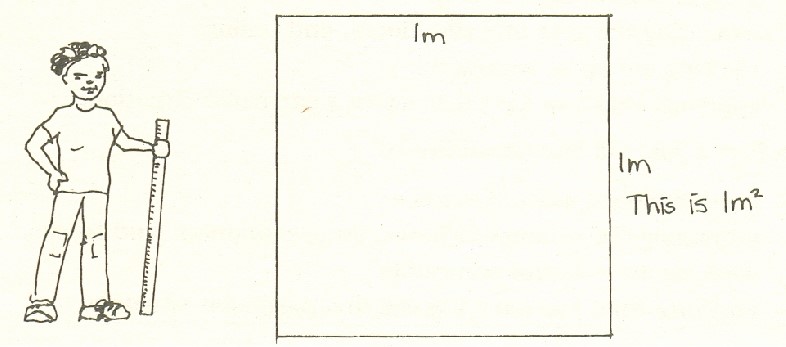
**Estimation**

What does estimate mean? It means to picture roughly how many square metres will fit onto the wall. In order to do this you have to know the size of a square metre.

**Standard Units**

Remember that the standard unit for measuring area is a square metre.

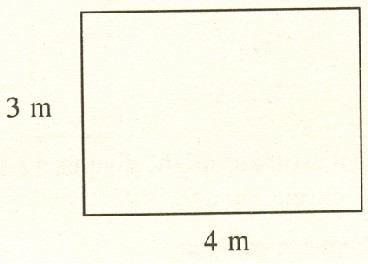
Take a metre stick and mark out a square 1 m × 1 m



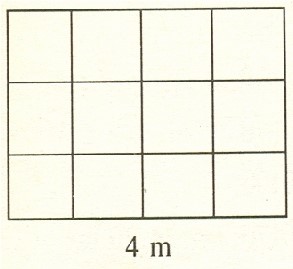
Thus area is the inside shape or space measured in square units on a flat surface. In rectangles and in squares, a simple calculation of length multiplied by breadth will give the number of square units. The square units could be centimetres, metres or whatever the requested unit of measure asks for.

### **Areas of rectangles and squares**

Look at the following rectangle. The width is 4 m, and the height 3 m. How many square metres can you fit onto the rectangle?



Now draw lines across the rectangle and you will see that there are 12 square metres. You get the answer by multiplying the width by the height of the wall.



3m

Hence the **area of a rectangle = length × width.**

In the example above we cold have calculate the area by saying:

Area = length × width = 4 m × 3 m = 12 m2

In a square the length = width. Then we refer to it as a side.

Hence we say: **Area of a square = side × side**

### **Areas of triangles**

Remember that the area of a rectangle is: length × width. Look at the following rectangle:

A

40

mm

B

C

The area of this rectangle is 80 × 40 = 3 200 mm2.

Can you guess the area of triangle ABC?

Yes, it is 1 600 mm2. The diagonal AC cuts the area of the rectangle in half.

*Perpendicular*

*two sides meet at an angle*

*of 90º.*

It is important that the base of the triangle and the height are **perpendicular** to each other.

The diagrams illustrate that two of the sides meet at an angle of 900.

|  |  |  |
| --- | --- | --- |
|  |  |  |

**Areas of circles**

You have learnt how to work out the area of squares, rectangles and triangles. We can also calculate the area of a circle if we know what the radius is. We do this by squaring the radius ( r × r = r²) and multiplying this number by Pi (p) = 3,142. So the formula for the area of a circle is calculated using the following formula: **Area of a circle = × π × r2**

**Working with smaller units**

When working with lengths smaller than a metre, you can work in parts of a metre, or in centimetres. For example you could use 0,5 metres or 50 centimetres.

When great accuracy is needed, for example in carpentry, you can use millimetres, for example 655 mm, instead of 0,655 metres.

**To summerise:**

The following formula can be used to calculate area of basic shapes (see the table on perimeter).

**Area of a triangle =*b* ×*h***

**Area of a square = *s* × *s***

**Area of a rectangle = *ℓ* × *b***

**Area of a circle =× π × *r*2**

**Illustrative examples**

**Example 1:** Calculate the perimeter and area of a triangle with side length equal to 3 m, 5 m and 7 m and a perpendicular height of 1,86 m from base = 7 m

Step 1: write down the formula.

Step 2: Check that the units are the same

Step 3 Substitute the length of the sides

Step 4: Add

**Answer:** P = s1 + s2 + s3

**=** 3 m + 5 m + 7 m

= 25 m

A **=*b* × *h***

Step 1: write down the formula.

Step 2: Check that the units are the same

Step 3: Substitute the base and height

Step 4: Add

=****x 1,86 m x 7 m

= 6,51 m2

**Example 2:** Calculate the perimeter and area of a square with side length equal to 8 m.

**Answer:** Perimeter = 4 × side

Step 1: write down the formula.

Step 2: Substitute the length of the side

Step 3: multiply

= 4 × 8 m

= 32 m

Area = side × side

Step 1: write down the formula.

Step 2: Substitute the length of the side

Step 3: multiply

= 8 m × 8m

= 64 m2

**Example 3:** Calculate the perimeter and area of a rectangle with length of 100 m, and a breadth of 45 m

Step 1: write down the formula.

Step 2: Substitute the length and width

Step 3: multiply

**Answer:** P = 2 × (*ℓ* + *b*)

**=** 2 × (100 m + 45 m)

= 290 m

A = *ℓ* × *b*

Step 1: write down the formula.

Step 2: Substitute the length and width

Step 3: multiply

= 100 m × 45 m

= 4 500 m2

**Example 4:** Calculate the circumference and area of a circle with radius of 4,5 m.

**Answer:** Circumference (Perimeter ) = 2 × π × *r*

Step 1: write down the formula.

Step 2: Substitute the radius and π

Step 3: multiply

= 2 × 3,142 × 4,5 m

= 28,26 m

A =× π × *r*2

Step 1: write down the formula.

Step 2: Substitute the radius and π

Step 3: multiply

Step 4: Write your answer to two decimal places.

=× 3,142 × (4,5 m)2

= 31,81275 m2

≅ 31,81 m2

**Reflection on the above examples:** Firstly, for each example we had to choose the correct formula. Secondly make sure the measurements given were in the same unit. Thirdly substitute and lastly use a calculator to simplify and arrive at an answer.

**Activity 2: Areas and perimeters of combined shapes.**

**Activity 2.1 The rectangle and triangle**

* 1. A garden can be subdivided into a rectangle (A) and a triangle (B) with

8 m

measurement as indicated below.

6 m

6 m

8,485 m

A

B

The owner needs to fence the garden and calculate the surface area of the garden so that he knows how much fertiliser to buy.

* + 1. Calculate the perimeter of the garden.
    2. If the fencing is sold in 10 m rolls, how many rolls of fencing will the owner have to buy?
    3. Calculate the area of the garden.
    4. The fertiliser can spread at a rate of 500 gram per square metre. Calculate how many kilograms of fertiliser must be bought.

**Reflection:**

Note that the perimeter is only the outer-edge. We do not add the dividing line between the rectangle and the triangle. Do you remember the properties of a rectangle? (Opposite sides are equal in length) This means that in many cases only the measurement of the one side is given and we use the property of the rectangle to find the other side. In all calculations of perimeter and area, we use the formula and substitute into the formula.

To calculate the fertiliser we use the ratio concept we studied in numbers.

**(Solution on page 17)**

**Activity 2.2 [Circle and a rectangle]**

Mrs Brown has a circular flower-bed in a rectangular lawn, as shown in the diagram alongside.

The radius of the flower-bed is 1,6 m.

The length of the rectangular lawn is 6 m and the breadth is 4 m.

1,5 m

# 4 m

# SUPPLEMENTARY EXAMINATION PAPER 2009

# 1,6 m

# SUPPLEMENTARY EXAMINATION PAPER 2009

# 6 m

# SUPPLEMENTARY EXAMINATION PAPER 2009

# 4 m

# SUPPLEMENTARY EXAMINATION PAPER 2009

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 2.2.1 | Write down the diameter of the flower-bed. |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 2.2.2 | Calculate the area of the flower-bed.  Use the formula: **Area = *π* r**, where ***π*** = 3,142 and **r** = radius |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 2.2.3 | Determine the perimeter of the rectangular lawn.  Use the formula: **Perimeter = 2 (*l* + *b*)**,where ***l =*** length and ***b =*** breadth |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
|  | 2.2.4 | Calculate the area of the lawn. Round up the answer to the nearest whole number.  Use the formula: **Area of lawn =** ***l* *b* – area of the flower-bed**,  where ***l =*** length , ***b =*** breadth |  |

**(Solution on page 17)**

**Reflection:**

Note that the diameter is double the radius.

To calculate area/perimeter we always write down the formula, check the units of measure are the same, substitute into the formula and then use our calculator to find the solution.

In 2.2.4, we have already calculated the area of the flower-bed, so we can take the value from above.

**Activity 2.3 [A circle and a square]**

|  |  |
| --- | --- |
| A circular glass tabletop is cut from a square piece of glass that is 136 cm by 136 cm, as shown in the picture below.  The length of the radius of the circle is 68 cm.  A flexible aluminium strip is attached to the circular edge of the tabletop to form an edging.  glass table #1 | 136 cm  136 cm cm  68 cm |

2.3.1 What is the length of the diameter of the table?

2.3.2 Calculate the perimeter of the square piece of glass.

Use the formula: **Perimeter of square = 4  length of side**

2.3.3 Calculate the area (in cm2) of the glass table-top.

Use the formula: **Area of circle = (radius)2** using **= 3,142**.

2.3.4 Calculate the circumference (in cm) of the glass table-top.

Use the formula: **Circumference of circle = 2 radius** using **= 3,142**.

2.3.5 The aluminium strip costs 84c per cm. Calculate the cost in rands for   
 425 cm of edging.

**Reflection:** Refer to the reflection in Activity 2.1 and Activity 2.2 and apply them to Activity 2.3

**(Solution on page 18)**

**SUMMARY ASSESSMENT**

1. Calculate the circumference and the area of a circular flowerbed with diameter 2,5 m.

2. A circular garden with a diameter of 20 m is surrounded by a 2 m gravel path as

indicated below. Calculate the area of the path.



3. Determine the perimeter and the area of the garden shown in the diagram.



4. Mrs Smith is the hockey coach at her school. She decided to raise funds for the hockey

club. A concert was held on the hockey field. After the concert she found that some of

the lines on the field were unclear and part of the grass on the field was damaged.

The dimensions of the hockey field are:

length = 98 m breadth = 75 m

Penalty spot

**.**

Goal post

Centre spot

Goal area

**75 m**

**98 m**

The following formulae may be used:

**Perimeter of a rectangle = 2 (*l* + *b*),** where ***l***= length and ***b***  = breadth

**Area of a circle =   (radius)**2,using ** =** 3,14

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 4.1 | All the outside boundary lines (bold lines) have to be re-marked and one of the goal areas (semicircle) has to be re-grassed. |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | (a) | Determine the total length of the boundary lines of the hockey field that need to be re-marked. |  |  |
|  | (b) | Calculate the area of the ONE goal area that has to be re-grassed, if the radius is 16 m. |  |  |
|  | (c) | Write down the shortest distance between the centre and the goal area. |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 4.2 | If it takes 15 minutes to re-mark 10 m of boundary lines, calculate how long, in hours, it would take to re-mark 100 m of boundary lines. |  |  |

**(Solution on page 19)**

**Solutions**

**Activity 1.1**

1 (a) Length = 7 cm

Width = 4 cm

(b) Length = 30 cm

Width = 20 cm

Perimeter = 2 × (length + width)

= 2 × (30 cm + 20 cm)

= 2 × 50 cm

= 100 cm

(c) Inner Perimeter = 4 × (side)

= 4× 8 cm

= 32 cm

Outer Perimeter = 4 × (side)

= 4× 10 cm

= 40 cm

**Activity 1.2**

1. Perimeter = side + side + side

= 8 cm + 10 cm + 10 cm

= 28 cm

1. Perimeter = 3 × side

= 3 × 50 cm

= 150 cm

**Activity 1.3**

1. 3,1415
2. 3,1415
3. 3,14167
4. 3,141625
5. 3,1416
6. 3,1416
7. 3,1416
8. 3,14159

**Activity 1.4**

1. Circumference = 2 × π × radius

= 2 ×3,142 × 7 m

= 43,988 m

1. Circumference = π × diameter

= 3,142 × 20 m

= 62,82 m

**Activity 2.1 [Rectangle and triangle]**

2.1.1 Perimeter = sum of lengths of the sides

= 6 m + 8 m + 8,485 m + 6 m + 8 m

= 36,485 m

2.1.2 Number of rolls of fencing = 36,485 ÷ 10

= 3,6485

≅ 4 rolls (you cannot buy a part roll)

2.1.3 Area of A = length × width

= 8 m × 6 m

= 48 m2

Area of B = × base × perpendicular height

= × 6 m × 6 m

= 18 m2

Total area = area A + Area B

= 48 m2 + 18 m2

= 66 m2

2.1.4 500 g = 0,5 kg

Amount of fertiliser = 66 × 0,5 kg

= 33 kg

**Activity 2.2 [Circle and rectangle]**

2.2.1 Diameter = 2 × 1,6 m

= 3,2 m

2.2.2 Area = 3,142 × (1,6 m)2

= 8,04352 m2

2.2.3 Perimeter = 2(6 m + 4 m)

= 2 × 10 m

= 20 m

2.2.4 Area of lawn = 6 m × 4 m – 8,04354 m2

= 24 m2 – 8,04354 m2

= 15,95648 m2

≅ 16 m2

**Activity 2.3**

2.3.1D = 136 cm

2.3.2 P = 4  length

= 4  136 cm

= 544 cm

2.3.3 A = 

= 3,142 (68 cm)

= 14 528,608 cm

2.3.4 Circumference = 2   radius

= 2  3,142  68 cm

= 427,312 cm

2.3.5 Cost = 428 84c

= 35 952c

= R359,52

**SUMMARY ASSESSMENT SOLUTION**

1. diameter = 2,5 m

Circumference = π × diameter

= 3,142 × 2,5 m

= 7,855 m

Radius = 0,5 × diameter

= 0,5 × 2,5 m

= 1,25 m

Area = π × (radius)2

= 3,142 × (1,25 m)2

= 4,909 m2 (rounded to 3 decimal places

2. Radius of the garden = 10 m

Area of garden = π × (radius)2

= 3,142 × (10 m)2

= 314,2 m2

Radius of (pathway and garden) = 10 m + 2 m

= 12 m

Area of (pathway and garden) = π × (radius)2

= 3,142 × (12 m)2

= 452,448 m2

Area of pathway = Area of (pathway and garden) – Area of garden

= 452,448 m2  – 314,2 m2

= 268,752 m2

3. Perimeter of shape = 12 m + 6 m + 6 m + 6 m + 18 m + 12 m

= 60 m

The shape can be divided into two square 12m by 12 m and 6 m by 6 m

Area of shape = 12 m × 12 m + 6 m × 6 m

= 144 m2 + 36 m2

= 180 m2

4.1 (a) Perimeter of a rectangle = 2 (*l* + *b*)

= 2 (98 m + 75 m)

= 346 m

4.1 (b) **Area of a circle =   (radius)**2

area (half a circle) = 0,5 × 3,142 × (16 m)2

= 402,176 m2

4.1 (c) Shortest distance = (98 ÷ 2 – 16) m

= 33 m

4.2 Shortest distance = (98 ÷ 2 – 16) m

= 33 m

**Unit 3 Surface area and Volume of right prisms (3-D)**

***By the end of this unit you should be able to:***

* Calculate Surface areas of right prisms (cube, rectangular and triangular) and right cylinders using given formulae;
* Calculate Volumes of right prisms (cube, rectangular and triangular) and right cylinders using given formulae

**Surface areas of right prisms (cube, rectangular and triangular) and right cylinders using given formulae**

Three dimensional (3-D) shapes have three dimensions (or measurements); a length, a breadth and a height**.** They are also called solids**,** even if they are hollow. Some examples of solids are cubes, rectangular solids and cylinders. Surface area is the sum of the area of each part that makes up a three-dimensional shape known as a right prism. Examples of right prisms are square-based and rectangular based prisms, triangular prisms and cylindrical prism.

A real life example of each of the prisms is:

**Cube** – a dice

**Rectangular prism** – opened or closed boxes

**Triangular prism** – triangular-shaped box.

**Cylinder** – a coffee/ tin.

**Surface Area of a rectangular solid**

The box below is a rectangular solid. The three dimensions are length (*l)*, width (*w*) and height (*h*).

In order to calculate the surface area of a solid, we need to calculate

each 2-D outside surface, called faces, of the solid. The rectangular solid below has 6 faces.

*l*

*=*

10

cm

*h*

=

4 cm

*w*

=

3 cm

Can you see why? Let us unfold the rectangular solid so that you can see each of the faces. This **‘**unfolded**’** diagram is called a **net or a development** in mathematics.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | A |  | *h* | *h* |  | *L* |
| E | C | *w* |  | F | *w* | D |
|  | B |  |  |  |  |  |

Now you can clearly see each face. Each face of the solid is a 2-D shape and you already know how to calculate the area of certain 2-D shapes. Can you see that each of these faces is a rectangle? Faces A and B have the same area. Faces C and D have the same area and faces E and F each have the same area. Hence the formula to calculate the surface area is:

**Surface Area of a rectangular prism =**

**2 (length × width + length × height + width × height)**

If the prism is a cube (all sides equal), the length = width = height. This means that:

**Surface area of a cube = 6 × side × side**

**Surface area of a cylinder**. Examine the two diagrams of a cylinder below. The first diagram is the 3-D view of the solid and the second diagram is the 2-D view of the unfolded cylinder (the net).

8

cm

8

cm

Circumference of circle

8

cm

The cylinder is made up of a rectangle and two circles. So there are three areas we need to add together in order to calculate the surface area of the cylinder. Do you remember how to calculate the area of a circle?

Area of circle = π × *r*2

The diameter of each of these two circles is 8 cm so the radius of each circle is 4 cm.

Area of circle = π × *r*2

= 3,142 × (4 cm)2

= 50,272 cm 2

When we unfold the cylinder into a net, we ‘roll’ out the circles to get the length of the rectangle. Do you remember that this length around the circle is called the circumference?

The circumference of a circle is calculated by:

Circumference of circle = π × diameter

=3,142 × 8 cm

= 25,136 cm

So the length of the rectangle is 25,136 cm. The width of the rectangle is equal to the height of the cylinder which is 13 cm. So the area of the rectangle is:

Area of rectangle = **length × width**

= 25,136 cm × 13 cm

= 326,768 cm2

Total surface area of the cylinder:

Area of circle + Area of circle + Area of rectangle

= 50,272 + 50,272 + 326,768

= 427,312 cm 2  » 427 cm

Hence the formula to calculate the surface area of a cylinder is given by:

**SA = 2π × *r*2 + 2π × *r* × *h,*** where π = 3,142; r = radius and h = height

**Surface area of a triangular prism –** A triangular prism is made up of three rectangular sides, and two triangular faces.

|  |  |
| --- | --- |
| http://www.teacherschoice.com.au/maths_library/area%20and%20sa/area_98.gif  S1  S2  S3  S1  S2  S3  H | TriangularPrismNet |

The area of a rectangle = length × width, in this case we can say side × height, so the

Area rectangular side of the prism = (Side 1 + side 2 + side 3) × height

The area of a triangle = base × perpendicular height, but the triangular prism has a floor and a roof. Hence there are two triangles:

To summarise:

Area of a triangular prism = base × perpendicular height +(Side 1 + side 2 + side 3) × height

Volumes of right prisms **(cube, rectangular and triangular) and right cylinders using given formulae**

Volume is a measure of how much space an object takes up (the capacity of a container).

**Example:**

|  |  |
| --- | --- |
| In the **cube** on the right, the volume is 3×3×3 or 27. If you count the small cubes you will find there are 27 of them. The volume of solid objects is measured in cubic units. For example in the cube alongside, if the sides are 3 meters long,then the volume is 27 cubic meters (27 m3).  http://www.mathopenref.com/volume.html | http://www.mathopenref.com/images/volume/democube.gif |

In general the volume of any cube can be found as follows:

**Volume of cube = side × side × side = (side)3**

The table below shows the formula for the surface area and volume of some right prisms.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **PRISM** | | **SURFACE AREA (SA)** | | **VOLUME (V)** |
| **Triangular prism**  http://www.teacherschoice.com.au/maths_library/area%20and%20sa/area_98.gif  ***h***  ***b*** | | **SA= *b × h* + ( s1+s2+s3) × *H*** | | **V = *b* ×*h* × *H*** |
| **Cube prism**  ***s***  ***s***  ***s*** | | **SA = 6 *× s* × *s*** | | **V = s3**  OR  **V = s × s × s** |
| **Rectangular prism**  ***ℓ***  ***b***  ***h*** | **SA = 2*ℓ*× *b*+2*ℓ*× *h* +2*b*× *h***  OR  **SA = 2(*ℓ*× *b*+*ℓ*× *h* +*b*× *h*)** | | **V = *ℓ* × *b*× *h*** | |
| **Cylinder**  ***r***  ***h*** | **SA = 2π × *r*2 + 2π × *r*× *h***  OR  **SA = 2π *r* (*r*+ *h*)** | | **V = π × *r*2× *h*** | |

The most important thing to remember when calculating perimeter, area, surface area and volume is that: ***All the dimensions must be in the same units***.

In the examination questions may also be set on combinations of shapes.

**Illustrative examples**

**Example:** Calculate the surface area and volume of each of the following prisms:

1. A triangular prism with a base = 7 m , perpendicular height = 1,86 m, the other two sides of length 3 m and 5 m, and with H = 6 m.
2. a square with side length equal to 8 m and a height of 3,5 m
3. a rectangle with length of 1 m, and a breadth of 45 cm and a height of 70 cm.
4. a cylinder with a radius of 45 cm and a height of 30 cm

**Answers:**

Step 1: write down the formula.

Step 2: Substitute the measurements of the given sides

Step 3: multiply

Step 4: Write your answer to two decimal places.

1. SA = *b × h* + ( s1+s2+s3)× *H*

= 7 m *×* 1,86 m + (7 m + 3 m + 5 m) × 6 m = 103,02 m2

V = *b* ×*h* ×H= ×7 m ×1,86 m ×6 m= 39,06 m3

1. SA = 6 *× s* × *s*

= 6 *×* 8 m *×* 8 m = 384m2

V = *s* × *s*× h = 8m × 8 m × 3,5 m = 224 m3

1. First convert all the measurements to the same unit. Length = 1 m = 100 cm

SA = 2*ℓ* × *b* + 2*ℓ* × *h* +2*b*× *h*

= 2× 100 cm *×* 45cm + 2 × 100 cm *×*70cm +2 × 45 cm *×* 70cm

= 29 300 cm2  = 2,93 m2

V = *ℓ* × *b*× h=100 cm *×* 45cm*×*70cm = 315 000 cm3  = 0,315 m3

1. SA= 2π *r* (*r*+ *h*)

= 2*×* 3,14*×*45 cm(45 cm + 30cm) = 21 195 cm2

V = π × *r*2× *h*= 2*×* 3,14× (45 cm)2 ×30 cm = 381 510 cm3

**Check validity of measurements in solutions against the contexts in terms of suitability and degree of accuracy.**

Always reflect on the answer and check that the unit of the answer is in line with the problem.

## Applications of measurement in real-life problem solving

Real life calculations based on measurement are an integral part of our life. If we want to paint of house or tile our floors we need to know how much it would cost, the amount of material we need to buy and all of these require some form of measurement.

The activities below are examples of measurement in real life.

**Worked Example 1**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1.1 Petru makes craft products that she sells at a craft market. She makes gift stockings (gift bags shaped like a sock) decorated with triangular shapes, as shown below. She sews three triangles onto each side of the stocking. | | |  |  |
| **Photograph of a gift stocking**  [Image result for christmas gift stockings  dots and triangles](http://www.google.co.za/imgres?imgurl=http://3.bp.blogspot.com/-JlFoGxqolnY/TsVaFwfg3vI/AAAAAAAAF-k/vXeCwlIi6kA/s1600/blue+with+button+trees.JPG&imgrefurl=http://www.shinyhappyworld.com/2011/11/free-stocking-pattern-free-ornament-pattern-fun-handmade-goodness.html&h=1000&w=1000&tbnid=199zveElOK586M:&zoom=1&docid=1RwG1g8fDVPQhM&ei=fpBEVZqeBqu07gb6iYGQAQ&tbm=isch&ved=0CAoQMygCMAI4hAc) | **Dimensions of the triangular pieces of fabric**  5 cm  3 cm | **Dimensions of a rectangular piece of fabric required for one side of a stocking**    30 cm  12 cm |  |  |

[www.marthastewart.com]

|  |  |  |  |
| --- | --- | --- | --- |
| 1.1.1 | | The area of one side of a stocking (without the triangular pieces) is 355,25 cm².  Calculate the area of the fabric that is left over if Petru cuts one complete stocking from two rectangular pieces of fabric.  You may use the following formula: **Area of rectangle = l × w** | |
| 1.1.2 | Calculate the total area of the triangular shapes needed to decorate one stocking.  You may use the following formula: **Area of triangle = × b × H** | |
| 1.1.3 | It takes Petru 18 minutes to cut, decorate and hand-stitch one stocking.  Determine at what time she will finish making NINE stockings if she starts at 08:25. | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1.2 | Petru buys rectangular boxes with reels of thread for stitching the stockings. The radius of a cylindrical reel is 11,5 mm.   |  |  |  | | --- | --- | --- | | **Reels of thread**  http://ecx.images-amazon.com/images/I/51bbCU6XdML.jpg | **A box with reels**  **of thread** | **Top view showing**  **dimensions of the box**  195 mm  120 mm |   Determine the maximum number of reels of thread that will fit exactly into a rectangular box that is 120 mm wide and 195 mm long. Show all calculations. | |
| 1.3 | Below is a photograph of a glass ornament that Petru makes using 250 mℓ cylindrical glass jars.   |  |  | | --- | --- | | **Picture of a glass ornament** | **250 mℓ cylindrical glass jar** | | T:\DRAFTS\Maths Lit P1\21728_lg1_resized[1].jpeg  Glass jar turned upside down  **` ` ` …**  **` ` ` …**  **` ` ` …**  Lid  Figure  Glitter  **` ` ` …**  [www.marthastewart.com] | Height  **Lid of the glass jar**  h  72 mm |   The inside radius of the glass jar is 3,25 cm.  The outside diameter of the lid of the jar is 72 mm and the height (h) is 9 mm.  The exterior surface of the lid is painted red.  The jar is filled 75% with water and a pinch of glitter is added to the water. A dash of glycerine is also added to keep the glitter from sinking too quickly.  The figure is glued to the inside of the lid before the lid is placed on the jar. The jar is then turned upside down. |
| 1.3.1 | Calculate (to the nearest cm²) the exterior surface area of the lid that needs to be painted.  You may use the following formula:  **Painted exterior surface area of lid=**  Where  **= 3,142**; **r** is the radius and **h** is the height of the lid. |

|  |  |  |
| --- | --- | --- |
| 1.3.2 | | Determine (to the nearest cm) the height of the water in the jar before the lid is placed on the jar.  You may use the following formula:  **Height of the water in the jar =**  1 cm³ = 1mℓ |
| 1.3.3 | | Use the conversions below to answer the following questions.   |  | | --- | | 1 pinch = teaspoon | | 2 pinches = 1dash | | 1 teaspoon = 5 mℓ | |
|  | Determine what fraction of a teaspoon equals one dash. | |

Answers:

|  |  |
| --- | --- |
| 1.1.1 | Total area of a rectangular piece = 30 cm × 12 cm = 360 cm²  Off-cut piece = 360 cm² – 355,25 cm² = 4,75 cm²  Total off-cut piece for both sides = 4,75 cm² × 2 = 9,5 cm² |
| 1.1.2 | Area of a triangle = × 3 cm × 5 cm  = 7,5 cm²  Area of 6 triangles = 7,5 cm²× 6  = 45 cm² |
| 2.1.3 | Time taken = 9× 18 minutes  = 162 minutes  = 2h 42 min  Finishing time = 08:25 + 2h42  = 11:07 |
| 1.2 | Number of reels along length = 195 mm ÷ 23mm  = 8,4782…  8  Number of reels along breadth = 120 mm ÷ 23mm  = 5,2173…  5  Total = 5 × 8 = 40 |
| 1.3.1 | Painted surface area of the lid = 3,142 × 3,6 cm(3,6 + 2 × 0,9) cm  ≈ 61 cm² |
| 1.3.2 | Capacity = 75% × 250 mℓ  = 187,5 mℓ  Volume = 187,5 cm³  Height of the water in the jar =    =  = 5,6497… cm 6 cm |
| 1.3.3 | 2 ×= |

**Activity 1**

Calculate a) the surface area and b) the volume of the following 3-D

shapes.

1.1 1.2

18

,5 cm

12

cm

,

5

8

m

m

8

,

5

m

m

,5

8

m

m

**Reflection:**  Are the units the same? Can you identify the shape? In 1.1 we have a cylinder and in 1.2 a cube.

Next write down the correct formula. Substitute into the formula an d use your calculator to determine the solution.

**[Solution on Page 18]**

**Activity 2**

1. Calculate the volume and surface area of a tissue box with dimensions 22 cm long, 110 mm wide and 80 mm high.
2. Calculate the surface areas (in cm2) of the rectangular seat cushions if the

dimensions are: length 65 cm, width 60 cm and thickness (depth) 50 mm.

|  |  |
| --- | --- |
|  |  |

**Reflection:**  Can you identify the shape of the tissue box and cushion? Are they the same shape? [In this case they are both rectangular prisms – hence have a length, a width and a height]

Next write down the correct formula. Substitute into the formula and use your calculator to determine the solution.

**[Solution on Page 18]**

**Activity 3**

|  |  |
| --- | --- |
| As a result of load shedding, Wayne, a chicken farmer, goes back to using a generator to provide dependable power for his chicken sheds and his farmhouse.  He buys a second-hand diesel tank with a radius of 1 m and a length of 2 m to store the fuel for the generator.  He decides to paint both the outside surface area of the tank and the stand on which it rests. The surface area of the stand is 1 m2. It takes 1  paint to paint 3 m2 of the surface area. |  |

1. Calculate the surface area (SA) of the tank in m2. Use the formula:

**SA = 2*****r*2 + 2**, where ***r*** = radius, ***h*** = height and use **=** 3,142

1. Calculate the quantity of paint (in litres) needed to paint both the outside of the tank and the stand. Round off your answer to the nearest litre.
2. If a 1  tin of paint costs R23,63 and a 5  tin of paint costs R113,15, calculate the most economical way to purchase the amount of paint needed in QUESTION 2.
3. Calculate the capacity (volume) of the diesel tank in litres where 1 m3 = 1 000 .

Use the formula: **V = *r*2*h*,** where ***r*** = radius, ***h*** = height and use **** = 3,142

**[Solution on Page 19]**

**Activity 4**

A foreign tourist visits Durban and he buys traditional Zulu-styled clothing outfits. He needs to buy a suitcase for these extra goods. The luggage shop has two suitcase to choose from, with the following dimensions:

NOTE: The clothing outfits have a volume of 9 655 cm³ and cam be folded and roll to fit in a tight space without gaps.

|  |  |  |
| --- | --- | --- |
| **Dimensions** | **SUITCASE A** | **SUITCASE B** |
| Length of the base | 34,5 cm | 61 cm |
| Width of the base | 22,5 cm | 30 cm |
| Height of the base | 12,5 cm | 12,5 cm |

1. Use the formula: **Volume = Length × Width × Height**, to calculate the volume of suitcase A and suitcase B.
2. Which of the two do you think he should buy? Give a reason.

**[Solution on Page 19]**

**Activity 5**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 5.1 | The Umgababa Men's Society is responsible for raising funds to take the mothers in the community on an outing on Mothers' Day. They decide to make chocolates and sell them to the community. They use a special chocolate recipe to make either round or triangular shaped chocolates. The price of each chocolate is determined by the volume of the chocolate. The chocolates are covered with foil wrapping.  The diagrams below show the dimensions of the two different shapes of chocolate.   |  |  | | --- | --- | | **ROUND CHOCOLATES**  **(CYLINDER)** | **TRIANGULAR CHOCOLATES**  **(TRIANGULAR PRISM)** | | Radius of the cylinder = 18,5 mm  Height of the cylinder = 10 mm | http://t0.gstatic.com/images?q=tbn:ANd9GcSvNk6R2aEFwzazxD5068cul3oyY_RpSTusMwcI-54jxfcdZOBT03tqWEVXAw  **The triangle has three equal sides.**  Each side of the triangle = 50 mm  Height of the triangle = 43,3 mm  Height of the prism = 10 mm | |  |  |
|  | The following formulae may be used:  **Volume of a cylinder =   r2  h**  **Total surface area of a cylinder = 2   r  (r + h)**,  where **=** 3,14; **r** = radius of the cylinder and **h** = height of the cylinder.  **Volume of a triangular prism =  s h  H**  **Total surface area of a triangular prism = (sh) + 3(sH)**,  where **s** = side of triangle, **h** = height of triangle and **H**  = height of prism |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
|  | Calculate the following: |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 5.1.1 | Volume of a round chocolate |  | (3) |
|  | 5.1.2 | Volume of a triangular chocolate |  | (3) |
|  | 5.1.3 | Total surface area of a round chocolate |  | (4) |
|  | 5.1.4 | Total surface area of a triangular chocolate |  | (3) |

|  |  |  |  |
| --- | --- | --- | --- |
| 5.2 | The foil wrapping used to cover the chocolates comes in rectangular sheets only. The sheets of silver and red foil are the same size, while the gold foil is a different size.   * A single sheet of silver or red foil can cover 6 round chocolates and 4 triangular chocolates. * A single sheet of gold foil can cover 12 triangular chocolates. * The gold foil will be used to wrap only triangular chocolates.   There are 7 sheets of silver foil, 5 sheets of red foil and 10 sheets of gold foil available to wrap the chocolates.  They use the formulae below to calculate the number of round and triangular chocolates that can be wrapped with the foil.  **Total number of round chocolates = 6  (r + s)**  **Total number of triangular chocolates = 4  (r + s) + (12  g)**  where: **r**  = number of sheets of red foil  **s** = number of sheets of silver foil  **g** = number of sheets of gold foil |  |  |

|  |  |  |  |
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|  | Calculate the total number of: |  |  |

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| --- | --- | --- | --- | --- |
|  | 5.2.1 | Chocolates that will be wrapped in gold foil |  | (2) |
|  | 5.2.2 | Round chocolates that will be wrapped |  | (3) |
|  | 5.2.3 | Triangular chocolates that will be wrapped |  | (3) |

**[Solution on Page 20]**

**SUMMARY ASSESSMENT**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | Tina is a livestock and vegetable farmer. She added a new rectangular butternut field to her existing rectangular vegetable fields by extending the length of her existing field by 33 m. The existing vegetable fields are enclosed with a fence with a gate. The fence is necessary to keep out livestock and to provide security.  The farm and vegetable field layout plans are shown below. | | | | | | | |  | |  |
|  | **Layout of Tina's farm showing the existing and new vegetable fields** | | | | | | **Detailed layout of the existing**  **fenced vegetable fields and**  **the new vegetable field** | |  | |  |
|  | existing fence  New butternut field  Existing vegetable field  125 m  95 m  33 m  gate  **New butternut field**  Existing fence  New fence  new fence | | | | | | [Source: www.kcfresh.wordpress.com] | |  | |  |
|  | | | 1.1 | | Use the layout plans to determine the number of vegetable fields Tina will now have on her farm. | | |  | | (2) | |
|  | | | 1.2 | | Tina has to fence in the new field. She will have to buy additional poles and wire for the fencing. To save on costs she will also use her existing wire fence and gate to erect the new fence.  Calculate: | | |  | |  | |
|  | | |  | (a) | | The length of wire fencing (sold in 5 m rolls only) she needs to buy so that the new butternut field is also enclosed | |  | | (3) | |
|  | |  | | (b) | | The number of additional poles she needs to buy if the poles are planted 1,5 m apart | |  | | (3) | |
|  | | | 1.3 | | Write down the ratio of the total length of the existing vegetable fields to the total length of the new extended vegetable fields. | | |  | | (2) | |
|  | | 1.4 | | Calculate the total area of Tina's new extended vegetable fields.  You may use the following formula: **Area of a rectangle = length width** | | | |  | | (3) | |

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| 2 | | Tina investigates the possibility of installing a cylindrical water storage tank on her farm. This will allow her to store rainwater for use during the dry seasons. She found the following data about water tanks on the Internet. | **Cylindrical water storage tank** |  |  |
|  | | |  |  |  | | --- | --- | --- | | **WATER STORAGE TANKS** | | | | **Volume\***  **ℓ** | **Diameter**  **mm** | **Height**  **mm** | | 1 000 | 1 100 | 1 300 | | 1 500 | 1 150 | 1 700 | | 2 000 | 1 200 | 1 900 | | 2 500 | 1 450 | 1 700 | | 5 000 | 1 840 | 2 000 | | 5 500 | 1 800 | 2 300 | | 10 000 | 2 200 | 3 000 | | \* **Approximate values** | | |   **1 m**3 **= 1 000 ℓ** | |  |  |
|  |  | **NOTE:** The actual volume of the tanks is generally greater than the listed volume.  [Source: [www.capewatersolutions.co.za](http://www.capewatersolutions.co.za)] | |  |  |

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|  | 2.1 | Convert the diameter of a 10 000 ℓ tank to metres. |  | (2) |

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| --- | --- | --- | --- | --- |
|  | 2.2 | If the height of the cylindrical section of the 10 000 ℓ tank is 3 m, calculate the actual volume (in litres) of the tank.  You may use the following formula:  **Volume of a cylinder =** ,where = 3,142 |  | (5) |

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| 3 | Tina has a greenhouse in which she grows strawberries. The sprinkler system in the greenhouse sprays a fine mist to ensure the strawberries get enough water. The strawberries are watered for a total of 2 hours and 45 minutes every day and the temperature in the greenhouse is kept constant at 25 °C.  The clock below shows the time each morning when the sprinkler system is switched off. |  |  |
|  | http://images.hayneedle.com/mgen/master:HMI231.jpg |  |  |

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|  | 3.1 | Determine the time the sprinkler system is switched on. |  | (3) |

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| --- | --- | --- | --- | --- |
|  | 3.2 | The thermometer Tina uses is calibrated in degrees Fahrenheit.  Determine the temperature reading on her thermometer if the required constant temperature of 25 °C has to be maintained.  You may use the following formula:  **Temperature in** |  | (3) |

**[Solution on Page 21]**

**SOLUTIONS OF ACTIVITIES**

**ACTIVITY 1**

* 1. Diameter = 12 cm

Radius = 6 cm

Surface area = 2 × π × (radius)2 + 2 × π × radius × height

= 2 × 3,142 × (6 cm)2 + 2 × 3,142 × 6 cm × 18,5 cm

= 226,224 cm2 + 697,524 cm2

= 923,748 cm2

Volume = π × (radius)2 × height

= 3,142 × (6 cm)2 × 18,5 cm

= 2 092,572 cm3

* 1. Surface area = 6 × (side)2

= 6 × (8,5 mm)2

= 433,5 mm2

Volume = (side)3

= (8,5 mm)3

= 614,125 mm3

**ACTIVITY 2**

1. Length = 22 cm; width = 110 mm = 11 cm; height = 80 mm = 8 cm

Volume = length × width × height

= 22 cm × 11 cm × 8 cm

= 1 936 cm3

Surface area = 2 × (length × width + length × height + width × height)

= 2 × (22 cm × 11 cm + 22 cm × 8 cm + 11 cm × 8 cm)

= 2 × (242 cm2 + 176 cm2 + 88 cm2)

= 2 × (506 cm2)

= 1 012 cm2

1. Height = thickness = 50 mm = 5 cm

Surface area = 2 × (length × width + length × height + width × height)

= 2 × (65 cm × 60 cm + 65 cm × 5 cm + 60 cm × 5 cm)

= 2 × (3 900 cm2 + 325 cm2 + 300 cm2)

= 2 × (4 550 cm2)

= 9 100 cm2

**ACTIVITY 3**

1 Radius = 1 m; Height = 2 m

Surface area = 2 × π × (radius)2 + 2 × π × radius × height

= 2 × 3,142 × (1 m)2 + 2 × 3,142 × 1 m × 2 m

= 6,282 m2 + 12,568 m2

= 18,85 m2

2 Total surface area = 18,85 m2 + 1 m2

=19,85 m2

3 Number of litres of paint = 19,85 ÷ 3

= 6,6167 ℓ

He needs to buy 7ℓ paint

Hence he must buy 1 X 5ℓ and 2 X 1ℓ paint which would cost:

R113,15 + 2 × R23,63 = R160,41

Note: If he bought 2 X 5ℓ it would cost R 226,30 and if he bought 7 X 1ℓ It would cost R165,41

4 Volume = π × (radius)2 × height

= 3,142 × (1 m)2 × 2 m

= 6, 284 m3

= 6 284 ℓ

**ACTIVITY 4**

1. Case A: Length = 34,5 cm; width = 22,5 cm; height = 12,5 cm

Volume = length × width × height

= 34,5 cm × 22,5 cm × 12,5 cm

= 9 703,125 cm3

Case B: Length = 61 cm; width = 30 cm; height = 12,5 cm

Volume = length × width × height

= 61 cm × 30 cm × 12,5 cm

= 22 875 cm3

1. He should use case A if that is the only things he is packing

**ACTIVITY 5**

|  |
| --- |
| 5.1.1 Volume = 3,14  (18,5 mm)  10 mm  = 10 746,65 mm |
| 5.1.2 Volume =  50 mm  43,3 mm  10 mm = 10 825 mm |
| 5.1.3 Total surface area of cylinder  = 2  3,14  18,5 mm  (18,5 mm + 10 mm)  = 2  3,14  18,5 mm  28,5 mm  = 3 311,13 mm2 |
| 5.1.4 Total surface area of triangular prism  = (50 mm  43,3 mm) + (3  50 mm  10 mm)  = 2 165 mm + 1 500 mm  = 3 665 mm |
| 5.2.1 1 sheet of gold foil wraps 12 chocolate  10 sheets wraps 120 chocolates |
| 5.2.2 Number of round chocolates = 6  (5 + 7)  = 72 |
| 5.2.3 Number of triangular chocolates = 4  (5 + 7) + (1210)  = 168 |

**SUMMARY ASSESSMENT SOLUTIONS**

|  |  |
| --- | --- |
| 1.1 | 7 |
| 1.2 (a) | Length of fencing = 33 m + 33 m = 66 m  Total length to buy = 70 m |
| 1.2 (b) | No of poles = 66 m ÷ 1,5 m = 44 poles |
| 1.3 | New length = 125 m + 33 m  = 158 m  Length of old field : Length of extended field  125 : 158 |
| 1.4 | Area = 158 m × 95 m  = 15 010 m |
| 2.1 | Diameter = 2 200 mm ÷ 1 000 = 2,2 m |
| 2.2 | Radius = 1,1 m  Volume = 3,142 × 1,1× 3  = 11,40546 m  = 11,40546 m3 × 1 000 m3/ℓ  = 11 405,46 litres |
| 3.1 | Time = 11:56  Time it switched on = 11h56 – 2h45  = 09h11  Time it switched on = 09:11 |
| 3.2 | Temperature in  =  +  = |