

A Guide to Using Measurement

Teaching Approach

The series on measurement consists of six video lessons and covers various aspects involved in measuring quantities of various kinds. The work covered in this section has application in many of the other sections of Maths Literacy. It should be taught over four to five weeks but has ongoing application throughout the rest of the year.

In general this section makes use of various formulae, which are usually given to the learners in an exam question. It also relies on understanding the use of various units of measurement and being able to make conversions from one unit to another.

In the Grade 11 year, there is opportunity for consolidation of the basics, but the questions start combining concepts and requiring the learner to synthesise answers through use of work already covered.

Use real examples in your classroom, that learners can relate to. Show video clips of vehicles traveling at different speeds, and use them to calculate the speed. Do experiments with water and volume calculations to show how cm^3 can be converted to litres. Show learners how to calculate their body mass index and explain the implications of having a high body mass index. Most of all, have fun with this section.

Video Summaries

Some videos have a 'PAUSE' moment, at which point the teacher or learner can choose to pause the video and try to answer the question posed or calculate the answer to the problem under discussion. Once the video starts again, the answer to the question or the right answer to the calculation is given.

Mindset suggests a number of ways to use the video lessons. These include:

- Watch or show a lesson as an introduction to a lesson
- Watch or show a lesson after a lesson, as a summary or as a way of adding in some interesting real-life applications or practical aspects
- Design a worksheet or set of questions about one video lesson. Then ask learners to watch a video related to the lesson and to complete the worksheet or questions, either in groups or individually
- Worksheets and questions based on video lessons can be used as short assessments or exercises
- Ask learners to watch a particular video lesson for homework (in the school library or on the website, depending on how the material is available) as preparation for the next days lesson; if desired, learners can be given specific questions to answer in preparation for the next day's lesson

1. Working with Length

This video introduces the idea of "rule of thumb" measurements and also explores some measurement of length and area.

2. Calculating Speed

Learners are introduced to the measurement of speed, time and distance and the units of kilometres per hour and metres per second. The method of calculating the cost of fuel for a trip is also shown.

3. Calculating Volume

This video focuses on the measurement and calculation of volume, using various shapes. The concept of multiplying an area by a length is introduced and substitution into a formula is shown as methods of calculating volumes of shapes.

4. Working with Mass

The measurement of mass is dealt with in this instalment and the conversion of grams to kilograms and tons is shown. The idea of price per kilogram is introduced as well as the concept of dosage for certain mass ranges.

5. Calculating Body Mass Index

This session expands on the ideas of mass measurement and relates mass to a concept called the Body Mass Index (BMI). The video introduces the formula and explains the meaning of numbers obtained from the formula.

6. Working with Temperature

The measurement of temperature is dealt with in this video and the Fahrenheit and Celsius scale are linked via formulae. Examples are done to demonstrate how the formulae are used to convert from one scale to the other.

Resource Material

Resource materials are a list of links available to teachers and learners to enhance their experience of the subject matter. They are not necessarily CAPS aligned and need to be used with discretion.

1. Measuring Length and Area and the “Rule of Thumb”	www.mathsexcellence.co.za	This is a brilliant website that includes many teaching sections as well as past papers. It even has a textbook for download and it's all free.
	http://www.mathsisfun.com/measure/	Measurement index.
	http://www.vendian.org/mncharity/dir3/bodyruler_angle/	Thumb as measurement device.
	http://en.wikipedia.org/wiki/Rule_of_thumb	An encyclopaedia article on rule of thumb.
2. Speed, Time and Distance	http://www.bbc.co.uk/bitesize/standard/maths_i/numbers/dst/revision/1/	Measuring speed, distance and time.
3. Measurements of Volume	http://en.wikipedia.org/wiki/Volume	An encyclopaedia article on volume.
	http://dl.clackamas.cc.or.us/ch104-02/volume_meas.htm	Volume measurements
	http://www.calculator.net/volume-calculator.html	Volume calculator
4. Measurements involving Mass	http://www.mathsisfun.com/measure/metric-mass.html	Mass measurements
	http://www.slideshare.net/joeltoh/measurements-mass	A slideshow on mass measurement.
5. Measuring the Body Mass Index	http://www.nhlbi.nih.gov/guidelines/obesity/BMI/bmicalc.htm	BMI calculator
	http://en.wikipedia.org/wiki/Body_mass_index	An encyclopaedia article on body mass index.
6. The Conversion of Temperature	http://ostermiller.org/calc/temperature.html	Temperature conversion

Task

Question 1

A learner used a trundle wheel to measure the length and breadth of the school field. The wheel has a diameter of 40cm. The wheel makes 100 revolutions for the length of the field and 50 revolutions for the breadth. Calculate the length and breadth of the field and round off the answers to the nearest metre.

Question 2

Two cars drive to Durban. The one car averages 105km/h while the other car averages 90km/h. What is the time difference between their journeys if the distance to Durban is 590km? Remember that $s = dt$

Question 3

Thabo needs to paint a wall and is unsure of how much paint he needs for the wall. He measured the length of the wall using a “rule of thumb” method by taking the distance from the tip of his fingers to his shoulder. The wall length was 5 of these units in length. He also estimated the height of the wall to be about 2m. The lady at the hardware store told Thabo that a 2 litre tin of paint will cover about 3m^2 wall surface.

- 3.1 How many 2 litre tins must Thabo buy?
- 3.2 What is the cost of the paint if a 2 litre tin costs R54,00?

Question 4

Koketso is going on holiday to Switzerland in December. She discovered that the average daytime temperature is 48°F and the nights can get as cold as 15°F . She is unsure of what type of clothing to pack and needs to convert these temperatures to degrees Celsius to be able to understand what the temperatures are like.

- 4.1 Using the formula $C = (F - 32) \frac{5}{9}$ calculate the average daytime temperature and night time temperature in degrees Celsius.
- 4.2 Make a suggestion to Koketso about what type of clothing she should take with her on holiday.

Question 5

The Smith family decided that they were going on holiday to Cape Town this year. They wanted to work out how long the trip would take them as well as the cost for fuel. They found out that the trip was 1400km to Cape Town and that fuel cost R12,18 per litre. Use $d = st$

- 5.1 How long would the trip take if they average 105km/h and stop for 30 minutes every two hours that they travel?
- 5.2 What would they pay in fuel costs if their vehicle averages 11,2 litres/100km?

Question 6



A swimming pool consists of a rectangle and two half circles. The width of the pool is 5m and the length of the rectangular part is 7m. Calculate the volume of water needed if the pool has a depth of 1,6m throughout.

Question 7

Tamara bought some 1,3kg tomatoes at R12,89/kg and 700g bananas at R7,59/kg. How much did she pay in total for these items?

Question 8

Ismail is 16 years old. He weighs 78kg and is 1,62m in height. Using the formula for Body Mass Index

$$BMI = \frac{mass}{(height)^2}$$

Use this information to suggest if Ismail is underweight, normal, overweight or obese.

$BMI < 17$ – <i>underweight</i>
$17 < BMI < 24$ – <i>normal</i>
$24 < BMI < 30$ – <i>overweight</i>
$BMI > 30$ – <i>obese</i>

Task Answers

Question 1

This question requires the learner to start off by measuring the circumference of the wheel.

$$C = 2\pi r$$

$$\therefore C = 2 \times 3.14 \times 20$$

$$\therefore C = 125.6\text{cm}$$

The circumference gives the distance for 1 revolution. Since the wheel makes 100 revolutions the learner must multiply the answer by one hundred.

$$125.6 \times 100 = 12560\text{cm}$$

The learner must convert this to metres.

$$\frac{12560}{100} = 125.6\text{m}$$

To calculate the breadth the learner should realise that 50 revolutions is half the number for the length and should therefore halve the answer obtained for the length.

$$\frac{125.6}{2} = 62.8\text{m}$$

These round off to length = 126m and breadth = 63m.

Question 2

The learner will need the formula for speed, which is $d = st$. They will have to rearrange the formula to get it in the form $t = d/s$

For each vehicle the time is calculated as follows:

$$\begin{aligned} 1. \quad t &= d/s \\ &= \frac{590}{105} \\ &= 5,6 \text{ hours} \end{aligned}$$

$$\begin{aligned} 2. \quad t &= d/s \\ &= \frac{590}{90} \\ &= 6,6 \text{ hours} \end{aligned}$$

The difference in time is $6,6 - 5,5 = 1$ hour.

Question 3

3.1. The learner will need to make the assumption that the rule of thumb method implies that the distance from the shoulder to the finger tips is 1m. So Thabo measured the wall to be 5m in length.

Next the learner will need to calculate the area of the wall using $A = l \times b$

$$\begin{aligned} A &= l \times b \\ &= 5 \times 2 \\ &= 10\text{m}^2 \end{aligned}$$

Next the learner must calculate how many tins of paint they need. Since one tin cover 3m^2 , and Thabo needs to cover 10m^2

$$\begin{aligned} \text{No of tins} &= \frac{10}{3} \\ &= 3,33 \end{aligned}$$

The learner needs to realise that since they need more than 3 tins and tins only come in whole numbers Thabo will have to purchase 4 tins, so they must round the answer up (not down).

3.2. To calculate the cost, the learner needs to take the number of tins and multiply it by the price of one tin of paint.

$$4 \times 54 = R216$$

Total price is R216.

Question 4

4.1. The learner will need to use the formula and convert both temperatures to Celsius.

$$\begin{aligned} C &= (F - 32) \cdot \frac{5}{9} & C &= (F - 32) \cdot \frac{5}{9} \\ &= (48 - 32) \cdot \frac{5}{9} & &= (15 - 32) \cdot \frac{5}{9} \\ &= 8,9^{\circ}C & &= -9,4^{\circ}C \end{aligned}$$

4.2. The type of clothing that will be needed is thick jackets, scarves and gloves for the cold.

Question 5

5.1. The first part of the question requires the learner to use the formula $d = st$ to calculate the time of the journey. The learner will need to rearrange the formula to do this.

Since the time is needed we use $t = \frac{d}{s}$

$$\begin{aligned} \therefore t &= \frac{1400}{105} \\ &= 13,3 \text{ hours} \end{aligned}$$

Since the family stops every two hours for half an hour we need to take the journey time of 13,3 hours and ask how many groups of 2 hours are there in this time. The answer is there are 6 sets of two hours in 13,3 hours.

$$\frac{13,3}{2} = 6,7$$

The learner must round down in this case as the family do not complete enough time to warrant a 7th stop (that would happen if the trip took 14 hours or up to 16 hours).

6 half hour stops add 3 hours to the journey so the total journey is $13,333 + 3 \text{ hours} = 16,333 \text{ hours}$.

The learner may be asked to convert time in hours to hours and minutes. To do this the learner must take the part of the number after the decimal i.e. 0,333 and multiply it by 60 (to turn the decimal part into seconds).

The answer is $0,333 \times 60 = 20$. Therefore the total journey is 16 hours 20 minutes.

5.2. To calculate the fuel cost the learner needs to find out how many units of 100km the journey takes. They will need to divide 1400 by 100.

$$\frac{1400}{100} = 14$$

For every hundred kilometres they use 11,2 litres of fuel so the total fuel usage is 14 times 11,2

$$14 \times 11,2 = 156,8l$$

Since 1 litre costs R12,19 the learner must multiply 156,8 by 12,19.

$$12,19 \times 156,8 = R1911,39$$

Question 6

This question requires the learner to use two formulas to calculate the area of the pool surface and then to use the area to calculate the volume.

$$\begin{aligned} \text{Area of rectangular part} &= \text{length} \times \text{breadth} \\ &= 5 \times 7 = 35\text{m}^2 \end{aligned}$$

The learner needs to realise that the two halves make a full circle and therefore they will have to calculate the area of a circle. Also to get the radius they need to halve the width of the pool.

$$\begin{aligned} \text{Area of circular part} &= \pi r^2 \\ &= 3,14 \times 2,5 \times 2,5 \\ &= 19,625\text{m}^2 \end{aligned}$$

Add the two parts to get total surface area

$$35 + 19,625 = 54,625\text{m}^2$$

To get the volume the learner must multiply the surface area by the depth.

$$54,625 \times 1,6 = 87,4\text{m}^3$$

The answer has to be converted to litres, so the learner must use the conversion rate of $1\text{m}^3 = 1000\text{l}$.

$$87,4 \times 1000 = 87400$$

So 87400 litres are needed to fill the pool.

Question 7

This question relies on the learner being able to use a price/kg and apply it to a mass as well as doing a conversion from grams to kilograms.

The first step is to take the price of the tomatoes and multiply it to the mass.

$$12,89 \times 1,3 = R16,76$$

For the bananas the learner must convert the 700g to kilograms. To do this they divide 700 by 1000.

$$\frac{700}{1000} = 0,7\text{kg}$$

Then the price needs to be calculated.

$$0,7 \times 7,59 = R5,31$$

Then the two totals must be added together.

$$16,76 + 5,31 = R22,07$$

The total price paid was R22,07

Question 8

The learner will need to use the formula to calculate Ismail's BMI.

$$\begin{aligned} \text{BMI} &= \frac{78}{1,62^2} \\ &= 29,7 \end{aligned}$$

Ismail is overweight and bordering on being considered obese.

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