Available online at www.elixirpublishers.com (Elixir International Journal)

Educational Technology

Elixir Edu. Tech. 47 (2012) 8846-8860

ISSN: 2229-712X

The DTML-conversion model with its mathematical formulas

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ARTICLE INFO

Article history:
Received: 10 April 2012;
Received in revised form:
18 May 2012;
Accepted: 9 June 2012;

Keywords
DTML,
Mathematical,
Conversion factor.

ABSTRACT

Conversion within quantities of same units and between quantities of different units is a thorny subject to students of Jasikan College of Education (Butterfield, Sutherland & Molyneux-Hodgson, 2000) and its treatment by tutors sometimes becomes very difficult such that most tutors resort to handling the subject theoretically/ abstractly. When this happens most students seemed not to comprehend the subject.

In view of this, the DTML-Conversion model (i.e. D-Conversion model, T-Conversion model, M-Conversion model and the L-Conversion model) was designed. The DTML-Conversion Model is a model that has been designed by the researcher to make the teaching of conversion in measurement very easy to tutors and meaningful to students. The DTML-Conversion Model was tested on first year students of Jasikan College of Education.

The researcher tested the DTML-Conversion model on 150 first year students in Jasikan College of Education by first teaching conversion using the traditional method which is the Conversion-factor for distance, time, mass and litre for a period of one month. A test was administered, collected and recorded, after which the DTML-Conversion model was introduced with similar test items. Comparison of the two test results showed that, students seemed to comprehend conversion in measurement with the DTML-Conversion model to the conversion-factor method.

Introduction

The DTML-Conversion Model is a model that has been designed by the researcher to make the teaching of conversion in measurement very easy to tutors and meaningful to students. This employs the use of a straight line divided into equal sections/parts depending on the physical quantity of concern. The three fundamental/basic physical quantities which are used in this model are distance, time and mass coupled with one derived quantity i.e. the Litre (Volume in Fluids).

Conversion within quantities of same units and between quantities of different units is a thorny subject to students (Butterfield, Sutherland & Molyneux-Hodgson, 2000) and its treatment by tutors sometimes becomes very difficult such that tutors resort to handling the subject theoretically/ abstractly. When this happens most students seemed not to comprehend the subject.

In view of this, Trimpe, 2000 & 2008 and http://www.bayhicoach.com designed a metric mania and metric conversion: stair-step method to enable students understands conversion of distance, litre and grams. Trimpe metric mania and the stair-step method even though very similar were good; however, it concentrated on only one dimension distance (i.e. considering distance) and just one aspect of the three dimension distance i.e. litre, while the DTML-Conversion extends from one distance dimension to two distance dimension and three distance dimension (i.e. considering distance in concern) and also each step in the metric mania is in multiples of decimals (i.e. 0.1) when dealing with smaller units of the basic unit and in multiples of ten (i.e. 10) when dealing with higher units also of the basic unit (Appendix A, and Appendix B) and also from http://www.bayhicoach.com that steps in metric system are all in multiples of ten. However, with the DTML-Conversion model, some steps were in multiples of 10 i.e. distance, litre and mass units while that of time unit was in multiples of sixty. All units with the exception of the smallest unit (started with zero) on straight that started with ten steps each or sixty steps each, and also in place of the basic unit for both higher units and smaller as in metric mania and the stair-step have been replaced with the smallest unit and the highest unit on a straight line.

The DTML-Conversion model was designed by the researcher from the premise that learning to convert between units of measurement is critical to learners development in the realm of science and other courses and that having access to a general method would support students' efficiency in conversion (Butterfield, Sutherland & Molyneux-Hodgson, 2000). The focus for designing the DTML-Conversion model was on the role of a general rule for converting and this arose out of a detailed observational study of first year diploma in basic education students of Jasikan College of Education working through their integrated science course on measurement (Molyneux & Sutherland, 1996).

Conversions are an integral part of much scientific practice, for example to allow for ease of data processing, to enable comparison and standardization and to support the understanding of physical quantities and processes (Molyneux and Sutherland, 1996). It is therefore crucial for students to become competent in converting between units.

The researcher having interacted with students' of teacher training college and havong taught for six years in Jasikan College of Education, designed a model (i.e. DTML-Conversion model) that would make the teaching of the subject practical, real and meaningful to both students and tutors in Colleges of Education in Ghana and at any other level. The DTML-Conversion model is much more an improved form of the metric

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mania and the stair-step method (Trimpe, 2008; http://www.bayhicoach.com). The DTML-Conversion model has been tested on first year students of Jasikan College of Education. First year students of the college were used because measurement (Physics) was part of their Integrated Science Syllabus.

This version only presents the conceptual, practical aspects of the DTML-Conversion model coupled with its proven mathematical formulars. The next version of the DTML-Conversion model will present the research findings of the use of the DTML-Conversion model on 2011/2012 first year diploma in basic education (DBE) students of Jasikan College of Education, Ghana.

Research Hypothesis

1. There is no significant statistical deference between the conversion-factor on length (one dimension distance) and the L-Conversion model on length (one dimension distance)
2. There is no significant statistical deference between the conversion-factor on area (two dimension distance) and the A-Conversion model on area (two dimension distance)
3. There is no significant statistical deference between the conversion-factor on volume (three dimension distance) and the V-Conversion model on volume (three dimension distance)
4. There is no significant statistical deference between the conversion-factor on mass and the M-Conversion model on mass
5. There is no significant statistical deference between the conversion factor on time and the T-Conversion model on time.
6. There is no significant statistical deference between the conversion factor on litre and the L-Conversion model on litre.

The conceptual and practical bases of the dtm-conversion model

The Distance-Conversion Model

The distance-Conversion Model (D-Conversion Model) has three parts, which are one dimension distance (the Length-Conversion Model), two dimension distance (the Area-Conversion Model) and three dimension distance (the Volume-Conversion Model).

A straight line is divided into six equal parts. The distance between each part is ten (10), hundred (100) and thousand (1000) depending on one's dimension.

Figure 1: The division of the straight line into equal parts of 10, 100 and 1000.

Figure 1a

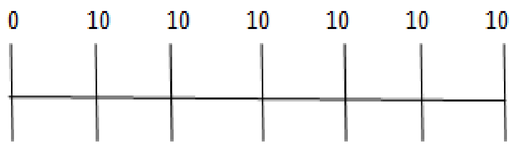


Figure 1b

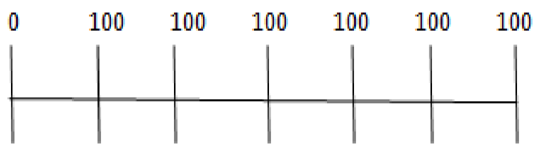
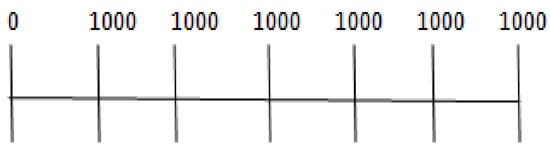


Figure 1c



The straight lines are labelled (mm, mm^2, mm^3), (cm, cm^2, cm^3), (dm, dm^2, dm^3), (m, m^2, m^3), (Dm, Dm^2, Dm^3), (Hm, Hm^2, Hm^3) and (Km, Km^2, Km^3).

mm = millimeter mm^2 = square millimeter
mm^3= cubic millimetre
cm = centimetre cm^2 = square centimetre
cm^3 = cubic centimetre
dm = decimetre dm^2 = square decimetre
dm^3 = cubic decimetre
m = metre m^2 = square metre
m = cubic metre
Dm = decametre Dm^2 = square decametre
Dm^3 = cubic decametre
Hm = hectometre Hm^2 = square hectometre
Hm^3 = cubic hectometre
Km = kilometre Km^2 = square kilometre
Km^3 = cubic kilometre

Figure 2: The Transformation of Figure-1 into Complete One, Two and Three Dimensions Distance-Conversion Model

Figure 2a

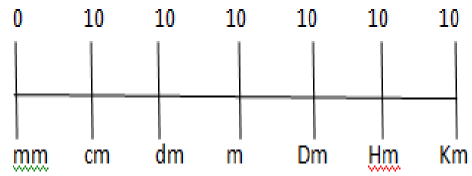


Figure 2b

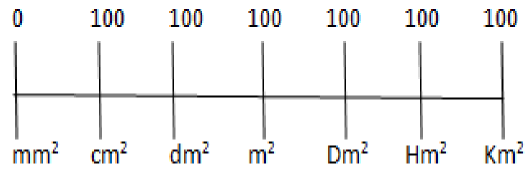
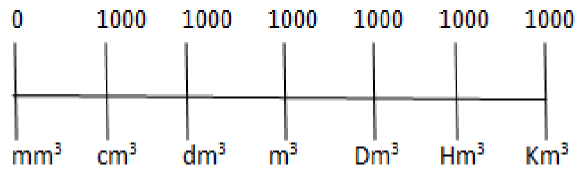


Figure 2c



The distance-conversion model has three dimensions (i.e. One Dimension Distance, Two Dimension Distance (Area) and Three Dimension Distance (Volume)). Each dimension of distance has six steps / movements.

One Dimension Distance (The Length (L)-Conversion Model)

This only looks at a one space with no common meeting point between two objects i.e. mm to cm, cm to dm, dm to m, m to Dm, Dm to Hm and Hm to Km. from figure 1, the straight line has been divided into 10 equal distances starting from mm to Km. This meant that 10 steps of mm will give 1 step of cm and it follows through to Km.

NB: when dealing with conversion, then one must be in the realms of multiplication (i.e. movement from the least unit to the maximum unit) and division (i.e. movement from the maximum unit to the least unit). With this straight line on distance, the least unit is the millimetre (mm) and the maximum unit is the kilometre (Km)

Figure 3

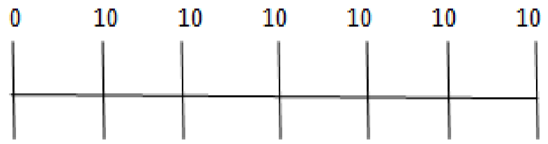


Figure 4: Complete labelled One Dimension Distance-Conversion Model

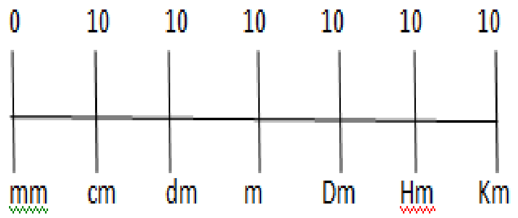
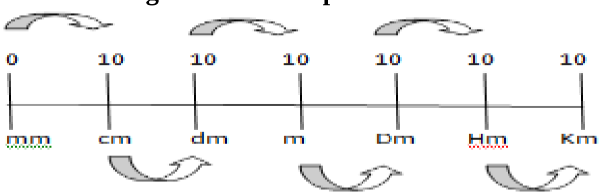


Figure 5: One Step/ Movement



In figure 5, one step was made starting from mm to the right i.e. the step from mm to cm. since moving from the least unit to the maximum unit deals with multiplication, it then implies that the first movement from mm to cm is 10 and the second movement from cm to dm is also 10, thus $10=10^1=10$ (i.e. 10mm = 1cm)

Step One / Movement One

$10(1\times10^1)$ mm = 1cm

$10(1\times10^1)$ cm = 1dm

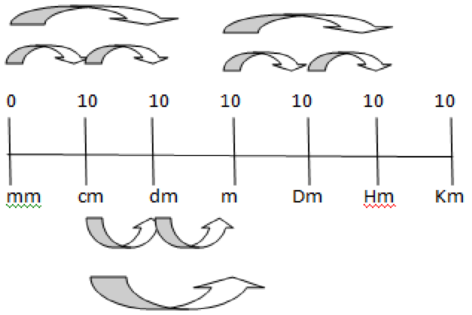
$10(1\times10^1)$ dm= 1m

$10(1\times10^1)$ m = 1Dm

$10(1\times10^1)$ Dm = 1Hm

$10(1\times10^1)$ Hm= 1Km

Figure 6: Two Steps/ Movements



In figure 6, two steps were made starting from mm to the right i.e. the first step from mm to cm and from cm to dm. since moving from the least unit to the maximum unit deals with multiplication, it then implies that the first movement from mm to cm is 10 and the second movement from cm to dm is also 10, thus $10\times10=10^2=100$ (i.e. 100mm = 1dm).

Step Two/ Movement Two

$100(1\times10^2)$ mm =1dm

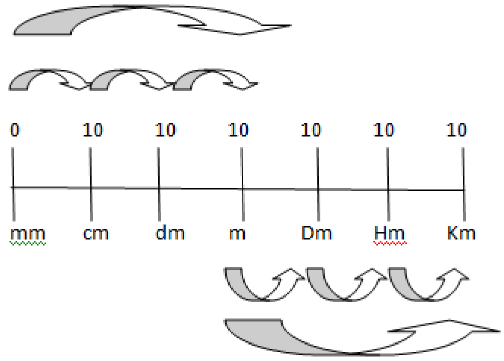
$100(1\times10^2)$ cm = 1m

$100(1\times10^2)$ dm = 1Dm

$100(1\times10^2)$ m = 1Hm

$100(1\times10^2)$ Dm= 1Km

Figure 7: Three Steps/ Movements



In figure 7, three steps were made starting from mm to the right i.e. the first step from mm to cm, cm to dm and from dm to m. since moving from the least unit to the maximum unit deals with multiplication, it then implies that the first movement from mm to cm is 10, the second movement from cm to dm is 10 and the last step from dm to m is also 10, thus $10\times10\times10=10^3=1000$ (i.e. 1000mm = 1m).

Step Three/ Movement Three

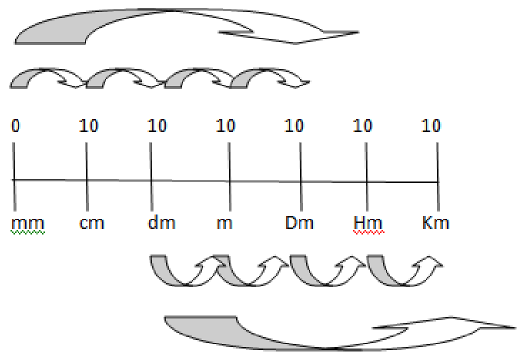
$1000(1\times10^3)$ mm = 1m

$1000(1\times10^3)$ cm = 1Dm

$1000(1\times10^3)$ dm = 1Hm

$1000(1\times10^3)$ m = 1Km

Figure 8: Four Steps/ Movements



In figure 8, four steps were made starting from mm to the right i.e. the first step from mm to cm, cm to dm, dm to m and from m to Dm. since moving from the least unit to the maximum unit deals with multiplication, it then implies that the first movement from mm to cm is 10, the second movement from cm to dm is 10, the third movement from dm to m is 10 and the last step from m to Dm is also 10, thus $10\times10\times10\times10=10^4=10000$ (i.e. 10000mm = 1Dm).

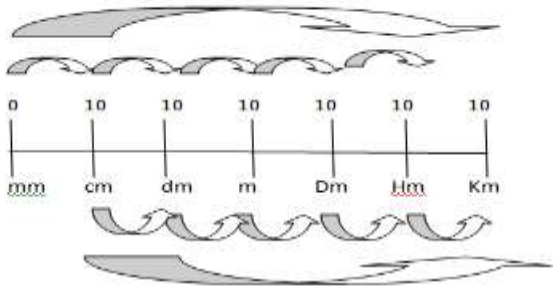
Step Four/ Movement Four

$10000(1\times10^4)$ mm = 1Dm

$10000(1\times10^4)$ cm = 1Hm

$10000(1\times10^4)$ dm = 1Km

Figure 9: Five Steps/ Movements



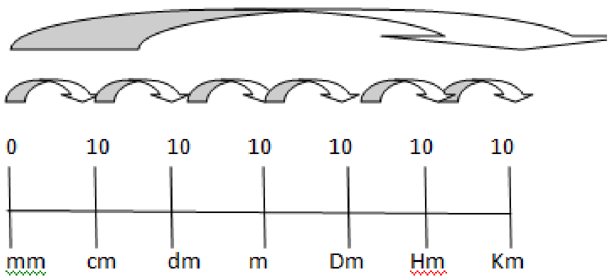
In figure 9, five steps were made starting from mm upward i.e. the first step from mm to cm, cm to dm, dm to m, m to Dm and from Dm to Hm. since moving from the least unit to the maximum unit deals with multiplication, it then implies that the first movement from mm to cm is 10, the second movement from cm to dm is 10, the third movement from dm to m is 10, the fourth movement from m to Dm is 10 and the last step from Dm to Hm is also 10, thus $10\times10\times10\times10\times10=10^5=100000$ (i.e. 100000mm = 1Hm).

Step Five/ Movement Five

$100000(1\times10^5)$ mm = 1Hm

$100000(1\times10^5)$ cm = 1Km

Figure 10: Six Steps/ Movements



In figure 10, six steps were made starting from mm to the right i.e. the first step from mm to cm, cm to dm, dm to m, m to Dm, Dm to Hm and from Hm to Km. since moving from the least unit to the maximum unit deals with multiplication, it then implies that the first movement from mm to cm is 10, the second movement from cm to dm is 10, the third movement from dm to m is 10, the fourth movement from m to Dm is 10, the fifth movement from Dm to Hm is 10 and the last step from Hm to Km is also 10, thus $10\times10\times10\times10\times10\times10=10^6=1000000$ (i.e. 1000000mm = 1Km).

Step Six/ Movement Six

$1000000(1\times10^6)$ mm = 1Km

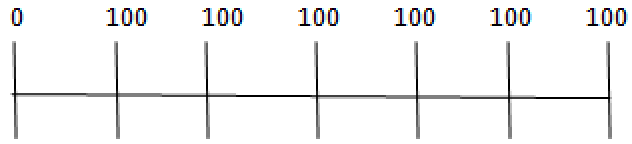
Table 1: One Dimension Distance Summary

Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
10mm=1cm	100mm=1dm	1000mm=1m	10000 mm=1Dm	100000 mm=1Hm	1000000 mm=1Km
10cm = 1dm	100cm = 1m	1000cm=1Dm	10000 cm=1Hm	100000 cm= 1Km	
10dm= 1m	100dm=1Dm	1000dm=1Hm	10000 dm=1Km		
10m = 1Dm	100m = 1Hm	1000m=1Km			
10Dm=1Hm	100Dm=1Km				
10Hm=1Km					

Two Dimension Distance (Area-Conversion Model)

A straight line is divided into seven equal parts. The distance between each part is hundred (100).

Figure 11



The number line is labelled mm^2, cm^2, dm^2, m^2, Dm^2, Hm^2 and Km^2.

mm^2 = millimetre square

cm^2 = centimetre square

dm^2 = decimetre square

m^2 = metre square

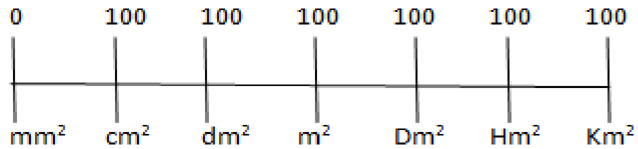
Dm^2 = decametre square

Hm^2 = hectometre square

Km^2 = kilometre square

Figure 12: The Complete Labelled Two Dimension Distance-Conversion Model

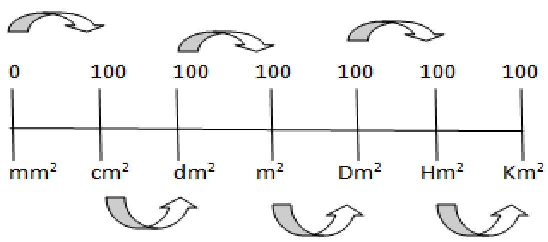
(Area-Conversion Model)



The two dimension of distance looks at two spaces (

) with a common meeting point between two objects (Asiedu & Baah-Yeboah, 2004; Brown, 1999; Serway & Jewett, 2004; Awe & Okunola, 1992; http://www.bayhicoach.com) i.e. mm^2 to cm^2, cm^2 to dm^2, dm^2 to m^2, m^2 to Dm^2, Dm^2 to Hm^2 and Hm^2 to Km^2. from figure 13, a straight line has been divided into 100 equal distances starting from mm^2 to Km^2. This meant that 100 steps of mm^2 will give 1 step of cm^2 and it follows through to Km^2.

Figure 13: One Step/ Movement



In figure 13, one step was made starting from mm^2 to the right i.e. the step from mm^2 to cm^2. since moving from the least unit to the maximum unit deals with multiplication, it then implies that the first movement from mm^2 to cm^2 is 100 and the second movement from cm^2 to dm^2 is also 100, thus $100=10^2=100$ (i.e. $100mm^2 = 1cm^2$).

The Mathematical proof:

Area= length*length=L^2

$1cm^2 = 1cm\times1cm$

But 10mm = 1cm

$\Rightarrow$ $1cm^2 = 1cm\times1cm = 10mm\times10mm = 10\times10(mm \times mm) = 10^2mm^2=100mm^2$

Step One / Movement One

$100(1\times10^2)\ mm^2 = 1cm^2$

$100(1\times10^2)\ cm^2 = 1dm^2$

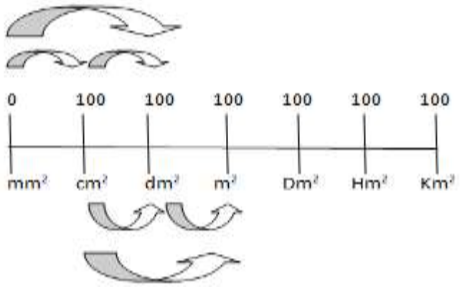
$100(1\times10^2)\ dm^2= 1m^2$

$100(1\times10^2)\ m^2 = 1Dm^2$

$100(1\times10^1)\ Dm^2 = 1Hm^2$

$100(1\times10^2)\ Hm^2= 1Km^2$

Figure 14: Two Step/ Movement



In figure 14, two steps were made starting from mm^2 to the right i.e. the first step from mm^2 to cm^2 and from cm^2 to dm^2. It then implies that the first movement from mm^2 to cm^2 is 100 and the second movement from cm^2 to dm^2 is also 100, thus $100\times100=10^4=10000$ (i.e. $10000mm^2 = 1dm^2$)

Step Two/ Movement Two

$10000(1\times10^4)\ mm^2 = 1dm^2$

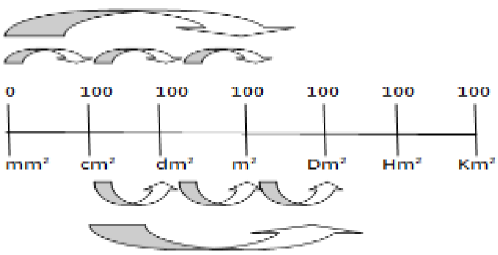
$10000(1\times10^4)\ cm^2 = 1m^2$

$10000(1\times10^4)\ dm^2 = 1Dm^2$

$10000(1\times10^4)\ m^2 = 1Hm^2$

$10000(1\times10^4)\ Dm^2 = 1Km^2$

Figure 15: Three Steps/ Movements



In figure 15, three steps were made starting from mm^2 to the right i.e. the first step from mm^2 to cm^2, cm^2 to dm^2 and from dm^2 to m^2, it then implies that the first movement from mm^2 to cm^2 is 100, the second movement from cm^2 to dm^2 is 100 and the last step from dm^2 to m^2 is also 100, thus $100\times100\times100=10^6=1000000$ (i.e. $1000000mm^2 = 1m^2$).

Step Three/ Movement Three

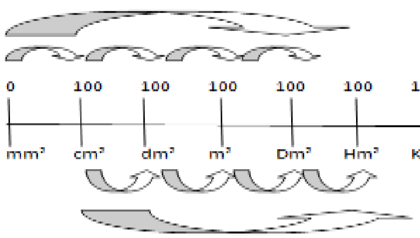
$1000000(1\times10^6)\ mm^2 = 1m^2$

$1000000(1\times10^6)\ cm^2 = 1Dm^2$

$1000000(1\times10^6)\ dm^2 = 1Hm^2$

$1000000(1\times10^6)\ m^2 = 1Km^2$

Figure 16: Four Steps/ Movements



In figure 16, four steps were made starting from mm^2 to the right i.e. the first step from mm^2 to cm^2, cm^2 to dm^2, dm^2 to m^2 and from m^2 to Dm^2, it then implies that the first movement from mm^2 to cm^2 is 100, the second movement from cm^2 to dm^2 is 100, dm^2 to m^2 is 100 and the last step from m^2 to Dm^2 is also 100, thus $100\times100\times100\times100=10^8=100000000$ (i.e. $100000000mm^2 = 1Dm^2$).

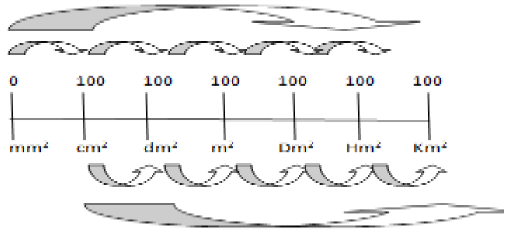
Step Four/ Movement Four

$100000000(1\times10^8)\ mm^2 = 1Dm^2$

$100000000(1\times10^8)\ cm^2 = 1Hm^2$

$100000000(1\times10^8)\ dm^2 = 1Km^2$

Figure 17: Five Steps/ Movements



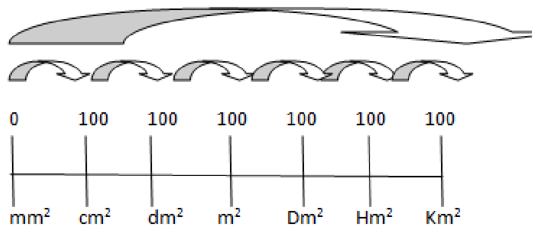
In figure 17, five steps were made starting from mm^2 to the right i.e. the first step from mm^2 to cm^2, cm^2 to dm^2, dm^2 to m^2, m^2 to Dm^2 and from Dm^2 to Hm^2, it then implies that the first movement from mm^2 to cm^2 is 100, the second movement from cm^2 to dm^2 is 100, dm^2 to m^2 is 100, m^2 to Dm^2 and the last step from Dm^2 to Hm^2 is also 100, thus $100\times100\times100\times100\times100=10^{10}=10000000000$ (i.e. $10000000000mm^2 = 1Hm^2$).

Step Five/ Movement Five

$10000000000(1\times10^{10})\ mm^2 = 1Hm^2$

$10000000000\ (1\times10^{10})\ cm^2 = 1Km^2$

Figure 18: Six Steps/ Movements



In figure 18, six steps were made starting from mm^2 to the right i.e. the first step from mm^2 to cm^2, cm^2 to dm^2, dm^2 to m^2, m^2 to Dm^2, Dm^2 to Hm^2 and from Hm^2 to Km^2, it then implies that the first movement from mm^2 to cm^2 is 100, the second movement from cm^2 to dm^2 is 100, dm^2 to m^2 is 100, m^2 to Dm^2, Dm^2 to Hm^2 and the last step from Hm^2 to Km^2 is also 100, thus $100\times100\times100\times100\times100\times100=10^{12}=1000000000000$ (i.e. $10000000000mm^2 = 1Km^2$).

Step Six/ Movement Six

$1000000000000(1\times10^{12})\ mm^2 = 1Km^2$

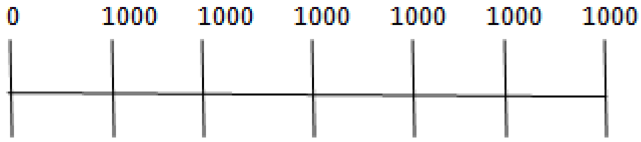
Table 2: Two Dimension Distance Summary

Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
$100(1\times10^2)\ mm^2=1cm^2$	$10000(1\times10^4)\ mm^2=1dm^2$	$1000000(1\times10^6)\ mm^2=1m^2$	$100000000(1\times10^8)\ mm^2=1Dm^2$	$10000000000(1\times10^{10})\ mm^2=1Hm^2$	$1000000000000(1\times10^{12})\ mm^2=1Km^2$
$100(1\times10^2)\ cm^2=1dm^2$	$10000(1\times10^4)cm^2=1m^2$	$1000000(1\times10^6)\ cm^2=1Dm^2$	$100000000(1\times10^8)\ cm^2=1Hm^2$	$10000000000\ (1\times10^{10})\ cm^2=1Km^2$	
$100(1\times10^2)\ dm^2=1m^2$	$10000(1\times10^4)\ dm^2=1Dm^2$	$1000000(1\times10^6)\ dm^2=1Hm^2$	$100000000(1\times10^8)dm^2=1Km^2$		
$100(1\times102)\ m^2=1Dm^2$	$10000(1\times104)m^2=1Hm^2$	$1000000(1\times106)\ m^2=1Km^2$			
$100(1\times102)\ Dm^2=1Hm^2$	$10000(1\times104)\ Dm^2=1Km^2$				
$100(1\times102)\ Hm^2=1Km^2$					

Three Dimension Distance (Volume-Conversion Model)

A straight line is divided into seven equal parts. The distance between each part is one thounsand (1000).

Figure 19



The number line is labelled mm^3, cm^3, dm^3, m^3, Dm^3, Hm^3 and Km^3.

mm^3 = millimetre cube

cm^3 = centimetre cube

dm^3 = decimetre cube = 1 Litre

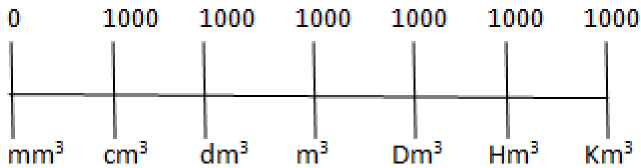
m^3 = metre cube

Dm^3 = decametres cube

Hm^3 = hectometre cube

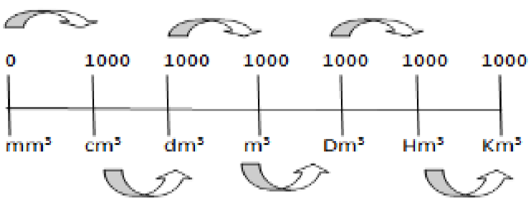
Km^3 = kilometre cube

Figure 20: The Complete Labelled Three Dimension Distance-Conversion Model (Volume-Conversion Model)



The three dimension of distance looks at three spaces () with a common meeting point between two objects (Asiedu & Baah-Yeboah, 2004; Brown, 1999; Serway & Jewett, 2004; Awe & Okunola, 1992; http://www.bayhicoach.com) i.e. mm^3 to cm^3, cm^3 to dm^3, dm^3 to m^3, m^3 to Dm^3, Dm^3 to Hm^3 and Hm^3 to Km^3. from figure 20, a straight line has been divided into 1000 equal distances starting from mm^3 to Km^3. This meant that 1000 steps of mm^3 will give 1 step of cm^3 and it follows through to Km^3.

Figure 21: One Step/ Movement



In figure 21, one step was made starting from mm^3 to the right i.e. the step from mm^3 to cm^3 is 1000, and the movement from cm^2 to dm^2 is also 1000, thus $1000(10^3)\ mm^3 = 1cm^3$

The Mathematical proof:

Volume = length × length × Length=L^3

$1cm^3 = 1cm\times1cm\times1cm$

But 10mm = 1cm

$\Rightarrow \quad 1cm^3 = 1cm\times1cm\times1cm \equiv 10mm\times10mm\times10mm$

Step One/ Movement One

$1000(1\times10^3)\ mm^3 = 1cm^3$

$1000(1\times10^3)\ cm^3 = 1dm^3$

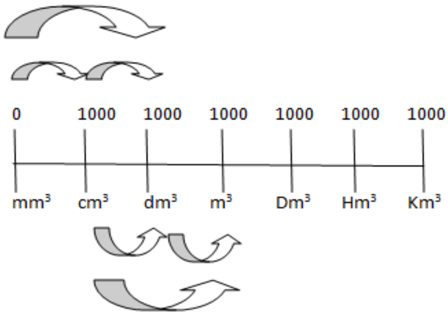
$1000(1\times10^3)\ dm^3 = 1m^3$

$1000(1\times10^3)\ m^3 = 1Dm^3$

$1000(1\times10^3)\ Dm^3 = 1Hm^3$

$1000(1\times10^3)\ Hm^3 = 1Km^3$

Figure 22: Two Step/ Movement



In figure 22, two steps were made starting from mm^3 to the right i.e. the first step from mm^3 to cm^3 and from cm^3 to dm^3. It then implies that the first movement from mm^3 to cm^3 is 1000 and the second movement from cm^3 to dm^3 is also 1000, thus $1000\times1000=10^6=1000000$ (i.e. $1000000mm^3 = 1dm^3$)

Step Two/ Movement Two

$1000000(1\times10^6)\ mm^3 = 1dm^3$

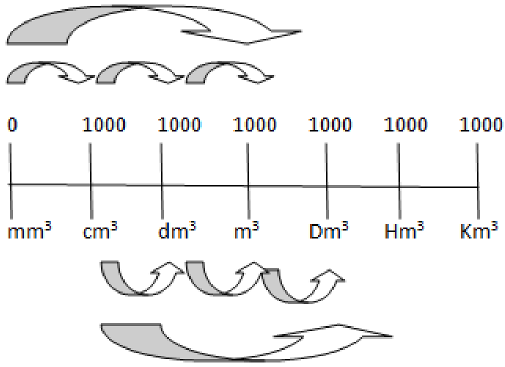
$1000000(1\times10^6)\ cm^3 = 1m^3$

$1000000(1\times10^6)\ dm^3 = 1Dm^3$

$1000000(1\times10^6)\ m^3 = 1Hm^3$

$1000000(1\times10^6)\ Dm^3 = 1Km^3$

Figure 23: Three Steps/ Movements



In figure 23, three steps were made starting from mm^3 to the right i.e. the first step from mm^3 to cm^3, cm^3 to dm^3 and from dm^3 to m^3, it then implies that the first movement from mm^3 to cm^3 is 1000, the second movement from cm^3 to dm^3 is 1000 and the last step from dm^3 to m^3 is also 1000, thus $1000\times1000\times1000=10^9=1000000000$ (i.e. $1000000000mm^3 = 1m^3$).

Step Three/ Movement Three

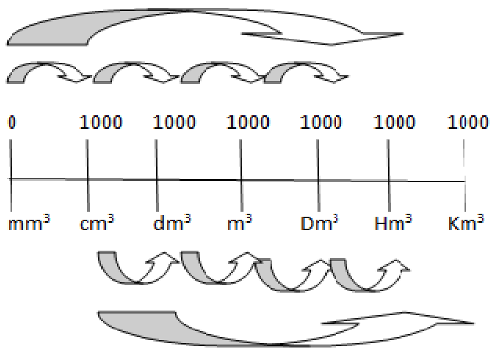
$1000000000(1\times10^9)\ mm^3 = 1m^3$

$1000000000(1\times10^9)\ cm^3 = 1Dm^3$

$1000000000(1\times10^9)\ dm^3 = 1Hm^3$

$1000000000(1\times10^9)\ m^3 = 1Km^3$

Figure 24: Four Steps/ Movements



In figure 24, four steps were made starting from mm^3 to the right i.e. the first step from mm^3 to cm^3, cm^3 to dm^3, dm^3 to m^3 and from m^3 to Dm^3, it then implies that the first movement from mm^3 to cm^3 is 1000, the second movement from cm^3 to dm^3 is 1000, dm^3 to m^3 is 1000 and the last step from m^3 to Dm^3 is 1000, thus $1000\times1000\times1000\times1000=10^{12}=1000000000000$ (i.e. $1000000000000mm^3 = 1Dm^3$).

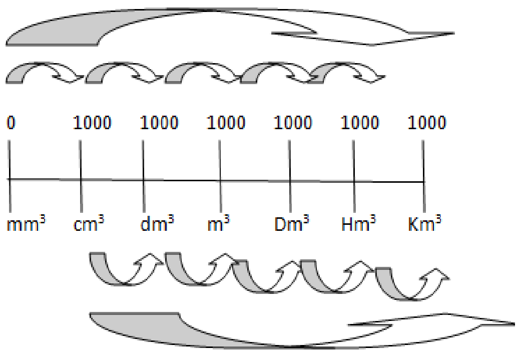
Step Four/ Movement Four

$1000000000000(1\times10^{12})\ mm^3 = 1Dm^3$

$1000000000000(1\times10^{12})\ cm^3 = 1Hm^3$

$1000000000000(1\times10^{12})\ dm^3 = 1Km^3$

Figure 25: Five Steps/ Movements



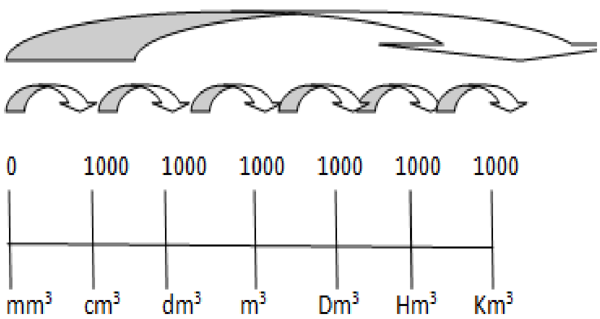
In figure 25, five steps were made starting from mm^3 to the right i.e. the first step from mm^3 to cm^3, cm^3 to dm^3, dm^3 to m^3, m^3 to Dm^3 and from Dm^3 to Hm^3, it then implies that the first movement from mm^3 to cm^3 is 1000, the second movement from cm^3 to dm^3 is 1000, dm^3 to m^3 is 1000, m^3 to Dm^3 is 1000 and the last step from Dm^3 to Hm^3 is also 1000, thus $1000\times1000\times1000\times1000\times1000=10^{15}=1000000000000000$ (i.e. $1000000000000000mm^2 = 1Hm^2$).

Step Five/ Movement Five

$1000000000000000(1\times10^{15})\ mm^3 = 1Hm^3$

$1000000000000000\ (1\times10^{15})\ cm^3 = 1Km^3$

Figure 26: Six Steps/ Movements



In figure 26, six steps were made starting from mm^3 to the right. The i.e. the steps are mm^3 to cm^3, cm^3 to dm^3, dm^3 to m^3, m^3 to Dm^3, Dm^3 to Hm^3 and from Hm^3 to Km^3, it then implies that the first movement from mm^3 to cm^3 is 1000, the second movement from cm^3 to dm^3 is 1000, dm^3 to m^3 is 1000, m^3 to Dm^3 is 1000, Dm^3 to Hm^3 is 1000 and the last step from Hm^3 to Km^3 is also 1000, thus $1000\times1000\times1000\times1000\times1000\times1000=10^{18}=1000000000000000000$ (i.e. $1000000000000000000mm^3 = 1Km^3$).

Step Six/ Movement Six

$1000000000000(1\times10^{18})\ mm^3 = 1Km^3$

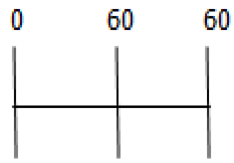
Table 3: Three Dimension Distance Summary

Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
1000 (1×10^3) mm^3 $=1cm^3$	1000000(1×10^6) mm^3 $=1dm^3$	1000000000(1×10^9) mm^3 $=1m^3$	1000000000000 $(1\times10^{12})mm^3=1$ Dm^3	1000000000000000(1×10^{15}) $mm^3 = 1Hm^3$	1000000000000(1×10^{18}) mm^3 $=1Km^3$
1000 (1×10^3) cm^3 = $1dm^3$	1000000(1×10^6) $cm^3 =$ $1m^3$	1000000000(1×10^9) $cm^3 =$ $1Dm^3$	1000000000000 $(1\times10^{12})cm^3 =$ $1Hm^3$	1000000000000000 (1×10^{15}) cm^3 $= 1Km^3$	
Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
1000 (1×103) dm3 = 1m3	1000000(1×106) dm3= 1Dm3	1000000000(1×109) dm3 = 1Hm3	1000000000000 (1×1012)dm3= 1Km3		
1000 (1×103) m3 = 1Dm3	1000000(1×106) m3= 1Hm3	1000000000(1×109) m3 = 1Km3			
1000 (1×103) Dm3 =1Hm3	1000000(1×106) Dm3= 1Km3				
1000 (1×103) Hm3 =1Km3					

The Time-Conversion Model

A number line is divided into two equal parts. The distance between each part is sixty (60).

Figure 2



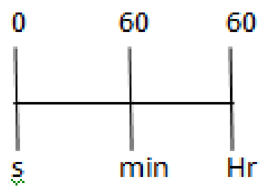
The number line is labelled s, min, Hr.

s = second

min = minute

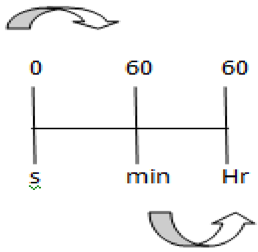
Hr = hour

Figure 2: The Complete Labelled Time-Conversion Model



The time-conversion model has two steps (i.e. Step One, and Step Two).

Figure 3: One Step/ Movement



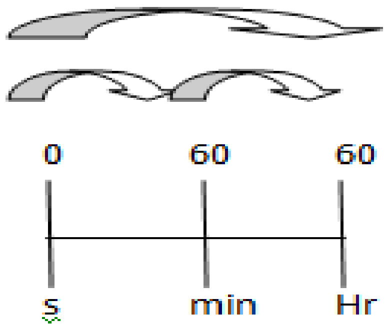
In figure 3, one step was made starting from s to the right i.e. the step from s to min, it then implies that the first movement from s to min is 60 and the second movement from min to Hr is also 60, thus $60=6\times10^1=6\times10$ (i.e. 60s = 1min)

Step One / Movement One

$60(6\times10^1)$ s = 1min

$60(6\times10^1)$ min = 1Hr

Figure 4: Two Steps/ Movements



In figure 4, two steps were made starting from s to the right i.e. the first step from s to min and from min to Hr. since moving from the least unit to the maximum unit deals with multiplication, it then implies that the first movement from s to min is 60 and the second movement from min to Hr is also 60, thus $60\times60=6^2\times10^2=36\times100$ (i.e. 3600s = 1Hr)

Step Two/ Movement Two

$3600(6^2\times10^2)$ s = 1Hr

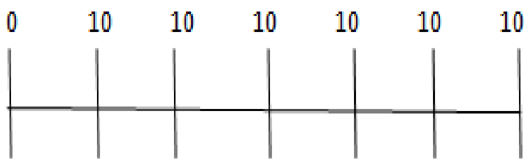
Table 4: Time-Conversion Model Summary

Step 1	Step 2
$60(6\times10^1)$s = 1min	$3600(6^2\times10^2)$s = 1Hr
$60(6\times10^1)$min = 1Hr	

The Mass-Conversion Model

A straight line is divided into six equal parts. The distance between each part is ten (10).

Figure 3



The number line is labelled mg, cg, dg, g, Dg, Hg and kg.

mg = milligram

cg = centigram

dg = decigram

g = gram

Dg = dekagram

Hg = hectogram

Kg = kilogram

Figure 2: The Complete Labelled Mass-Conversion Model

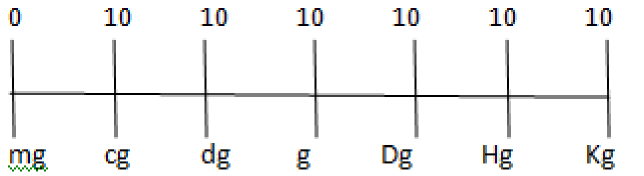
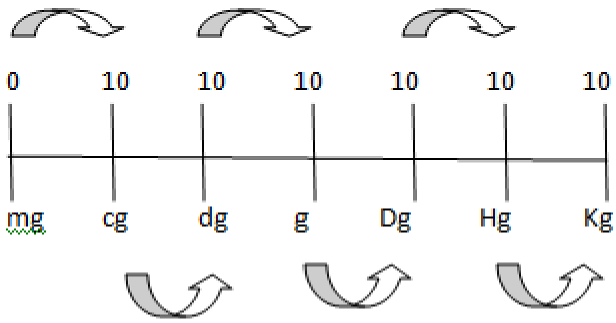


Figure 3: One Step/ Movement



In figure 3, one step was made starting from mg to the right i.e. the step from mg to cg, cg to dg, dg to g, g to Dg, Dg to Hg, and Hg to Kg. This then implies that the movement from mg to cg is 10 thus $10=1\times10^1$ (i.e. 10mg = 1cg)

Step One / Movement One

10mg = 1cg

10cg = 1dg

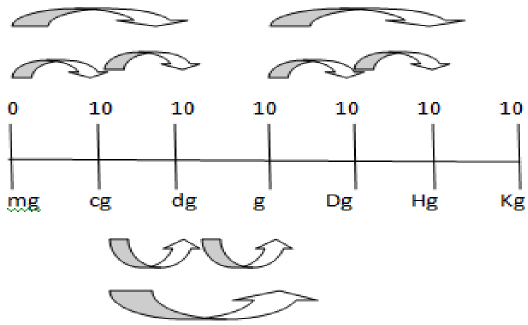
10dg = 1g

10g = 1Dg

10Dg = 1Hg

10Hg = 1Kg

Figure 5: Two Step/ Movement



In figure 5, two steps were made starting from mg to the right i.e. the step from mg to dg, cg to g, dg to Dg, g to Hg, and Dg to Kg. This then implies that the movement from mg to dg is 100 thus $10\times10=1\times10^2$ (i.e. 100mg = 1dg)

Step Two / Movement Two

100mg = 1dg

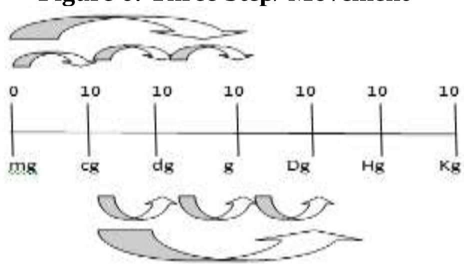
100cg = 1g

100dg = 1Dg

100g = 1Hg

100Dg = 1Kg

Figure 6: Three Step/ Movement



In figure 6, three steps were made starting from mg to the right i.e. the step from mg to g, cg to Dg, dg to Hg, and g to Kg. This then implies that the movement from mg to g is 1000 thus $10×10×10=1×10^3$ (i.e. 1000mg = 1g)

Step Three / Movement Three

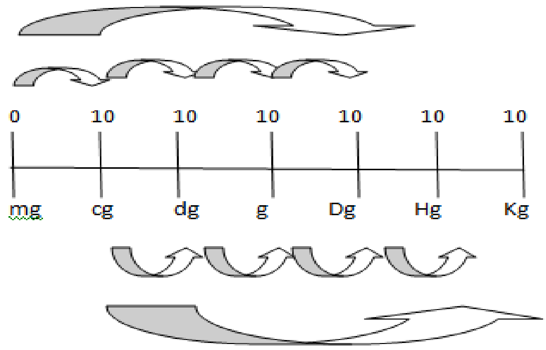
1000mg = 1g

1000cg = 1Dg

1000dg = 1Hg

1000g = 1Kg

Figure 7: Four Step/ Movement



In figure 7, four steps were made starting from mg to the right i.e. the step from mg to Dg, cg to Hg, and dg to Kg. This then implies that the movement from mg to Dg is 10000 thus $10×10×10×10=1×10^4$ (i.e. 10000mg = 1Dg)

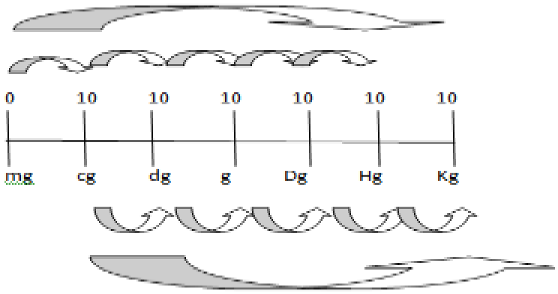
Step Four / Movement Four

10000mg = 1Dg

10000cg = 1Hg

10000dg = 1Kg

Figure 8: Five Step/ Movement



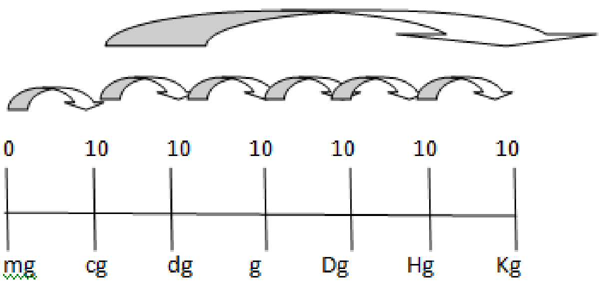
In figure 8, five steps were made starting from mg to the right i.e. the step from mg to Hg, and cg to Kg. This then implies that the movement from mg to Hg is 100000 thus $10×10×10×10×10=1×10^5$ (i.e. 100000mg = 1Hg)

Step Five / Movement Four

100000mg = 1Hg

100000cg = 1Kg

Figure 9: Six Step/ Movement



In figure 9, six steps were made starting from mg to the right i.e. the step from mg to Kg. This then implies that the movement from mg to Kg is 1000000 thus $10×10×10×10×10×10=1×10^6$ (i.e. 1000000mg = 1Kg)

Step Six / Movement Four

1000000mg = 1Kg

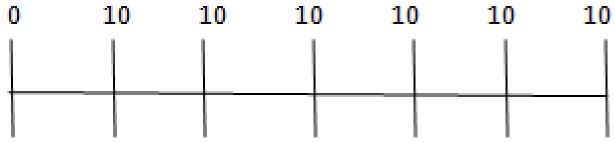
Table 5: Mass-Conversion Model Summary

Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
10mg=1 cg	100mg=1 dg	1000mg = 1g	10000mg=1 Dg	100000mg= 1Hg	1000000 mg = 1Kg
10cg = 1dg	100cg = 1g	1000cg= 1Dg	10000cg=1 Hg	100000cg= 1Kg	
10dg = 1g	100dg= 1Dg	1000dg=1 Hg	10000dg=1 Kg		
10g = 1Dg	100g = 1Hg	1000g = 1Kg			
10Dg= 1Hg	100Dg=1 Kg				
10Hg =1Kg					

The Litre-Conversion Model

A straight line is divided into six equal parts. The distance between each part is ten (10).

Figure 4



The number line is labelled mL, cL, dL, L, DL, HL and KL.

mL = millilitre

cL = centilitre

dL = decilitre

L = litre

DL = dekalitre

HL = hectolitre

KL = kilolitre

Figure 2: The Complete Labelled Litre-Conversion Model

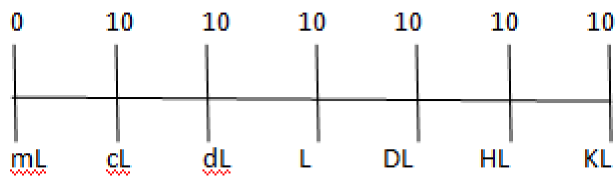
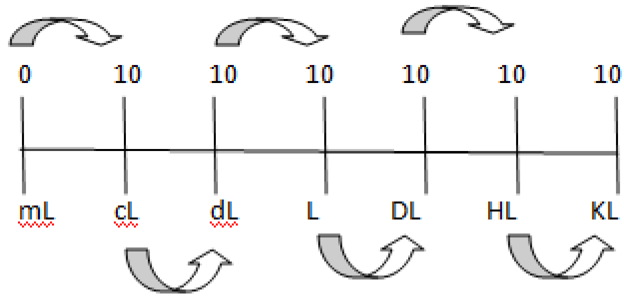


Figure 3: One Step/ Movement



In figure 3, one step was made starting from mL to the right i.e. the step from mL to cL, cL to dL, dL to L, L to DL, DL to HL, and HL to KL. This then implies that the movement from mL to cL is 10 thus $10=1×10^1$ (i.e. 10mL = 1cL)

Step One / Movement One

10mL = 1cL

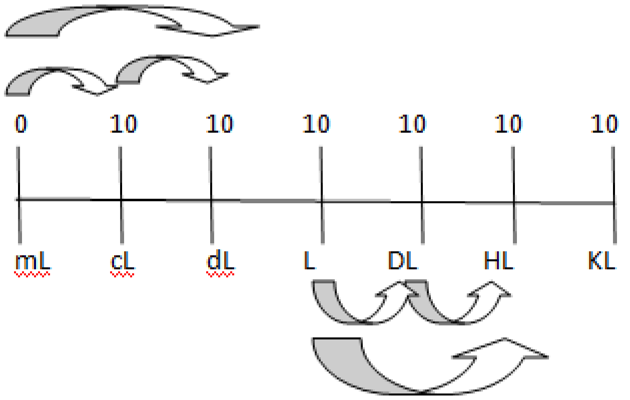
10cL = 1dL

10dL = 1L

10L = 1DL

10DL = 1HL
10HL = 1KL

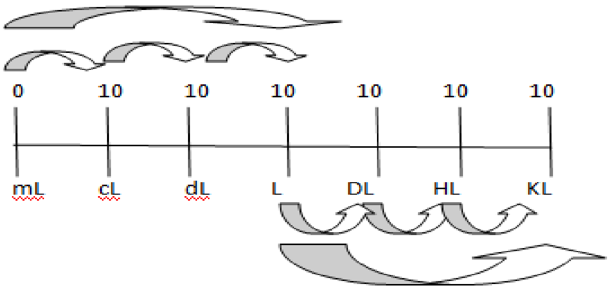
Figure 5: Two Step/ Movement



In figure 5, two steps were made starting from mL to the right i.e. the step from mL to dL, cL to L, dL to DL, L to HL, and DL to KL. This then implies that the movement from mL to dL is 100 thus $10\times10=1\times10^2$ (i.e. 100mL = 1dL)

Step Two / Movement Two
100mL = 1dL
100cL = 1L
100dL = 1L
100L = 1HL
100DL = 1KL

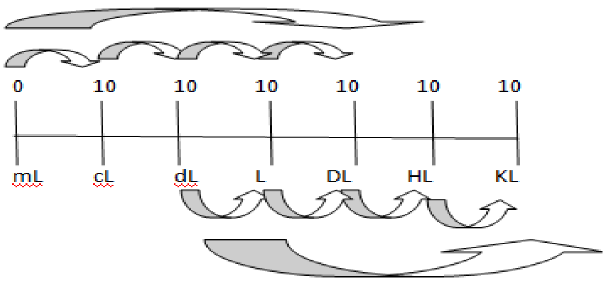
Figure 6: Three Step/ Movement



In figure 6, three steps were made starting from mL to the right i.e. the step from mL to L, cL to DL, dL to HL, and L to KL. This then implies that the movement from mL to L is 1000 thus $10\times10\times10=1\times10^3$ (i.e. 1000mL = 1L)

Step Three / Movement Three
1000mL = 1L
1000cL = 1DL
1000dL = 1HL
1000L = 1KgL

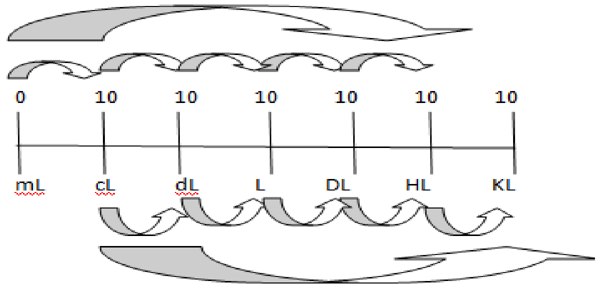
Figure 7: Four Step/ Movement



In figure 7, four steps were made starting from mL to the right i.e. the step from mL to DL, cL to HL, and dL to KL. This then implies that the movement from mL to DL is 10000 thus $10\times10\times10\times10=1\times10^4$ (i.e. 10000mL = 1DL)

Step Four / Movement Four
10000mL = 1DL
10000cL = 1HL
10000dL = 1KL

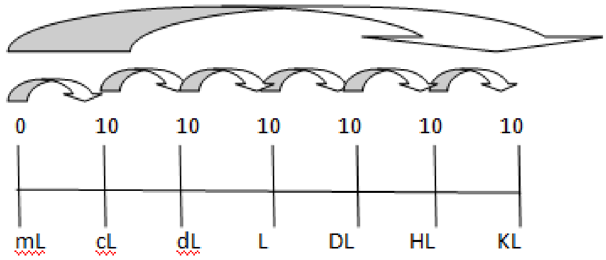
Figure 8: Five Step/ Movement



In figure 8, five steps were made starting from mL to the right i.e. the step from mL to HL, and cL to KL. This then implies that the movement from mL to HL is 100000 thus $10\times10\times10\times10\times10=1\times10^5$ (i.e. 100000mL = 1HL)

Step Five / Movement Four
100000mL = 1HL
100000cL = 1KL

Figure 9: Six Step/ Movement



In figure 9, six steps were made starting from mL to the right i.e. the step from mL to KL. This then implies that the movement from mL to KL is 1000000 thus $10\times10\times10\times10\times10\times10=1\times10^6$ (i.e. 1000000mL = 1KL)

Step Six / Movement Four
1000000mL = 1KL

Table 6: Litre-Conversion Model Summary

Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
10mL=1 cL	100mL=1 dL	1000mL = 1L	10000mL= 1DL	100000mL= 1HL	1000000 mL = 1KL
10cL = 1dL	100cL = 1L	1000cL= 1DL	10000cL=1 HL	100000cL= 1KL	
10dL = 1L	100dL= 1DL	1000dL=1 HL	10000dL=1 KL		
10L = 1DL	100L = 1HL	1000L = 1KL			
10DL= 1HL	100DL=1 KL				
10HL =1KL					

Mathematical proof of the number of steps/movements on the DTML-conversion model

Movement In One Dimension

The one dimension of units in the DTML-Conversion model are Length, Mass, Litre, and Time.

Figure 1: the Length (L)-Conversion Model

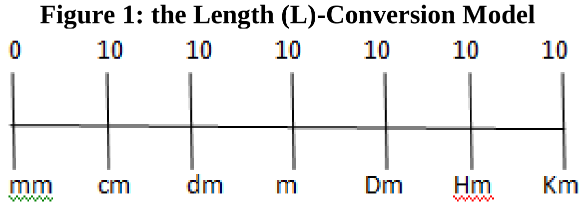


Figure 2: the Mass (M)-Conversion Model

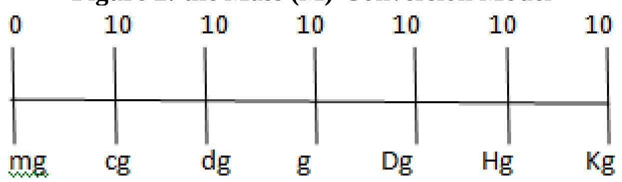


Figure 3: the Litre-Conversion Model

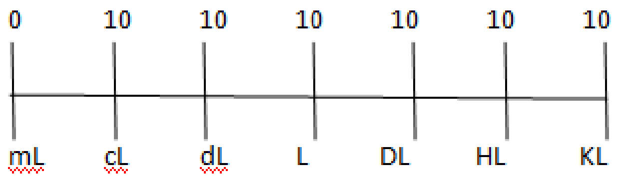


Figure 4: the Time (T)-Conversion Model

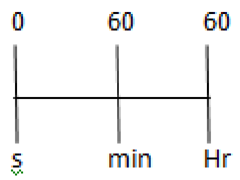
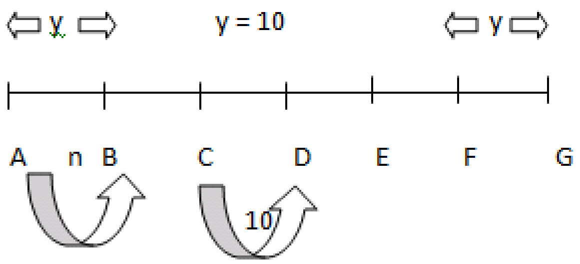


Figure 1, 2 and 3 will be considered now and after the proving, will be applied to figure 4

Figure 5: the proved Diagram for One Dimension-Conversion Model



A = mm = mg = mL (figure 1, 2 and 3)

Let y = equal distance/space between alphabets (figure 5)

n = the number of steps / movements from the starting point, A

h = the index of the spaces between the alphabets i.e. y^h

From figure 5, n depends on y.

Mathematically,

$n \propto y$

Hence, n = ky, k= constant of proportionality

Let y be raised to an index h

$n_h = ky^h$, $k \neq 0$, if $k = 1 = (\frac{n}{(y)h}) = (\frac{n}{(10)h})$

$n_h = y^h$, but y = 10 (figure 5)

$n_h = y^h = 10^h$

$n_h = 10^h$

Application of $n = 10^h$ to One Dimension of L, T, M and Litre-Conversion Model

To determine the starting point to the steps/movements, then h = 0

From $n_h = 10^h$

$n_0 = 10^0 = 1$ unit, so the starting point A (figure 5) is 1 unit

To determine the first movement/ step to the right of the starting point A, then h = 1

From $n = 10^h$

$n_1 = 10^1 = 10$ units, so the first movement from the starting point A (figure 5) is a distance of 10 units

To determine the second movement/ step to the right of the starting point A, then h = 2

From $n_h = 10^h$

$n_2 = 10^2 = 10\times10 = 100$ units, so the second movement from the starting point A (figure 5) is a distance of 100 units

To determine the third movement/ step to the right of the starting point A, then h = 3

From $n_h = 10^h$

$n_3 = 10^3 = 10\times10\times10 = 1000$ units, so the third movement from the starting point A (figure 5) is a distance of 1000 units

To determine the fourth movement/ step to the right of the starting point A, then h = 4

From $n_h = 10^h$

$n_4 = 10^4 = 10\times10\times10\times10 = 10000$ units, so the fourth movement from the starting point A (figure 5) is a distance of 10000 units

To determine the fifth movement/ step to the right of the starting point A, then h = 5

From $n_h = 10^h$

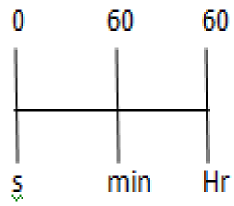
$n_5 = 10^5 = 10\times10\times10\times10\times10 = 100000$ units, so the fifth movement from the starting point A (figure 5) is a distance of 100000 units

To determine the sixth movement/ step to the right of the starting point A, then h = 6

From $n_h = 10^h$

$n_6 = 10^6 = 10\times10\times10\times10\times10\times10 = 1000000$ units, so the sixth movement from the starting point A (figure 5) is a distance of 1000000 units

Figure 4: the Time (T)-Conversion Model



Now a very closer look at figure 4 reveals that, instead of $n = 10^h$ as in figures 1, 2 and 3, n now rather becomes $n_h = 60^h$ in figure 4.

To determine the starting point to the steps/movements, then h = 0

From $n_h = 60^h$

$n_0 = 60^0 = 1$ unit, so the starting point s (figure 4) is 1 unit

To determine the first movement/ step to the right of the starting point s, then h = 1

From $n_h = 60^h$

$n_1 = 60^1 = 60$ units, so the first movement from the starting point s (figure 4) is a distance of 60 units

To determine the second movement/ step to the right of the starting point s, then h = 2

From $n_h = 60^h$

$n_2 = 60^2 = 60\times60 = 3600$ units, so the second movement from the starting point s (figure 4) is a distance of 3600 units

Movement In Two Dimensions

The two dimensions of units in the DTML-Conversion model is Area.

Figure 6: the Area (A)-Conversion Model

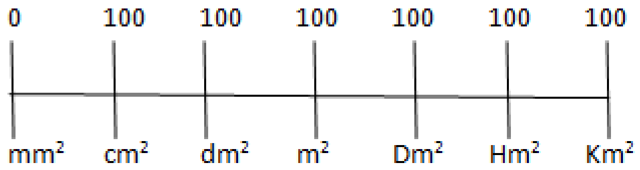
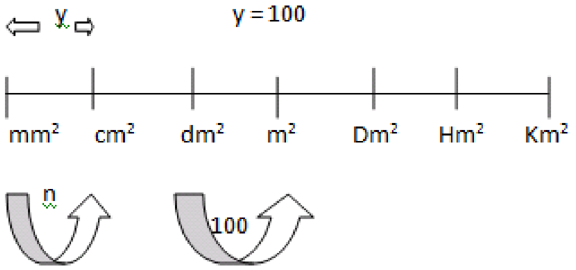


Figure 7: the proved Diagram for Two Dimension-Conversion Model



Let y = equal distance/space between alphabets (figure 7)

n = the number of steps / movements from the starting point, mm^2

h = the index of the spaces between the alphabets i.e. y^h

From figure 7, n depends on y.

Mathematically,

$n \propto y$

Hence, n = ky, k= constant of proportionality

Let y be raised to an index h

$n_h = ky^h$, $k \neq 0$ if k = 1

$n_h = y^h$, but y = 100 (figure 7)

$n_h = y^h = 100^h$

$n_h = 100^h$

Application of $n = 100^h$ to Two Dimension i.e. Area-Conversion Model

To determine the starting point to the steps/movements, then h = 0

From $n_h = 100^h$

$n_0 = 100^0 = 1$ unit, so the starting point mm^2 (figure 7) is 1 unit

To determine the first movement/ step to the right of the starting point mm^2, then h = 1

From $n_h = 100^h$

$n_1 = 100^1 = 100$ units, so the first movement from the starting point mm^2 (figure 7) is a distance of 100 units

To determine the second movement/ step to the right of the starting point mm^2, then h = 2

From $n_h = 100^h$

$n_2 = 100^2 = 100 \times 100 = 10000$ units, so the second movement from the starting point mm^2 (figure 7) is a distance of 10000 units

To determine the third movement/ step to the right of the starting point mm^2, then h = 3

From $n_h = 100^h$

$n_3 = 100^3 = 100 \times 100 \times 100 = 1000000$ units, so the third movement from the starting point mm^2 (figure 7) is a distance of 1000000 units.

To determine the fourth movement/ step to the right of the starting point mm^2, then h = 4

From $n_h = 100^h$

$n_4 = 100^4 = 100 \times 100 \times 100 \times 100 = 100000000$ units, so the fourth movement from the starting point mm^2 (figure 7) is a distance of 100000000 units

To determine the fifth movement/ step to the right of the starting point mm^2, then h = 5

From $n_h = 100^h$

$n_5 = 100^5 = 100 \times 100 \times 100 \times 100 \times 100 = 10000000000$ units, so the fifth movement from the starting point mm^2 (figure 7) is a distance of 10000000000 units

To determine the sixth movement/ step to the right of the starting point mm^2, then h = 6

From $n_h = 100^h$

$n_6 = 100^6 = 100 \times 100 \times 100 \times 100 \times 100 \times 100 = 1000000000000$ units, so the sixth movement from the starting point mm^2 (figure 7) is a distance of 1000000000000 units

Movement in three dimensions

The three dimensions of units in the DTML-Conversion model is Volume.

Figure 8: the Volume (V)-Conversion Model

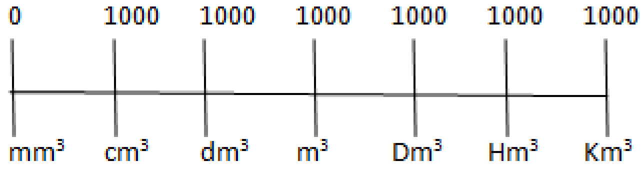
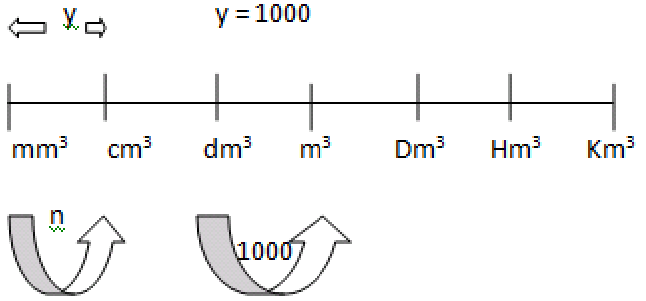


Figure 9: the Proved Diagram for Three Dimension-Conversion Model



Let y = equal distance/space between alphabets (figure 9)

n = the number of steps / movements from the starting point, mm^3

h = the index of the spaces between the alphabets i.e. y^h

From figure 9, n depends on y.

Mathematically,

$n \propto y$

Hence, n = ky, k= constant of proportionality

Let y be raised to an index h

$n_h = ky^h$, $k \neq 0$, if k = 1

$n_h = y^h$, but y = 1000 (figure 9)

$n_h = y^h = 1000^h$

$n_h = 1000^h$

Application of $n = 1000^h$ to Three Dimension i.e. Volume-Conversion Model

To determine the starting point to the steps/movements, then h = 0

From $n_h = 1000^h$

$n_0 = 1000^0 = 1$ unit, so the starting point mm^3 (figure 9) is 1 unit

To determine the first movement/ step to the right of the starting point mm^3, then h = 1

From $n_h = 1000^h$

$n_1 = 1000^1 = 1000$ units, so the first movement from the starting point mm^3 (figure 9) is a distance of 1000 units

To determine the second movement/ step to the right of the starting point mm^3, then h = 2

From $n_h = 1000^h$

$n_2 = 1000^2 = 1000 \times 1000 = 1000000$ units, so the second movement from the starting point mm^3 (figure 9) is a distance of 1000000 units

To determine the third movement/ step to the right of the starting point mm^3, then h = 3

From $n_h = 1000^h$

$n_3 = 1000^3 = 1000\times1000\times1000 = 1000000000$ units, so the third movement from the starting point mm^3 (figure 9) is a distance of 1000000000 units

To determine the fourth movement/ step to the right of the starting point mm^3, then h = 4

From $n_h = 1000^h$

$n_4 = 1000^4 = 1000\times1000\times1000\times1000 = 1000000000000$ units, so the fourth movement from the starting point mm^3 (figure 9) is a distance of 1000000000000 units

To determine the fifth movement/ step to the right of the starting point mm^3, then h = 5

From $n_h = 1000^h$

$n_5 = 1000^5 = 1000\times1000\times1000\times1000\times1000 = 1000000000000000$ units, so the fifth movement from the starting point mm^3 (figure 9) is a distance of 1000000000000000 units

To determine the sixth movement/ step to the right of the starting point mm^3, then h = 6

From $n_h = 1000^h$

$n_6 = 100^6 = 1000\times1000\times1000\times1000\times1000\times1000 = 1000000000000000000$ units, so the sixth movement from the starting point mm^3 (figure) is a distance of 1000000000000000000 units

Mathematical proof of converting within units with the dtml-conversion model

Let y = the given unit

c = the unit in which the given unit is to be converted

n = the number of steps / movements from the starting point

d = the dimension of a quantity

If, y depends on n.

Mathematically,

$y \propto n$

Hence, y = cn, c= constant of proportionality

Let y be raised to an index d

$y = cn^d$; $c\neq0$, if for one dimension d = 1, for two dimension d =2, and for three dimension d = 3

$y = cn^d$, if d = 1(one dimension)

$y = cn^d = cn^1 = cn$ (one dimension)

$y = cn^d$, if d = 2, then $y = cn^2$ (two dimension; n is the number of steps/movement in the one dimension-conversion model)

$y = cn^d = cn^2 = cn$ (two dimension; n is the actual number of steps in the two dimension-conversion model)

$y = cn^d$, if d = 3, then $y = cn^3$ (three dimension; n is the number of steps/movement in the one dimension-conversion model)

$y = cn^d = cn^3 = cn$ (three dimension; n is the actual number of steps in the three dimension-conversion model).

Application of $y = cn^d$ to One Dimension of L, M, T and Litre-Conversion Model

$y = cn^d$, for one dimension, d = 1

y = cn

Example 1

Convert 2cm to m

Data:

y = the given unit (i.e. 2cm), n = number of steps (two steps, n_2 = 100 i.e. converting from cm to m is a two step/movement i.e. n_2 = 100), c = the unit in which the given unit is to be converted

Solution

y = cn

2cm = c×100cm/m

$\frac{2cm}{100cm}\times1m = c$

0.02m = c

Example 2

Change 0.001g to dg

Data:

y = 0.001g, n = 1÷10 (moving from g to dg is one movement but it is the reverse of dg to g, hence instead of n= 10, the reverse is n = (1÷10), c =?

Solution

y = cn

$0.001g = c\times\frac{1}{10g/dg}$

$\frac{0.001g}{1/10g}\times1dg = c$

0.001×10dg = c

0.01dg = c

Example 3

Convert 534kL to mL

Data:

y = 534kL, n = 1÷1000000 (moving from kL to mL is six steps/movement but it is the reverse of mL to kL, hence instead of n = 1000000, the reverse is n = (1÷1000000), c =?

Solution

y = cn

$534kL = c\times\frac{1}{1000000\ kL/mL}$

$\frac{543kL}{\frac{1}{1000000\ kL/mL}} = c$

534×1000000mL = c

534000000mL = c

Example 4

Change 200s to hr.

Data:

y = 200s, n = 3600 (moving from s to hr is two steps/movements), c =?

Solution

y = cn

200 = c× (3600) s/hr

$\frac{200s}{3600s}\times1hr = c$

$\frac{200}{3600s}\ hr = c$

0.056 hr = c

Application of $y = cn^2$ to Two Dimension i.e. Area (A)-Conversion Model

Example 1

Convert $2cm^2$ to m^2

Data:

y = the given unit (i.e. $2cm^2$), n = number of steps (two steps, $n_2 = 10000 = n_{2\#}^2 = 100^2$ i.e. $n_{2\#}$ is the two step / movement in the one dimension-conversion model, also converting from cm^2 to m^2 is a two step/movement i.e. n_2 = 10000), c = the unit in which the given unit is to be converted.

Solution

By using $n_{2\#}$ = 100 (two step / movement in the one dimension-conversion model)

$y = cn^d$, for two dimension, d =2

$y = cn^d = cn^2$

$2cm^2 = c\times n_{2\#}^2 = c\times100^2cm^2/m^2$

$2cm^2 = c\times10000cm^2/m^2$

$(\frac{2}{10000}\ cm^2/cm^2)\times 1m^2 = c$

$\frac{2}{10000}m^2 = c$

$0.0002m^2 = c$

By using $n_2 = 10000$ (actual two step / movement in the two dimension-conversion model)

$y = cn_2$

$2cm^2 = c\times 10000cm^2/m^2$

$(\frac{2}{10000}\ cm^2/cm^2)\times 1m^2 = c$

$0.0002m^2 = c$

Example 2

Convert $2m^2$ to cm^2

Data:

y = the given unit (i.e. $2m^2$), n = number of steps (two steps in a reverse direction i.e. from m^2 to cm^2, $n_2 = 1\div 10000 = n_{2\#}^2 = (1\div 100)^2$ i.e. $n_{2\#}$ is the two step / movement in the one dimension-conversion model, also converting from m^2 to cm^2 is a two step/movement but in a reversed direction i.e. $n_2 = 1\div 10000$, c = the unit in which the given unit is to be converted.

Solution

By using $n_{2\#} = \frac{2}{100}$ (two step / movement in the one dimension-conversion model)

$y = cn^d$, for two dimension, d =2

$y = cn^d = cn^2$

$2m^2 = c\times n_{2\#}^2 = c\times (1\div 100^2)\ m^2/cm^2$

$2m^2 = c\times 10000m^2/cm^2$

$[\frac{2}{(\frac{1}{100})2}\ m^2/m^2]\times 1cm^2 = c$

$2\times 10000cm^2 = c$

$20000cm^2 = c$

By using $n_2 = \frac{1}{1000}$ (actual two step / movement in the two dimension-conversion model)

$y = cn_2$

$2m^2 = c\times (\frac{1}{1000})\ m^2/cm^2$

$(2m^2\times 10000m^2)\times 1cm^2 = c$

$20000cm^2 = c$

Application of $y = cn^3$ to Three Dimension i.e. Volume (V)-Conversion Model

Example 1

Convert $2cm^3$ to m^3

Data:

y = the given unit (i.e. $2cm^3$), n = number of steps (two steps, $n_2 = 1000000$ i.e. $1000\times 1000 = n_{2\#}^3 = 100^3$ i.e. $n_{2\#}$ is the two step / movement in the one dimension-conversion model, also converting from cm^3 to m^3 is a two step/movement i.e. $n_2 = 1000000$, c = the unit in which the given unit is to be converted.

Solution

By using $n_{2\#} = 100$ (two step / movement in the one dimension-conversion model)

$y = cn^d$, for three dimension, d =3

$y = cn^d = cn^3$

$2cm^3 = c\times n_{2\#}^3 = c\times 100^3cm^3/m^3$

$2cm^3 = c\times 1000000cm^3/m^3$

$(\frac{2}{1000000}\ cm^3/cm^3)\times 1m^3 = c$

$\frac{2}{1000000}m^3 = c$

$0.000002m^3 = c$

By using $n_2 = 1000000$ (actual two step / movement in the three dimension-conversion model)

$y = cn_2$

$2cm^3 = c\times 1000000cm^3/m^3$

$(\frac{2}{1000000}cm^3/cm^3)\times 1m^3 = c$

$0.000002m^3 = c$

Example 2

Convert $2m^3$ to cm^3

Data:

y = the given unit (i.e. $2m^3$), n = number of steps (two steps but in a reversed movement, $n_2 = 1\div 1000000$ i.e. $= n_{2\#}^3 = 1\div 100^3$ i.e. $n_{2\#}$ is the reversed two step / movement in the one dimension-conversion model, also converting from m^3 to cm^3 is a reversed two step/movement i.e. $n_2 = 1000000$, c = the unit in which the given unit is to be converted.

Solution

By using $n_{2\#} = \frac{1}{100}$ (two step / movement in the one dimension-conversion model)

$y = cn^d$, for three dimension, d =3

$y = cn^d = cn^3$

$2m^3 = c\times n_{2\#}^3 = c\times (1\div 100^3)\ m^3/cm^3$

$2m^3 = c\times \frac{1}{1000000}cm^3/m^3$

$(2m^3\times 1000000m^3)\times 1cm^3 = c$

$2\times 1000000cm^3 = c$

$2000000cm^3 = c$

By using $n_2 = \frac{1}{1000000}$ (actual two step / movement in the three dimension-conversion model)

$y = cn_2$

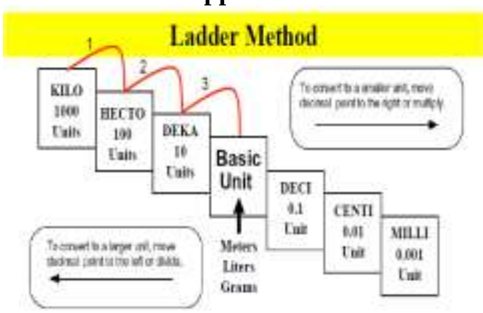
$2m^3 = c\times \frac{1}{1000000}m^3/cm^3$

$(2m^3\times 1000000m^3)\times 1cm^3 = c$

$2000000cm^3 =$

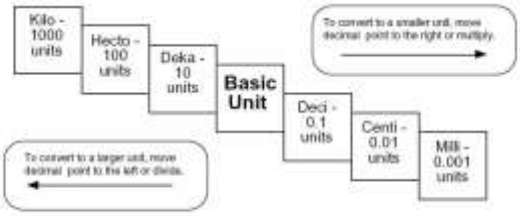
C

Appendix A



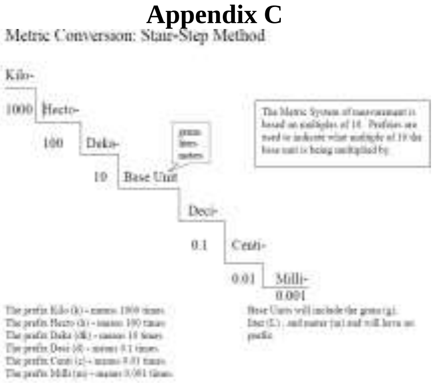
(Trimpe, 2008)

Appendix B



(Trimpe, 2000)

Appendix C



(See http://www.bayhicoach.com)

Reference

Asiedu P & Baah-Yeboah A.H (2004). Aki-Ola series; *physics for senior high schools in west africa (millennium ed. 3)*. Accra; Aki-Ola Publications

Awe O & Okunola O.O (1992). *Comprehensive certificate physics (SSCE ed.)*. Ibadan; University Press

Brown M (1999). Schaum's outlines; *physics for engineering and science*. New York; McGraw-Hill

Butterfield A, Sutherland R & Molyneux-Hodgson S (2000). Learning conversions in science: the case of vocational students in the UK. *ALT J Volume 8, number 3*

Molyneux, S. and Sutherland, R. (1996), 'Mathematical competencies of GNVQ science students: the role of computers. Report to the Leverhulme Trust, September, *The University of Bristol, School of Education*

Serway R.A & Jewett J.W, Jr (2004). *Physics for scientists and engineers (ed.6)*. California;Thomson Learning

Trimpe T (2000). *Metric Mania*, http://sciencespot.net/

Trimpe T. (2008). *Metric mania: metric conversions ladder method*, http://sciencespot.net/

http://www.bayhicoach.com