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The reverse DTML-conversion model with its mathematical formulas

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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 Reverse DTML-Conversion model (i.e. The Reverse D-Conversion model, The Reverse T-Conversion model, The Reverse M-Conversion model and The Reverse L-Conversion model) was designed. The Reverse 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.

Keywords: The Reverse D-Conversion model; The Reverse T-Conversion model; The Reverse M-Conversion model; The Reverse L-Conversion model; mathematical formula

The reverse DTML-conversion model with its mathematical formulas

1. Introduction

The Reverse 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. 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 studies in 2000 and 2008 and http://www.bayhicoach.com designed a metric mania and metric conversion: stair-step method to enable students understands conversion of distance, litre (volume) and grams (mass). 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 Reverse DTML-Conversion extends from one distance dimension to two distance dimension and three distance dimension (i.e. considering distance) 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 (10) and decimal (0.1).

However, with the Reverse DTML-Conversion model, all steps with respect to length (i.e. one dimension distance) , mass and litre S.I units are in multiples of ten (10). All steps with respect to Area (i.e. two dimension distance) are in multiples of hundreds (100), all steps with respect to volume (i.e. three dimension distance) are in multiples of thousands (i.e. 1000), and all steps with respect to time are in multiples of sixty (60). All units on the number line started with zero mark through ten steps, hundred steps, thousand step and 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 in ten steps, hundred steps, thousand step and sixty steps.

The Reverse 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 Reverse 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 (Institute of Education, 2010).

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 & 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 has taught for six years in Jasikan College of Education, designed a model (i.e. Reverse DTML-Conversion model) that would make the teaching of the subject practical and real to both students and tutors in Colleges of Education in Ghana. The Reverse DTML-Conversion model is much more an improved form of the metric mania and the stair-step method (Trimpe, 2008; http://www.bayhicoach.com). The Reverse 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 was part of their Integrated Science Syllabus.

The Reverse DTML-Conversion Model is made up of three most basic fundamental physical quantities i.e. Distance, Time and Mass. This version instead of presenting the research aspect of the reverse DTML-Conversion models rather presents only the conceptual framework and practical aspects of the Reverse DTML-Conversion model.

1.1 Research hypothesis

The following research hypothesis guided the researcher in transforming the DTML-Conversion model (Kumassah, 2012) into the Reverse DTML-Conversion model.

- 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)
- 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)
- 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)
- There is no significant statistical deference between the conversion-factor on mass and the M-Conversion model on mass
- There is no significant statistical deference between the conversion factor on time and the T-Conversion model on time.
- There is no significant statistical deference between the conversion factor on litre and the L-Conversion model on litre.

2. Conceptual framework

2.1 The reverse distance-conversion model

The reverse distance-Conversion Model (the reverse D-Conversion Model) has three parts, which are in three distance dimensions (the reverse Length-Conversion Model i.e. D1/L-Conversion model) which is a one dimension distance, two dimension distance (the Area-Conversion Model i.e. D2/A-Conversion model) and three dimension distance (the Volume-Conversion Model i.e. D3/V-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

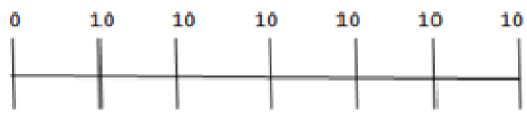


Figure 1b

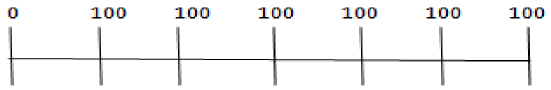
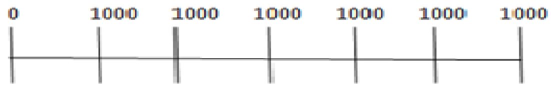


Figure 1c



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 = millimetre	mm^2 = square millimetre	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 kilometer

Figure 2. The transformation of figure-1 into complete One, Two and Three dimensions reverse distance-conversion model

Figure 2a

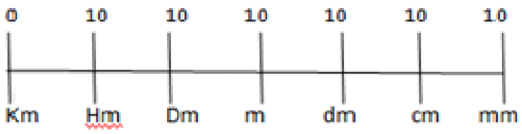


Figure 2b

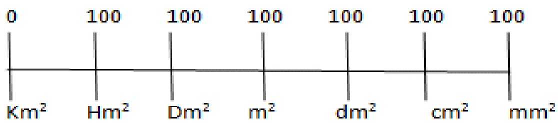
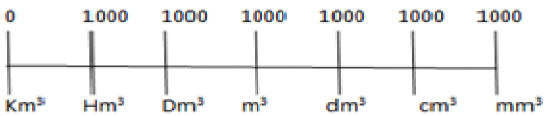


Figure 2c



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 reverse length (l)-conversion model)

This only looks at a one space with no common meeting point between two objects i.e. Km to Hm, Hm to

Dm, Dm to m, m to dm, dm to cm and cm to mm. from figure 1, the straight line has been divided into 10 equal distances starting from Km to mm. This meant that 1 step of Km will give 10 steps of Hm and it follows through to mm.

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

Figure 2d

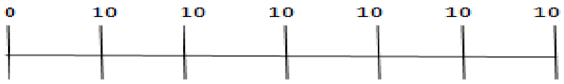


Figure 3: Complete labeled one dimension reverse distance-conversion model

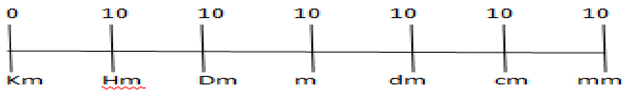
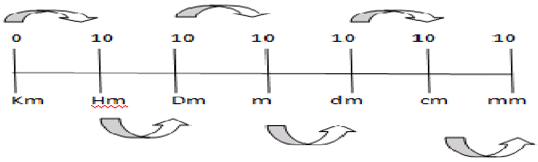


Figure 3a: One Step/ Movement

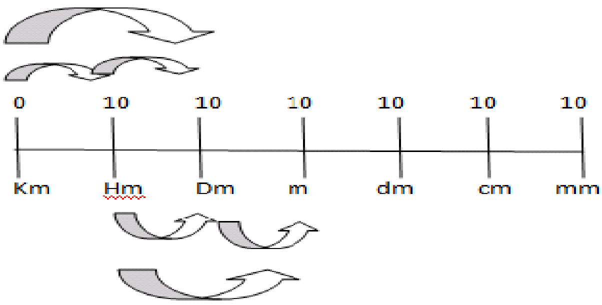


In figure 3a, one step was made starting from Km to the right i.e. the step from Km to Hm, it then implies that the first movement from Km to Hm is 10 and the second movement from Hm to Dm is also 10, thus 10=101=10 (i.e. 1Km=10Hm)

Step One / Movement One

1Km=10(1×10^1) Hm
1Hm=10(1×10^1) Dm
1Dm=10(1×10^1) m
1m=10(1×10^1) dm
1dm=10(1×10^1) cm
1cm=10(1×10^1) mm

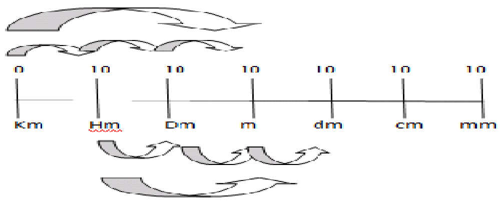
Figure 3b: Two Steps/ Movements



In figure 3b, two steps were made starting from Km to the right i.e. the first step from Km to Hm and from Hm to Dm, it then implies that the first movement from Km to Hm is 10 and the second movement from Hm to Dm is also 10, thus $10\times10=10^2=100$ (i.e. 1Km= 100Dm).

Step Two/ Movement Two
1Km= 100(1×10^2) Dm
1Hm= 100(1×10^2) m
1Dm= 100(1×10^2) dm
1m= 100(1×10^2) cm
1dm= 100(1×10^2) mm

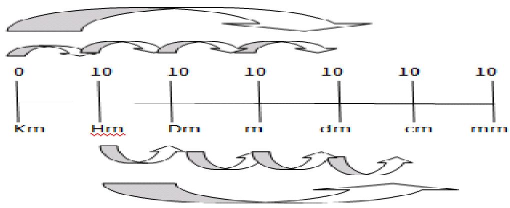
Figure 3c: Three Steps/ Movements



In figure 3c, three steps were made starting from Km to the right i.e. the first step from Km to Hm, Hm to Dm and from Dm to m, it then implies that the first movement from Km to Hm is 10, the second movement from Hm to Dm is 10 and the last step from Dm to m is also 10, thus 10×10×10=10^3=1000 (i.e. 1Km=1000m).

Step Three/ Movement Three
1Km=1000(1×10^3) m
1Hm=1000(1×10^3) dm
1Dm=1000(1×10^3) cm
1m=1000(1×10^3) mm

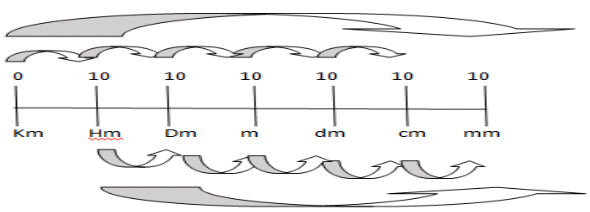
Figure 3d: Four Steps/ Movements



In figure 3d, four steps were made starting from Km to the right i.e. the first step from Km to Hm, Hm to Dm, Dm to m and from m to dm, it then implies that the first movement from Km to Hm is 10, the second movement from Hm 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 10×10×10×10=10^4=10000 (i.e. 1Km=10000dm).

Step Four/ Movement Four
1Km=10000(1×10^4) dm
1Hm=10000(1×10^4) cm
1Dm=10000(1×10^4) mm

Figure 3e: Five Steps/ Movements



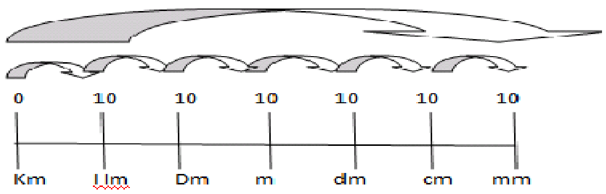
In figure 3e, five steps were made starting from Km to the right i.e. the first step from Km to Hm, Hm to Dm, Dm to m, m to dm and from dm to cm, it then implies that the first movement from Km to Hm is 10, the second movement from Hm to Dm is 10, the third movement from Dm to m is 10, the fourth movement from m to dm is 10 and the last step from dm to cm is also 10, thus $10\times10\times10\times10\times10=10^5=100000$ (i.e. 1Km =100000cm).

Step Five/ Movement Five

1Km =100000(1×10^5) cm

1Hm =100000(1×10^5) mm

Figure 3f: Six Steps/ Movements



In figure 3f, six steps were made starting from Km right i.e. the first step from Km to Hm, Hm to Dm, Dm to m, m to dm, dm to cm and from cm to mm, it then implies that the first movement from Km to Hm is 10, the second movement from Hm 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 cm is 10 and the last step from cm to mm is also 10, thus $10\times10\times10\times10\times10\times10=10^6=1000000$ (i.e. 1Km =1000000mm).

Step Six/ Movement Six

1Km =1000000(1×106) mm

Table 1

One Dimension reverse Distance Summary

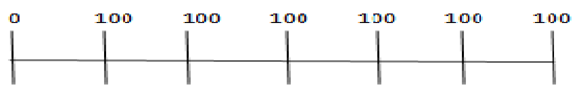
Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
1Km=10(1×10^1) Hm	1Km= 100(1×10^2) Dm	1Km=1000(1×10^3) m	1Km=10000(1×10^4)dm	1Km =100000(1×10^5) cm	1Km =1000000(1×10^6) mm
1Hm=10(1×10^1) Dm	1Hm= 100(1×10^2) m	1Hm=1000(1×10^3) dm	1Hm=10000(1×10^4)cm	1Hm =100000(1×10^5) mm	
1Dm=10(1×10^1) m	1Dm= 100(1×10^2)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

Table 1 continued

Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
1dm=10(1×10^1) cm	1dm= 100(1×10^2) mm				
1cm=10(1×10^1) mm					

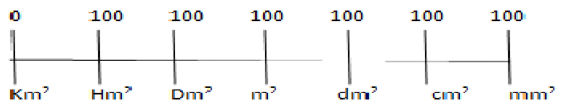
2.2 The Reverse Two Dimension Distance model (Area (A)-Conversion Model)

Figure 4: A straight line is divided into seven equal parts. The distance between each part is hundred (100).



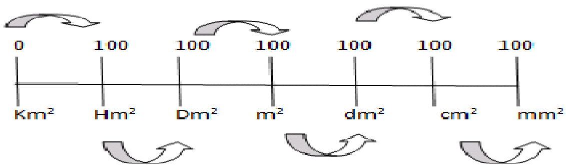
The number line is labelled Km2, Hm2, Dm2, m2, dm2, cm2 and mm2.
Km2 = square kilometre
Hm2 = square hectometre
Dm2 = square decametre
m2 = square metre
dm2 = square decimetre
cm2 = square centimetre
mm2 = square millimeter

Figure 4.1: the Complete Labelled Two Dimension reverse Distance-Conversion Model (A-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. Km^2 to Hm^2, Hm^2 to Dm^2, Dm^2 to m^2, m^2 to dm^2, dm^2 to cm^2 and cm^2 to mm^2. From figure 13, a straight line has been divided into 100 equal distances starting from Km^2 to mm^2. This meant that 1 step of Km^2 will give 100 steps of Hm^2 and it follows through to mm^2.

Figure 4a: One Step/ Movement



In figure 4a, one step was made starting from Km^2 right i.e. the step from Km^2 to Hm^2, it then implies that the first movement from Km^2 to Hm^2 is 100 and the second movement from Hm^2 to Dm^2 is also 100, thus $100=10^2=100$ (i.e. $1Km^2=100Hm2$).

The Mathematical proof:

Area= length*length=L^2

$1Km^2 = 1Km\times1Km$

But 1Km = 10Hm

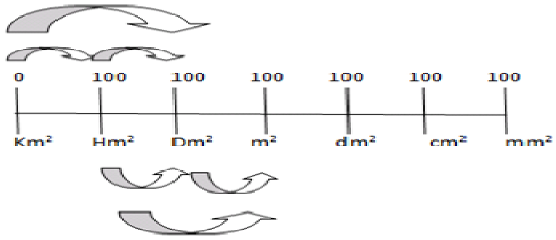
$\Rightarrow$ $1Km^2 = 1Km\times1Km= 10\ Hm \times10\ Hm = 10\times10(Hm \times Hm) = 10^2\ Hm^2=100\ Hm^2$

Step One / Movement One

$1Km^2=100(1\times10^2)\ Hm^2$
$1Hm^2=100(1\times10^2)\ Dm^2$
$1Dm^2=100(1\times10^2)\ m^2$
$1m^2=100(1\times10^2)\ dm^2$
$1dm^2=100(1\times10^2)\ cm^2$

2.3 $1cm^2=100(1\times10^2)\ mm^2$

Figure 4b: Two Step/ Movement

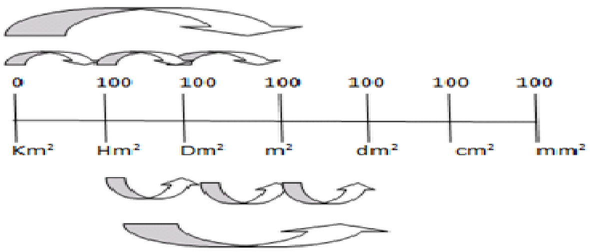


In figure 4b, two steps were made starting from Km^2 right i.e. the first step from Km^2 to Hm^2 and from Hm^2 to Dm^2. It then implies that the first movement from Km^2 to Hm^2 is 100 and the second movement from Hm^2 to Dm^2 is also 100, thus $100\times100=10^4=10000$ (i.e. $1Km^2=10000Dm^2$).

<u>Step Two/ Movement Two</u>

$1Km^2=10000(1\times10^4)\ Dm^2$
$1Hm^2=10000(1\times10^4)\ m^2$
$1Dm^2=10000(1\times10^4)\ dm^2$
$1m^2=10000(1\times10^4)\ cm^2$
$1dm^2=10000(1\times10^4)\ mm^2$

Figure 4c: Three Steps/ Movements

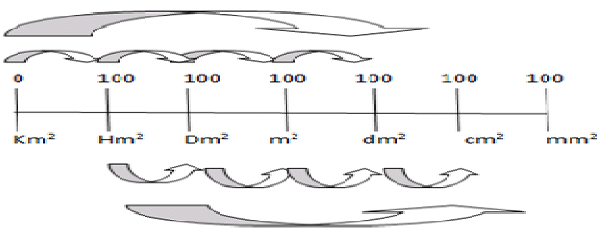


In figure 4c, three steps were made starting from Km^2 to the right i.e. the first step from Km^2 to Hm^2, Hm^2 to Dm^2 and from Dm^2 to m^2, it then implies that the first movement from Km^2 to Hm^2 is 100, the second movement from Hm^2 to Dm^2 is 100 and the last step from Dm^2 to m^2 is also 100, thus $100\times100\times100=10^6=1000000$ (i.e. $1km^2=1000000m^2$).

Step Three/ Movement Three

$1Km^2=1000000(1\times10^6)\ m^2$
$1Hm^2=1000000(1\times10^6)\ dm^2$
$1Dm^2=1000000(1\times10^6)\ cm^2$
$1m^2=1000000(1\times10^6)\ mm^2$

Figure 4d: Four Steps/ Movements

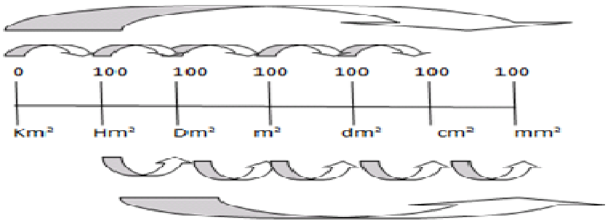


In figure 4d, four steps were made starting from Km^2 to the right i.e. the first step from Km^2 to Hm^2, Hm^2 to Dm^2, Dm^2 to m^2 and from m^2 to dm^2, it then implies that the first movement from Km^2 to Hm^2 is 100, the second movement from Hm^2 to Dm^2 is 100, Dm^2 to m^2 is 100 and the last step from m^2 to dm^2 is also 100, thus $100\times100\times100\times100=10^8=100000000$ (i.e. $1Km^2=100000000dm^2$)

Step Four/ Movement Four

$1Km^2=100000000(1\times10^8)\ dm^2$
$1Hm^2=100000000(1\times10^8)\ cm^2$
$1Dm^2=100000000(1\times10^8)\ mm^2$

Figure 4e: Five Steps/ Movements

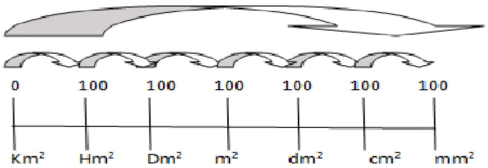


In figure 4e, five steps were made starting from Km^2 to the right i.e. the first step from Km^2 to Hm^2, Hm^2 to Dm^2, Dm^2 to m^2, m^2 to dm^2 and from dm^2 to cm^2, it then implies that the first movement from Km^2 to Hm^2 is 100, the second movement from Hm^2 to Dm^2 is 100, Dm^2 to m^2 is 100, m^2 to dm^2 and the last step from dm^2 to cm^2 is also 100, thus $100\times100\times100\times100\times100=10^{10}=10000000000$ (i.e. $1Km^2=10000000000cm^2$).

Step Five/ Movement Five

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

Figure 4f: Six Steps/ Movements



In figure 4f, six steps were made starting from Km^2 to the right i.e. the first step from Km^2 to Hm^2, Hm^2 to Dm^2, Dm^2 to m^2, m^2 to dm^2, dm^2 to cm^2 and from cm^2 to mm^2, it then implies that the first movement from Km^2 to Hm^2 is 100, the second movement from Hm^2 to Dm^2 is 100, Dm^2 to m^2 is 100, m^2 to dm^2, dm^2 to cm^2 and the last step from cm^2 to mm^2 is also 100, thus $100\times100\times100\times100\times100\times100=10^{12}=1000000000000$ (i.e. $1Km^2=10000000000mm^2$).

Step Six/ Movement Six

$1Km^2=10000000000(1\times10^{12})\ mm^2$

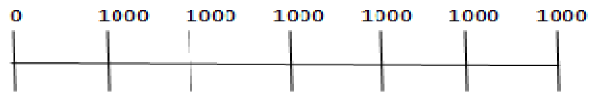
Table 2

Two Dimension Distance Summary

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

2.4 Reverse Three Dimension Distance (Volume (V)-Conversion Model)

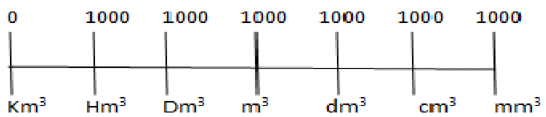
Figure 5: A straight line is divided into seven equal parts. The distance between each part is one thousand (1000)



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

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

Figure 5.1: The Complete Labelled Three Dimension Reverse Distance-Conversion Model (V-Conversion Model)



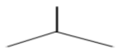
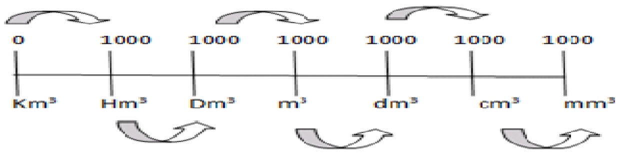
The three dimension of distance looks at three spaces () with a common meeting point between two objects (Asiedu & Baah-Yeboah, 2004; Brown, 1999; Serway & Jewett, 2004; Awe & Okunola, 1992; http://www.bayhicoach.com) i.e. Km^3 to Hm^3, Hm^3 to Dm^3, Dm^3 to m^3, m^3 to dm^3, dm^3 to cm^3 and cm^3 to mm^3. From figure 20, a straight line has been divided into 1000 equal distances starting from Km3 to mm3. This meant that 1 step of Km^3 will give 1000 steps of Hm^3 and it follows through to mm3.

Figure 5a: One Step/ Movement



In figure 5a, one step was made starting from Km^3 to the right i.e. the step from Km^3 to Hm^3 is 1000, and the movement from Hm^3 to Dm^3 is also 1000, thus $1km^3=1000(10^3)$ Hm^3. The Mathematical proof:

Volume = length × length × Length=L^3

$1Km^3$ = 1Km×1Km×1Km

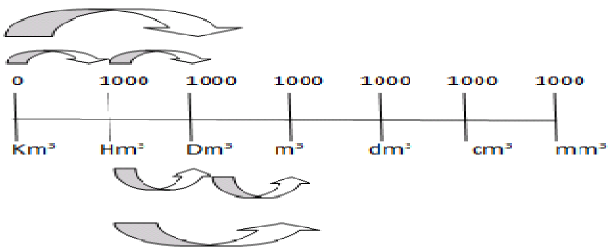
But 1Km = 10Hm

⇨ $1Km^3 = 1Km\times1Km\times1Km \equiv 10Hm \times10Hm \times10Hm = (10)^3(Hm)^3 = 1000Hm^3$

Step One/ Movement One

$1Km^3=1000(10^3)\ Hm^3$
$1Hm^3=1000(10^3)\ Dm^3$
$1Dm^3=1000(10^3)\ m^3$
$1m^3=1000(10^3)\ dm^3$
$1dm^3=1000(10^3)\ cm^3$
$1cm^3=1000(10^3)\ mm^3$

Figure 5b: Two Step/ Movement

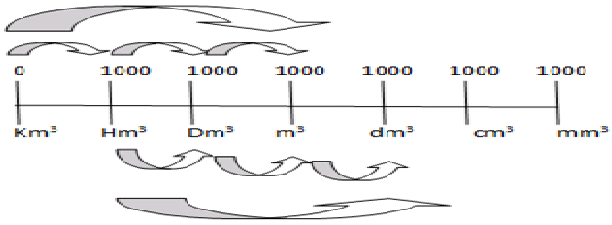


In figure 5b, two steps were made starting from Km^3 to the right i.e. the first step from Km^3 to Hm^3 and from Hm^3 to Dm^3. It then implies that one movement from Km^3 to Hm^3 is 1000 and the second movement from Hm^3 to Dm^3 is also 1000, thus $1000\times1000=10^6=1000000$ (i.e. $1Km^3=1000000Dm^3$).

Step Two/ Movement Two

$1Km^3=1000000(1\times10^6)\ Dm^3$
$1Hm^3=1000000(1\times10^6)\ m^3$
$1Dm^3=1000000(1\times10^6)\ dm^3$
$1m^3=1000000(1\times10^6)\ cm^3$
$1dm^3=1000000(1\times10^6)\ mm^3$

Figure 5c: Three Steps/ Movements

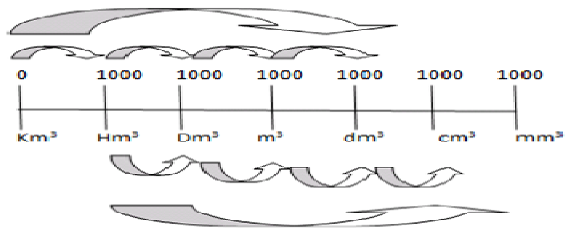


In figure 5c, three steps were made starting from Km^3 to the right i.e. the first step from Km^3 to Hm^3, Hm^3 to Dm^3 and from Dm^3 to m^3, it then implies that the first movement from Km^3 to Hm^3 is 1000, the second movement from Hm^3 to Dm^3 is 1000 and the last step from Dm^3 to m^3 is also 1000, thus $1000\times1000\times1000=10^9=1000000000$ (i.e. $1Km^3=1000000000m^3$).

Step Three/ Movement Three

$1Km^3=1000000000(1\times10^9)\ m^3$
$1Hm^3=1000000000(1\times10^9)\ dm^3$
$1Dm^3=1000000000(1\times10^9)\ cm^3$
$1m^3=1000000000(1\times10^9)\ mm^3$

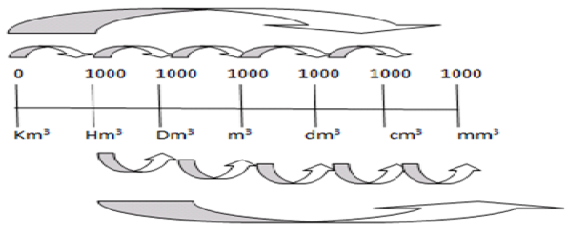
Figure 5d: Four Steps/ Movements



In figure 5d, four steps were made starting from Km^3 to the right i.e. the first step from Km^3 to Hm^3, Hm^3 to Dm^3, Dm^3 to m^3 and from m^3 to dm^3, it then implies that the first movement from Km^3 to Hm^3 is 1000, the second movement from Hm^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. $1Km^3 =1000000000000dm^3$).

Step Four/ Movement Four
$1Km^3 =1000000000000(1\times10^{12})\ dm^3$
$1Hm^3 =1000000000000(1\times10^{12})\ cm^3$
$1Dm^3 =1000000000000(1\times10^{12})\ mm^3$

Figure 5e: Five Steps/ Movements



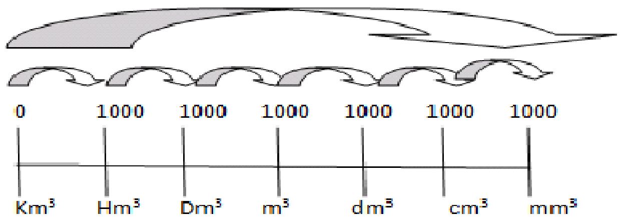
In figure 5e, five steps were made starting from Km^3 to the right i.e. the first step from Km^3 to Hm^3, Hm^3 to Dm^3, Dm^3 to m^3, m^3 to dm^3 and from dm^3 to cm^3, it then implies that the first movement from Km^3 to Hm^3 is 1000, the second movement from Hm^3 to Dm^3 is 1000, to the last step from dm^3 to cm^3 is also 1000, thus $1000\times1000\times1000\times1000\times1000=10^{15}=1000000000000000$ (i.e. $1Hm^3 = 1000000000000000mm^3$).

Step Five/ Movement Five

$1Km^3$ =1000000000000000(1×10^{15}) cm^3

$1Hm^3$ =1000000000000000(1×10^{15}) mm^3

Figure 5f: Six Steps/ Movements



In figure 5f, six steps were made starting from Km^3 to the right. The i.e. the steps are Km^3 to mm^3, Hm^3 to Dm^3, Dm^3 to m^3, m^3 to dm^3, dm^3 to cm^3 and from cm^3 to mm^3, it then implies that the first movement from Km^3 to Hm^3 is 1000, the second movement from Hm^3 to Dm^3 is 1000, Dm^3 to m^3 is 1000, m^3 to dm^3 is 1000, dm^3 to cm^3 is 1000 and the last step from cm^3 to mm^3 is also 1000, thus 1000×1000×1000×1000×1000×1000=10^{18}=1000000000000000000(i.e.1Km^3=10000000000000000mm^3).

Step Six/ Movement Six

$1Km^3$= 10000000000000000mm^3

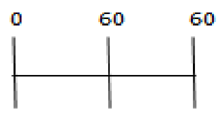
Table 3

reverse Three Dimension Distance Summary

Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
$1Km^3$=1000 (10^3) Hm^3	1Km3=1000000(1×106)Dm3	$1Km^3$=1000000000 (1×10^9)m^3	$1Km^3$=1000000000000 (1×10^{12}) dm^3	$1Km^3$=1000000000000000 (1×10^{15}) cm^3	$1Km^3$=10000000000000000(1×10^{18}) mm^3
$1Hm^3$=1000(10^3) Dm^3	1Hm3=1000000(1×106)m3	$1Hm^3$=1000000000(1×10^9)dm^3	$1Hm^3$=1000000000000(1×10^{12}) cm^3	$1Hm^3$=1000000000000000(1×10^{15}) mm^3	
$1Dm^3$=1000(10^3) m^3	1Dm3=1000000(1×106)dm3	$1Dm^3$=1000000000(1×10^9)cm^3	$1Dm^3$=1000000000000 (1×10^{12}) mm^3		
$1m^3$=1000 (10^3) dm^3	1m3=1000000(1×106) cm3	$1m^3$=1000000000(1×10^9)mm^3			
$1dm^3$=1000(10^3) cm^3	1Km3=1000000(1×106)Dm3				
$1cm^3$=1000(10^3) mm^3					

2.5 The Reverse Time (T)-Conversion Model

Figure 6: A number line is divided into two equal parts. The distance between each part is sixty (60)

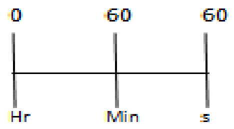


The number line is labelled Hr, min, and s.

s = second

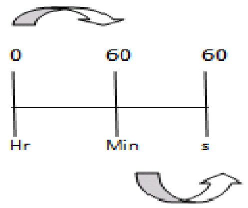
min = minute
Hr = hour

Figure 6.1: The Complete Labelled Reverse T-Conversion Model



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

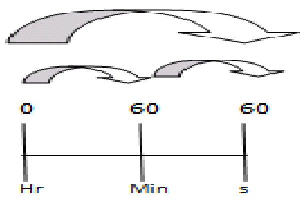
Figure 6a: One Step/ Movement



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

Step One / Movement One
1 Hr = 60min
1 min = 60 s

Figure 6b: Two Steps/ Movements



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

Step Two/ Movement Two
1Hr = 3600s

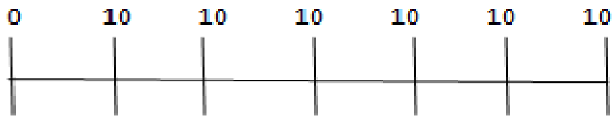
Table 4

The Reverse Time-Conversion Model Summary

Step 1	Step 2
1 Hr = 60min	1Hr = 3600s
1 min = 60 s	

2.6 The Reverse Mass (M)-Conversion Model

Figure 7: A straight line is divided into six equal parts. The distance between each part is ten (10)



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

Kg = kilogram
Hg = hectogram
Dg = dekagram
g = gram
dg = decigram
cg = centigram
mg = milligram

Figure 7.1: The Complete Labelled Reverse M-Conversion Model

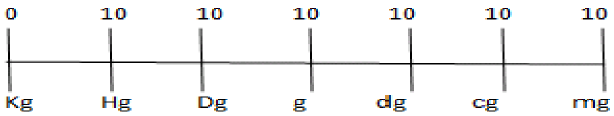
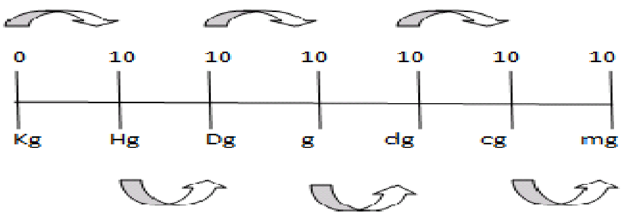


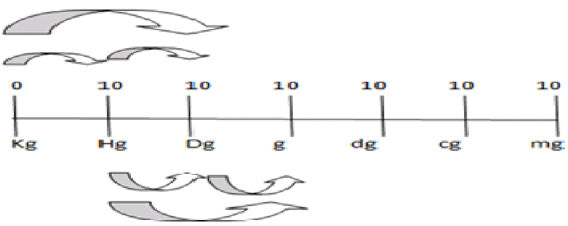
Figure 7a: One Step/ Movement



In figure 7a, one step was made starting from Kg to the right i.e. the step from Kg to Hg, Hg to Dg, Dg to g, g to dg, dg to cg, and cg to mg. This then implies that one movement from Kg to Hg is 10 thus $10=1\times10^1$ (i.e. 1Kg = 10Hg).

Step One / Movement One
1Kg = 10Hg
1Hg = 10Dg
1Dg = 10g
1g = 1dg
1dg = 10cg
1cg = 10mg

Figure 7b: Two Step/ Movement

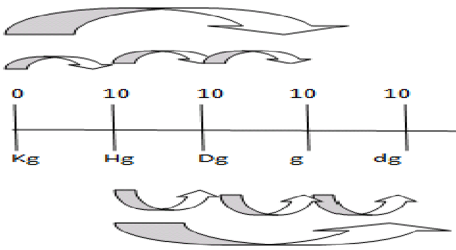


In figure 7b, two steps were made starting from Kg to the right i.e. the step from Kg to Dg, Hg to g, Dg to dg, g to cg, and dg to mg. This then implies that one movement from Kg to Dg is 100 thus $10 \times 10 = 1 \times 10^2$ (i.e. 1Kg = 100Dg).

Step Two / Movement Two

1Kg = 100Dg
1Hg = 100g
1Dg = 100dg
1g = 100cg
1dg = 100mg

Figure 7c: Three Step/ Movement

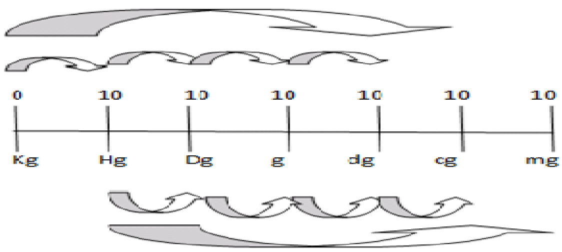


In figure 7c, three steps were made starting from Kg to the right i.e. the step from Kg to g, Hg to dg, Dg to cg, and g to mg. This then implies that one movement from Kg to g is 1000 thus $10 \times 10 \times 10 = 1 \times 10^3$ (i.e. 1Kg = 1000g).

Step Three / Movement Three

1Kg = 1000g
1Hg = 1000dg
1Dg = 1000cg
1g = 1000mg

Figure 7d: Four Step/ Movement

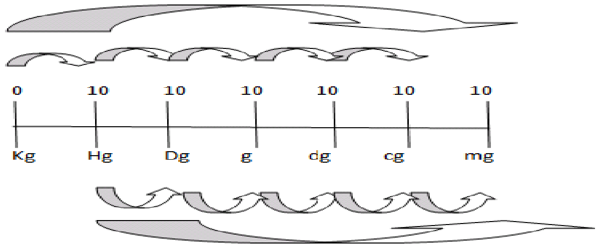


In figure 7d, four steps were made starting from Kg to the right i.e. the step from Kg to dg, Hg to cg, and Dg to mg. This then implies that one movement from Kg to dg is 10000 thus $10 \times 10 \times 10 \times 10 = 1 \times 10^4$ (i.e. 1Kg = 10000dg).

Step Four / Movement Four

1Kg = 10000 dg
1Hg = 10000 cg
1Dg = 10000 mg

Figure 7e: Five Step/ Movement

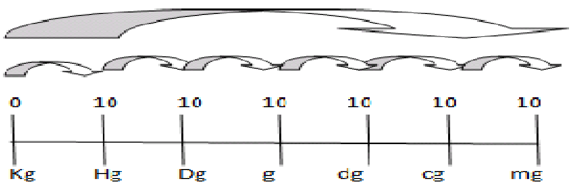


In figure 7e, five steps were made starting from Kg to the right i.e. the step from Kg to cg, and Hg to mg. This then implies that one movement from Kg to cg is 100000 thus $10\times10\times10\times10\times10=1\times10^5$ (i.e. 1Kg = 100000 cg).

Step Five / Movement Four

1Kg = 100000 cg
1Hg = 100000 mg

Figure 7f: Six Step/ Movement



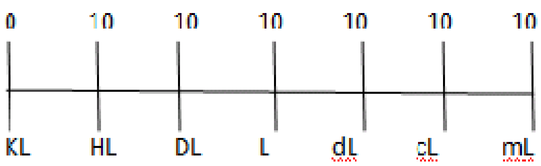
In figure 7f, six steps were made starting from Kg to the right i.e. the step from Kg to mg. This then implies that one movement from Kg to mg is 1000000 thus $10\times10\times10\times10\times10\times10=1\times10^6$ (i.e. 1Kg = 1000000 mg).

Step Six / Movement Four
1Kg = 1000000mg

Table 5

Reverse Mass-Conversion Model Summary

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



2.7 The Reverse Liter (L)-Conversion Model

Figure 8: A straight line is divided into six equal parts. The distance between each part is ten (10)

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

KL = kiloliter
HL = hectoliter
DL = dekaliter
L = liter
dL = deciliter
cL = centiliter
mL = milliliter

Figure 8.1: The Complete Labelled reverse L-Conversion Model

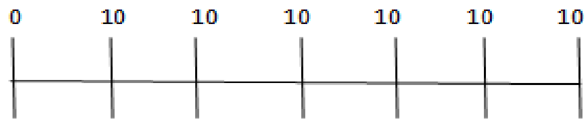
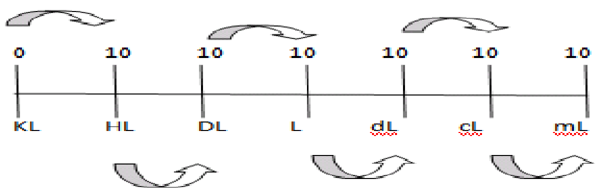


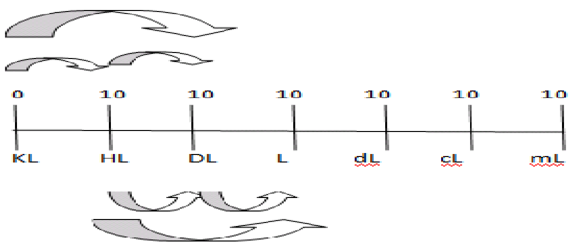
Figure 8a: One Step/ Movement



In figure 8a, one step was made starting from KL to the right i.e. the step from KL to HL, HL to DL, DL to L, L to dL, dL to cL, and cL to mL. This then implies that one movement from KL to HL is 10 thus $10=1\times10^1$ (i.e. 1KL = 10HL).

Step One / Movement One
1KL = 10HL
1HL = 10DL
1DL = 1L
1L = 10dL
1dL = 10cL
1cL = 10mL

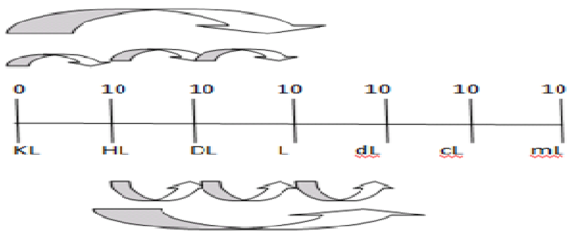
Figure 8b: Two Step/ Movement



In figure 8b, two steps were made starting from KL to the right i.e. the step from KL to DL, HL to L, DL to dL, L to cL, and dL to mL. This then implies that the movement from KL to DL is 100 thus $10\times10=1\times10^2$ (i.e. 1KL = 100DL).

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

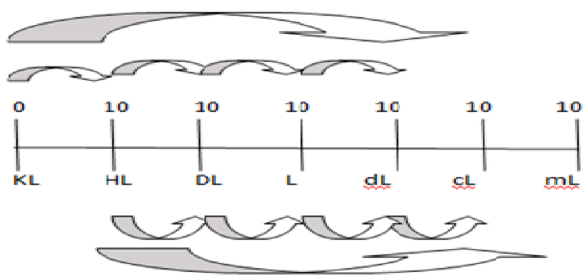
Figure 8c: Three Step/ Movement



In figure 8c, three steps were made starting from KL to the right i.e. the step from KL to L, HL to dL, DL to cL, and L to mL. This then implies that one movement from KL to L is 1000 thus $10\times10\times10=1\times10^3$ (i.e. 1KL = 1000L).

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

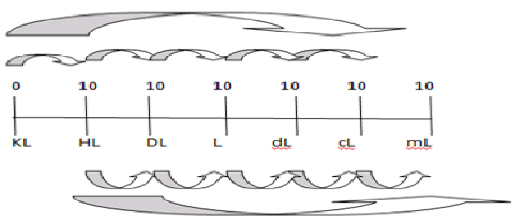
Figure 8d: Four Step/ Movement



In figure 8d, four steps were made starting from KL to the right i.e. the step from KL to dL, HL to cL, and DL to mL. This then implies that one movement from KL to dL is 10000 thus $10\times10\times10\times10=1\times10^4$ (i.e. 1KL = 10000dL).

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

Figure 8e: Five Step/ Movement

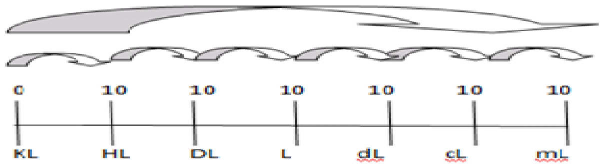


In figure 8e, five steps were made starting from KL to the right i.e. the step from KL to cL, and HL to mL. This then implies that one movement from KL to cL is 100000 thus 10×10×10×10×10=1×105 (i.e. 1KL = 100000cL).

Step Five / Movement Four

1KL = 100000cL
1HL = 100000mL

Figure 8f: Six Step/ Movement



In figure 8f, six steps were made starting from KL to the right i.e. the step from KL to mL. This then implies that one movement from KL to mL is 1000000 thus 10×10×10×10×10×10=1×106 (i.e. 1KL = 1000000mL).

Step Six / Movement Four
1KL = 1000000mL

Table 5

Liter-Conversion Model Summary

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

3. Mathematical proof of the number of step/movements on the DTML-CONVERSION model

3.1 Movement in one dimension

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

Figure 1: the Length (L)-Conversion Model

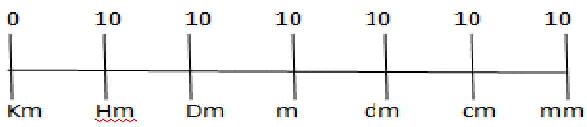


Figure 2: the Mass (M)-Conversion Model

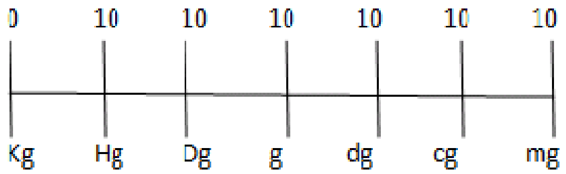


Figure 3: the Liter-Conversion Model

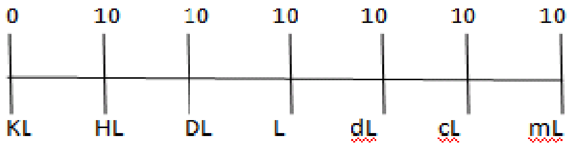


Figure 4: the Time (T)-Conversion Model

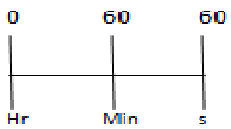
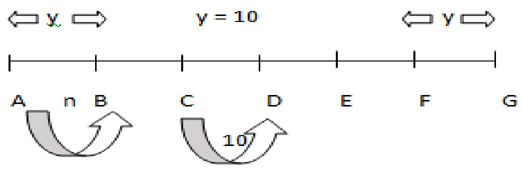


Figure 1, 2 and 3 will be considered now and after the proving, will be applied to figure 4.

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



Where A = Km = Kg = KL (figure 1, 2 and 3) and G = 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 $k = 1 = (n/y^h) = (n/10^h)$
$n_h = y^h$, but y = 10 (figure 5)
$n_h = y^h = 10^h$
$n_h = 10^h$

Application of $n = 10^h$ to Reverse One Dimension of L, T, M and Liter- 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

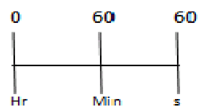
- To determine the fifth movement/ step to the right of the starting point A, then h = 5

  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 Reverse 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 Hr (figure 4) is 1 unit

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

  From $n_h = 60^{h,}$ $n_1 = 60^1 = 60$ units, so the first movement from the starting point Hr (figure 4) is a distance of 60 units

- To determine the second movement/ step to the right of the starting point Hr, 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

3.2 Movement in two dimensions

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

Figure 6: the reverse Area (A)-Conversion Model

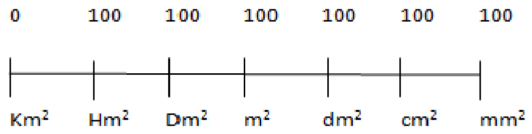
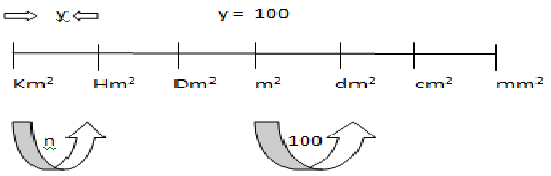


Figure 7: the Proved Diagram for reverse Two Dimension-Conversion Model



Let y = equal distance/space between alphabets (figure 7)
n = the number of steps / movements from the starting point Km^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 reverse 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 Km^2 (figure 7) is 1 unit.

- To determine the first movement/ step to the right of the starting point Km^2, then h = 1
  From $n_h = 100^{h,}$ $n_1 = 100^1 = 100$ units, so the first movement from the starting point Km^2 (figure 7) is a distance of 100 units.

- To determine the second movement/ step to the right of the starting point Km^2, then h = 2
  From $n_h = 100^{h,}$ $n_2 = 100^2 = 100\times100 = 10000$ units, so the second movement from the starting point Km^2 (figure 7) is a distance of 10000 units.

- To determine the third movement/ step to the right of the starting pointKm^2, then h = 3
  From $n_h = 100^{h,}$ $n_3 = 100^3 = 100\times100\times100 = 1000000$ units, so the third movement from the starting point Km^2 (figure 7) is a distance of 1000000 units.

- To determine the fourth movement/ step to the right of the starting point Km^2, then h = 4
  From $n_h = 100^{h,}$ $n_4 = 100^4 = 100\times100\times100\times100 = 100000000$ units, so the fourth movement from the starting point Km^2 (figure 7) is a distance of 100000000 units.

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

  From $n_h = 100^{h,} n_5 = 100^5 = 100\times100\times100\times100\times100 = 10000000000$ units, so the fifth movement from the starting point Km^2 (figure 7) is a distance of 10000000000 units.

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

  From $n_h = 100^{h,} n_6 = 100^6 = 100\times100\times100\times100\times100\times100 = 1000000000000$ units, so the sixth movement from the starting point Km^2 (figure 7) is a distance of 1000000000000 units.

3.3 Movement in three dimensions

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

Figure 8: the Volume (V)-Conversion Model

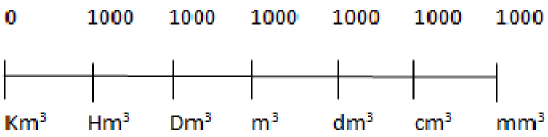
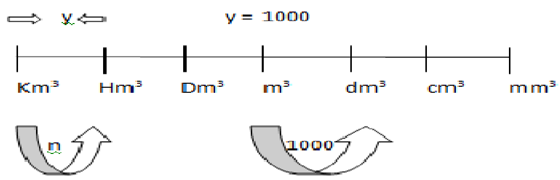


Figure 9: the Proved Diagram for reverse Three Dimension-Conversion Model



Let y = equal distance/space between alphabets (figure 9)
n = the number of steps / movements from the starting point, Km^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)
$n_h = y^h = 1000^h$
$n_h = 1000^h$

3.4 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 nh = 1000h, n0 = 10000 = 1 unit, so the starting point Km3 (figure 9) is 1 unit.

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

  From $n_h = 1000^{h,} n_1 = 1000^1 = 1000$ units, so the first movement from the starting point Km^3 (figure 9) is a distance of 1000 units.

- To determine the second movement/ step to the right of the starting point Km^3, then h = 2
  From nh = 1000h, n2 = 1000^2 = 1000×1000 = 1000000 units, so the second movement from the starting point Km3 (figure 9) is a distance of 1000000 units.

- To determine the third movement/ step to the right of the starting point Km^3, then h = 3
  From nh = 1000h, n3 = 1000^3 = 1000×1000×1000 = 1000000000 units, so the third movement from the starting point Km^3 (figure 9) is a distance of 1000000000 units.

- To determine the fourth movement/ step to the right of the starting point Km^3, then h = 4
  From nh = 1000h, n4 = 1000^4 = 1000×1000×1000×1000 = 1000000000000 units, so the fourth movement from the starting point Km3 (figure 9) is a distance of 1000000000000 units.

- To determine the fifth movement/ step to the right of the starting point Km^3, then h = 5
  From nh = 1000h, n5 = 1000^5 = 1000×1000×1000×1000×1000 = 1000000000000000 units, so the fifth movement from the starting point Km3 (figure 9) is a distance of 1000000000000000 units.

- To determine the sixth movement/ step to the right of the starting point Km^3, then h = 6
  From nh = 1000h, n6 = 100^6 = 1000×1000×1000×1000×1000×1000 = 1000000000000000000 units, so the sixth movement from the starting point Km3 (figure) is a distance of 1000000000000000000 units.

4. Mathematical proof of converting within units with the reverse 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
$y = cn^d$; $c \neq 0$, 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)

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

y = cnd, 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, n2 = 100 i.e. converting from cm to m is a two step/movement i.e. n2 = 100), c = the unit in which the given unit is to be converted.

Solution

$y = cn$

$2cm = c\times100cm/m$

$2cm/100cm\times1m = c$

$0.02m = c$

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

$y = cn$

$0.001g = c\times 1/10g/dg$

$0.001g/ (1/10g) \times1dg = c$

$0.001\times10dg = c$

$0.01dg = c$

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

$y = cn$

$534kL = c\times 1/1000000kL/mL$

$534kL/ (1/1000000kL/mL) = c$

$534\times1000000mL = c$

$534000000mL = c$

Example 4

Change 200s to hr.

Data:

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

Solution

$y = cn$

$200s = c\times (3600)\ s/hr$

$200s/3600s\times1hr = c$

$(200/3600) \times1hr = c$

$0.056\ hr = c$

4.2 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

$y = cn^d = cn^2$

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

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

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

$2/10000m^2 = c$

$0.0002m^2 = c$

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

$y = cn_2$

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

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

$0.0002m^2 = c$

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

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

$y = cn^d = cn^2$

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

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

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

$2\times 10000cm^2 = c$

$20000cm^2 = c$

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

$y = cn_2$

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

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

$20000cm^2 = c$

4.3 Application of y = cn3 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. $1000\times1000 = n_{2\#}^3 = 100^3$ 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

$y = cn^d = cn^3$

$2cm^3 = c\times n_{2\#}^3 = c\times100^3cm^3/m^3$

$2cm^3 = c\times1000000cm^3/m^3$

$(2/1000000cm^3/cm^3)\times1m^3 = c$

$2/1000000m^3 = c$

$0.000002m^3 = c$

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

$y = cn_2$

$2cm^3 = c\times1000000cm^3/m^3$

$(2/1000000cm^3/cm^3)\times1m^3 = c$

$0.000002m^3 = c$

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, $n_2 = 1\div1000000$ i.e. = $n_{2\#}^3 = 1\div100^3$ 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 $n_{2\#} = 1/100$ (two step / movement in the one dimension-conversion model)

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

$y = cn^d = cn^3$

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

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

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

$2\times 1000000cm^3 = c$

$2000000cm^3 = c$

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

$y = cn_2$

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

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

$2000000cm^3 = c$

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