Unit Conversions
in
Dimensional
Analysis

Involving Multiple
Unit Conversions

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Unit Conversions in Dimensional Analysis
Involving the Conversions of More than One Unit at a Time

Sometimes, one may have to do a unit conversion problem that involves the simultaneous conversion of two or more units to other units at a time. For example, one may be asked to do the following unit conversion problems:

1) Express **25 g/cm^3** in **kg/m^3**.
2) Express **20 lbs/ft** in **g/cm**.
3) Express **50 kg/sec** in **lbs/min**.

In this kind of situation, the first thing to do is to take a look at the units that are involved in the problem.

Steps to Follow:

a) Since the units are presented in ratios or fractions (i.e. the unit is composed of a unit making up its numerator and another unit making up its denominator) as in [g/cm^3, lbs/ft, kg/sec], identify the unit making up the numerator of the original unit, and also identify the unit making up the denominator of the original unit. For example, we can see that in Question 1, the unit making up the **numerator** of the original unit is **grams** and the unit the unit making up the **denominator** of the original unit is **cm^3**.

b) The next thing to do is to **identify** the units making up the numerator and the denominator of new unit that the value is going to be expressed in. For instance, in Question 1, the unit making up the **numerator** of the final unit that our value is going to be expressed in is **kg** and the unit making up the **denominator** of the unit is **m^3**.

c) For the time being, simply ignore the number in front of the original unit that has to be converted, and just concentrate only on the unit that you are going to convert.

d) The next move is to convert the unit in the numerator of the original unit to the unit in the numerator of the final unit. (you are going to have a value expressed in the units of the numerator of the final unit; Let's call this value **FACTOR A**).

e) Then convert the unit in the denominator of the original unit to the unit in the denominator of the final unit (you are going to have a value expressed in the units of the denominator of the final unit; Let's call this value **FACTOR B**).

f) For some time now we have been ignoring the number that was in front of the original unit that was to be converted. At this point, we are now going to consider **the number that was in front of the original unit** that had to be converted.

g) What we are going to do next is to:

(1) Multiply this number by **FACTOR A**.

(2) Divide it by **FACTOR B**

(3) And then write out the ***final units*** after the result.

And that's it! The question has been solved.

In order to make the picture clearer, let's take a close look at some of this type of unit conversions problems by solving the sample questions that I presented at the beginning of this study guide:

SAMPLE CALCULATIONS

Questions:

Solve the following problems:

(1) Express **25 g/cm^3** in **kg/m^3**.

(2) Express **20 lbs/ft** in **g/cm**.

(3) Express **50 kg/sec** in **lbs/min**.

Solutions:

Question 1: Express **25 g/cm^3** in **kg/m^3**

Steps:

(A) Let's ignore the number **25** for the time being.

IDENTIFICATION OF UNITS

(B) The unit in the numerator of the original unit is grams and the unit in the numerator of the final unit is kilograms.

(C) The unit in the denominator of the original unit is cm^3 and the unit in the denominator of the final unit is m^3.

CONVERSION OF UNITS IN THE NUMERATOR AND DENOMINATOR OF ORIGINAL UNIT TO THE UNITS OF THE NUMERATOR AND DENOMINATOR OF THE FINAL UNIT.

(D) Let's convert the units in the numerator and denominator of original unit to the units of the numerator and denominator of the final unit and from there we can know what **FACTOR A** and **FACTOR B** are going to be:

Lets change 1 **gram** into **kilograms**:

At this point, I am not going to show all the details that are involved in changing grams to kilograms.

1 g = 0.001 kg

Therefore, **FACTOR A** = 0.001

(D) Let's change 1 cm^3 into m^3:

1 cm^3 = 0.000001 m^3

Therefore, **FACTOR B** = 0.000001

FINAL STEPS:

(E) Multiply **25** by FACTOR A (0.001)

$25 \times 0.001 = 0.025$

(F) Then divide the result by FACTOR B (0.000001)

0.025 / 0.000001 = 25,000

(G) Write out the final units after the result

25,000 kg/m^3

And that's our answer!

25 g/cm^3 is equivalent to 25,000 kg/m^3

Question 2: Express **20 lbs/ft** in **g/cm**

Steps:

(A) Let's ignore the number **20** for the time being.

IDENTIFICATION OF UNITS

(B) The unit in the numerator of the original unit is lbs and the unit in the numerator of the final unit is grams.

(C) The unit in the denominator of the original unit is ft and the unit in the denominator of the final unit is cm.

CONVERSION OF UNITS IN THE NUMERATOR AND DENOMINATOR OF ORIGINAL UNIT TO THE UNITS OF THE NUMERATOR AND DENOMINATOR OF THE FINAL UNIT.

(D) Let's convert the units in the numerator and denominator of original unit to the units of the numerator and denominator of the final unit, and from there we can know what **FACTOR A** and **FACTOR B** are going to be:

Let's change 1 **pound** into **grams**:

1 lb = 454 grams

Therefore, **FACTOR A** = 454

(E) Let's change 1 ft into cm

1 ft = 30.48 cm

Therefore, **FACTOR B** = 30.48

FINAL STEPS:

(F) Multiply 20 by FACTOR A (454)

$20 \times 454 = 9080$

(G) Then divide the result by FACTOR B (30.48)

9080 / 30.48 = 297.90

(H) Write out the final units after the result

297.90 g/cm

And that's our answer!

20 lbs/ft is equivalent to 297.90g/cm

Question 3: Express **50 kg/sec** in **lbs/min**.

Steps:

(A) For the time being, let's ignore the number **50**.

IDENTIFICATION OF UNITS

(B) The unit in the numerator of the original unit is kg and the unit in the numerator of the final unit is lbs.

(C) The unit in the denominator of the original unit is secs and the unit in the denominator of the final unit is min.

CONVERSION OF UNITS IN THE NUMERATOR AND DENOMINATOR OF ORIGINAL UNIT TO THE UNITS OF THE NUMERATOR AND DENOMINATOR OF THE FINAL UNIT.

(D) Let's convert the units in the numerator and denominator of original unit to the units of the numerator and denominator of the final unit, and from there we can know what **FACTOR A** and **FACTOR B** are going to be:

Let's change 1 kilogram into pounds:

1 kg = 2.2 lbs

Therefore, **FACTOR A** = 2.2

(E) Let's change 1 second into minutes

1 sec = 0.0166 mins

Therefore, **FACTOR B** = 0.0166

FINAL STEPS:

(F) Multiply 50 by FACTOR A (2.2)

$50 \times 2.2 = 110$

(G) Then divide the result by FACTOR B (0.0166)

110 / 0.0166 = 6600

(H) Write out the final units after the result

6600 lbs/min

And that's our answer!

50 kg/sec is equivalent to 6600 lbs/min

Thank you very much for your attention.
I hope this study guide will be of help to you in your studies.
If there are any misspellings or misrepresentation of any information in this study guide that might result in your misunderstanding or misinterpretation of any of my explanations, please do not hesitate to let me know.
You may contact me at **ELmeuko@aol.com**, if you have any questions, comments or suggestions.

Sincerely,
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