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Maths for Nurses:
Unit conversions

This booklet will provide an overview of the unit conversions for nursing students.

If you have any problems in answering the questions within the booklet please contact skills@library.leeds.ac.uk for personal help using the maths support drop-in sessions. Also check out these e-videos and quizzes:

- University of Leeds *Maths for nurses*

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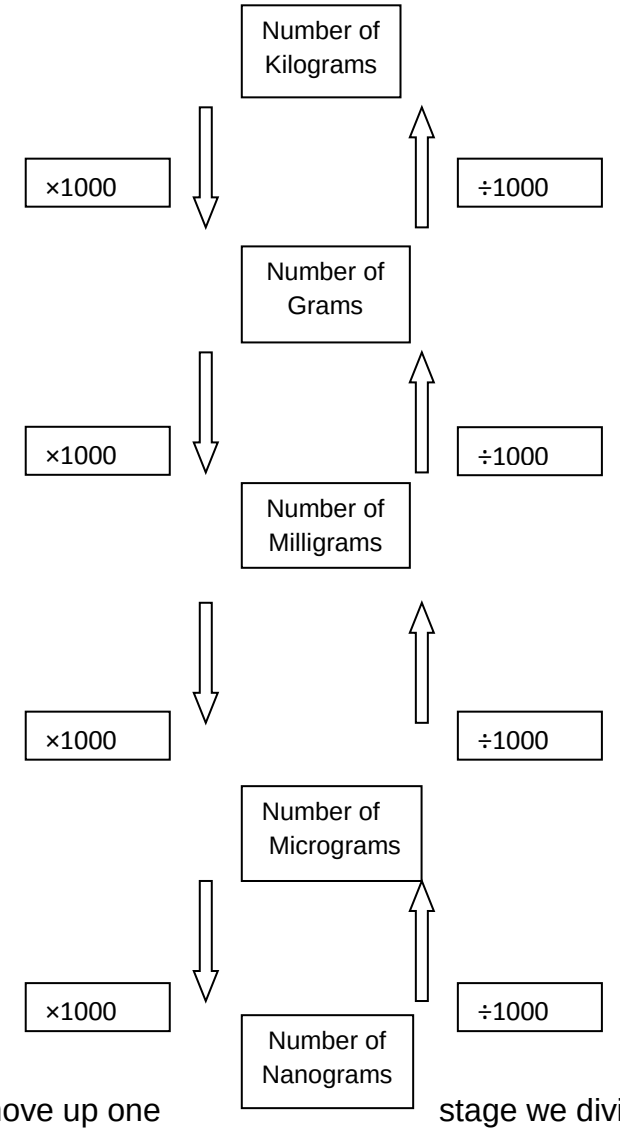
Unit Conversion

In your chosen field you are likely to need to convert weights/volumes from one unit to another.

a) Metric Measurements of Weight

Name	Abbreviation	Notes
Kilogram	kg	Approx. the weight of a litre of water
Gram	g	One thousand grams to a kilogram
Milligram	mg	One thousand mg to the gram
Microgram	mcg	One million mcg to the gram
Nanogram	ng	One thousand ng to the mcg

Conversion Chart



To move up one stage we divide by 1000 and to go down one stage we multiply by 1000. If we want to move up two stages we divide by 1000 twice (i.e. divide by 1000000= 1 million)

Example

Convert 3 kilograms into grams.
As we can see from the table, there are 1000 grams in a kilogram.
We have 3 kilograms, so 3 × 1000 = 3000
3kg = 3000g.

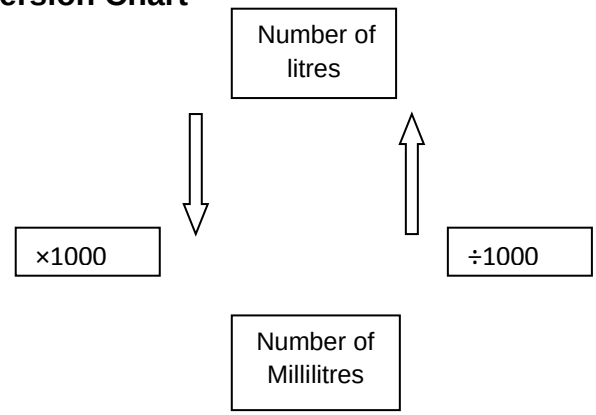
From the conversion chart, the arrow from kilograms to grams carries the instruction '×1000'. So 3 × 1000 = 3000. We have 3000g.

Note There is a greater chance of serious error when using abbreviations of measures.
For example mg, ng, and mcg may be hard to distinguish if written by hand. To avoid this, it is best to write out the whole name of the measure.

b) Metric Measurements of Liquids

Name	Abbreviation	Notes
Litre	l	Abbreviation is a lower-case L
Millilitre	ml	One thousand millilitres to a litre

Conversion Chart



There is also the Centilitre (cl), so named as there are a hundred of them in a litre.
A single Centilitre is equivalent to 10ml. Centilitres are normally used to measure wine.

Examples

1. Convert 575 millilitres into litres.
From the diagram, we see that to convert from millilitres to litres, we divide the number of millilitres by 1000.
So we have 575 ÷ 1000 = 0.575 litres

2. Convert 2.67 litres into millilitres.
To convert from litres to millilitres we multiply the number of litres by 1000.
So we have 2.67 × 1000 = 2670 millilitres

Estimation
Always look at the answers you produce to check they are sensible. A good way to do this is to estimate the answer.
In Example 1 above we can use our knowledge of litres and millilitres to estimate the result. We have 575 millilitres. If we had 1000 millilitres we would have a litre. Half a litre would be 500 millilitres, so our result will be a little over half a litre.

Exercise 1

1. Copy and complete the following, using the tables and diagrams
a) 1 kilogram = ____ grams
b) 1 gram = ____ milligrams
c) 1 gram = ____ micrograms
d) 1 microgram = ____ nanograms
e) 1 litre = ____ millilitres

2. Convert the following into milligrams
a) 6 grams b) 26.8 grams c) 3.924 grams d) 405 grams

3. Convert the following into grams
a) 1200mg b) 650mg c) 6749mg d) 3554mg

4. Convert the following into milligrams
a) 120 micrograms b) 1001 micrograms c) 2675 micrograms
d) 12034 mcg

5. Convert the following: (you may find it easier to work out the answers in two stages):
a) 1.67grams into micrograms b) 0.85grams into micrograms
c) 125 micrograms into grams d) 6784 micrograms into grams
e) 48.9 milligrams into nanograms f) 3084 nanograms into milligrams

6. Convert the following into litres
a) 10 millilitres b) 132 millilitres c) 2389 millilitres d) 123.4 millilitres

7. Convert the following into millilitres
a) 4 litres b) 6.2 litres c) 0.94 litres d) 12.27 litres

8. A patient needs a dose of 0.5 g of medicine A. They have already had 360mg.
a) How many more mg do they need?
b) What is this value in grams?
c) A dose of 1400 mcg has been prepared. Will this be enough?

Drug Calculations

Drug calculations vary depending on whether you are dealing with liquid or solid medications, or if the dose is to be given over a period of time. In this section I will go over each of these situations in turn.

It is very important that you know how drug dosages are worked out, because it is good practise to always check calculations before giving medication, no matter who worked out the original amount. It is far better to point out a mistake on paper than overdose a patient.

a) Tablets
Working out dosage from tablets is simple.

Formula for dosage:

$$\frac{\textbf{Total dosage required}}{\textbf{Dosage per tablet}} = \textbf{Number of tablets required}$$

Note-If your answer involves small fractions of tablets, it would be more sensible to try to find tablets of a different strength rather than try to make $\frac{2}{3}$ of a tablet for example.

Examples
1. A patient needs 500mg of X per day. X comes in 125mg tablets. How many tablets per day does he need to take?

Total dosage required is 500mg,
Dosage per tablet is 125mg
So our calculation is $\frac{500}{125} = 4$
He needs 4 tablets a day

b) Liquid Medicines
Liquid medicines are a little trickier to deal with as they will contain a certain dose within a certain amount of liquid, such as 250mg in 50ml, for example.
To work out the dosage, we use the formula:

$$\frac{\text{What you want}}{\text{What you've got}} \times \text{What it's in}$$

Note: In order to use this formula, the units of measurement must be the same for 'What you want' and 'What you've got'; i.e. both mg or both mcg etc.

Examples

2. We need a dose of 500mg of Y. Y is available in a solution of 250mg per 50ml.

In this case,

What we want = 500
What we've got = 250
What it's in = 50

So our calculation is $\frac{500}{250} \times 50 = 100$

We need 100ml of solution.

3. We need a dose of 250mg of Z. Z is available in a solution of 400mg per 200ml.

In this case,

What we want = 250
What we've got = 400
What it's in = 200

So our calculation is $\frac{250}{400} \times 200 = 125$

We need 125ml of solution.

c) Medicine over Time

1) Tablets/liquids

This differs from the normal calculations in that we have to split our answer for the total dosage into 2 or more smaller doses.

Look at Example 1 again. If the patient needed the 500mg dose to last the day, and tablets were taken four times a day, then our total of 4 tablets would have to be split over 4 doses.

Total amount of liquid/tablets for day = Amount to be given per dose
Number of doses per day

We would perform the calculation: 4÷4=1
So he would need 1 tablet 4 times a day.

2) Drugs delivered via infusion

For calculations involving infusion, we need the following information:

- The total dosage required
- The period of time over which medication is to be given
- How much medication there is in the solution

Example

4. A patient is receiving 500mg of medicine X over a 20 hour period.
X is delivered in a solution of 10mg per 50ml.
What rate should the infusion be set to?

Here our total dosage required is 500mg

Period of time is 20 hours
There are 10mg of X per 50ml of solution

Firstly we need to know the total volume of solution that the patient is to receive.
Using the formula for liquid dosage we have:
$\frac{500}{10}\times 50=2500$ So the patient needs to receive 2500mls.
We now divide the amount to be given by the time to be taken: $\frac{2500}{20}=125$
The patient needs 2500mls to be given at a rate of 125mls per hour

Note: Working out medicines over time can appear daunting, but all you do is work out how much medicine is needed in total, and then divide it by the amount of hours/doses needed

d) Drugs labelled as a percentage
Some drugs may be labelled in different ways to those used earlier.

V/V and W/V
Some drugs may have V/V or W/V on the label.
V/V means that the percentage on the bottle corresponds to volume of drug per volume of solution i.e 15% V/V means for every 100ml of solution, 15ml is the drug.
W/V means that the percentage on the bottle corresponds to the weight of drug **per volume** of solution. Normally this is of the form 'number of grams per number of millilitres'. So in this case 15% W/V means that for every 100ml of solution there are 15 grams of the drug.

If we are converting between solution strengths, such as diluting a 20% solution to make it a 10% solution, we do not need to know whether the solution is V/V or W/V.

Examples
5. We need to make up 1 litre of a 5% solution of A. We have stock solution of 10%.
How much of the stock solution do we need? How much water do we need?

We can adapt the formula for liquid medicines here:

<u>What we want</u> × What we want it to be in
What we've got

We want a 5% solution. This is the same as $\frac{5}{100}$ or $\frac{1}{20}$.
We've got a 10% solution. This is the same as $\frac{10}{100}$ or $\frac{1}{10}$.
We want our finished solution to have a volume of 1000ml.
Our formula becomes:

$$\frac{\frac{1}{20}}{\frac{1}{10}}\times 1000 = \frac{1}{20}\times\frac{10}{1}\times 1000 \text{ (using the rule for dividing fractions)}$$

$$=\frac{1}{2}\times 1000 = 500 \text{ . We need 500mls of the A solution.}$$

Which means we need 1000 - 500 = 500mls of water.

(Alternatively you can use the fact that a 5% solution is half the strength of a 10% solution to see that you need 500ml of solution and 500ml of water)

6. You have a 20% V/V solution of drug F. The patient requires 30ml of the drug. How much of the solution is required?

20% V/V means that for every 100ml of solution we have 20ml of drug F.
Using our formula:

$$\frac{\text{What you want}}{\text{What you've got}} \times \text{What it's in}$$

This becomes $\frac{30}{20} \times 100 = 150$

We need 150mls of solution.

7. Drug G comes in a W/V solution of 5%. The patient requires 15 grams of G. How many mls of solution are needed?

5% W/V means that for every 100mls of solution, there are 5 grams of G.

Using the formula gives us

$\frac{15}{5} \times 100 = 300$

300mls of solution are required.

Note In very rare cases, a drug may be labelled with a ratio. If this is the case, refer to the Drug Information Sheet for the specific medication in order to be completely sure how the solution is made up.

Suggested Reading

Drug Calculations for Nurses-A Step By Step Approach
Robert Lapham and Heather Agar
ISBN 0-340-60479-4

Nursing Calculations Fifth Edition
J.D. Gatford and R.E.Anderson
ISBN 0-443-05966-7

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Exercise 2

1. How many 30mg tablets of drug B are required to produce a dosage of:

a) 60mg b) 120mg c) 15mg d) 75mg

2. Medicine A is available in a solution of 10mg per 50ml. How many mls are needed to produce a dose of:

a) 30mg b) 5mg c) 200mg d) 85mg

3. Medicine C is available in a solution of 15micrograms per 100ml. How many mls are needed to produce a dose of:

a)150mcg b) 45mcg c)30mcg d) 75mcg

4. Medicine D comes in 20mg tablets. How many tablets are required in each dose for the following situations:

a) total dosage 120mg , 3 doses b) total dosage 60mg, 2 doses

c) total dosage 100mg, 5 doses d) total dosage 30mg, 3 doses

5. At what rate per hour should the following infusions be set?

a) Total dosage 300mg, solution of 25mg per 100mls, over 12 hours

b) Total dosage 750mg, solution of 10mg per 30mls, over 20 hours

c) Total dosage 450mg, solution of 90mg per 100mls, over 10 hours

6. Drug B comes in a 20% V/V stock solution.

i) How much of the solution is needed to provide:

a) 50ml of B b) 10ml of B c) 200ml of B

ii) How would you make up the following solutions from the stock solution?

a) Strength 20% volume 1 litre b) Strength 10% volume 750ml

iii) What strength are the following solutions?

a) Volume 1 litre, made up of 600ml stock solution, 400ml water

b) Volume 600ml, made up of 300ml stock solution, 300ml water

7. Drug C comes in a 15% W/V stock solution.

i) How much of the solution is needed to provide:

a) 30g of C b) 22.5gof C c) 90g of C

ii) How would you make up the following solutions from the stock solution?

a) Strength 5% volume 900ml b) Strength 10% volume 750ml

iii) How many grams of C are in the following solutions?

a) Volume 1 litre, made up of 400ml stock solution, 600ml water

b) Volume 800mls, made up of 450ml stock solution, 350ml water

Answers to exercises

Exercise 1

1 a) 1kg=1000g b) 1g=1000mg c) 1g=1000000mcg
d) mcg=1000ng e) 1 litre=1000ml

2 a) 6g=6000mg b) 268g=26800mg c) 3.924g=3924mg
d) 405g=405000m4g

3 a) 1200mg=1.2g b) 650mg=0.65g c) 6749mg=6.749g
d) 3554mg=3.554g

4 a)120mcg=0.12mg b) 1001mcg=1.001mg c)2675 mcg= 2.675mg
d) 12034mcg=12.034mg

5 a) 1.67g=1670000mcg b) 0.85g=850000mcg
c) 125 mcg= 0.000125g d) 6784mcg=0.006784g
e) 48.9mg=48900000ng f) 3084ng=0.003084mg

6 a) 10ml=0.01litres b) 132ml=0.132litres c) 2389ml=2.389litres
d) 123.4ml=0.1234 litres

7 a) 4litres=4000ml b) 6.2litres=6200ml c) 0.94litres=940ml
d) 12.27litres=12270ml

8 a) 140 milligrams b) 0.14 grams
c) no, the correct dose would be 140000mcg

Exercise 2

1. a) 2 tablets b) 4 tablets c) $\frac{1}{2}$ tablet d) $2\frac{1}{2}$ tablets

2. a) 150ml b) 25ml c) 1000ml d) 425ml

3. a) 1000ml b) 300ml c) 200ml d) 500ml

4. a) 2 tablets b) $1\frac{1}{2}$ tablets c) 1 tablet d) $\frac{1}{2}$ tablet

5. a) 100ml per hour b) 112.5 ml per hour c) 50ml per hour

6. i)a) 250ml b) 50ml c) 1 litre
ii) a) 1 litre stock, no water b) 375ml stock, 375ml water
iii) a) 600ml stock contains 120ml B b) 300ml stock contains 60ml B
So 120ml in 1000ml= $\frac{120}{1000}$=12% So 60ml in 600ml= $\frac{60}{600}$=10%

7. i) a) 200ml b) 150ml c) 600ml
ii) a) 300ml stock, 600ml water b) 500ml stock, 250ml water
iii) a) 60g b) 67.5g