Medicines Management numeracy assessment Revision Pack

The contents of this pack are designed to help staff prepare for the numeracy assessment element of the mandatory Medicines Management training.

Contents

The Royal College of Nursing have further useful learning materials available at the web address below:

https://www.rcn.org.uk/clinical-topics/safety-in-numbers

We advise that staff use the revision learning materials to help prepare for the numeracy assessment.

1. **Medicines Management numeracy assessment Revision guide:** Drug volumes, pump rates and drop rates

1 Tonne	1000 kilograms
1 Kilogram	1000 grams
1 Gram (g)	1000 milligrams
1 Milligram (mg)	1000 micrograms
1 Microgram (mcg)	1000 nanograms
1 litre	1000 millilitres
0.5 litre	500 millilitres

To convert a larger unit (such as a milligram) into a smaller unit (such as a microgram) you must multiply by 1000 (because there are 1000 micrograms in 1 milligram) e.g. 5mgs x1000 = 5000 mcgs

To convert a smaller unit (such as a milligram) into a larger unit (such as a gram) you must divide by 1000 (because there are 1000 milligrams in 1 gram) e.g. 5000mgs ÷ 1000 = 5 grams

Drug calculations

Example A Available - Ampoule of 600 microgram in 1 ml
Prescribed - 0.4mg

Step 1 Are both quantities in the same units?

Not in this example.
Convert to the smaller unit (in this case mg to microgram)

By

- multiplying by 1000 (repeat it if you use a calculator)
- moving the decimal point three times to the right
- fitting it into a table

mg	microgram
1 •	0 0 0 •
0 •	5 0 0 •
0 •	4 0 0 •

Whichever way you do it – The prescribed dose is 400 microgram

Step 2 A rough estimate

Rough estimate

600 microgram = 1 ml (dose needed is less than this)

300 microgram = 0.5 ml (dose is more than this)

400 microgram will be between these volumes

Step 3 The usual "formula"

Calculate

Want is the desired dose, in this case 400mcgs
Got is the dose it's supplied as, in this case 600mcgs
In is the amount/format/volume it's supplied in, in this case 1ml

$$\frac{\text{Want x In}}{\text{Got}} \qquad \frac{400 \times 1}{600} = 0.6666\text{ml} = 0.67$$

Double check with rough estimate

Step 4 Is this what you expected?

600 microgram = 1 ml
400 microgram = 0.67 ml
300 microgram = 0.5 ml

Answer 0.67 ml
Or 0.7ml depending on need for accuracy.

Example B Available – 5ml vial of 50mg/ml
Prescribed - 0.12 g

Step 1 Are both quantities in the same units?

Not in this example.
Convert to the smaller unit (in this case gram to milligram)

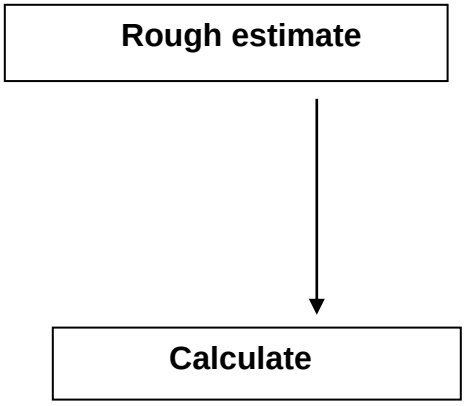
By

- multiplying by 1000 (repeat it if you use a calculator)
- moving the decimal point three times to the right
- fitting it into a table

g	mg
1 •	0 0 0 •
0 •	5 0 0 •
0 •	1 2 0 •

Whichever way you do it – The prescribed dose is 120 mg

Step 2 **A rough estimate**



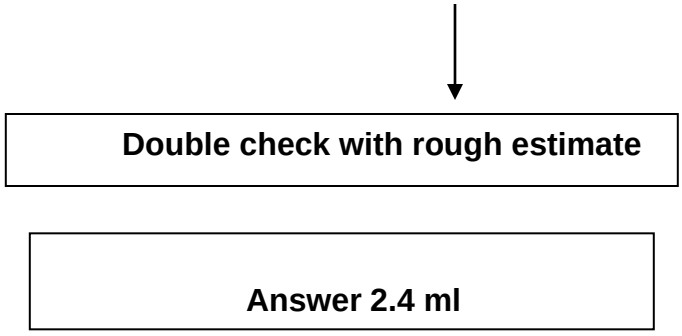
50 mg = 1 ml **IGNORE THE 5ML 50mg is in each ml**
(dose needed is more than this)
100 mg = 2ml (dose is more than this)
150 mg = 3ml (dose is less than this)
120mg will be between 2ml and 3ml

Step 3 **The usual "formula"**

Want is the desired dose, in this case 120mgs
Got is the dose it's supplied as, in this case 50mgs
In is the amount/format/volume it's supplied in, in this case 1ml

$$\frac{\text{Want}}{\text{Got}} \times \text{In} \qquad \frac{120}{50} \times 1 = 2.4 \text{ ml}$$

Step 4 **Is this what you expected?**



100mg = 2 ml
120mg = 2.4 ml
150= 3 ml (or 200mg = 4ml)

Setting infusion rates using a volumetric pump

All users of medical devices must be supervised until competent to do so

To set ml per hour the "formula" sounds like the prescription;

a) The doctor prescribes 1 litre of normal saline over 8 hours. How many mls per hour must the infusion pump be set at?

Formula:

Volume Requested / Time (in hours) = millilitres per hour (mls/hr)

Convert 1 litre into mls (there are 1000mls in 1 litre)

1000 (mls) / 8 (hours) = 125mls/hr

b) The doctor prescribes 250 ml is to be given over 75 minutes

The hourly rate will be this x 60 (60 minutes in 1 hour)

Formula:

Volume (mls) / Minutes x 60

250 / 75 x 60 = 200

Answer 200 ml per hour

Setting infusion rates counting drops

If a fluid without drugs is being given and you are not using a pump the formula is similar

Example If 1 litre is to be given over 8 hours.

Convert this into mls and minutes

Then 1 litre (1 x1000 =1000ml)
over 8 hours (8 x 60 =480 mins)

$$\frac{1000}{480}$$

Gives how many mls each minute

The drop rate will be this multiplied by the drops per ml
For clear fluids this is x 20 (check the giving set package)

x 20

Formula

$$\frac{\text{Volume(mls)}}{\text{Minutes}} \times \text{drops per ml}$$

$\frac{1000}{480} \times 20 = 41.6666$

Answer 42 drops per minute

If blood is being given you can use a pump with a pump giving set including blood filter

If you are counting drops this is usually 15 drops per ml

(The table at the bottom of the blue fluid charts uses 15 drops/ml!)

Example If 280 ml is to be given over 2 hours

$\frac{280}{120} \times 15 = 34.99$

Answer 35 drops per minute

Helpful tips

Read the question carefully;

- What is it telling you?
- What is it asking you?

Some questions will require you to do two calculations before you find the answer. Are the units the same e.g. does the question discuss both grams and mgs? If so then you need to convert the question into mgs in order to find the answer. It is always sensible to convert either the prescribed dose or the stock dose to the same unit of measurement.

You cannot administer part of a drop therefore the number needs to be rounded up if equal to or greater than .5 or down if less than .5

Not all questions will require the need to use a formula to find the answer.

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Basic mathematics and numeracy skills Part 1: Addition

By Martina O'Brien, Associate Professor Adult Nursing, London South Bank University

It is essential to be able to understand basic mathematical skills such as addition, subtraction, multiplication and division in order to calculate medicine doses accurately. Once you have mastered these skills, you can then apply them to the various formulae that are used to calculate medicine doses. It is vital to have a "sense of number" (Lapham & Agar, 2015), in order for you to be able to recognise if your answer is incorrect. Although calculators are a useful aid to working out calculations, studies have shown that they can give a false sense of security, particularly for people who lack an understanding of mathematical concepts (Grugnetti *et al.*, 2017). Learners working under supervision should always check their calculations with the person they are working with.

Understanding the value of numbers

One-digit numbers

3

Numbers with a single digit, which are the numbers 0 to 9—are termed 'units'. For example, the number 3 has three 'units'.

Two-digit numbers

56

Numbers with two digits, which are the numbers 10 to 99—are made up of 'units' and 'tens'. The number 56 has five 'tens' and six 'units'.

Three-digit numbers

109

Numbers with three digits, which are the numbers 100 to 999—are made up of 'hundreds', 'tens' and 'units'. The number 109 has one 'hundred', zero 'tens' and nine 'units'.

Four-digit numbers

7365

The numbers 1000 to 9999 are made up of 'thousands', 'hundreds', 'tens' and 'units'. The number 7365 has seven 'thousands', three 'hundreds', six 'tens' and five 'units'.

Relatively small numbers, in particular whole numbers, are usually quite easy to add up in your head without the need for paper, pen or calculator. If you need to work the sum out on paper, it is often easier to deal with the parts (or digits) of each number separately. Each digit will have a different value. Using a "place-value chart" (Lawson & Hennefer, 2010), you can place each digit in the correct column according to its place-value, as shown below. A decimal is a number that is not whole: digits to the right of the decimal point (DP) represent fractions of a unit.

You can chart the whole number 9468 like this:

Thousands	Hundreds	Tens	Units
Th	H	T	U
9	4	6	8

The whole number 9468 comprises nine 'thousands', four 'hundreds', six 'tens' and eight 'units'.

You can chart the decimal number 0.125 like this:

Units	DP	Tenths	Hundredths	Thousandths
U	.	1/10ths	1/100ths	1/1000ths
0	.	1	2	5

When using decimals, the digits that appear after the decimal point (i.e., to its right) have different values. For example, the number 0.125 has no 'units', a single 'tenth', two 'hundredths' and five 'thousandths'.

Basic mathematics and numeracy skills Part 1: Addition Page 2

Addition

$27 + 5 = 32$

When you **add** numbers greater than zero, the answer is always bigger than any of the numbers you started with.

Applying the mathematical principle of addition will result in the final numerical value increasing. Adding numbers can be done in a variety of ways: in your head, using a calculator or using pen and paper to draw up a place-value chart. This section will demonstrate two methods that can be used.

Method 1: Adding using a place-value chart

A simple example: add 210 and 325.

Step 1

	H	T	U
	2	1	0
+	3	2	5
=			5

Write out a place-value chart and put in your numbers. Start working with the smallest units (so working from right to left); in this example, add the 'units' together to make 5. Write the 5 in the 'units' column of the answer.

Step 2

	H	T	U
	2	1	0
+	3	2	5
=		3	5

Then add the 'tens' together; this gives 3. Write the 3 in the 'tens' column of the answer.

Step 3

	H	T	U
	2	1	0
+	3	2	5
=	5	3	5

Finally add the 'hundreds' together; this gives 5. Write the 5 in the 'hundreds' column of the answer. The total is 535.

A more complicated example: add 234.62 and 698.12. When adding larger numbers, it may be necessary to "carry numbers forward" to continue with the calculation.

Step 1

	H	T	U	DP	1/10	1/100
	2	3	4	.	6	2
+	6	9	8	.	1	2
=				.		4

First add the 'hundredths' together to give 4. Write the 4 in the 'hundredths' column of the answer, at the far right-hand side.

Step 2

	H	T	U	DP	1/10	1/100
	2	3	4	.	6	2
+	6	9	8	.	1	2
=				.	7	4

Next add the 'tenths'; this gives 7. Write the 7 in the 'tenths' column of the answer.

Step 3

	U	DP
	4	.
	+8	.
	12	.

12 is made up of one 'ten' and two 'units'

Then add the 'units' together; this gives 12—but you cannot write 12 in this column, which is only for units (numbers from 0 to 9).

Step 4

	H	T	U	DP	1/10	1/100
	2	+1 3	4	.	6	2
+	6	9	8	.	1	2
=			2	.	7	4

To overcome this problem, write the 2 from the 12 in the 'units' column of the answer and carry forward the 1 (which in real terms has a value of 10) to the column of numbers to the left of the 'units' column (the 'tens' column). This is because the digits that are 'tens' need to be added together. (Remember to include the decimal point in your answer line.)

Step 5

	H	T	U	DP	1/10	1/100
	+1 2	+1 3	4	.	6	2
+	6	9	8	.	1	2
=		3	2	.	7	4

Then add the 'tens' together, including the digit that has been 'carried forward' (in real terms these have a value of 30, 90 and 10, respectively); this gives 13 (in real terms this is actually 130). Place the 3 'tens' to the left of the 'unit' of 2 and 'carry forward' the 1 (which has a real value of 100) to the column to the left of the 'tens' column (the 'hundreds' column). This is because the digits that are 'hundreds' need to be added together.

Step 6

	H	T	U	DP	1/10	1/100
	+1 2	+1 3	4	.	6	2
+	6	9	8	.	1	2
=	9	3	2	.	7	4

Finally, add the 'hundreds' together, including the digit that has been carried forward (in real terms these have a value of 200, 600 and 100, respectively); this gives 9 (which is equivalent to 900). Place the 9 in the 'hundreds' column. The answer to the calculation is 932.74.

Basic mathematics and numeracy skills Part 1: Addition Page 3

Method 2: Adding by breaking up or regrouping numbers

Another method that can be used for addition is to break numbers up into their smaller components. It is quicker and easier to add up numbers with fewer digits—that is, numbers that contain 'units' only, such as 4. It is also easier to add up larger numbers that have, for example, no 'units', such as 30; or no 'tens' or 'units', such as 700. To apply this method to the example 34 + 798, you can calculate as follows:

34 is equivalent to 30 + 4 and 798 is equivalent to 700 + 90 + 8

4 + 8 = 12

30 + 90 = 120

700 + 120 = 820

820 + 12 = 832

So, 34 + 798 = 832

There is no single correct way to perform an addition calculation of this kind. You may be able to spot useful combinations of numbers. You could calculate the same example, therefore, by adding 98 and 4 to make 102, which is an easier number to calculate with than 98.

34 + 798 is equivalent to 30 + 700 + 4 + 98

30 + 700 = 730

4 + 98 = 102

730 + 100 + 2 = 832

Regrouping numbers with the help of number bonds

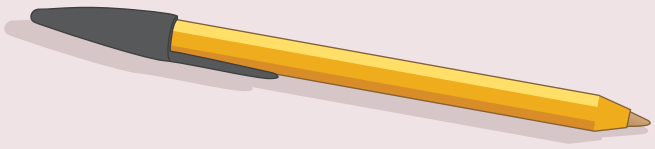
Number bonds for 10

1 + 9 = 10
2 + 8 = 10
3 + 7 = 10
4 + 6 = 10
5 + 5 = 10
6 + 4 = 10
7 + 3 = 10
8 + 2 = 10
9 + 1 = 10

Number bonds for 20

1 + 19 = 20
2 + 18 = 20
3 + 17 = 20
4 + 16 = 20
5 + 15 = 20
6 + 14 = 20
7 + 13 = 20
8 + 12 = 20
9 + 11 = 20

It can be helpful to regroup numbers by recognising pairs of numbers that, when added together, make numbers that are easy to calculate with, such as 10, 20 or 100. Examples of these pairs, which are also known as number bonds, are shown above. The example calculation on the right shows how you can use number bonds to make calculations easier.



Example

Add 33 + 174 + 196

By breaking up the numbers and applying the principles of regrouping as described above, the calculation will look like this:

30 + 170 + 190 + 3 + 4 + 6

30 + 170 = 200 (number bonds for 200)

4 + 6 = 10 (number bonds for 10) and

190 + 10 = 200 (number bonds for 200)

200 + 200 = 400

Add the remaining 3

400 + 3 = 403

So, 33 + 174 + 196 = 403

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Basic mathematics and numeracy skills
Part 2: Subtraction

By Martina O'Brien, Associate Professor Adult Nursing, London South Bank University

Applying the mathematical principle of subtraction will result in the final numerical value decreasing (if both numbers are above zero, i.e., positive). You can use similar methods for these calculations to those used for addition calculations. Although calculators are a useful aid to working out calculations, studies have shown that they can give a false sense of security, particularly for people who lack an understanding of mathematical concepts (Grugnetti *et al.*, 2017). This section demonstrates three different methods you can use for calculations involving subtraction.

27 − 5 = 22 When you **subtract** one number from another (and both are above zero), the answer will be smaller than the number you started with.

Method 1: Subtracting using a place-value chart

Example: subtract 945 from 1364

Step 1

	Th	H	T	U
	1	3	6	4
−		9	4	5
=				

Write out the calculation, putting the digits in the correct columns. (For further explanation of the columns, see Part 1 of this series on addition.)

Step 2

	U	DP
	4	.
	5	.
	−1	.

Subtracting 5 from 4 would produce a negative value

Starting from the far right-hand column, if the upper digit is more than or the same as the lower digit in the 'units' column, you can subtract the lower digit from the digit above. However, in this example, 5 is greater than 4, so you cannot subtract it, as this would give a negative value.

Step 3

	Th	H	T	U
	1	3	5 ~~6~~	1 4
−		9	4	5
=				9

In order to proceed with the calculation, it is necessary to "carry over" one 'ten' from the 'tens' column into the 'units' column. This changes the 4 in the 'units' column to 14. Subtracting 5 from 14 gives 9. Write this in the 'units' column of the answer line.

Step 4

	Th	H	T	U
	1	3	5 ~~6~~	1 4
−		9	4	5
=			1	9

In the 'tens' column, there are now only five 'tens' rather than the original six as one 'ten' was carried over to the 'units' column in step 3. Subtracting 4 from 5 gives 1. Write this answer in the correct column in the answer line.

Step 5

	H	
	3	
	9	
	−6	

Subtracting 9 from 3 would produce a negative value

In the 'hundreds' column, it is not possible to subtract 9 from 3.

Step 6

	Th	H	T	U
	0 ~~1~~	1 3	5 ~~6~~	1 4
−		9	4	5
=			1	9

In order to proceed with the calculation, it is necessary to 'carry over' one 'thousand' from the 'thousands' column to the 'hundreds' column, changing the number 3 to 13.

Step 7

	Th	H	T	U
	0 ~~1~~	1 3	5 ~~6~~	1 4
−		9	4	5
=		4	1	9

Subtracting 9 from 13 gives 4. Write this answer in the correct column in the answer line.

Step 8

	Th	H	T	U
	0 ~~1~~	1 3	5 ~~6~~	1 4
−		9	4	5
=		4	1	9

Finally, in the 'thousands' column, there are no 'thousands' remaining as 1000 was 'carried over' to the 'hundreds' column.

Answer

1364 − 945 = 419

The final answer to the calculation is 419.

Do not undertake or attempt any procedure unless you are, or have supervision from, a properly trained, experienced and competent person. Always first explain the procedure to the patient and obtain their consent, in line with the policies of your employer or educational institution.

Basic mathematics and numeracy skills Part 2: Subtraction Page 2

Method 2: Subtracting by regrouping or breaking up numbers

The strategy of regrouping or breaking up numbers into a series of smaller equivalents can also be used in subtraction to make the calculation easier. In the following example, you are asked to subtract 21.25 from 90. In the calculation 90 - 21.25, there is no need to break up 90, as it is an easy number to deal with. But 21.25 is equivalent to 20 + 1 + 0.25.

It is quicker and easier to subtract numbers with fewer digits, such as those numbers that contain 'units' only, e.g. '1'. When working with larger numbers, it is also easier to subtract those that have no 'units', e.g. '20'. If decimal numbers are involved, this will usually present the most difficult part of the calculation, so it is sensible to subtract any decimal numbers last.

To apply this strategy to 90 – 21.25, you can calculate as follows:

$$90 - 20 = 70$$

$$70 - 1 = 69$$

$$69 - 0.25 = 68.75$$

Method 3: Subtracting by rounding numbers

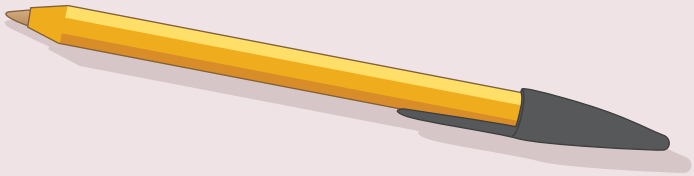
When working out subtraction calculations, an alternative method involves increasing a number to a 'round' value to make it easier to work with. For example, to work out 62 - 49, first round up the 49 to 50:

$$62 - 50 = 12$$

As too much has been subtracted (50 is greater than 49 by 1) add 1 to the answer to compensate :

$$12 + 1 = 13$$

Therefore $62 - 49 = 13$



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Basic mathematics and numeracy skills Part 3: Multiplication

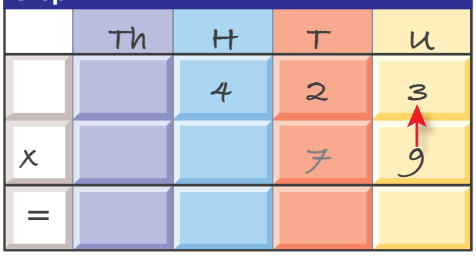
By Martina O'Brien, Associate Professor Adult Nursing, London South Bank University

Applying the mathematical principle of multiplication to numbers that are equal to or greater than 1 will result in the final numerical value increasing. In order to multiply correctly, it is important to be competent in addition. Put simply, multiplication is adding the same amount a certain number of times. Knowing your "times tables" makes performing multiplication calculations quicker and easier. Although calculators are a useful aid to working out calculations, studies have shown that they can give a false sense of security, particularly for people who lack an understanding of mathematical concepts (Grugnetti *et al.*, 2017). This section will demonstrate two different methods that you can use when performing calculations involving multiplication.

Method 1: Multiplying using a place-value chart (also known as long multiplication)

Example: 423 multiplied by 79. First write out the calculation, putting the numbers in the correct columns (Part 1 of this series explains the use of columns).

Step 1



First, you have to multiply each of the digits in the top number (423) by the digit 9 in the 'units' column of the lower number (79). (Later, you will multiply the top number by the 7 in the 'tens' column, but for now, ignore the 7 in the lower number.) First, multiply together the digits in the 'units' column (indicated by the red arrow).

Step 2

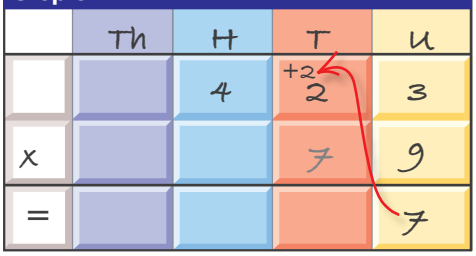
3 x 9 is the same as

3 + 3 + 3 + 3 + 3 + 3 + 3 + 3 + 3

= 27

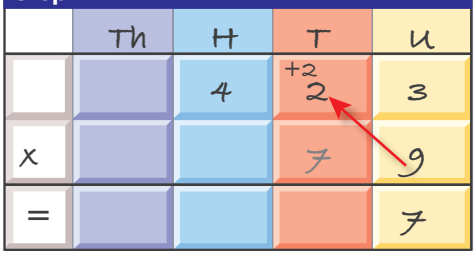
The answer to 3 x 9 is 27.

Step 3



Place the 7 in the 'units' column on the answer line, and "carry forward" the 2 to the 'tens' column. (If you are not familiar with carrying forward, refer to Part 1 of this series, on addition.)

Step 4



Next, multiply the 2 in the 'tens' column of the top number by the 'unit' 9.

Step 5

2 x 9 is the same as

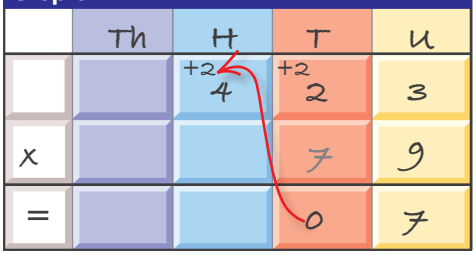
2 + 2 + 2 + 2 + 2 + 2 + 2 + 2 + 2

= 18

(NB. Remember that the actual value of this number is 180, which you have to add to the 20 that you carried forward earlier)

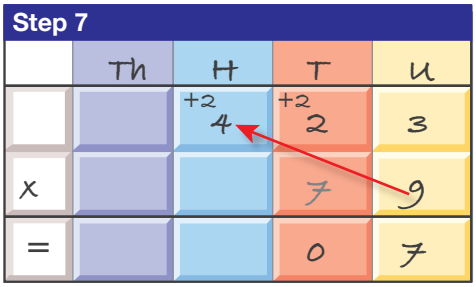
The answer to 2 x 9 is 18; add this answer to the 2 'tens' you carried forward in step 3, to give 20.

Step 6



Place the 0 in the 'tens' column and then carry forward the 2 to the 'hundreds' column.

Step 7



Then multiply the 4 in the 'hundreds' column of the top number by the 'unit' 9.

Step 8

4 x 9 is the same as

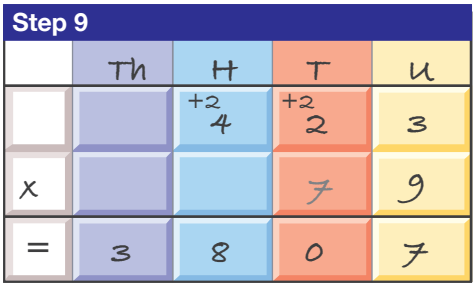
4 + 4 + 4 + 4 + 4 + 4 + 4 + 4 + 4

= 36

(NB. Remember that the actual value of this number is 3,600, which you have to add to the 200 that you carried forward earlier.)

The answer to 4 x 9 is 36; add this answer to the 2 'hundreds' you carried forward in step 6, to give 38.

Step 9



Place the 8 in the 'hundreds' column. Carry forward the 3 and place it in the 'thousands' column. This completes the multiplication of the top number with the 9 in the 'units' column of the lower number.

Basic mathematics and numeracy skills Part 3: Multiplication Page 2

Method 1: Multiplying using a place-value chart (continued)

Having multiplied the top number by the digit 9, you should now ignore the 9 and multiply the top number by the 7 in the 'tens' column of the lower number.

Step 10

	Th	H	T	U
		+2 4	+2 2	3
x			7	9
=	3	8	0	7
				0

First place a 0 in the 'units' column of the lower answer row: this is because you are multiplying by 7 'tens', which are equal to 70. Then multiply the 3 in the 'units' column of the top number by the 7 in the 'tens' column (see red arrow).

Step 11

3 x 7 is the same as

3 + 3 + 3 + 3 + 3 + 3 + 3

= 21

(NB. Remember that the actual value of this number is 210.)

The answer to 3 x 7 is 21.

Step 12

	Th	H	T	U
		+2 4	+2 2	3
x		+2	7	9
=	3	8	0	7
			1	0

Place the 1 in the 'tens' column in the answer line and carry forward the 2 to the 'hundreds' column.

Step 13

	Th	H	T	U
		+2 4	+2 2	3
x		+2	7	9
=	3	8	0	7
			1	0

Next multiply the 2 'tens' by 7.

Step 14

2 x 7 is the same as

2 + 2 + 2 + 2 + 2 + 2 + 2

= 14

(NB. Remember that the actual value of this number is 20 x 70, which is 1,400.)

The answer to 2 x 7 is 14; add this answer to the 2 'hundreds' you 'carried forward' in step 12, to give 16.

Step 15

	Th	H	T	U
		+2 4	+2 2	3
x	+1	+2	7	9
=	3	8	0	7
		6	1	0

Place the 6 in the 'hundreds' column of the answer line and carry forward the 1 to the 'thousands' column.

Step 16

	Th	H	T	U
		+2 4	+2 2	3
x	+1	+2	7	9
=	3	8	0	7
		6	1	0

Next multiply the 4 'hundreds' by 7.

Step 17

4 x 7 is the same as

4 + 4 + 4 + 4 + 4 + 4 + 4

= 28

(NB. Remember that the actual value of this number is 400 x 70, which is 28,000.)

The answer to 4 x 7 is 28; add this answer to the 1 'thousand' you carried forward in step 15, to give 29.

Step 18

	T. Th	Th	H	T	U
			+2 4	+2 2	3
x		+1	+2	7	9
=		3	8	0	7
	2	9	6	1	0

Place the 9 in the 'thousands' column. Carry forward the 2 and place it in the 'tens of thousands' column. This completes the multiplication of the top number with the 7 'tens'.

Step 19

	T. Th	Th	H	T	U
			+2 4	+2 2	3
x		+1	+2	7	9
	+1	+1 3	8	0	7
+	2	9	6	1	0
=	3	3	4	1	7

The final stage in the calculation is to add the two numbers in the answer lines together. The final answer to 423 x 79 is 33,417.

Tip

Remember that in multiplication (as in addition) it does not matter which way round the figures are placed.

3 x 9 is the same as 9 x 3

4 x 7 is the same as 7 x 4

Refer to part 1 of this series on addition if you are unsure how to reach your final answer.

Basic mathematics and numeracy skills Part 3: Multiplication Page 3

Method 2: Multiplying using the boxes method

An alternative method for multiplication calculations is to use the boxes method. When using this method, you need to split the numbers into their 'units', 'tens', 'hundreds', 'thousands', etc.

Step 1

	Th	H	T	U
124		100	20	4

So, in the example 124 x 37, first split 124 into 100, 20 and 4.

Step 2

	Th	H	T	U
37			30	7

Likewise, you need to split 37 into 30 and 7.

Then draw a grid of the right number of columns and the right number of rows. In this example, you need a grid of three columns and two rows. (Alternatively, you could draw the grid with two columns and three rows.) In this example, label the columns with 100, 20 and 4 and label the rows with 30 and 7, as shown below. You will then multiply each number along the top of the grid with each number down the side of the grid, to generate (in this example) six numbers that you will then total together to find the answer to the calculation. Remember, when multiplying, it does not matter what order you multiply the numbers in.

Step 1

	100	20	4
30	3000		
7			

First multiply 30 by 100 to give 3000 and write this in the correct box.

Step 2

	100	20	4
30	3000	600	
7			

Then multiply 30 by 20 to give 600 and write this in the correct box.

Step 3

	100	20	4
30	3000	600	120
7			

Multiply 30 by 4 to give 120.

Step 4

	100	20	4
30	3000	600	120
7	700		

Multiply 7 by 100 to give 700.

Step 5

	100	20	4
30	3000	600	120
7	700	140	

Multiply 7 by 20 to give 140.

Step 6

	100	20	4
30	3000	600	120
7	700	140	28

Multiply 7 by 4 to give 28.

Step 8: (a)

	100	20	4
30	3000	600	120
7	700	140	28

(b)

Th	H	T	U
+1 3	0	0	0
	6	0	0
	1	2	0
	7	0	0
	1	4	0
		2	8
4	5	8	8

The final stage using this method is to add together all the numbers within the boxes, using a place-value chart. The final answer to 124 x 37 is 4588. Refer to part 1 of this series, on addition, if you are unsure how to reach your final answer.

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Basic mathematics and numeracy skills Part 4: Division

By Martina O'Brien, Associate Professor Adult Nursing, London South Bank University

Applying the mathematical principle of division will result in the final numerical value decreasing (if the divisor—the number by which you are dividing—is equal to or greater than 1). In order to divide correctly it is important to be competent in subtraction, addition and multiplication. Although calculators are a useful aid to working out calculations, studies have shown that they can give a false sense of security, particularly for people who lack an understanding of mathematical concepts (Grugnetti *et al.*, 2017). Part 4 of our five-part series on basic mathematics and numeracy skillls will demonstrate three methods that you can use for calculations involving division, and explain the BODMAS rule for the order of mathematical operations.

Method 1: Dividing using short division

This quick method is useful for those with reasonably proficient numeracy skills. It is similar to long division (which will be covered on the following page) but the multiplication and subtraction are done in your head. In the calculation below, 7 is known as the **divisor** and 945 is known as the **dividend**.

To calculate 945 ÷ 7 the numbers need to be set out as shown:

$$7\overline{)945}$$

The first step is to work out how many times you can divide 7 into 9. In other words, how many lots of 7 are there in 9?

The divisor 7 goes into 9 only once with 2 remaining. This remaining number is commonly called the 'remainder'. Write the digit 1 on the answer line over the 9 in the 'hundreds' column and carry forward the remainder of 2, placing it to the left of the 4 in the 'tens' column of the dividend.

$$\begin{array}{r} 1 \\ 7\overline{)9^{2}45} \end{array}$$

You can use the principles of addition to work out how many times 7 goes into 24:
(7 + 7 + 7 = 21)
before applying the principles of subtraction to come up with your remainder of 3 (24 – 21 = 3)

Next, work out how many times 7 goes into 24. 7 goes into 24 three times, with 3 remaining. 7 cannot be subtracted from 3, therefore 3 is the remainder.

Place the number 3 next to the number 1 on the answer line and place the remainder of 3 to the left of the 5, so your calculation looks like this:

$$\begin{array}{r} 1\ 3 \\ 7\overline{)9^{2}4^{3}5} \end{array}$$

Alternatively, you can use subtraction to work out how many times 7 goes into 24.

$$24 - 7 = 17$$
$$17 - 7 = 10$$
$$10 - 7 = 3$$

To work out how many times 7 goes into 35, once again, you can use addition:

$$7 + 7 = 14$$
$$7 + 7 + 7 = 21$$
$$7 + 7 + 7 + 7 = 28$$
$$7 + 7 + 7 + 7 + 7 = 35$$

Five lots of 7 make up 35

Now you need to work out how many times 7 goes into 35. 7 goes into 35 five times. Place 5 on the answer line next to the number 3, as shown here:

$$\begin{array}{r} 1\ 3\ 5 \\ 7\overline{)9^{2}4^{3}5} \end{array}$$

Since there are no remaining numbers, this is the end of the calculation.
The answer to 945 ÷ 7 is 135.

Alternatively, to work out how many times 7 goes into 35, you can use subtraction:

$$35 - 7 = 28$$
$$28 - 7 = 21$$
$$21 - 7 = 14$$
$$14 - 7 = 7$$
$$7 - 7 = 0$$

Subtracting five lots of 7 from 35 gives zero

Basic mathematics and numeracy skills Part 4: Division Page 2

Method 2: Dividing using long division

To calculate 648÷4 the numbers need to be set out as shown:

$$4\overline{)648}$$

The first step is to work out how many times you can divide 4 into 6. In other words, how many lots of 4 are there in 6?

The divisor 4 goes into 6 only once with 2 remaining. Write the digit 1 on the answer line, above the 6 in the 'hundreds' column of the dividend and write the number 4 under the 6. Subtract the 4 from the 6 to give 2. Write the 2 in the same column as shown. This is commonly termed a 'remainder'.

$$\begin{array}{r} 1 \\ 4\overline{)648} \\ -\,4 \\ \hline 2 \end{array}$$

Next, the 4 in the 'tens' column is brought into the calculation as follows:

$$\begin{array}{r} 1 \\ 4\overline{)648} \\ -\,4 \\ \hline 24 \end{array}$$

Work out how many times 4 goes into 24. There are 3 possible ways to work this out: addition, subtraction or multiplication (see boxes on right). Six lots of 4 gives 24, so place the 6 next to the 1 on the answer line and place 24 under the number 24. Subtract 24 from 24 to give a remainder of 0.

$$\begin{array}{r} 16 \\ 4\overline{)648} \\ -\,4 \\ \hline 24 \\ -\,24 \\ \hline 0 \end{array}$$

Finally, the 8 in the 'units' column is brought into the calculation. Using addition, subtraction or multiplication, 8 can be divided by 4 twice. Place 2 next to the 6 on the answer line as shown. The answer to 648 ÷ 4 is 162. Any remainders that cannot be divided equally will result in your calculation becoming a decimal number.

$$\begin{array}{r} 162 \\ 4\overline{)648} \\ -\,4 \\ \hline 24 \\ -\,24 \\ \hline 08 \end{array}$$

One way to work out how many times 4 goes into 24 is to use the principles of addition:

$$4 + 4 = 8$$
$$4 + 4 + 4 = 12$$
$$4 + 4 + 4 + 4 = 16$$
$$4 + 4 + 4 + 4 + 4 = 20$$
$$4 + 4 + 4 + 4 + 4 + 4 = 24$$

Six lots of 4 make up 24.

Subtraction is another method that can be used to find out how many times 4 goes into 24:

$$24 - 4 = 20$$
$$24 - 4 - 4 = 16$$
$$24 - 4 - 4 - 4 = 12$$
$$24 - 4 - 4 - 4 - 4 = 8$$
$$24 - 4 - 4 - 4 - 4 - 4 = 4$$
$$24 - 4 - 4 - 4 - 4 - 4 - 4 = 0$$

Subtracting six lots of 4 from 24 gives zero.

Similarly, applying the principles of multiplication will also work:

$$1 \times 4 = 4$$
$$2 \times 4 = 8$$
$$3 \times 4 = 12$$
$$4 \times 4 = 16$$
$$5 \times 4 = 20$$
$$6 \times 4 = 24$$

Multiplying 4 six times gives 24.

Basic mathematics and numeracy skills Part 4: Division Page 3

Method 3: Dividing using the subtraction method

To calculate 160÷32, one method is to keep subtracting 32 until no more can be taken away.

160 – 32 = 128
128 – 32 = 96
96 – 32 = 64
64 – 32 = 32
32 – 32 = 0

5 lots of 32 have been subtracted to give a zero; i.e. no more can be taken away. Therefore:
160 ÷ 32 = 5

To double-check the answer, multiply 32 by 5. This comes to 160, thus confirming that 160 can be divided by 32, five times.

You can use a similar method for the following example (416 ÷ 32) involving larger numbers.

416
320 - (32 x 10 = 320)

An easy multiple of 32 is 320 (32 x 10). Take 320 from 416 to give 96.

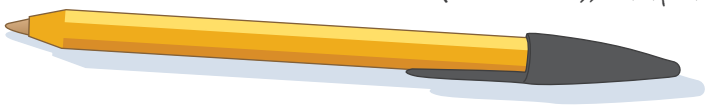
96
32 - (32 x 1 = 32)

Subtract 32 from 96. (This is one multiple of 32.)

64
64 (32 x 2 = 64)

0

96 – 32 is 64 and you may notice that 32 x 2 is also 64. (ie 2 multiples of 32.) You have taken away 13 multiples of 32 (10 + 1 + 2), therefore the answer to 416 ÷ 32 is 13.



Sequence of order for application of mathematical principles

Some mathematical calculations require you to manipulate more than two numbers.
When confronted with such a calculation you must follow the correct sequence of mathematical operations to ensure that you obtain the correct answer.

BODMAS is an acronym used to help you remember the correct sequence of mathematical operations to use.
The correct order to follow when dealing with more complex calculations is:

Brackets
Order (or Other)
Division
Multiplication
Addition
Subtraction

Example: Calculate 5 + 3 x 2
If 5 + 3 is calculated first, this gives:
5 + 3 = 8 and 8 x 2 = 16

Applying the rules of BODMAS, however, multiplication takes priority in the sequence of mathematical operations:
3 x 2 = 6 and 6 + 5 = 11

The correct answer is 11.

NB: Order or Other refers to powers, such as 10^2, 5^3, etc. Powers are not covered in this section.
Take care when using calculators to ensure that you enter the correct order of mathematical operations. Not all calculators are programmed to follow the BODMAS rule.

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Basic mathematics and numeracy skills Part 5: Understanding units of measurement

Edited by Martina O'Brien, Associate Professor Adult Nursing, London South Bank University

The accepted units of measurement in the UK are known as the International System of Units (Système International d'Unités) or SI units (Lapham & Agar, 2015). SI units have fully replaced imperial units in the UK and are much easier to work with, as they use the metric system. The NHS throughout the UK uses SI units, so healthcare professionals must ensure that they are familiar with the units used for measuring mass (weight), volume and length, and that they are able to carry out unit conversions. Medication is always prescribed in SI units and it is vital that you are able to carry out conversions quickly and accurately, as a mistake could mean you administer the wrong dose of medicine to a patient. All healthcare professionals are responsible for ensuring that that they understand units and can convert between different units of the same type, for example between units of mass (weight); see below. The Nursing and Midwifery Council's standards of proficiency require nurses to be proficient and accurate when calculating dosages of prescribed medicines and to be able to carry out accurate calculations for a range of medications (NMC, 2018). In addition, joint guidance from the Royal Pharmaceutical Society and Royal College of Nursing recommends that you should ask a second person to double-check calculations where practicable and raise any uncertainties with the prescriber or a pharmacy professional (RPS/RCN, 2019).

Although imperial units are not used in healthcare professional settings, many patients still use them. They may, for example, give their height in feet and inches and weight in stones and pounds. It is important that nurses are able to communicate with patients in a way that patients understand. For this reason, healthcare professionals need to develop their understanding of imperial units and be able to convert them to SI units; for example, if discussing the need for weight loss, it would be more meaningful to many patients to discuss weights in stones and pounds rather than kilograms. Sometimes the dose of a medicine will depend on the patient's weight. The dose will be written in SI units. The medication administration chart may read, for example, "10 mg of [the medicine] per kilogram of body weight". While all patients should be weighed on admission, occasionally this is not possible. Patients' own estimates of their weight should never be used for calculating dosage as they may not be accurate. Nevertheless, if the patient's weight is known using imperial units, the weight can be converted to SI units to provide a rough guide.

Units of mass (weight)

The SI unit for measuring mass (weight) is the kilogram. Units less than a kilogram include the gram (g), milligram (mg), microgram and nanogram. Each of these units is 1000 times smaller than the previous one. The active ingredients of medicines are usually measured in grams, milligrams or micrograms. Although the numbers look enormous (see table below), these units are very easy to work with, provided that you understand how to multiply and divide (see Parts 3 and 4 of this clinicalskills.net series on Basic mathematics and numeracy skills) and how to work with decimals.

It may help you to understand why these units are defined as units of mass and not weight, and what the difference is between the two. To understand the difference, imagine weighing yourself on planet Earth, then, using the same scales, weighing yourself on the Moon. Your weight would be much greater (heavier) on Earth due to the effect of gravity; your mass, however, would remain the same. Medication contains a measured amount of the active ingredient. For example, a paracetamol tablet contains 500 mg of paracetamol. Even though the paracetamol, the active ingredient, would be heavier on Earth than on the Moon (it would weigh 500 mg on Earth but less when weighed on the Moon), the amount (mass) of paracetamol that the tablet contains would remain the same.

SI units of mass

SI units of mass (weight)	In 1 kilogram there are...
Kilogram (kg)	1
Grams (g)	1000
Milligrams (mg)	1 000 000
Micrograms (mcg should not be used)	1 000 000 000
Nanograms (ng should not be used)	1 000 000 000 000

Note that the abbreviation for micrograms (mcg) should not be used as it can easily be mistaken for milligrams (mg) especially when written by hand. Micrograms (and nanograms) should always be written in full (*BNF*, 2019a).

Conversions of SI units of mass

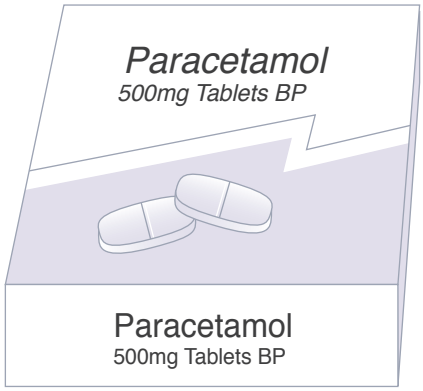
Units	Equals:
1 gram (g)	1000 mg
1 milligram (mg)	1000 micrograms
1 microgram	1000 nanograms

There are 1000 milligrams in 1 gram and 1000 micrograms in 1 milligram.

Basic maths and numeracy skills Part 5: Understanding units of measurement Page 2

Converting units of mass (weight)

It is important to understand the units of mass (weight) if you are to be certain of administering the correct dosage. You will sometimes need to convert between different units of the same type of measurement when giving medication: for example, if paracetamol 1g is prescribed, you will need to know that this dose is the same as two tablets of 500 mg.



As there is a thousand-fold difference between units of mass, converting the units is fairly straightforward.
To convert grams to milligrams, and milligrams to micrograms, multiply by 1000.
To convert milligrams to grams, and micrograms to milligrams, divide by 1000.
(See Part 3 and Part 4 of this series to review your understanding of how to multiply and divide.)

Converting grams to milligrams and milligrams to micrograms

When working with whole numbers, it is possible to multiply by 1000 by adding three zeros to the right of the number, so 1 g becomes 1000 mg.

Alternatively, another way is to move the decimal point to the right. Moving the decimal point one place to the right multiplies the number by 10; moving it two places to the right multiplies it by 100; moving it three places to the right multiplies it by 1000.

Note that you should never use unnecessary zeros after the decimal point when writing prescriptions in order to avoid confusion, e.g., in case 1 g is mistaken for 1000 g; this method is only for use in working out calculations.

Example: convert 1 gram to milligrams (mg).

1 gram can be written as 1.0000 g. (When dealing with whole numbers you can place as many zeros to the right of the decimal point as you wish as this does not change the value of the number.) Then, to multiply by 1000, move the decimal point three places to the right.

1.0000 g
1.0000 g x 10
1.0000 g x 100
1.0000 g x 1000

So 1.0000 g becomes 1000.0 mg.

Example: convert 1000 milligrams to grams using the same method.

To convert milligrams to grams or micrograms to milligrams, divide by 1000 by moving the decimal point three places to the left.

1000.0 mg
1000.0 mg ÷ 10
1000.0 mg ÷ 100
1000.0 mg ÷ 1000

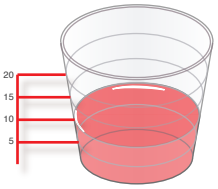
So, 1000.0 mg becomes 1.0 g. (Or, using another example, 1000.0 micrograms would become 1.0 mg.)

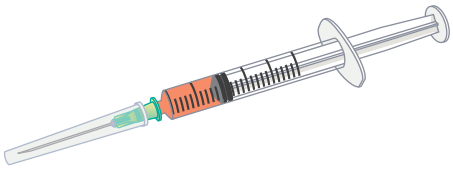
Most SI units are converted in a similar way.

Basic maths and numeracy skills Part 5: Understanding units of measurement Page 3

SI units of volume

The SI unit for measuring volume (liquid) is the litre (l or L).
Volume can also be measured in smaller units, millilitres (ml or mL).
Each millilitre is one-thousandth (1/1000) of a litre.





Converting units of volume

To convert 1 litre to millilitres, multiply by 1000. To convert millilitres to litres, divide by 1000.

SI unit of volume (liquid or gas)	In 1 litre:
Litre (L)	1
Millilitre (mL)	1000

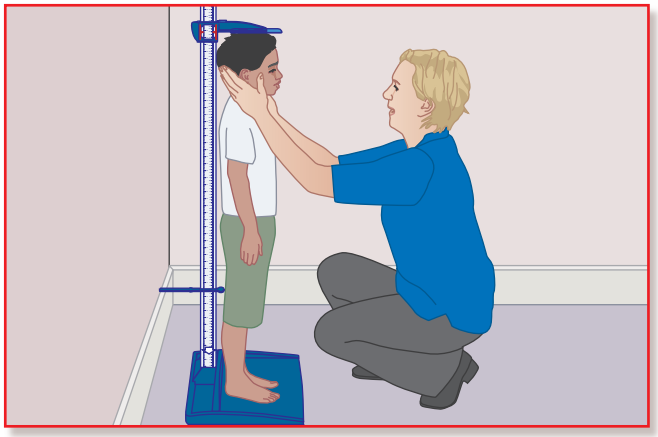
SI unit of length

The SI unit for measuring length is the metre (m). Units less than a metre are the centimetre (cm), which is one-hundredth (1/100) of a metre, and the millimetre (mm), which is one-tenth (1/10) of a centimetre.

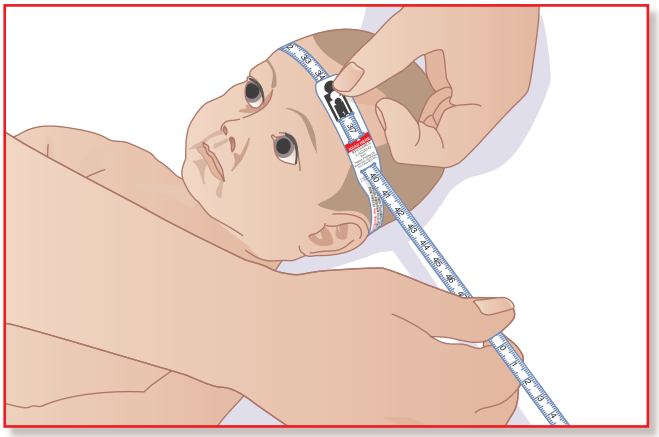
SI unit of length	In 1 metre:
Metre (m)	1
Centimetre (cm)	100
Millimetre (mm)	1000

Converting units of length

Converting the different SI units of length is slightly different than for volume or mass, as the units are not all in multiples of a thousand.



In order to convert metres to centimetres, remember that there are 100 centimetres in 1 metre and that you therefore need to multiply by 100. To do this, either add two zeros to the number or move the decimal point two places to the right. For example, a measurement of 0.92 m becomes 92 cm.



To convert centimetres to millimetres, remember that there are only 10 millimetres in 1 centimetre and that you therefore need to multiply by 10. To do this, add one zero to the number or move the decimal point one place to the right. For example, a measurement of 24 cm becomes 240 mm.

Basic maths and numeracy skills Part 5: Understanding units of measurement Page 4

More examples of conversions

To practise conversions, cover the answer column below, do the calculations yourself, then check your answers.

Convert:	Answer
3 g to milligrams	3000 mg
1.6 g to milligrams	1600.0 mg
100.25 mg to grams	0.10025 g
2 mg to micrograms	2000 micrograms
1.5 mg to micrograms	1500 micrograms
3.2 g to milligrams	3200 mg
250 micrograms to milligrams	0.25 mg
1.2 g to milligrams	1200 mg
0.75 g to micrograms	750,000 micrograms
0.5 L to millilitres	500 mL
750 mL to litres	0.750 litre
1.5 L to millilitres	1500 mL
45 cm to millimetres	450 mm
375 mm to centimetres	37.5 cm
568 cm to metres	5.68 m
98 mm to metres	0.098 m

All metric units are recognised by the *British National Formulary* (*BNF*, 2019b). The RCN (2019) offers a useful online resource that you can use to check your understanding of SI units; see Key reading list.

Calculating dose by body weight

It may sometimes be necessary to calculate the dosage of a medicine according to the body weight of the patient. The prescription will be written as milligrams of the medicine per kilogram of body weight (mg per kg). To calculate the dose of the medicine that needs to be administered, multiply the dosage of the medicine in milligrams by the weight of the patient in kilograms. (See also page 7 of “Calculations for medicines administration”.)

Example: A patient weighing 62 kg is prescribed a medicine at a dosage of 2 mg per kg. How much medicine should you administer?
Answer: 62 x 2 = 124, so you will need to administer 124 mg of the medicine.

Here are some examples of calculations of medicine dosages to be administered according to body weight:

Prescribed amount of the medicine	Calculation
Give 3 mg per kg Patient’s weight is 75 kg	3 x 75 = 225 mg
Give 4 micrograms per kg Patient’s weight is 56 kg	4 x 56 = 224 micrograms
Give 1.5 mg per kg Patient’s weight is 48 kg	1.5 x 48 = 72 mg

Basic maths and numeracy skills Part 5: Understanding units of measurement

Imperial units

Imperial units do not use the metric system so conversions between these units are more complicated.

Imperial units of mass (weight)

The main imperial units that a healthcare professional needs to know are stones, pounds and ounces. In hospital, patients are weighed in kilograms but they will often want to know their weight in stones and pounds; this is especially true of elderly patients who will be less familiar with SI units. As previously stated, imperial units are never used when calculating the dosage of medication.

Imperial units of mass (weight)	In 1 stone:
Stone	1
Pound (lb)	14 lb
Ounce (oz)	224 oz (there are 16 ounces in a pound)

(thecalculatorsite.com, 2019)

Imperial units of length

The main imperial units of length that a health professional needs to know are yards, feet and inches. Patients' height will normally be measured in metres but they may want to know their height in feet and inches.

Imperial units of length	In 1 yard:
Yard (yd)	1
Feet (ft or ')	3'
Inches (in or ")	36" (There are 12 inches in 1 foot)

(thecalculatorsite.com, 2019)

Conversion of imperial units of mass (weight) to SI units and vice versa

Imperial units of mass (weight)	In SI units:
1 stone	6.35 kg
1 pound	0.45 kg
1 ounce	28 g

SI units of mass (weight)	In imperial units:
1 kg	2.21 lb
1 g	0.035 oz

So, to convert pounds to kilograms, multiply by 0.45 (or you could divide by 2.21); and to convert kilograms to pounds, divide by 0.45 (or you could multiply by 2.21). Conversions between imperial and metric units are also available online, see Key reading.

Conversion of imperial units of length to SI units and vice versa

Imperial units of length	In SI units:
1 yard	914.4 mm or 91.4 cm
1 foot	304.8 mm (305 mm)
1 inch	25.4 mm

SI units of length	In imperial units:
1 metre	3.28 feet
1 centimetre	0.39 inches

So, to convert metres to feet, multiply by 3.28; and to convert feet to metres, divide by 3.28 (thecalculatorsite.com, 2019). Conversions between imperial and metric units are also available online, see Key reading.

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Calculations for medicines administration

By Martina O'Brien, Associate Professor Adult Nursing, London South Bank University

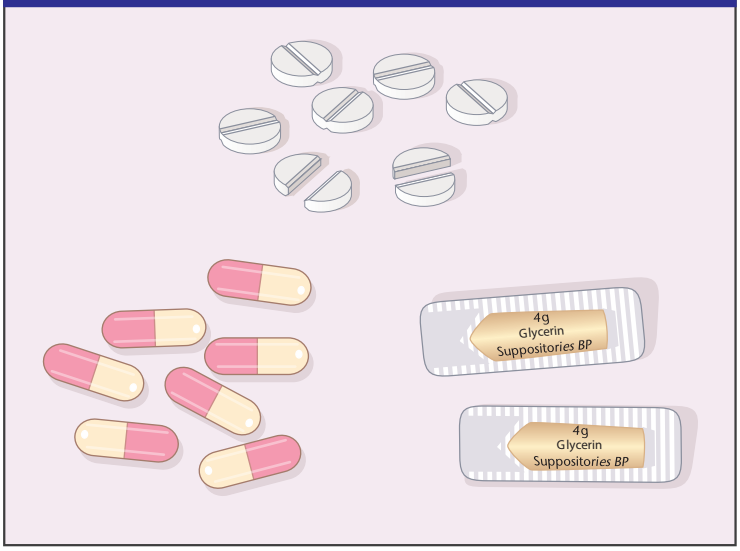
The administration of medicines is a vital component of nursing care; it is an activity that nurses undertake on a regular basis. If you are to calculate, dispense and administer the correct doses of medicines to patients, you must be confident in your application of basic mathematical principles. Errors in medicines administration, particularly those where the dose has been calculated incorrectly, are all too common in nursing practice; such errors can be detrimental to the patients in your care. NHS Improvement (2019) estimates that there are approximately 237 million medication errors per year in the NHS in England. Of these, about 66 million are potentially clinically significant. For more on the role of calculation skills in reducing medication errors, see Brindley (2019) in Key reading.

The Nursing and Midwifery Council's standards of proficiency require nurses to be proficient and accurate when calculating dosages of prescribed medicines and to be able to carry out accurate calculations for a range of medications (NMC, 2018). You should ask a second person to double-check calculations where practicable and raise any uncertainties with the prescriber or a pharmacy professional (RPS/RCN, 2019).

If you are not confident in basic mathematics then you should revisit the 5-part series on basic mathematics and numeracy skills before you proceed with these pages. It is vital to have a good understanding of basic mathematical principles, so that you can apply these to the various formulae that are used to calculate medicine doses accurately.

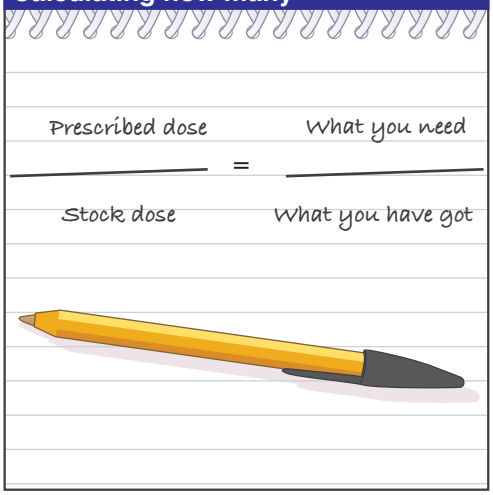
Before you calculate the quantity of a medicine to administer to a patient, you must be sure that the dose prescribed is appropriate for your patient. You therefore need to have a good understanding of your patient's medical condition and any factors that can influence the amount of a medicine to be given (e.g., renal function, body weight, etc.). Learners working under supervision should always check their calculations with the person they are working with.

1 Calculations for solid forms of medicines (capsules, suppositories and tablets)



Solid forms of medicines, such as capsules, suppositories and tablets, are measured in grams (g), milligrams (mg), micrograms and, for some medicines, nanograms. Although you may see the abbreviations mcg and ng for micrograms and nanograms respectively, the recommended practice is to write these units in full, rather than using their abbreviated terms (*BNF*, 2019a). The aim is to prevent anyone misreading such abbreviations, which could result in a patient receiving the wrong dose of a medicine.

Calculating how many



A useful formula to calculate how many capsules, suppositories or tablets should be administered is: (prescribed dose) divided by (stock dose). You need to divide the amount that has been prescribed by the stock dose. Put simply: (What you need) divided by (What you've got).

Example 1: first check what you need

			Time
DRUG (Approved Name in capitals) FLUCLOXACILLIN		Dose 500 mg	06 00
			08 00
Additional Instructions	Start Date 25/9/20	Route PO	12 00
	End Date 31/9/20		14 00
Signature	Pharmacy	Frequency 4 times daily	18 00
			22 00 (24.00)
DRUG (Approved Name in capitals)		Dose	06 00
			08 00
Additional Instructions	Start Date	Route	12 00
	End Date		14 00
Signature	Pharmacy	Frequency	18 00
			22 00
DRUG (Approved Name in capitals)		Dose	06 00

In this example, you can see from the medicines administration chart that the patient has been prescribed 500 mg of flucloxacillin four times daily.

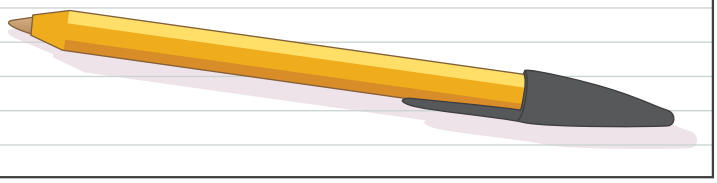
Check what stock you have got

The medicine is stored in a bottle which contains capsules of 250 mg.

Calculations for medicines administration Page 2

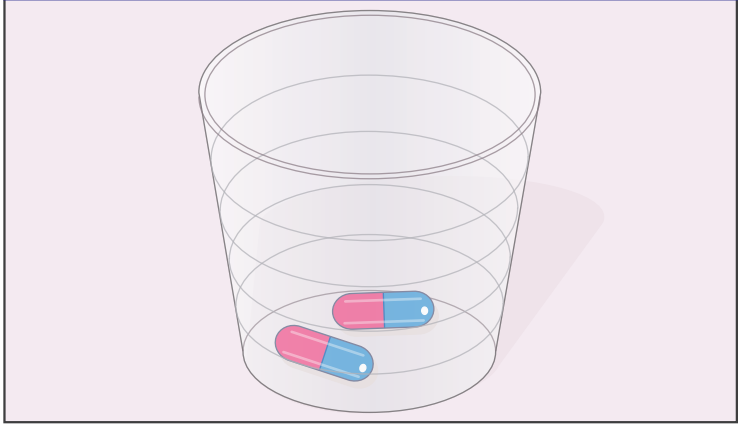
Calculate the dose

Prescribed dose / Stock dose = 500mg / 250mg = 2



The prescribed dose is 500 mg and the stock dose is 250 mg. To calculate how many capsules to dispense per dose, divide the prescribed dose by the stock dose, as shown above.

Dispense the correct number of items



Therefore, two capsules need to be dispensed. This is a fairly simple calculation.

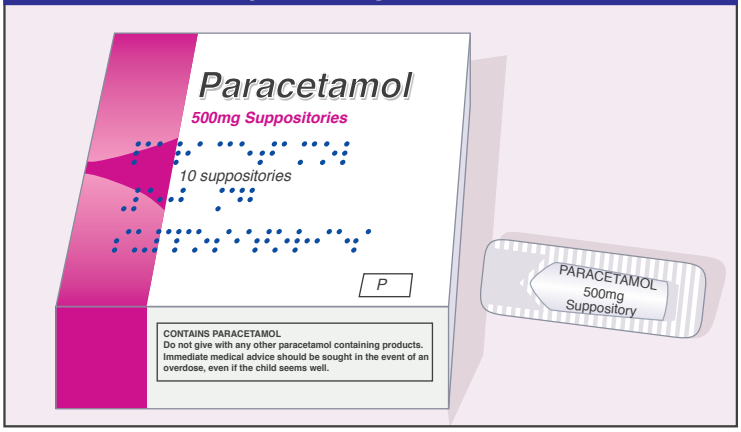
Example 2: check what you need

PREOPERATIVE AND 'ONCE ONLY' PRESCRIPTIONS

Date	Drug Approved Name (BLOCK LETTERS)	Dose	Route	Time	Doctor's Signature	Given by	Ti Gi
25/5/20	PARACETAMOL	1g	PR		Dr Little	A Dunning	

This example shows how you would calculate a dose of medicine if the prescribed dose differed in its unit of measurement to the stock dose. A patient is prescribed 1 g of paracetamol as a once-only prescription.

Check what stock you have got



The medicine is stored in a box which contains suppositories of 500 mg.

Dose conversion

Prescribed dose / Stock dose = 1 g / 500 mg

Convert 1 gram to milligrams

1 g x 1000 = 1000 mg

To do this multiply by 1000

1000 mg / 500 mg = 2 suppositories

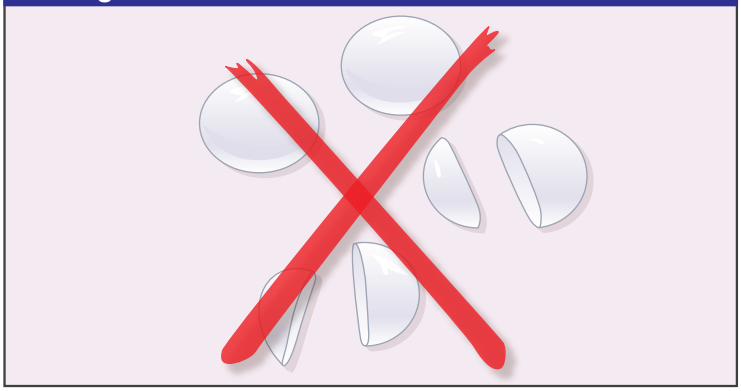
To calculate the number of suppositories to administer, you must convert either the prescribed dose or the stock dose to the same unit of measurement; this is known as dose conversion. In order to do this accurately, you need to understand the SI units of measurement and their equivalences (see "Basic mathematics and numeracy skills Part 5: Units of measurement"). It is always safer, where possible, to avoid using decimal numbers in medicines calculations. Doing so means there is potential for the decimal point to be placed incorrectly, resulting in a patient receiving 10, 100 or 1000 times under or over the prescribed dose.

Dispense the correct number of items

Therefore, you need to administer two paracetamol suppositories.

Calculations for medicines administration Page 3

Cutting tablets



You should never cut tablets in order to administer the required dose, unless they are scored and it is therefore appropriate to do so. This is because it is not always possible to accurately divide a non-scored tablet to administer the correct dose. Suppositories should never be cut, for the same reason. Some tablets, such as enteric-coated or sustained-release tablets, should also never be cut. Capsules should never be opened; doing so could affect the way the body utilises the medicine. It may also render the medicine unlicensed (*BNF*, 2019b). A sensible rule to follow is that if your calculated answer requires you to give a fraction of a tablet or suppository or several tablets or suppositories in one dose then your calculation may be incorrect.

Checking with the prescriber

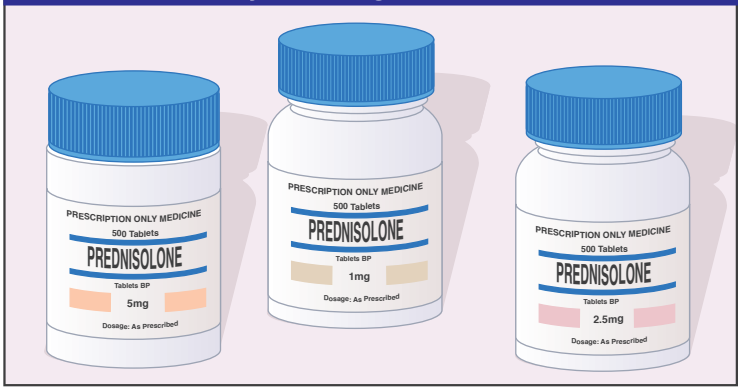
It is important to remember that, occasionally, the prescribed dose may be incorrect. You should always verify the correct dose that should be prescribed before you dispense any medicines. If you are unsure, you must check with the prescriber before dispensing the medicine. Also, refer to the clinicalskills.net procedures, “Administration of medicines: key principles” and “Routes of administration”.

Example 3: choosing the correct stock dose

			Time				
DRUG (Approved Name in capitals) PREDNISOLONE		Dose 15 mg	06 00				
			08 00				
Additional Instructions	Start Date 25/11/20	Route PO	12 00				
	End Date 27/11/20		14 00				
Signature D Flemming	Pharmacy Hl	Frequency Once daily	18 00				
			22 00				
DRUG (Approved Name in capitals)		Dose	06 00				
			08 00				

It is good practice to administer the lowest number of tablets possible to achieve the required dose. So, if you have a choice with your stock dose, always choose the one that will enable you to dispense the least amount of medicine (fewest units) to meet the prescribed dose. In this example, the patient is prescribed prednisolone 15 mg once daily.

Check what stock you have got



The available stock supply is as follows: prednisolone 1-mg, 2.5-mg and 5-mg tablets.

Calculate the dose

Using 1 mg stock dose of prednisolone:

$$\frac{\text{Prescribed dose } 15}{\text{Stock dose } 1} = 15 \times 1\text{-mg tablets}$$

Using 2.5 mg stock dose of prednisolone:

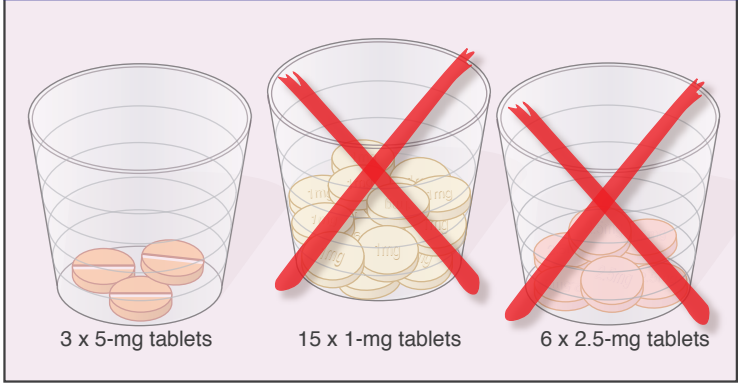
$$\frac{\text{Prescribed dose } 15}{\text{Stock dose } 2.5} = 6 \times 2.5\text{-mg tablets}$$

Using 5 mg stock dose of prednisolone:

$$\frac{\text{Prescribed dose } 15}{\text{Stock dose } 5} = 3 \times 5\text{-mg tablets}$$

To calculate the most appropriate stock dose or combination of stock doses to use, divide the prescribed dose by the stock dose.

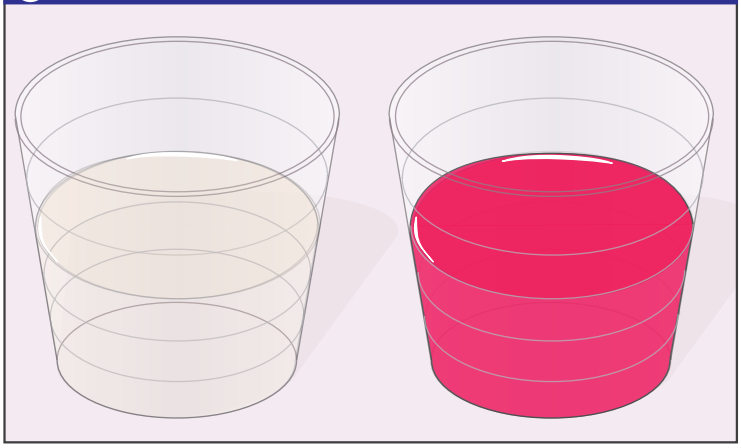
Dispensing the correct number of items



The stock dose of choice in this example is prednisolone 5-mg tablets. Although the patient would still receive the correct dose if the other combinations were used, they would be expected to swallow a much larger quantity of tablets. This could prove unpleasant and difficult for some patients, particularly those with swallowing difficulties.

Calculations for medicines administration Page 4

2 Calculations for liquid forms of medicines



Liquid medicines are measured in litres (L), millilitres (mL) and, for some medicines, in moles (mol), millimoles (mmol) or micromoles. Some liquids are also measured in units. You may see units abbreviated as u or iu but units should always be written in full and not in their abbreviated terms (*BNF*, 2019a).

Calculating the amount of medicine in liquid form

$$\frac{\text{Prescribed dose}}{\text{Stock dose}} \times \text{Volume of solution}$$

$$\frac{\text{What you Need 'N'}}{\text{What you Have 'H'}} \times \text{Volume of Solution 'S'}$$

When administering medicines in a liquid form, the prescription should state the required dose (in e.g., grams, milligrams, micrograms) and the strength of the liquid. There are a few exceptions but these are relatively few (e.g., lactulose is prescribed in millilitres (mL)). To calculate the amount of a medicine in liquid form that needs to be administered, you can use the above formula. A useful mnemonic to remember is: 'N_HS' (see red box).

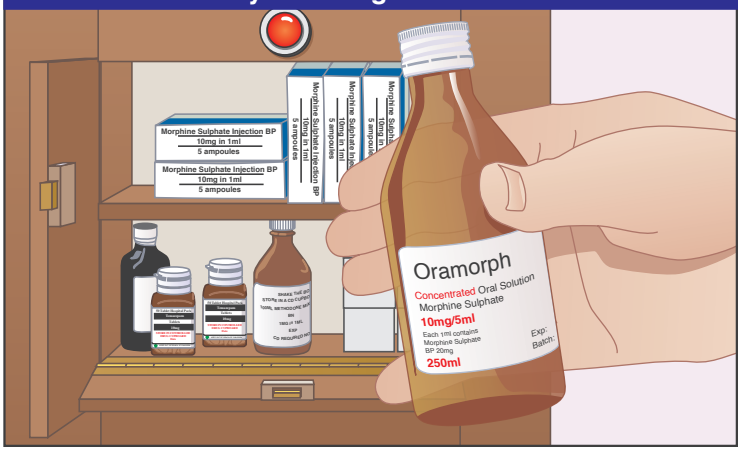
Example: first check what you need

AS REQUIRED PRESCRIPTIONS

DRUG (APPROVED NAME) ORAMORPH				Date			
Dose 20 mg	Max. Frequency 4 hourly	Route PO	Start Date 25/9/20	Time			
Signature [signature]		Valid Period 3 days	Pharm. [signature]	Dose / Route			
Additional Instructions/Indication				Given by			

In this example, the prescription states that the patient is to receive 20 mg of morphine sulphate solution (Oramorph).

Check what stock you have got

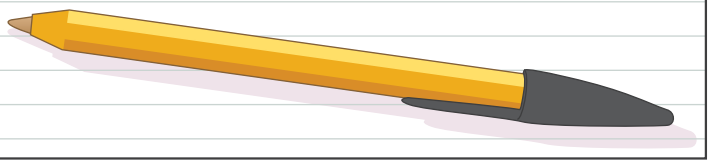


In the controlled drugs cupboard, where this medicine is stored, there is a bottle containing a liquid 10 mg/5 mL-strength solution of morphine sulphate (Oramorph).

Calculate how much liquid to administer

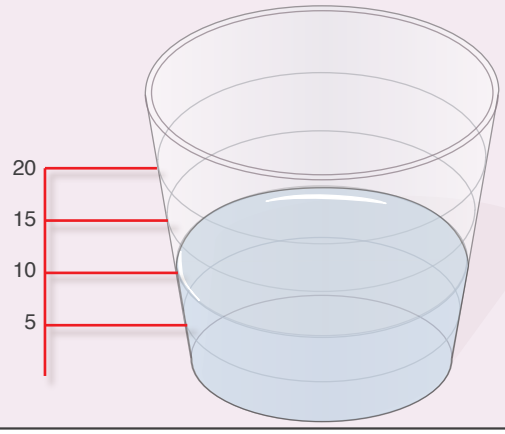
$$\frac{\text{Prescribed dose}}{\text{Stock dose}} \times \text{Volume of solution}$$

$$\frac{20\text{ mg}}{10\text{ mg}} \times 5\text{ mL} = 10\text{ mL}$$



The prescribed dose is 20 mg, and the stock dose is 10 mg, in a volume of 5 mL. Calculating the dose according to the recommended formula allows you to work out that the required volume of this medicine is 10 mL.

Administer the correct amount



Therefore, you need to administer 10 mL of morphine sulphate (Oramorph). Morphine sulphate (Oramorph) is a clear liquid but has been shaded here for clarity.

Calculations for medicines administration Page 5

Alternative method for calculating liquid medicines

Stock dose = 1 mg/5 mL

∴1 mg in 5 ml x 2 = 2 mg in 10 mL

∴2 mg in 10 ml x 2 =4 mg in 20 mL

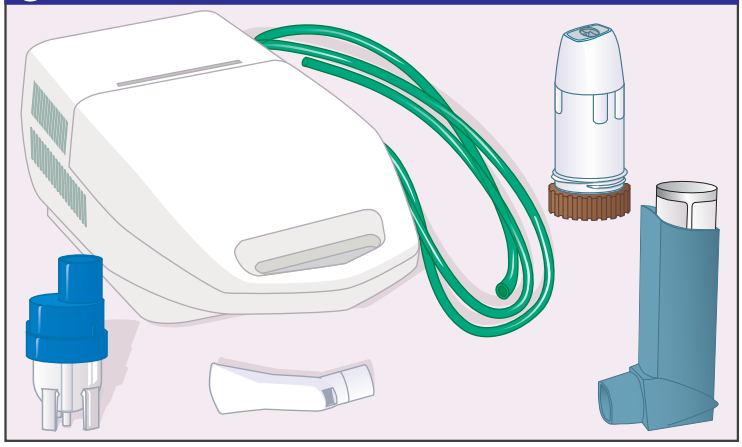
∴20 mL loperamide hydrochloride

A patient is prescribed loperamide hydrochloride 4 mg. The stock dose is loperamide hydrochloride 1 mg/5 mL. It follows that there are 2 mg in 10 mL (calculate this by doubling: 5 mL + 5 mL) and 4 mg in 20 mL (doubling again: 10 mL + 10 mL). Therefore administer 20 mL of loperamide hydrochloride.

Check your calculations with a registered nurse

A sensible rule to follow is that if your answer requires you to administer a large or a very small volume of liquid in one dose then your calculation may be incorrect.

3 Calculations for nebulised and inhaled medicines



Nebulisers are administered in a liquid form. To calculate the amount of a nebulised medicine to administer to a patient, follow the formulae outlined in the calculations for liquid forms of medicines in the section above.

Example: first check what you need

AS REQUIRED PRESCRIPTIONS

DRUG (APPROVED NAME) SALBUTAMOL				Date		
Dose 100 micrograms	Max. Frequency 4 hourly	Route INHAL	Start Date 25/5/20	Time		
Signature A Flemming		Valid Period 4 DAYS	Pharm. SC	Dose / Route		
Additional Instructions/Indication				Given by		
DRUG (APPROVED NAME)						

Inhaled medicines may be in the form of a powder, a spray or an aerosol. Administration of inhaled medicines is usually via a metered dose inhaler. In this example, the patient requires 100 micrograms of salbutamol via aerosol inhaler.

Check what you have got and calculate the dose

100 micrograms/metered inhalation

= 100 micrograms per puff

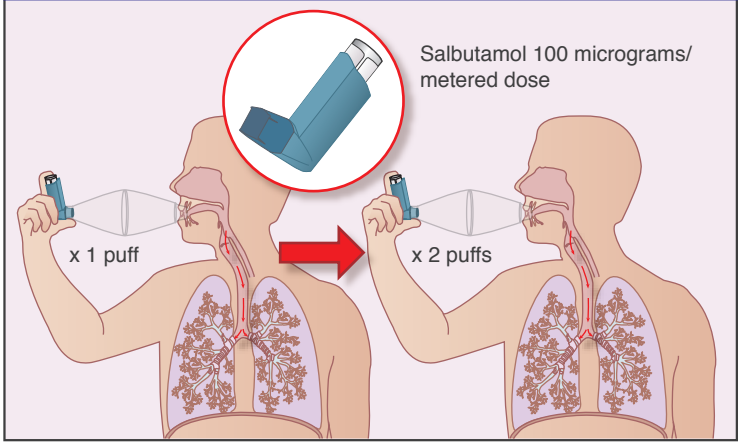
The dose that can be administered

is 100 micrograms

1 puff = 100 micrograms

To find out what you have got, you need to be able to quantify each puff as a dose. The stock dose is salbutamol 100 micrograms/metered inhalation.

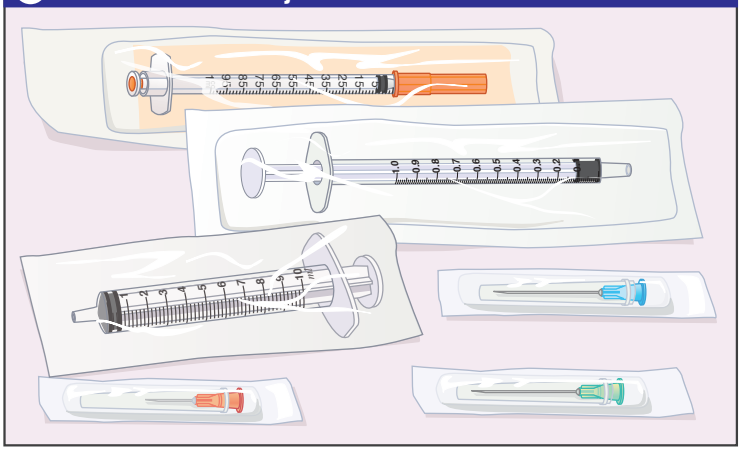
Administer the medicine



The patient will receive 100 micrograms of salbutamol per puff.

Calculations for medicines administration Page 6

4 Calculations for injectable medicines



You must draw up injections in a liquid form to allow safe administration. To calculate the volume of an injection to administer to a patient, follow the formulae outlined in the calculations for liquid forms of medicines in the section above.

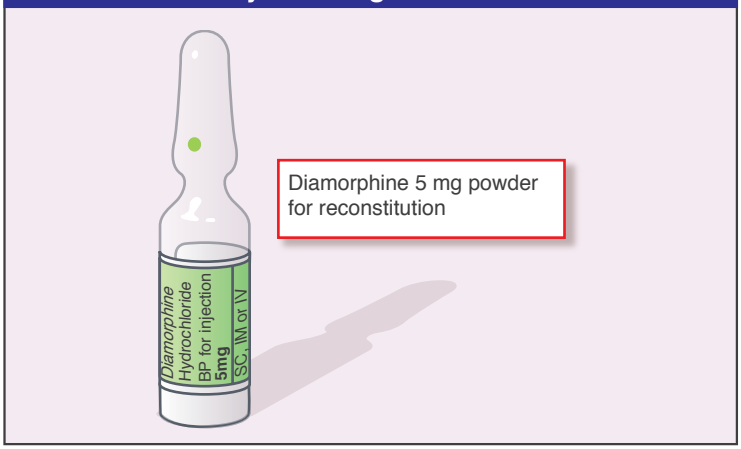
Example: first check what you need

AS REQUIRED PRESCRIPTIONS

DRUG (APPROVED NAME) DIAMORPHINE				Date			
Dose 2.5 mg	Max. Frequency	Route SC	Start Date 25/9/20	Time			
Signature		Valid Period	Pharm.	Dose / Route			
Additional Instructions/Indication				Given by			
DRUG (APPROVED NAME)							

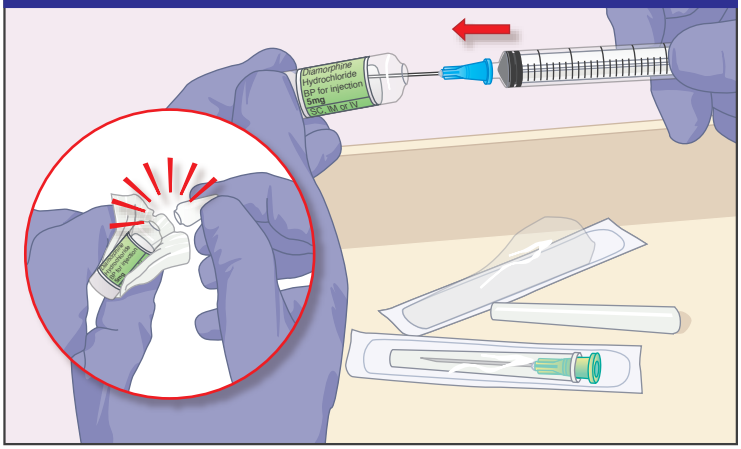
In this example, the patient is prescribed diamorphine 2.5 mg via the subcutaneous route.

Check what stock you have got



Manufacturers supply some injectable medicines in a powder format. This has to be reconstituted into a liquid in order to administer to patients. In this case, the stock dose is diamorphine 5 mg ampoules containing a powder format of the medicine.

Dissolve the medicine



You will need to dissolve the medicine in water for injection (water is the diluent of choice for this medicine; 0.9% sodium chloride is an alternative diluent for some other medicines). When deciding the volume of diluent, it is important to bear in mind the route of administration. For subcutaneous routes, the recommended volume should not exceed 1–2 mL (Dougherty & Lister, 2015). Larger volumes can increase pain and irritation at the injection site (Zijlstra *et al.*, 2018).

Calculate the dose

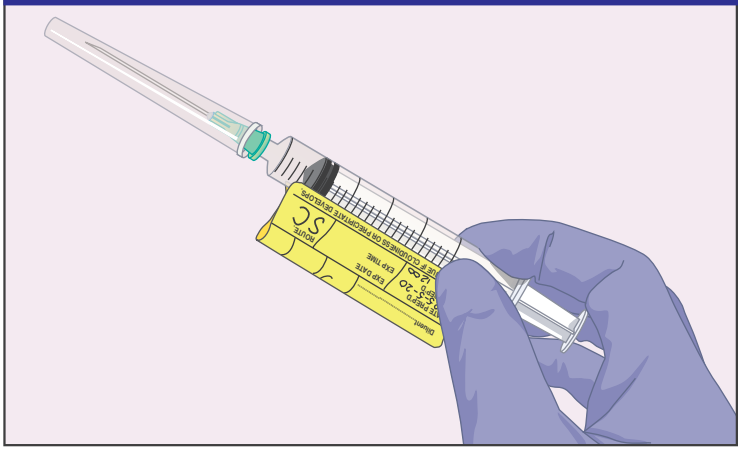
What you Need 'N' / What you Have 'H' x Volume of Solution 'S'

$\frac{2.5\text{ mg}}{5\text{ mg}} \times 2\text{ mL} = 1\text{ mL}$

1 ml of the reconstituted diamporphine contains 2.5 mg of diamorphine.

If the medicine is diluted with, for example, 2 mL of water for injection, the reconstituted dose becomes 5 mg/2 mL. To calculate the volume to administer to the patient, follow the formula outlined in the calculations for liquid forms of medicines in the section above.

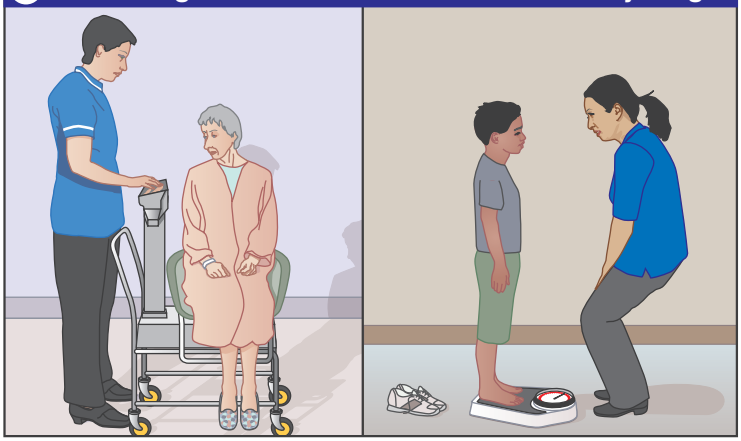
Administer the correct amount



The patient will receive an injection of 1 mL containing 2.5 mg diamorphine. For more information on administration of injections, see the clinicalskills.net section on Medicines Management.

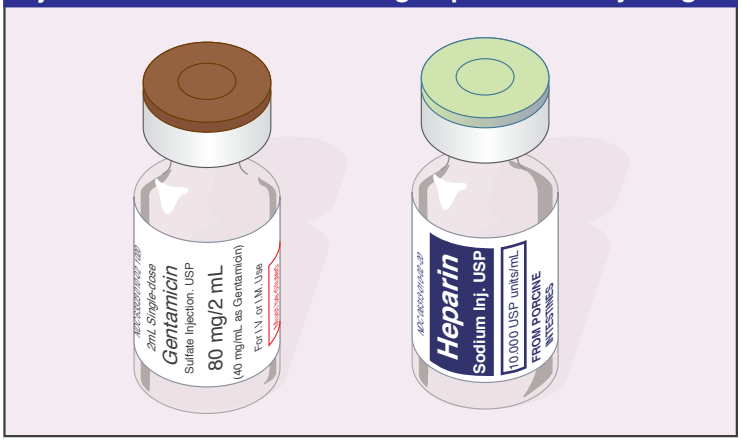
Calculations for medicines administration Page 7

5 Calculating doses of medicines based on body weight



Some doses of medicines need to be calculated according to the body weight of the patient, because they will achieve a higher concentration in someone who weighs less than in someone who is heavier. The higher concentration could be detrimental for some patients. The weight is always calculated in kilograms (kg) for this purpose.

Injectable medicines according to patient's body weight



Common medicines administered via injections that are calculated in this way include heparin, gentamicin and some chemotherapy medicines. Other forms of medicines, such as tablets, may also be prescribed according to the patient's body weight—particularly for children.

Example

3 mg x 60 kg = 180 mg

The patient is to receive 180 mg of gentamicin but divided into three doses per day.

$$\frac{180}{3} = 60 \text{ mg}$$

In this example, a patient is prescribed gentamicin 3 mg/kg via the intramuscular route, given in three doses per day. The patient weighs 60 kg. To calculate how much gentamicin you would expect the patient to be prescribed, you need to multiply the prescribed dose by the body weight. The patient is to receive 180 mg of gentamicin but divided into three doses per day. The patient should therefore receive 60 mg of gentamicin every 8 hours.

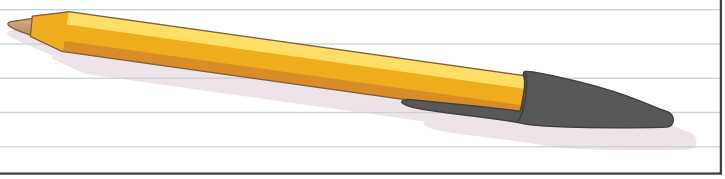
Confirm the prescribed dose

			Time			
DRUG (Approved Name in capitals) GENTAMICIN		Dose 60mg	06 00			
			08 00			
Additional Instructions To be given over 3 minutes	Start Date 25/11/20	Route IM	12 00			
	End Date		14 00			
Signature	Pharmacy	Frequency 3 times daily	18 00			
			22 00			
DRUG (Approved Name in capitals)		Dose	06 00			
			08 00			

The medication administration chart should be made out as shown above. It is the prescriber's responsibility to work out the dose that the patient needs to receive. Nevertheless, the nurse should understand how this is done, in order to ascertain whether the prescribed dose is indeed correct. If you have any doubts arising from what is written on the chart, you should always raise these with the prescriber.

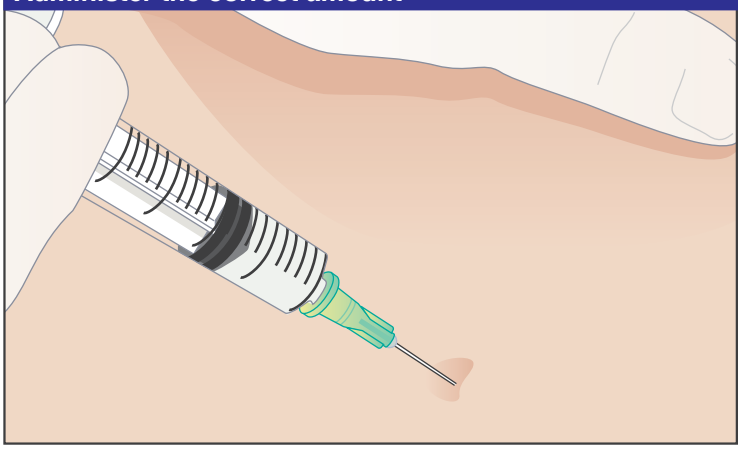
Calculate how much medicine to administer

$$\frac{60}{40} \times 1 = 1.5 \text{ mL}$$



To calculate how much liquid to administer per dose, the strength of the medicine needs to be known. The stock dose is gentamicin 40 mg/mL. To calculate the volume to administer to the patient, follow the formula outlined in calculations for liquid forms of medicines in the section above.

Administer the correct amount



The patient should receive 1.5 mL, which is equivalent to 60 mg per dose.

clinicalskills.net

Intravenous infusions: calculating rates

Edited by Edda Hensler, Senior Lecturer in Nursing, University of Brighton

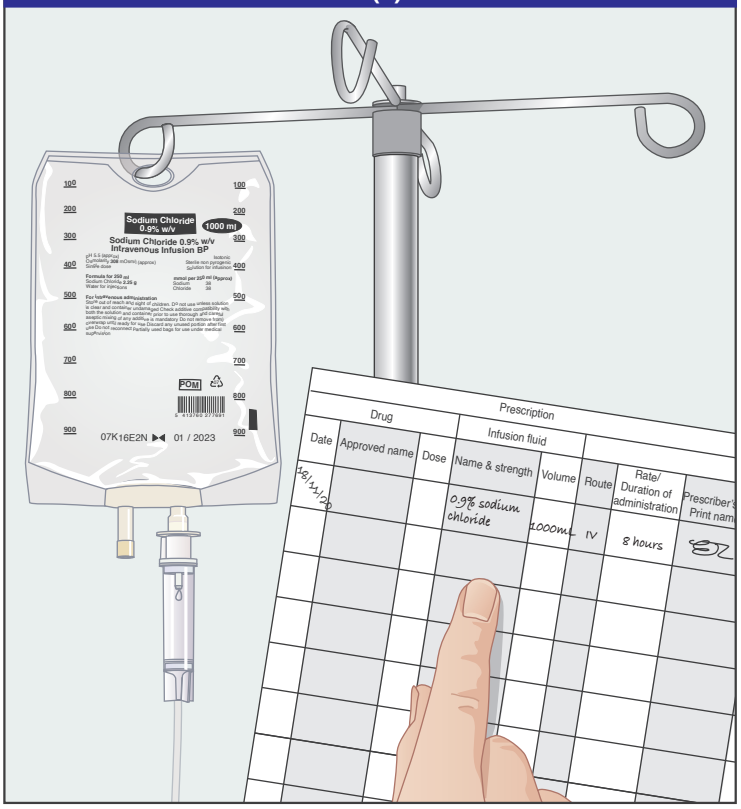
Two main types of devices are used for the delivery of infusion therapy: manual flow control devices, such as standard administration sets, and electronic infusion devices, such as infusion pumps.

Manual flow control devices rely solely on gravity to deliver the infusion therapy. The administration set has a drip chamber and a roller clamp to control the number of drops of fluid that pass through the drip chamber. Standard administration sets provide 20 drops per mL, blood administration sets provide 15 drops per mL and paediatric administration sets (burettes) 60 drops per mL.

The nature of a manual flow control device means that its flow rate can vary, and there will be limits on the extent to which it is possible to set the flow rate accurately. This type of device is therefore ideal when the infusion therapy does not contain additives such as medicines that must be delivered at an exact rate, or when adverse effects are unlikely to occur following variations in the flow rate. Manual flow control devices may also be used where the patient's condition is stable and no complications are expected, if local policy allows (RCN, 2016). Some patients, such as those receiving several different medicines via infusion, children, older people and those with cardiovascular disease are more vulnerable to the variations in flow rate that may occur with gravity infusion. For these groups, an accurate flow rate is vital: infusion therapy should be delivered via an infusion pump, which is programmed to deliver the volume of fluid at a set mL per hour (Lister *et al.*, 2020). When choosing the delivery method, assess risk according to patient condition, prescribed therapy, rate of infusion and care setting (MHRA, 2015; MHRA, 2014).

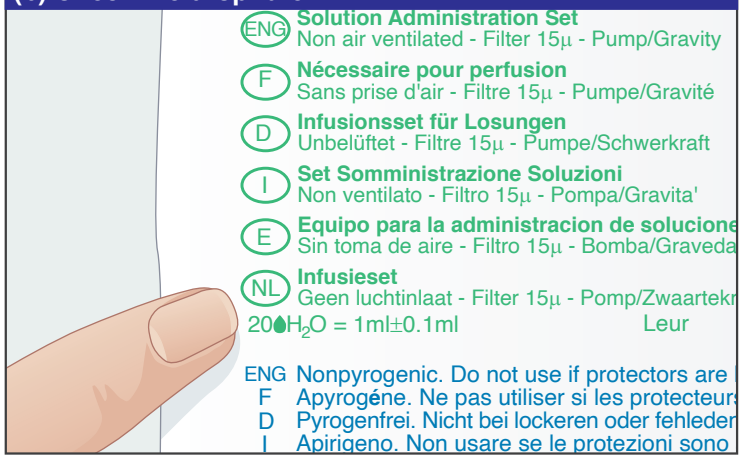
Infusion pumps are mains and battery powered. They include a wide range of safety and alarm features such as air-in-line detectors, low battery, occlusion and end of infusion. These devices are expensive; they may not be easy to set up; and they may require the use of dedicated giving sets. Staff can only use them if they have undergone the appropriate training in line with local policy (Bacon & Hoffman, 2020; MHRA, 2015). (See also the clinicalskills.net procedure, "Infusion pumps and devices".) Electrically operated infusion pumps must be serviced regularly in line with local policy. This procedure outlines how to calculate the rate using a manual flow control device or an infusion pump.

Manual flow control device: (a) Check the fluid volume



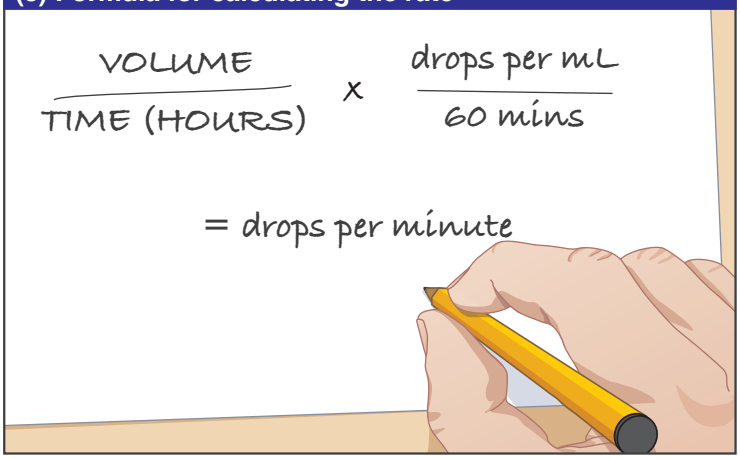
Check the patient's prescription, to find out the type and volume of fluid prescribed and the length of time over which the infusion will take place. (See clinicalskills.net procedure, "Intravenous administration of medication".)

(b) Check the drop rate



Examine the packaging of the administration set to find out the drop rate. In this example, using a standard administration set, the drop rate shown on the packaging is 20 drops per mL.

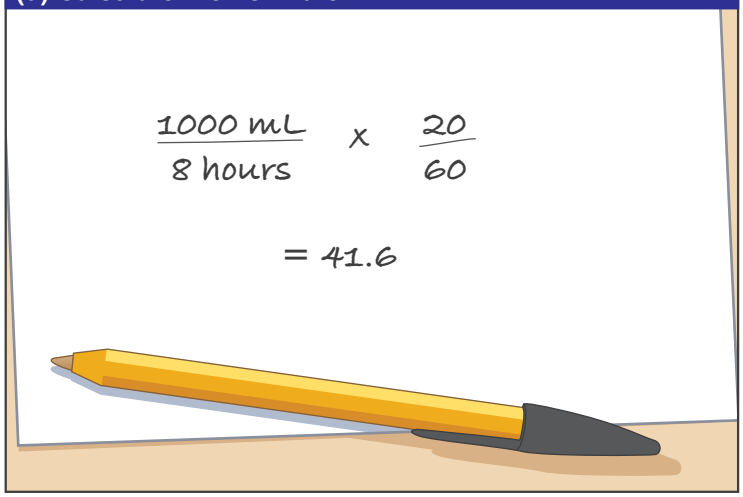
(c) Formula for calculating the rate



To calculate the rate when using a manual flow control device, use the following formula: volume of fluid (in mL) divided by time (in hours), multiplied by the drop rate (20 in this case) over 60 (minutes) (Lister *et al.*, 2020). The number of drops provided may vary according to manufacturer, so always check the packaging for the drop rate.

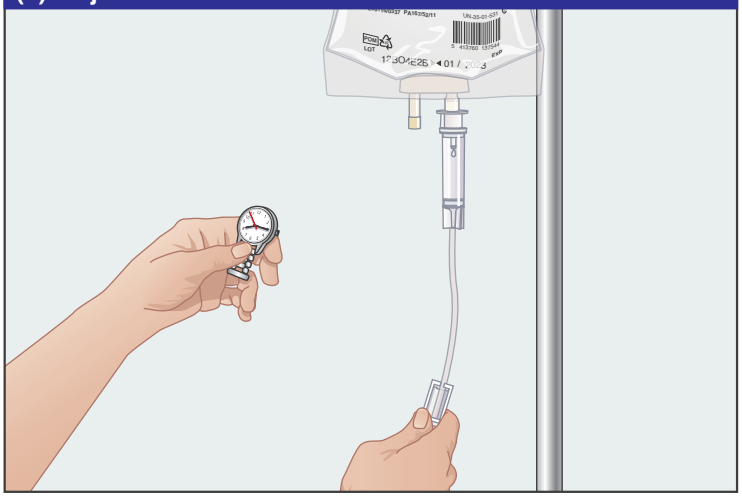
Intravenous infusions: calculating rates Page 2

(d) Calculate the flow rate



The number that you obtain from your calculation will be in drops per minute—in this example, when rounded up, 42 drops.

(e) Adjust the flow rate



You will then need to adjust the flow rate using the roller clamp. Count how many drops fall into the drip chamber in 1 minute. After setting up the infusion, check the flow rate regularly; follow local policy.

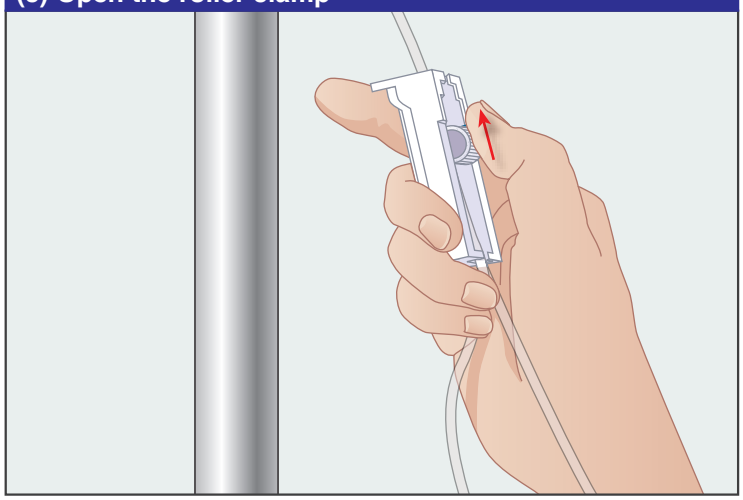
Using an infusion pump: (a)

Electrically operated infusion pumps deliver infusion therapy with precision (RCN, 2016). Clamp the pump on a suitable stand. (See also the clinicalskills.net procedure, “Infusion pumps and devices”.)

(b) Insert the tubing

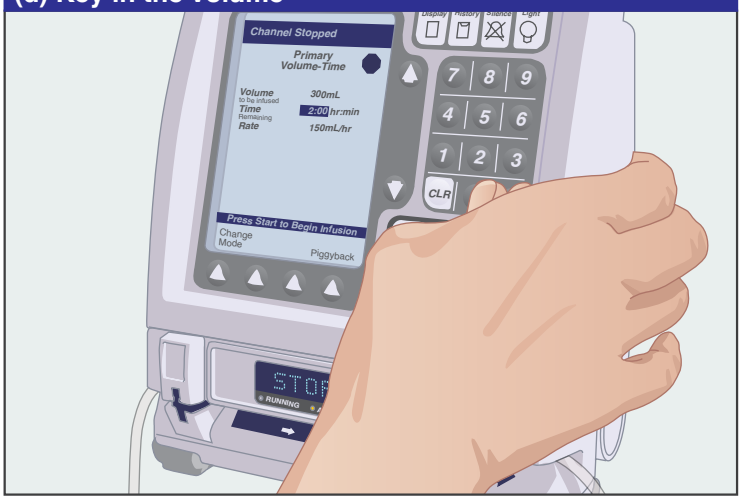
Check the administration set is compatible with the pump. Switch the pump on. When prompted, feed the tubing through the pump, following manufacturer’s instructions. Directions for setting up the pump may vary according to the brand. Ensure you are trained in line with local policy for each device.

(c) Open the roller clamp



Open the roller clamp fully for infusions through pumps, as pumps regulate administration rates. Make sure that all other clamps are open.

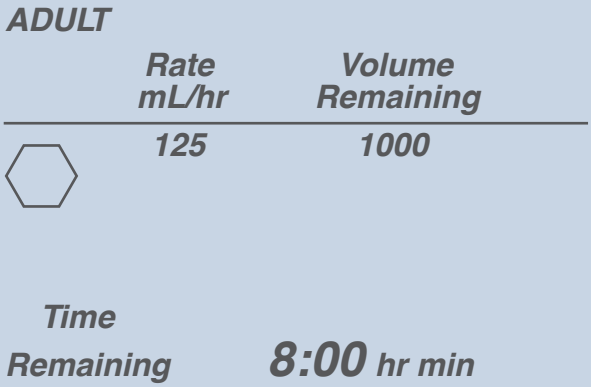
(d) Key in the volume



Using the keys on the pump, programme the pump with the volume of the infusion and the time over which it needs to be given.

Intravenous infusions: calculating rates Page 3

(e) Check the information displayed

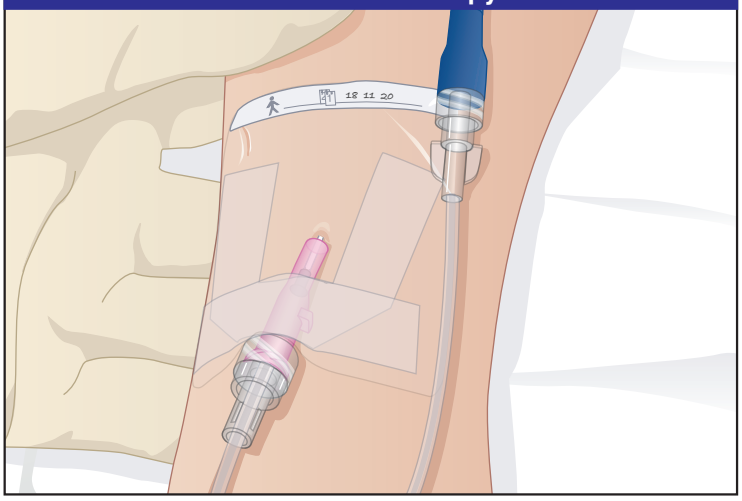


Check that the data shown on the display is correct and in line with the prescription.

(f) Check and start the pump

The infusion starts when you press the “Start” key. Check that the pump is working and the infusion has begun.

Monitor the site and flow of IV therapy

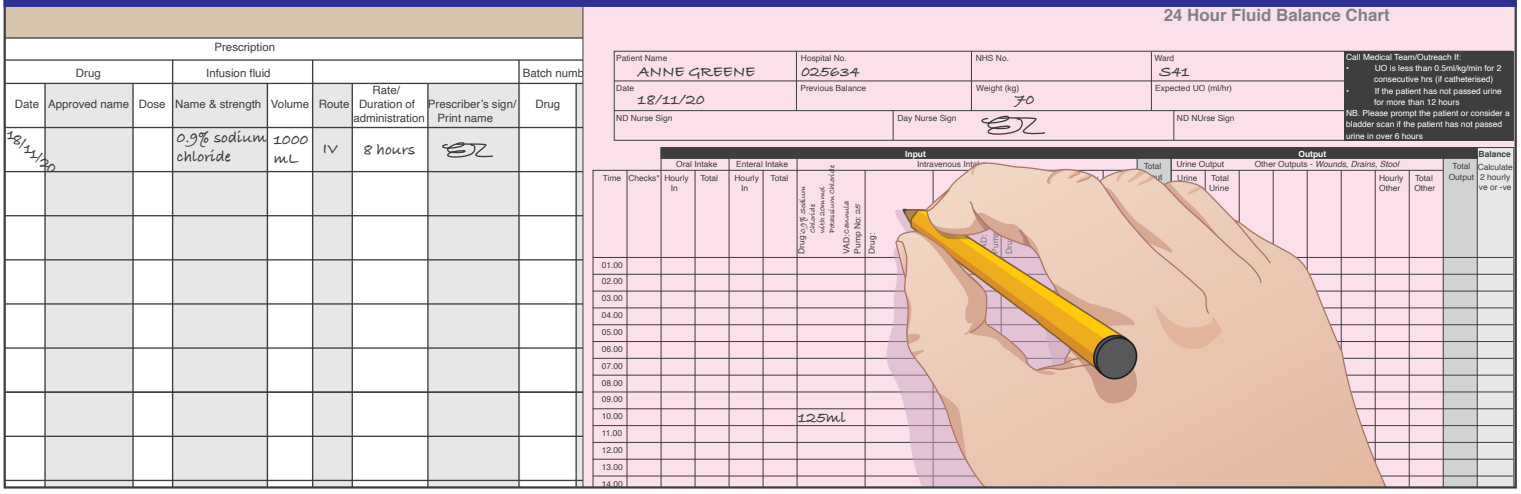


Monitor the site regularly (the frequency will depend on the type of medication or fluid being administered) for signs of infection, bleeding and no-flow situations. Check the flow rate regularly, especially when using a manual flow control device, as moving the arm may occlude the flow.

Does the patient feel pain?

Ask the patient to report any pain, discomfort or change in sensation at the insertion site (Welyczko, 2020) or if they notice any leakage from the cannula. Ask the patient to seek assistance when dressing and undressing.

Record all information



Record all relevant information on the fluid balance chart and prescription chart. Include the date, start time, type and volume of infusion and batch number. Document the volume that has been infused each hour according to local policy. Sign the documents according to local policy. For further information, see also: Lister *et al.*, 2020; RCN, 2016.

3. Medicines Management numeracy assessment sample questions

1. Digoxin 125mcg has been prescribed daily for a patient in Atrial Flutter. The tablets available to you in the drug cupboard are 62.5mcg per tablet and 125mcg per tablet. **What are the possible combinations of tablets you could administer?**

2. A patient is prescribed 0.1mg of levothyroxine. Levothyroxine is available in 25mcg tablets. **How many tablets would you give?**

3. A patient is prescribed Morphine Sulphate slow-release tablets 110mg B.D., stock available is 10mg and 100mg. **What is the lowest amount of tablets you could give?**

4. Patient A is prescribed Metronidazole 350mg T.D.S for 3 days. **What is the total amount of Metronidazole in grams that Patient A will receive over a 3 day course?**

5. The chemotherapy drug Chlorambucil is prescribed daily at 80micrograms/kg/day. Your patient weighs 80 kg. **What is the total amount of Chlorambucil that your patient will receive?**

6. The drug Amphotericin B is prescribed for a systemic fungal infection for patient X. The dose prescribed is 3mg/kg/day Patient X weighs 83.5kg. **What is the dose of Amphotericin B required in mg for half a day?**

7. Patient A is prescribed Ibuprofen 300mg T.D.S stock strength available is 150mg per tablet. **How many tablets will you give in total per day?**

8. Clexane when given for unstable angina is administered 1mg per kg. Your patient is 90kgs hence your dose for administration is 90mg. The Clexane dose available that would accommodate this is 150mg per 1ml. **How much of the 1ml injection would you administer?**

9. You have been asked to administer Gentamicin IV for a patient with endocarditis. The patient weighs 70kgs. The recommended dose is 3-5mg per kg. The advice from pharmacy is that 5mg per kg is appropriate in this patient.

a) **How many mg intravenously should be administered?**

b) **The available dose for Gentamycin is 80mgs in 2mls. How many mls is required then for our 70kg patient?**

10. You have been asked to administer 50mg of IV cyclizine which has been mixed with water for injection up to a volume of 10mls. This need to be administered as a slow bolus intravenously over 5 minutes. **How many mls per minute will this administer?**

4. Medicines management numeracy assessment sample questions and answers

1. Digoxin 125mcg has been prescribed daily for a patient in Atrial Flutter. The tablets available to you in the drug cupboard are 62.5mcg and 125mcg. **What are the possible combinations of tablets you could administer?**

   2 x 62.5mcgs tablets or 1 125mcg tablet.
   Use formula Want x In
   Got

2. A patient is prescribed 0.1mg of levothyroxine. Levothyroxine is available in 25mcg tablets, **how many tablets would you give?**

   Are the units the same?
   No. Change 0.1mgs into mcgs, x 1000
   0.1 x 1000 + 100
   Use formula 100 x 1 = 4 tablets
   25

3. A patient is prescribed Morphine Sulphate slow release tablets 110mg B.D., stock available is 10mg and 100mg. **What is the lowest amount of tablets you could give?**

   1 x 100mg tablet + 1 x 10mg tablet

4. Patient A is prescribed Metronidazole 350mg T.D.S for 3 days. What is **the total amount of Metronidazole in grams that Patient A will receive over a 3 day course?**

   TDS = 3 times a day
   3 x 350 = 1050mgs/day
   1050mgs x 3 days = 3150mgs, convert to grams by dividing by 1000 = 3.15gms

5. The chemotherapy drug Chlorambucil is prescribed daily at 80micrograms/kg/day. Patient A weighs 80 kg, **what is the total amount of Chlorambucil that Patient A will receive in a day?**

   80 mcgs x 80kgs = 6400mcgs

6. The drug Amphotericin B is prescribed for a systemic fungal infection for patient X. The dose prescribed is 3mg/kg/day Patient X weighs 83.5kg. **What is the dose of Amphotericin B required in mg for half a day?**

   3mgs x 83.5kgs = 250.5mgs per day
   250.5mgs ÷ 2 = 125.25mgs

7. Patient A is prescribed Ibuprofen 300mg t.d.s., stock strength available is 150mg. **How many tablets will you give in total per day?**

   TDS = 3 times a day
   Use formula $\frac{300}{150} \times 1 = 2$
   2 tablets x 3 times a day = 6

8. Clexane when given for unstable angina is administered 1mg per kg. Your patient is 90kgs hence your dose for administration is 90mg. The Clexane dose available that would accommodate this is 150mg per 1ml. **How much of the 1ml injection would you administer?**

   Use formula $\frac{90}{150} \times 1 = 0.6$mls

9. You have been asked to administer Gentamicin IV for a patient with endocarditis. The patient weighs 70kgs. The recommended dose is 3-5mg per kg. The advice from pharmacy is that 5mg per kg is appropriate in this patient. The available dose for Gentamycin is 80mgs in 2mls.

   a) **How many mg intravenously should be administered?**

      5mg x 70kgs = 350mgs

   b) **How many mls is required then for our 70kg patient?**

      Use formula $\frac{350}{80} \times 2 = 8.75$mls

10. You have been asked to administer 50mg of IV cyclizine which has been mixed with water for injection up to a volume of 10mls. This need to be administered as a slow bolus intravenously over 5 minutes. **How many mls per minute will this administer?**

10mls ÷ 5 minutes = 2mls per minute