Part 1
. . . .
DIAGNOSIS

Chapter 1

CALCULATIONS REVISION

LEARNING OUTCOMES

By the end of this chapter you will have familiarised yourself with the basics of decimals, metric measures, percentages, fractions, ratios and averages.

FEELING A BIT RUSTY?

Don't worry if picking up this book and the word 'calculations' gave you palpitations! We'll start nice and gently and summarise the basics. You may remember most of this already and feel confident enough to skip the chapter completely, and go straight to the self-assessment test in Chapter 2, or you may need to build up your confidence and reacquaint yourself with the basics.

Symbols and Signs

+	plus or addition sign; example: **6 + 9 = 15**
−	decrease, subtract or minus sign; example: **11 − 4 = 7**
×	multiply or 'times by' sign; example: **9 × 6 = 54**
÷ or **/**	division or 'divide by' sign; example: **25/5 = 5**
=	the equals sign; example: **9 × 10 = 90**
:	ratio
>	greater than
<	less than

Seeing this sign **/** means divided by…

QUICK TIP

It is a good idea to reacquaint yourself with your times tables.

×	1	2	3	4	5	6	7	8	9	10	11	12
1	1	2	3	4	5	6	7	8	9	10	11	12
2	2	4	6	8	10	12	14	16	18	20	22	24
3	3	6	9	12	15	18	21	24	27	30	33	36
4	4	8	12	16	20	24	28	32	36	40	44	48
5	5	10	15	20	25	30	35	40	45	50	55	60
6	6	12	18	24	30	36	42	48	54	60	66	72
7	7	14	21	28	35	42	49	56	63	70	77	84
8	8	16	24	32	40	48	56	64	72	80	88	96
9	9	18	27	36	45	54	63	72	81	90	99	108
10	10	20	30	40	50	60	70	80	90	100	110	120
11	11	22	33	44	55	66	77	88	99	110	121	132
12	12	24	36	48	60	72	84	96	108	120	132	144

GLOSSARY

Decimal

A decimal is a number that is expressed in the counting system that uses units of tens.

DECIMAL

Decimal numbers describe tenths, hundredths and thousandths of a number. For example, 1.25 is equal to one whole unit, plus a fraction of one (25 hundredths).

Rounding Decimal Numbers

Sometimes it is necessary to 'round up' or 'round down' a decimal number or a whole number. This is particularly true in infusion drip rate calculations, as it is impossible to give a 'point' or part of a drop when setting an infusion rate; for example, 7.2 drops: how would you get the 0.2? Other

medication calculations may need to be highly accurate and *incorporate* all the 'points', but as a general rule:

If the number after the point is 4 or less: round down
If the number after the point is 5 or more: round up

This is often known as the 'rule of 5s'.
Therefore, 7.2 drops becomes 7 drops only; 2.8 becomes 3.

QUICK TIP

I get it! Decimal places are numbers to the right of the decimal point. Example: 5.72 has two decimal places.

e.g.
EXAMPLE

Let me show you an example…

39.4 rounds down to **39**
2.82 rounds down to **2.8** (one decimal place)
0.864 rounds down to **0.86** (two decimal places)
31.7 rounds up to **32**
39.8 rounds up to **40**
1.65 rounds up to **1.7** (one decimal place)
0.421 rounds down to **0.42** (two decimal places)

Now, have a go at working some out for yourself: You didn't really expect me to do all the work, did you?

QUICK TIP

Add a zero before the decimal point: for example, .2 should be 0.2, otherwise it could be mistaken for 2.

Activity 1.1

ACTIVITY

Round each of the following to one decimal place.

SECTION ONE
1   2.66
2   1.32
3   1.75
4   1.98
5   4.64

Round each of the following to the nearest whole number.

SECTION TWO
1   55.8
2   43.2
3   99.56
4   33.33
5   66.66

METRIC MEASURES

The metric system is based on multiples of 10.
So, for weight:

1 kilogram (kg)	=	1000 grams (g)
1 gram (g)	=	1000 milligrams (mg)
1 milligram (mg)	=	1000 micrograms
1 microgram	=	1000 nanograms (ng)
1 nanogram (ng)	=	1000 picograms (pg)

NOTE: where medications are concerned micrograms should *not* be abbreviated on prescription charts to mcg. This is due to the abbreviations for milligram (mg) and microgram (mcg) being quite similar, and they may be mis-read by the person administering the drug. As a nurse you may also see μ, which is another way of writing 'micro'. So, μg means micrograms.

Nanograms and picograms are very small units indeed (and are very rarely used in prescriptions).

For volume:

1 litre (L) = **1000 millilitres (mL)**

Conversion from One Unit to Another

In drug calculations it is best to work in whole numbers – that is, 125 micrograms and not 0.125 mg – as fewer mistakes may be made. Therefore it is necessary to be able to convert easily from one unit to another. To do this you have to multiply or divide by a thousand.

Converting Larger Units to the Next Smaller Unit

To convert a larger unit to a smaller unit you multiply by 1000.

NOTE: the × symbol means multiply.

Let me show you an example…

e.g.
EXAMPLE

Convert 5 g to milligrams: $5 \times 1000 = 5000$ mg

Convert 0.25 kg to grams: $0.25 \times 1000 = 250$ g

This can be done another way, simply by 'bouncing' the decimal point.

To multiply by 1000 you move the decimal point three places to the right.

Changing 5 g to milligrams: 5   .   0   0   0 g   = 5000 mg

Converting Smaller Units to the Next Larger Unit

To convert a smaller unit to the next larger unit you divide by 1000.

NOTE: the / symbol = Divided by.

e.g.
EXAMPLE

Let me show you an example...

Convert 6000 g to kilograms: 6000/1000 = 6 kg

Convert 325 mg to grams: 325/1000 = 0.325 g

To bounce using the decimal point method.

To divide by 1000 you move the decimal point three places to the left.

Changing 5000 mg to grams: 5000.0 mg = 5 g

QUICK TIP

Once you have written a decimal point in your result, any noughts at the end of the answer become unnecessary.

For example: 0.6000 is written as 0.6.

QUICK TIP

Here is a quick way of remembering this: going up to larger units: divide and move decimal place to the left ↑ ÷ ← ·

going down to smaller units: multiply and move decimal place to the right ↓ × · →

Activity 1.2

SECTION ONE
1. 6000 mg to grams
2. 39 000 mL to litres
3. 350 mL to litres
4. 0.07 micrograms to milligrams
5. 4000 g to kilograms
6. 4500 mg to grams
7. 0.8 mg to micrograms
8. 9 micrograms to nanograms
9. 1300 g to kilograms
10. 0.462 mg to grams

SECTION TWO
1. 0.72 g to mg
2. 1.4 mg to micrograms
3. 0.03 g to milligrams
4. 2 g to kilograms
5. 2.5 L to millilitres
6. 0.7 mg to micrograms
7. 61.25 L to millilitres
8. 92 kg to grams
9. 0.02 mg to micrograms
10. 0.023 mg to grams

SECTION THREE
1. 20 micrograms to mg
2. 634 g to kilograms
3. 0.0635 mg to micrograms
4. 0.25 micrograms to nanograms
5. 8 kg to grams
6. 1527 micrograms to milligrams
7. 21.9 L to millilitres
8. 64.5 micrograms to milligrams
9. 349.8 g to kilograms
10. 50 mL to litres

SECTION FOUR
1. 3 L to millilitres
2. 1.2 mg to micrograms
3. 0.04 mg to micrograms
4. 0.12 g to milligrams
5. 0.02 mg to grams
6. 0.02 micrograms to nanograms
7. 2.386 kg to grams
8. 4 ng to micrograms
9. 1234 mL to litres
10. 320 mg to grams

PERCENTAGES

Fractions, decimals and percentages all represent parts of a whole. For example:

50% = **0.5** = **½** = **one half**

A bag of 5% glucose means that there are 5 parts of glucose per 100 parts of water. 'Per cent' means 'per 100'.

GLOSSARY

Percentage
A percentage is a way of expressing a number as a fraction of 100.

Calculating the Percentage of a Number

$$\text{Value} = \frac{\text{number}}{100} \times \text{percentage required}$$

e.g.
EXAMPLE

Let me show you an example...

Mrs Noto has to decrease her 160 mL of medication by 15%. How many millilitres has this to be reduced by? In other words, how much of the medication does Mrs Noto still have to take?

$$\frac{160}{100} \times 15 = \frac{8}{5} \times 15 = 24 \text{ mL}$$

160 mL minus 24 mL = 136 mL

Mrs Noto still needs to take 136 mL of the medication.

Finding One Amount as a Percentage of Another

$$\text{Percentage} = \frac{\text{smaller number}}{\text{larger number}} \times 100$$

Let me show you an example...

e.g.
EXAMPLE

In a calculations test 280 student nurses out of 400 passed the test first time. What percentage was this?

$$\frac{280}{400} \times 100 = \frac{280}{4} = 70\%$$

Now have a go at working some examples out for yourself.

QUICK TIP

Remember: a percentage indicates a number of parts in a hundred.

Activity 1.3

ACTIVITY

Calculate the following:
1   20% of 450 mL
2   15% of 1200 mL
3   In a numeracy test 240 out of 300 score more than 50. What percentage is this?
4   In a Clinical Directorate 85 out of 400 nursing staff are male. What percentage is this?

NOTE: did you ever wonder how much 0.9% sodium chloride in grams there is in 1 L of fluid? This is known as weight in volume, or w/v. We work this out:

$$\frac{0.9\%}{100} \times 1000 \text{ mL} = 9 \text{ g}$$

In a 50 mL bag of fluid, this would equate to 0.45 g (or 450 mg).

$$\frac{0.9\%}{100} \times 50 \text{ mL} = 0.45 \text{ g}$$

NOTE: percentage concentrations can be expressed in the following ways:

w/w	weight in weight
w/v	weight in volume
v/v	volume in volume

Strength of a Solution

This can be expressed as percentage weight versus volume = number of grams per 100 mL. For example, 30% sodium chloride = 30 grams in 100 mL.

Some drugs, such as local anaesthetics, are also presented in solutions of different percentages. To work out how many milligrams per millilitre there are in 1% lignocaine, we already know that 1% means 1 in 100.

Convention tells us that 1 mL is equivalent to 1 g. Therefore, 1% lignocaine means that there is 1 g of anaesthetic in every 100 mL of the solution. We could also say that there are 1000 mg of lignocaine in 100 mL of solution.

1 mL of 1% lignocaine will therefore contain:

$$\frac{1000}{100} = 10 \text{ mg/mL}$$

Therefore, 1% of lignocaine is equivalent to 10 mg per mL.

FRACTIONS

Many drug calculations require you to work with fractions. A fraction is a portion of a whole that indicates division into equal parts. For example: one large tablet cut into quarters:

$$\frac{1 \text{ large tablet}}{4} = \frac{1}{4}$$

NOTE: when administering medications, tablets should only ever be cut into halves, if the tablet is scored (has a line down its centre). Tablets should *never* be broken into four pieces as this is too inaccurate a dose.

Simplifying Fractions

To cancel down (or simplify) a fraction, you will need to divide the numerator and the denominator by the same number. This is called a common factor.

Example 1:

$$\frac{25}{55} = \frac{5}{11} \text{ Common factor} = 5$$

GLOSSARY

Fraction
A fraction represents a part of a whole.
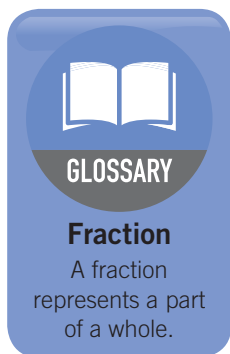
Example 2:

$$\frac{100}{225} = \frac{4}{9} \text{ Common factor} = 25$$

NOTE:

$$\frac{2}{4} = \frac{3}{6} = \frac{4}{8} = \frac{5}{10}$$

These are all the same as $\frac{1}{2}$, or, expressed another way, 50%.

QUICK TIP

The numerator is the top number in a fraction and a denominator is the bottom number.

Changing Fractions into Decimals

Divide the top number by the bottom number.

Example:

$$\frac{4}{5} = \textbf{4.0 divided by 5} = \textbf{0.8}$$

Activity 1.4

ACTIVITY

Change the following fractions to decimals, giving your answer to one decimal place.

1 $\frac{25}{3}$ **2** $\frac{15}{2}$ **3** $\frac{175}{5}$ **4** $\frac{125}{6}$ **5** $\frac{250}{6}$ **6** $\frac{122}{7}$

Simple Conversions from Fractions, Decimals and Percentages

Let me show you something:

$$\frac{20}{100} \text{ can be broken down to } \frac{2}{10}$$

by removing one zero from the top and one from the bottom.

This can be broken down to '2 goes into 2 once, and 2 goes into 10 five times'. This makes a *simplified fraction*:

$$\frac{1}{5}$$

This is the same as 20%: 20% is one-fifth of 100%, as there are five lots of 20 in 100%.

Fraction	Simplified fraction	How this is expressed in words	Decimals	Percentage
$\frac{10}{100}$	$\frac{1}{10}$	One-tenth	0.1 (0.10)	10%
$\frac{20}{100}$	$\frac{1}{5}$	One-fifth	0.2 (0.20)	20%
$\frac{25}{100}$	$\frac{1}{4}$	One-quarter	0.25	25%
$\frac{33}{100}$	$\frac{1}{3}$	One-third	0.33	33%
$\frac{50}{100}$	$\frac{1}{2}$	One-half	0.5 (0.50)	50%
$\frac{66}{100}$	$\frac{2}{3}$	Two-thirds	0.66	66%
$\frac{75}{100}$	$\frac{3}{4}$	Three-quarters	0.75	75%

RATIOS

A ratio is a way of describing a mixture of two or more components. For example, to mix substances A and B in the ratio 2:1 means that there are two parts of A to every one part of B, making three parts in total: 2 + 1 = 3.

GLOSSARY

Ratio
A ratio is the relative sizes of two or more values.

e.g.
EXAMPLE

Let me show you an example…

A carton of 500 mL of concentrated juice has the instruction 'dilute 7 parts of water to 1 part of juice'. How much juice can be made from this bottle to give to a ward of patients during a heat wave? First we must pull out the information we need to work this out, and disregard the waffle.

Dilute 7 parts of water to 1 part of juice: this equates to 7:1, which means there are eight parts in total (7 + 1 = 8).

Each part is worth 500 mL.

$$500 \times 1 = 500$$
$$500 \times 7 = 3500$$
$$3500 + 500 = 4000 \text{ mL in total.}$$

or

$$500 \text{ mL} \times 8 = 4000 \text{ mL (or 4 L)}$$

A strength of a solution may also be given as a ratio as 1 *in* 4. This means that 1 part of stock solution has been added in 3 parts of diluted solution.

Let me show you an example…

e.g.
EXAMPLE

The ratio 1 in 10 means that there is one part stock solution to every nine parts of dilutant: 10 parts in total. 10 minus 1 = 9 parts of dilutant, therefore 1 in 10 equates to 1:9.

Therefore 1 in 4 means 1 part of stock solution added in 4 parts of diluted solution.

1:3 means one part of stock solution added to three parts of dilutant.

Don't worry, let's look at another one: a learning disabilities nurse is taking her client to a swimming session. The pool is 20 m wide and 50 m long. What is the simplest ratio of the pool's width to its length?

Both the 20 and the 50 can be divided by 10:

$$20/10 = 2$$
$$50/10 = 5$$

Therefore, the simplest form of the ratio is **2:5**.

NOTE: adrenaline for anaphylaxis is expressed as 1:1000. This means that there is 1 mg for every 1 mL (1 mg/mL), which is equivalent to *1 g in every 1000 mL*. Therefore, if we were to administer 0.5 mg of the drug, we would need to give 0.5 mL.

Adrenaline for cardiac arrest is expressed as 1:10 000. This means that there is 1 mg in 10 mL (or 0.1 mg for every 1 mL), or *1 g in 10 000 mL*. As we administer the whole 10 mL of the drug, we are giving 10 times the volume than for anaphylaxis situations (10 mL).

See how you get on in Activity 1.5. Don't go peeking at the answers: have a go first!

Activity 1.5

ACTIVITY

1 How much stock solution is present in 100 mL of diluted solution if expressing this as the ratio (i) 1 in 4 and (ii) 1:4?
2 How much stock solution is present in 5 L of diluted solution if expressing this as the ratio (i) 1 in 9 and (ii) 1:9?
3 How much stock solution is present in 550 mL of diluted solution if expressing this as the ratio (i) 1 in 10 and (ii) 1:10?
4 How much stock solution is present in 600 mL of diluted solution if expressing this as the ratio (i) 1 in 3 and (ii) 1:3?

AVERAGES

An average may be a mode, median, range or mean:

- **mode:** the most common figure in a series of figures;
- **median:** the figure in the centre of a series of values placed in order;
- **range:** the lowest to the highest value;
- **mean:** most commonly referred to as the 'average'. All values added together and divided by the number of units.

Let me show you an example...

e.g.

EXAMPLE

Brendan Topa's temperature during the day has been:

06:00	37.2°C (degrees Celsius)		
08:00	37.2°C	16:00	38.0°C
10:00	37.8°C	18:00	37.6°C
12:00	38.0°C	20:00	37.4°C
14:00	38.0°C	22:00	37.0°C

What is the mode?

38.0°C, as there are three recordings of this figure.

What is the median?

37.0	37.2	37.2	37.4	37.6
37.8	38.0	38.0	38.0	

The median is 37.6 when the values are placed in numerical order.

What is the range?

37.0–38.0: the smallest figure to the largest figure is the difference of one whole degree celsius (1°C).

What is the mean?

$$37.2 + 37.2 + 37.8 + 38.0 + 38.0 + 38.0 + 37.6 + 37.4 + 37.0 =$$
$$3382/9 \text{ (number of units)} = 37.57777 = 37.6°C$$

Activity 1.6

1   What is the mean average of Judith Goodman's intracranial pressure recordings? **NOTE:** intracranial pressure is the pressure of cerebrospinal fluid within the ventricles and subarachnoid space in the brain (I know, too much information!).

08:00	19 mmHg
09:00	19 mmHg
10:00	19.5 mmHg
11:00	18.0 mmHg
12:00	17 mmHg

KEY POINTS

- Revising calculations basics in decimals, metric measures, converting units, percentages, fractions, ratios and averages.
- Looking at how the strength of a solution can be expressed.