Great Western Hospitals NHS
NHS Foundation Trust

GWH

Practice Drug Calculations Workbook

Contents

Introduction

The aims of this package are to:

1. Give participants an opportunity to become familiar with and proficient in the use of formulae to correctly calculate medicine dosages.

2 To encourage participants to practice calculations by using the practice questions before undergoing the medical calculations test.

3 To deliver information regarding further sources of help available to those involved in the calculation of medicine doses, before attending the test.

This workbook has been designed to help you understand and practice the calculations required to safely administer drugs. The examples and formulae included are appropriate for the calculation of drug doses delivered via a variety of routes; oral, subcutaneous injection, intramuscular injection, intravenous injection and infusion. The workbook is arranged into several sections with formulae, examples and practice questions for each section. It is recommended that you attempt these practice questions before attending the medicine calculation test.

If you are experiencing difficulty when completing this workbook or have any question regarding the contents of this workbook, please contact Carol Frape (Training and Development Coordinator) or any of the Medical Device and clinical skills team on ext 5095/ 4453. (If off site call 01793 60 – 5095/4453)

= Drug calculations test questions

Section 1 Units and Equivalences

Units: the basic principles

There are many different units in medicine. For example:

Drug strengths	Digoxin injection 500 microgram in 1ml
Dosages	Dobutamine 3 micrograms/kg/min
Patient electrolyte levels	Sodium 137mmol/L

It is therefore important to have a basic knowledge of the units used in medicine and how they are derived.

It is particularly important to have an understanding of the units in which drugs can be prescribed; and how to convert from one to another; this last part being very important as it is the basis of all drug calculations.

Units

S.I. units are another name for the metric system of measurements. The aim of metrication is to make the calculation simpler. S.I or Systeme Interenationale was introduced to the NHS in 1975 and is the standard system in most disciplines for measurement world wide.

The S.I system defines a base unit for particular measurement (e.g. gram) with a prefix when what is being measured becomes very small (micrograms) or very large (kilograms)

Base units

Quantity	Name of unit	Unit symbol
Weight	kilogram	Kg
Volume	Litre	L or l
Amount of substance	Mole	Mol

S.I .units is the standard way in which weights and volumes are described

Do NOT use plurals

Always put a 0 before a decimal point e.g. - 0.4 not .4

Micrograms, Nanograms and units should always be written in full.

Equivalences of weight

Unit	Symbol		Equivalent
1 kilogram	kg	=	1 000 grams
1 gram	g	=	1 000 milligrams
1 milligram	mg	=	1 000 micrograms
1 microgram	mcg	=	1 000 nanograms

Equivalences of volume

Unit	Symbol		Equivalent	Symbol
1 litre	L or l	=	1 000 millilitres	ml

Equivalences of amount of substance

Unit	Symbol		Equivalent	Symbol
1 mole	mol	=	1 000 millimoles	mmol
1 millimole	mmol	=	1 000 micromoles	micromoles

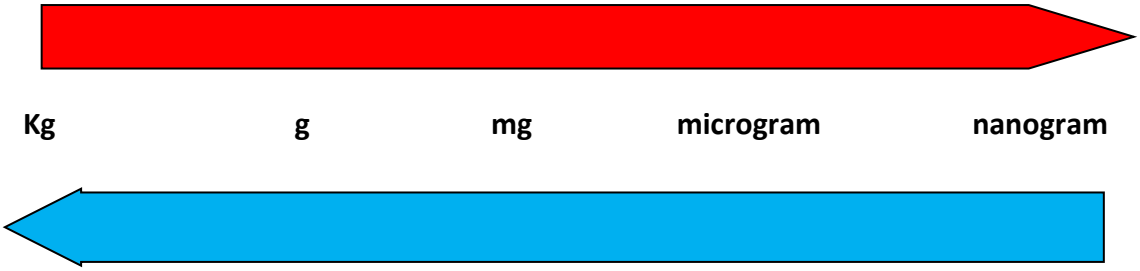
Converting from one unit to another

To convert from a larger unit to a smaller unit, **multiply** by 1000

To convert from a smaller unit to a larger unit, **divide** by 1000

In each case, **the decimal point moves three places** either to the right or to the left, depending upon whether you are converting from a large unit to a smaller unit or vice versa

(move decimal point 3 places to the right) multiply by 1000



Divide by 1000 (move decimal point 3 places left)

To convert **BIG** to small (multiply)

1 kg = 1000 g	1 g = 1000 mg	1mg = 1000 microgram	1 microgram = 1000 nanogram

To convert BIG to **small**, think BIG, think "Go forth and Multiply"

To convert **small** to BIG, think **small**, think "Divide up"

If you understand how to convert units then go to the next Section!

If you need a little more practice then read on…..

The relationship with making something bigger or smaller is all about the '0's you have – how many you add on or take off to make the number 10 times, 100 times or 1000 times bigger or smaller.

Starting with a whole number (no decimal point – or 'parts')

To make something BIGGER just add the same number of 0's

36 x 10 =360 (10 times bigger)

X 100 = 3600 (100 times bigger)

X 1000 =36000 (1000 times bigger)

To make something **smaller** just take off the same number of '0's

42,000 ÷ 10 = 4,200 (10 times smaller)

÷ 100 = 420 (100 times smaller)

÷ 1000 = 42 (1000 times smaller)

Including decimal points

Which is the bigger number?

0.42

42

4.2

If you line them up under the decimal point it becomes clear

42.00

4.20

0.42

When multiplying move the point to the right to make the number bigger

When dividing move the point to the left to make the number smaller.

Practice Questions

1. Convert 375mg into grams.

2. Convert 498mgs into (micrograms)

3. Convert 0.00769L into ml

4. Convert 17005 micrograms into grams

5. Convert 0.76 gram into mg

6. Convert 8452 ml into Litres

SECTION 2 CALCULATING DOSES

Be ready to convert all weights into the same units (G, mg) and all volumes into the same units (Litre, ml)

Take calculations step by step and write down all your working including all the units.

Calculating doses (oral tablets)

Whilst administering oral drugs, a prescription chart informs you of the total dose that the patient is to receive. Your task is to find out the amount of drug in each tablet. Then you would need to calculate how many of the tablets would be required to make up the total prescribed drug amount.

The formula is:

Amount prescribed ('what you want') = the number of tablets
Amount in each tablet ('what you've got)

e.g. a patient is prescribed 300mg Allopurinol. The tablets are available as 100mg strength.

How do you remember the equation?

Patient comes first, if you didn't have the patient and the prescribed dose you wouldn't be doing this. Therefore the first element in the equation is the prescription (what you want)

Then go to the cupboard and the second element is the drug (what you've got)

The third element is the amount of tablets you will need to give to dispense the prescription correctly (number of tablets)

$\frac{300mg}{100mg}$ = 3 tablets

You may also need to convert what you want or what you've got into the same S.I. unit to enable you to make this calculation.

e.g. a patient is prescribed 1.5g of a drug that is available in 500mg tablets. It is very important that the prescribed amount and the drugs available are in the same units. So 1.5g is the same as 1500mg.

$\frac{1500mg}{500mg}$ = 3 tablets

Practice questions

1. 500mg is prescribed, tablets are 250mg each – how many tablets would you administer?

2. 1mg is prescribed, tablets are 500 micrograms each – how many tablets would you administer?

3. 2 tablets each contain 150mgs – what is the total dose in milligrams?

4. 3 tablets each contain 250mg – what is the total dose in milligrams?

5. 50mg is prescribed, tablets are 12.5mg each – how many tablets would you administer?

Calculating doses (liquids)

When a drug prescribed is in liquid form the availability is given in terms of the concentration of the drug within a stated volume. For example, as long as the quantity of the drug to be administered is known and the concentration of the drug in the solution is known the dose can be calculated.

Most often this is necessary because the drugs are usually prescribed by weight (mgs, grams), whereas the drugs are labelled by concentration.

The formula would be

Volume required = dose prescribed (what you want) X Volume of solution
Dose you have available (what you have got)

e.g.

A patient is prescribed 10mgs Dexamethasone. Concentration available is 4mg/ml vials. How many mls do you need to give?

10mgs Dexamethasone (what we want) X 1ml (volume of stock solution)
4mgs/ml (what you have got)

= 2.5mls

9mgs morphine prescribed (what we want) X 1ml (volume of stock solution)
15mg vials (what we have got)

= 0.6ml

Practice Questions

1. You are required to give 1750 units Heparin. The solution contains 1000units/ml. What volume would you draw up?

2. Prescription : 125 micrograms of Digoxin

   Available : Digoxin at 50 micrograms per ml

How many ml would you give?

3. The ampoule reads 500 micrograms in 5ml. How much solution is needed to give 10 micrograms?

4. Drug available as 20mg/5ml, the prescription is for 40mg, how many ml should be given?

5. If there are 250mg in 1ml, how much solution is required to give 5mg?

Section 3 Calculating Intravenous infusion rates (in millilitres per hour)

When infusing drugs/fluids via a syringe driver or volumetric infusion pump, it is necessary to calculate the infusion rate in millilitres per hour.

It is vital that you consider the type of pump or syringe driver that you will be using. For quantities over 50ml you would use a volumetric pump (Volumat MC) which delivers fluid in multiples of 1ml per hour, but can be altered to give fractions of a ml; for quantities under 50ml you would use a syringe pump (Asena GH syringe pump), which delivers fluid at a rate of 0.1 – 99.9ml/hr. In the community you may use the T34 ambulatory syringe driver which will deliver over 24hours only, where you will only use a maximum volume of 20mls and the pump will pick up 0.1ml measurements.

You would administer the drug calculated either to the nearest millilitre or part of a millilitre, depending on which piece of equipment is most appropriate to use.

The formula would be:

Total volume to be infused **=** **rate**
Time to be infused over

e.g.

1000mls 0.9% sodium Chloride = 125ml/hr
8hrs

T34 syringe driver:

17ml = 0.7ml/hr
24hrs

OR

(What you want X 60mins / What you have) X Volume of solution

A solution contains 5000mg of the drug in 250ml 0.9% Sodium Chloride. The prescription is to give the solution at 20mg/min. To work out the rate (ml/hr) calculate as follows:

(20mg x 60mins / 5000mg) X 250ml = 60ml

Practice Questions

1. You are required to give 300ml blood over 4 hours, what rate would you set the pump at?

2. 1L 5% Dextrose is prescribed over 6 hours, how many ml should be infused per hour?

3. 30,000 units of Heparin, made up to a total of 30ml is to be given over 24 hours using a syringe driver, calculate the rate per hour.

4. 250mg Furosemide (strength 10mg/ml) is added to 100ml 0.9% Sodium Chloride. This is to be infused over 2 hours. What rate would you set the pump to?

5. If the maximum rate for intravenous infusion of Furosemide is 4mg per minute, what is the fastest rate that 80mgs added to 100ml 0.9% Sodium Chloride can be infused over?

Section 4 Calculating intravenous drip rates (in drops per minute)

Where available always use a pump to administer infusions. However, calculating drips per minute is necessary when a pump cannot be obtained and the 'gravity' method is used. In order to calculate the drip rate, in drops per minute:

The formula would be

$$\textbf{Rate} = \frac{\textbf{volume}}{\textbf{Time in hours}} \times \frac{\textbf{Drops per ml}}{\textbf{Minutes per hour}}$$

The number of drops per ml, will be indicated on the outer packaging of the infusion set (giving set)

For the purposes of this calculation exercise

Blood and 'thick' fluids = 15 drops per ml

Clear fluids = 20 drops per ml

ALWAYS CHECK THE PACK FOR THIS INFORMATION BEFORE SETTING UP THE INFUSION

e.g. A patient is to receive 1L 5%Glucose in 8 hours. Calculate the rate in drops per minute using the standard giving set (20 drops per ml)

$$\frac{\text{1000ml (volume)}}{\text{8 hours (time in hours)}} \times \frac{\text{20 drops per ml}}{\text{60 minutes (minutes per hour)}}$$

$$= \frac{1000}{8} \times \frac{20}{60} = \frac{20\,000}{480}$$

= 41.6 = **42 drops per minute (to the nearest drop)**

Practice questions

1. 350ml of blood is to be given to a patient over 4 hours using a blood administration set (15 drops per ml). Calculate the drip rate per minute

2. 500ml of Hartmann's Solution is to be given to a patient over 6 hours using a standard giving set (20 drops per ml). Calculate the drip rate per minute.

3. 100ml 0.9% Sodium Chloride has 20ml of sterile water containing Benzylpenicillin added to it. The infusion needs to be given over 2 hours using a standard administration set (20 drops per ml). Calculate the drip rate per minute.

4. A patient is to have 3 litres of 0.9% Sodium Chloride in 24 hours. He has received 1500ml in 8hrs using a standard administration set (20 drops per ml). How many drops per minute are required to correct the infusion?

5. 100ml 0.9% Sodium Chloride has 10ml sterile water containing Aciclovir added to it. The infusion needs to be given over 1 hour using a standard administration set (20 drops per ml). Calculate the drip rate per minute.

Section 5 Calculating drug dose according to body weight

Some drugs e.g. anticoagulant drugs and paediatric drugs can be calculated in dose per kilogram of body weight

The formula would be

Total dose per day = dose per kg X weight (in kg)

Single dose = Dose per day
Number of doses

e.g.

A patient is prescribed a drug at 30mg per kilogram in 3 doses. The patient weighs 80kg.

30mg (per kg) X 80kg = 2400mg (total dose per day)

2400mg (total dose per day) = 800mg per single dose
3 doses

Practice Questions

1. A patient is prescribed Erythromycin 40mg/kg per day in 4 doses. The patient is a child and weighs 14kg. How much of the drug do you give in each dose?

2. A patient is prescribed a drug, 60mg/kg per day in 4 doses. The patient weighs 56kg. How much of the drug do you give in each dose?

3. A patient is prescribed a drug, 50mg/kg per day TDS. The patient weighs 90kg. How much of the drug do you give in each dose?

4. A patient is prescribed a drug, 150 mcg/kg per day in 4 doses. The patient is a child and weighs 64kg. How much of the drug do you give in each dose?

5. A patient is prescribed 40mg/kg per day 8 hourly. The patient is a child and weighs 26kg. How much of the drug do you give in each dose?

Section 6 Low Molecular Weight Heparin Doses

A patient is prescribed 16 000 units of Dalteparin. You have a 0.7ml pre-filled syringe

(25 000 units in 1ml). How much in volume do you give?

Note: If you need to know how many units are in the 0.72ml pre filled syringe?

25 000 units x 0.72mls = 18 000 units,
*however many prefilled syringes such as Dalteparin always display what is in the syringe, not what it equals to in 1ml (Dalteparin are 25000iu/ml)

The formula would be

What you want x volume that the drug is in
What you have got

16 000 x 1mls = 0.64ml
25000

Or

16 000 x 0.72mls = 0.63mls
18 000

Practice Questions

1. A patient is prescribed 15 000 units of Dalteparin. You have 0.9ml pre filled syringe

(25 000 units in 1ml) How much in volume do you give?

2. A patient is prescribed 8 000 units of Dalteparin. You have a 0.4ml pre filled syringe

(25 000 units in 1ml). How much in volume do you give?

3. A patient is prescribed 11 000 units of Dalteparin. You have a 0.5ml pre filled syringe

(25 000 units in 1ml). How much in volume do you give?

Answers

SI Units and Conversions

1. 375mg ÷ 1000 = **0.375g**
2. 498mg x 1000 = **498,000mcg**
3. 0.00769L x 1000 = **7.69mls**
4. 17005 mcg ÷ 1000 = 17.005 mgs ÷ 1000 = **0.017005g**
5. 0.76g x 1000 = **760 mg**
6. 8452 ml ÷ 1000 = **8.452L**

Calculating Doses (Oral)

1. $\frac{500mg}{250mg}$ = **2**
2. 1mg x 1000 = $\frac{1000mcg}{500mcg}$ = **2**
3. 2 x 150mgs = **300mgs**
4. 3 x 250mg = **750mgs**
5. $\frac{50mgs}{12.5mg}$ = **4**

Calculating Doses (Liquids)

1. $\frac{1750}{1000}$ = **1.75mls**
2. $\frac{125}{50}$ = **2.5mls**
3. $\frac{10}{500}$ = 0.02 x 5mls = **0.1ml**
4. $\frac{40mg}{20mg}$ = 2 x 5mls = **10mls**
5. $\frac{5mg}{250mg}$ = 0.02 x 1ml = **0.02mls**

Calculating intravenous drip rates in millilitres per hour

1. $\frac{300mls}{4hrs}$ = **75ml/hr**
2. $\frac{1000mls}{6hrs}$ = **166.6ml/hr**
3. $\frac{30mls}{24hr}$ = **1.25ml/hr**
4. $\frac{250mg}{10mg/ml}$ =25mls + 100ml = $\frac{125}{2}$

   = **62.5 ml/hr**
5. $\frac{80mgs}{4mg\ per\ min}$ = **20 mins**

Calculating drip rates in drops per minute

1. $\frac{350}{4} \times \frac{15}{60} = \frac{5250}{240}$

   = **21.875 drops per minute = 22 dpm**

2. $\frac{500}{6} \times \frac{20}{60} = \frac{10000}{360}$

   = **27.77 drops per minute = 28dpm**

3. $\frac{120}{2} \times \frac{20}{60} = \frac{2400}{120}$

   = **20 drops per minute**

4. $\frac{1500}{16} \times \frac{20}{60} = \frac{30\,000}{960}$

   = **31.25 drops per minute = 31 dpm**

5. $\frac{110}{60} \times \frac{20}{60} = \frac{2200}{3600}$

   = **36.66 drops per minute = 37 dpm**

Dalteparin Doses: note: slight differences are acceptable, as you would have to round up or down to one decimal point anyway

1. 15000/25000 x 1 = **0.6ml**
   or
   15000/22500 x 0.9ml = **0.59mls**
   Would therefore give = 0.6ml

2. 8000/25000 x 1ml = **0.32mls (= 0.3ml)**
   or
   8000/10000 x 0.4mls = **0.32mls**
   Would therefore give = 0.3ml

3. 11000/25000 x 1ml = **0.44ml (= 0.4ml)**
   or
   11000/12500 x 0.5mls = **0.44mls**
   Would therefore give = 0.4ml

Calculating dose according to body weight

1. 40mg x 14kg = 560mg 560 ÷ 4 doses
   = **140mg per dose**

2. 60mg x 56kg = 3360mg 3360 ÷ 4 doses
   = **840mg per dose**

3. 50mg x 90kg = 4500mg 4500 ÷ 3 doses
   = **1500mg per dose**

4. 150mcg x 64kg = 9600mcg 9600 ÷ 4 doses
   = 2400mcg per dose ÷ 1000 = **2.4mg**

5. 40mg x 26kg = 1040mg 1040 ÷ 3 doses
   = **346.6mg per dose**

Other sources of help

British National Formulary (BNF). British Medical Association & Royal Pharmaceutical Society of Great Britain: https://www.bnf.org/

Available in hardcopy in the Academy Library
OR via the Pharmacy intranet pages.

Medusa website - via GWH Pharmacy Intranet pages

3Ts Formulary – NHS –via Pharmacy Intranet pages:

http://gwh-extranet/formulary.aspx

NMC Advice sheet – Medicines Management, www.nmc-uk.org/

Marsden Manual (9th Edition)

NHS England – www.england.nhs.uk