Intravenous Drug and Fluid Administration Training
Calculation Practice Formulae and Questions in Preparation for On Line Calculation Test

The aim of these notes is to explain the types of calculation you may need to make when administering IV therapy. It also gives you a chance to practice them if you feel you need it.

Concentration of drug

mg per mL

There are various ways of quoting the concentration of drug in an injection. The most usual way is the number of mg of drug per ml of liquid i.e. mg/mL. For injection ampoules this is usually the number of mg in the volume of the ampoule e.g. 10mg in 2ml or 50mg in 5ml.

If the prescribed dose is the full contents of the ampoule it is straightforward. However, sometimes the dose required is a fraction of the ampoule. There is a straightforward formula for working this out which can be used for the majority of calculations:

$$\textbf{Volume needed} = \frac{\textbf{What you want}}{\textbf{What you've got}} \times \textbf{the Volume that it is in}$$

E.g. A patient is prescribed Pethidine I.V 75mg. The ampoule is 100mg in 2ml.
How many mL is 75mg?

$$\textbf{Volume} = \frac{\textbf{What you want}}{\textbf{What you've got}} \times \textbf{What it is in}$$

$$\frac{75}{100} \times 2$$ Cancelling 5 e.g. 75/5 = 15 $$\frac{\not{75}\ 15}{\not{100}\ 20} \times 2$$ Cancelling 5 again e.g. 15/5 = 3 $$\frac{\not{15}\ 3}{\not{20}\ 4} \times 2$$

$$\frac{3}{4} \times 2$$ Cancelling 2 e.g. 4/2 = 2 $$\frac{3}{\not{4}\ 2} \times \not{2}\ 1$$ $$\frac{3}{2}\ \text{mL} = 1.5\text{mL}$$

The concentration for some drugs will be quoted in millimoles per ml (mmol/mL) e.g. Potassium Chloride Strong Injection contains 2mmol Potassium per ml. Other drug concentrations e.g. insulin, heparin will be measured in units per ml. Calculations for these drugs are carried out in the same way as for drugs measured in mg per ml. Just make sure all the units in the equation match.

Percentage Concentration

Drug concentration may also be measured as % (w/v). It means the number of grams dissolved in 100mls of solution i.e. grams per 100ml. This is the same whatever the size of the container e.g. Glucose 5% means that 5 grams of glucose is dissolved in 100ml of fluid. This is the same in a 500ml bag as it is in a 1 litre bag, but obviously the 1 litre bag actually contains twice as much glucose, as the 500ml one because it is twice as big. This way of measuring the concentration is also sometimes used in ointments and creams but calculations involving these are rare and should be referred to a pharmacist for advice. However, we can use the same formula as before:

E.g. A patient is prescribed 20g of glucose to be given as Glucose 50% injection. How many mL do you give?

$$\frac{\textbf{What you want}}{\textbf{What you've got}} \quad \textbf{X} \quad \textbf{What it is in}$$

50% is 50g in 100ml (remember the volume it is in is 100mL)

$$\frac{20}{50} \times 100$$

Cancelling 50
e.g. 100/50 = 2

$$\frac{20}{\cancel{50}\ 1} \times \cancel{100}\ 2 \qquad \frac{20}{1} \times 2 = 40\text{mL}$$

One in.... concentration (Uncommon calculation)

This is only used for measuring the concentration of such things as adrenaline or tuberculin. It is stated as 1 in 100, 1 in 10,000 etc. It means grams in mL.
I.e. 1 in 100 means 1 gram in 100mls and 1 in 10,000 means 1 gram in 10,000mls

So 1 in 10,000 is weaker than 1 in 1000.

E.g. To give 1mg of adrenaline using 1 in 10,000 injection you will use the formula but remember to make sure the units are all the same value

1 in 10,000 = 1g in 10,000mls
= 1000mg in 10,000mls

$$\frac{\textbf{What you want}}{\textbf{What you've got}} \quad \textbf{X} \quad \textbf{What it is in}$$

$$\frac{1}{1000} \times 10{,}000$$

Cancelling 1000
e.g. 10,000/1,000 = 10

$$\frac{1}{\cancel{1{,}000}\ 1} \times \cancel{10{,}000}\ 10 = 10\text{mls}$$

Displacement Values (Rare in adult doses)

If you require only a part of the contents of a vial or ampoule to give the prescribed dose, then you need to know the total volume you have to be able to calculate how much to give. This is more likely to be the case in paediatric or neonatal practice.

When this is a pre-mixed solution, then the ampoule or vial usually states the total volume it contains. When the drug is available as a dry powder which has to be reconstituted before use, then whether or not it has a displacement value is important.

The displacement value is, as the name suggests, the volume of fluid which is displaced by the powder. It is negligible for many injections, and so does not affect the calculation. Drugs such as amoxicillin and co-amoxiclav have displacement values which should be taken into account when using part vials.

E.g. if you needed to give a 300mg dose of amoxicillin

The monograph for amoxicillin on the Trust intranet shows that 500mg of amoxicillin displaces 0.4mls of fluid.

This means that when a 500mg vial is reconstituted with 10ml Water for Injection the final volume is 10.4mls.

So to give a dose of 300mg

$$\frac{\textbf{What you want}}{\textbf{What you've got}} \ \mathbf{X} \ \textbf{What it is in}$$

Remember that the final volume is 10.4mls because of the displacement value

$$\frac{300}{500} \ \mathbf{X}\ 0.4 \quad \text{Cancelling 100 on top and bottom} \quad \frac{3}{5} \ \mathbf{X}\ 10.4 \ = \ \frac{31.2}{5} \ = \ \textbf{6.24mls}$$

Details of the displacement values for individual drugs are given in the relevant monograph within the Trust Intravenous Administration Guide (available on the GHNHSFT intranet) Medusa guidelines.

Units

It is important when using any equation to make sure all the units are the same.
See GHNHSFT intranet section or the BNF on prescription writing for further information on how doctors should prescribe dose units

To change grams to milligrams multiply by 1000
I.e. move the decimal point 3 places to the right
So 1g = 1000mg

To change milligrams to micrograms multiply by 1000
I.e. move the decimal point 3 places to the right
So 1mg = 1000 mcg (this is sometimes written as μg but can be mistaken for mg and should not be used)

To change milligrams to grams divide by 1000
I.e. move the decimal point 3 places to the left
So 1mg = 0.001g

To change micrograms to milligrams divide by 1000
I.e. move the decimal point 3 places to the left
So 100 micrograms = 0.1mg

Drip Rate Calculations

It is important that calculation of the rate of I.V. administration is accurate. However, it is useful to be able to perform these calculations from first principles and to do them step by step. E.g. At what rate (drops per minute) do you need to set the giving set to administer 1000mls of glucose 5% over 8 hours?

Step 1 - How many mL per hour?

This is the total volume (1000mls) divided by the time (8 hours).

$$\frac{\mathbf{1,000}}{\mathbf{8}} = \mathbf{125mls}$$

Step 2 - How many mL per minute?

This is the number of mL per hour (125) divided by the number of minutes per hour (60)

$\frac{\mathbf{125}}{\mathbf{60}}$ it is a good idea to keep this as a fraction and move on to step 3

Step 3 - How many drops per minute

This is the number of number of drops per ml multiplied by the number of mL per minute

The number of drops per ml depends on the **fluid** you are giving
and the **type of administration** set you are using

A **standard giving** set gives **20 drops per ml** of solutions
A blood giving set gives 15drops per ml of blood
A **micro drop** or **paediatric giving** set gives **60 drops per** ml of solutions

Using a standard giving set number of drops per minute = number of drops per ml x number of mL per minute

$\mathbf{20 \times \frac{125}{60}}$ Cancelling 20 e.g. 60/20 = 3 $\mathbf{\not{20}\ 1 \times \frac{125}{\not{60}\ 3} = 41.6}$

As it is not possible to give a fraction of a drop the answer is 'rounded up' to **42**. **Remember** For decimal point answers, below .5 you round down and for above .5 you round up. For an answer of **.**5 you will make a judgement call.
If we are giving solutions via a giving set the number of drops per ml and the 60 minutes per hour always stay the same. This means that steps 2 and 3 can be combined

So whenever aqueous solutions are given via a standard giving set:
Drops per minute = mL per hour divided by 3

For aqueous solutions given by a paediatric (micro drop) giving set:
Drops per minute = mL per hour

Drug Addition to IV Fluids (More Common in Specialist Units)

If the whole dose is going to be given over a period of time (e.g. 500mg of Clarithromycin in 250mls glucose 5% over 60 minutes) then the calculation is the same as calculating the drip rate (see above).

However some drugs, particularly in ITU, CCU, HDU etc., drugs are prescribed in mg per minute or micrograms per kg per hour.

Often the drugs are very potent and it is crucial that they are given at the correct rate. This may often mean making up a stock solution and setting a suitable rate of administration.

Here again it is useful to perform the calculation in steps:

E.g. administer lignocaine 1mg per minute using a solution of 1 gram lignocaine in 500ml glucose 5%

Step 1 - How many mL per minute

Firstly ensure all the units are the same (see above)

Lignocaine 1g in 500mls
To change grams to milligrams multiply by 1000
I.e. move the decimal point 3 places to the right
So 1g = 1000mg

$$\frac{\textbf{What you want}}{\textbf{What you've got}} \; \textbf{X what it is in}$$

$$\frac{1}{1{,}000} \times 500$$

Cancelling 500
e.g. 1,000/500 = 2

$$\frac{1}{\cancel{1{,}000}\ 2} \times \cancel{500}\ 1 \qquad \frac{1}{2} \times 1 = 0.5\text{ml per minute}$$

Step 2 - How many drops per minute
As discussed above this depends on the type of solution and the type of giving set you are using:

I.e. blood in a standard blood giving set = 15 drops per mL
Solutions in a standard set = 20 drops per mL
Solutions in a paediatric giving set = 60 drops per mL

Assuming you are using a standard set i.e. 20 drops per mL
Then Drops per minute = mL per minute x drops per mL
I.e. 0.5 x 20 = 10 drops per minute

If a drug is prescribed as mcg/kg/min there is an extra step

E.g. A woman weighing 40kg needs dobutamine at 5mcg/kg/minute. The stock solution which has been prepared contains 500mg in 500ml of glucose 5% Use a micro drop giving set.

Step 1 - How many mcg per minute

= 5 x 40 = 200mcg/minute

Now we can proceed as before

Step 2 - How many mL per minute

Again convert to same units
Solution contains 500mg in 500mls
Dose required is 200mcg/minute
To convert mcg to mg divide by 1000
I.e. move decimal point 3 places to the left
So 200mcg = 0.2mg

therefore $\frac{0.2}{500}$ **X 500** Cancelling 500 e.g. 500/500 = 1 $\frac{0.2}{\cancel{500}\ 1}$ **X** $\cancel{500}$ **1** $\frac{0.2}{1}$ **X 1 = 0.2ml per minute**

Step 3 - How many drops per minute

Drops per minute = mL per minute x drops per mL

= 0.2 x 60 = 12 drops per minute

The Next Section Shows Further Formulae Formats if Required:

- Solving clinical calculation drip rate problems
- Drug concentrations
- Percentage concentrations
- Displacement values and drug dosage calculations
- Multiplying and dividing by 1000
- Using Formulae- "what you want"
- Using division
- Division involving maximum rates per minute
- Converting between metric units

Solving Clinical Calculation Drip Rate and Infusion Pump Problems

To find the **drip rate, in drops per minute (dpm),** of a quantity of drug prescribed to be administered over a given length of time we may first find the rate of ml per hour. This is done by dividing the prescribed quantity of ml by the given number of hours over which it is to be given. Next we may find the rate of ml per minute by dividing the answer to the previous step by 60. Following this we may find the required drip rate in drops per minute by multiplying the rate of ml per minute by the number of drops per ml.

To find the hourly **infusion pump setting (in ml/hour)** which is required in order to administer a prescribed dosage of a drug over a given length of time we need to divide the quantity of the drug, in ml, by the number of hours.

Question: A prescription asks for 500ml of Sodium Chloride 0.9% over 4 hours.

a) To how many dpm should a standard set giving 20 drops per ml be set?

b) To how many ml per hour should an infusion pump be set?

1st step: $\frac{500ml}{4\ hour}$ = 125 ml per hour. This is the answer to question **b) 125 ml/hour**

2nd step: $\frac{125\ ml\ per\ hour}{60\ minutes}$ x 20 drops per ml = 41.666. So answer to a) is **42 dpm**

On a calculator these steps may be performed like this:

500ml ÷ 4 hours ÷ 60 minutes x 20 drops per ml = 41.666… which rounds to 42 dpm.

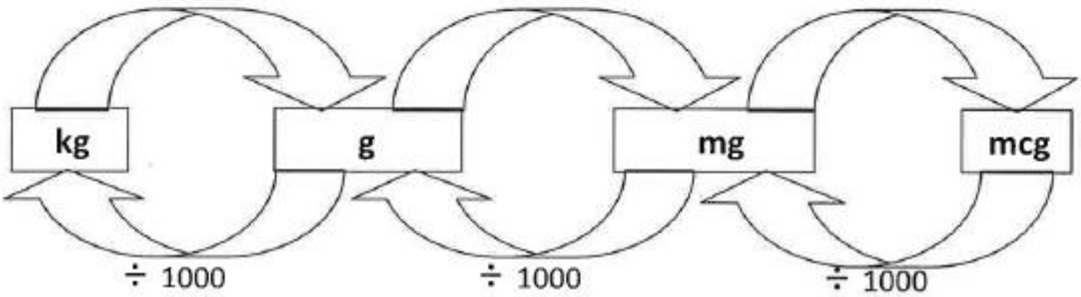
Note: if a drug is prescribed to be given in less than an hour then in order to find the **drip rate** we may omit the first step. For example, if 70ml is to be given over 20 minutes using a standard giving set:

70ml ÷ 20 minutes x 20 drops per ml = **70 dpm.**

To find the **infusion pump** setting for the same example we can first divide the quantity of drug by the time in minutes to find rate in ml per minute, and then multiply this answer by 60 in order to find the setting of the pump in ml per hour:

70ml ÷ 20 minutes x 60 = **210 ml/hour**

Converting between metric units



Of the metric units of measure for mass (weight) given in the diagram above, the largest is kilogram (kg) and smallest is microgram (mcg).

1kg = 1000 grams, 1g = 1000mg and 1g = 1000000mcg. Therefore 1mg = 1000mcg.

When converting from a larger unit of measure to a smaller multiply by the appropriate value, as shown by the direction of the arrows in the diagram above. Maths is full of opposites, so when converting from smaller units to larger divide by the values shown by the arrows.

Volume is measured in litres and millilitres, and the same principle applies when converting between these units of measure: when converting from litres to ml multiply by 1000, and when converting from ml to litres divide by 1000.

> Using conversions in clinical calculations
>
> The need to convert between metric units often arises. For example:
>
> How many mg of levothyroxine are there in a 100mcg tablet? Answer: 100mcg ÷ 1000 = 0.1mg. Note: we converted from a smaller unit of measure to a larger so divided.
>
> How many mg are there in a 1.2g dose of benzylpenicillin? Answer: 1.2g X 1000 = 1200mg. Note: we converted from a larger unit of measure to a smaller so multiplied.

Answer the following Question:

Tamsulosin is available as 400 mcg capsules, using the above prescription how many capsules would you administer?

Using division to solve problems involving maximum rates of drugs per minute

$$\frac{Dose\ required}{Maximum\ rate\ per\ minute}$$

This formula will find the length of time for which a certain drug should be administered when there is a maximum rate per minute to consider.

Note: take care to make sure that the dose required and maximum rate per minute are in the same units e.g. mg.

An example mg per minute calculation

A prescription asks for a dose of 1.2g of a drug to be administered at no more than 40mg per minute. How many minutes should this dose be given over?

First convert the 1.2g to mg, giving 1200mg. The values can now be entered into the fraction:

$$\frac{1200}{40} = 30\ minutes$$

The fraction is Top ÷ Bottom, so this is 1200mg ÷ 40mg per minute = 30 minutes

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Using Division

Division is often used to find how many items of a given size are needed in order to make up a required amount of a substance. Before completing any calculations using division it is often essential to make sure that the values are all written in the same units of measure.

Using division in clinical calculations

You have a prescription for Digoxin 0.25mg each morning. How many 125mcg tablets would you give?

In this example the required amount of the substance Digoxin is 0.25mg. The substance Digoxin is available in tablets of a given size: 125mcg. To find out how many tablets should be given we need to divide the quantity required, 0.25mg, by the size of each tablet, 125mcg.

However, before we can undertake this we must ensure that the units of measure are the same for both values. In this example it is best to convert the 0.25mg into mcg. This gives 0.25mg x 1000 = 250mcg. Now we can perform the calculation: 250 ÷ 125 = 2 tablets.

Note: this division could have been written as a fraction:

$$\frac{250}{125} = 2$$

Using Formulae

The formula given for solving many clinical calculation problems is:

$$\frac{What\ you\ want}{What\ you've\ got}\ x\ What\ it\ is\ in$$

Great care must be taken when putting the values into the fraction part of formulae such as this: it is important that the units of measure are the same for the values on the top of the fraction and on the bottom. For most situations, the best way to approach this is to convert the values given in the larger unit of measure to those given in the smaller. Also note that one method of performing the calculation is to divide the top of the fraction by the bottom and then multiply the answer to that by 'what it is in'.

Applying the formulae to a clinical calculations scenario

What volume of solution containing 1mg per ml is needed to give a dose of 600mcg?

To solve this first determine which values correspond with the wording of the formula. We want 600mcg, we have got 1mg and it is in 1ml. Notice that in this scenario 'what we want' and 'what we have got' are both measured in units of weight, whilst 'what it is in' is measured in units of volume.

Before entering the values into the formula we make sure that the values for the top and bottom of the fraction part are in the same units of measure. Here we should convert the 1mg into mcg. So 1mg x 1000 = 1000mcg. Now we can enter the values into the formula:

$$\frac{600mcg}{1000mcg}\ x\ 1ml$$

This gives: 600 ÷ 1000 x 1ml = 0.6ml. Therefore the volume of solution required to give a dose of 600mcg is 0.6ml.

Note: Often the value on the top of the fraction is larger than on the bottom. Don't worry about this, just follow the formula: Pethidine injection contains 50mg in 1ml. What volume of injection is needed to give a dose of 100mg? Using the formula gives:

$$\frac{100mg}{50mg}\ x\ 1ml$$

Answer the following question:

A patient is prescribed 500mg of Intravenous Flucloxicillin. It is out of hours and the ward only has a 1 gram vial. The IV monograph for Flucloxilcillin instructs you to add 15 mls of water for injection to the 1 gram vial. How much of this solution do you need for the prescribed dose?

Multiplying and dividing by 1000

It is often necessary to multiply and divide values by 1000. To perform these calculations quickly using written methods we can use the following techniques:

When multiplying by 1000 you can move the decimal point 3 places to the right. When dividing by 1000 you can move the decimal point 3 places to the left.

Note: if you are multiplying a whole number by 1000 you can just add 3 zeros.

Multiplying and dividing by 1000 in clinical calculations

Convert 4g to mg. To achieve this we need to calculate 4 x 1000. Because this is a whole number then to perform this using written methods you can just add 3 zeros to the 4:

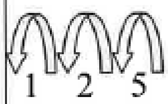
4 x 1000 = 4000mg

Convert 0.25mg to mcg. To achieve this we need to calculate 0.25 x 1000. To perform this using written methods you can write the number out and put an extra couple of zeros at the end first if you like – this gives you something to 'jump' the decimal over:

This means the decimal point has moved to be in the position 0250.0

We finish by tidying this up, which gives 250mcg.

Convert 125mg to grams. To achieve this we need to calculate 125 ÷ 1000. To perform this using written methods you can move the decimal 3 places to the left:



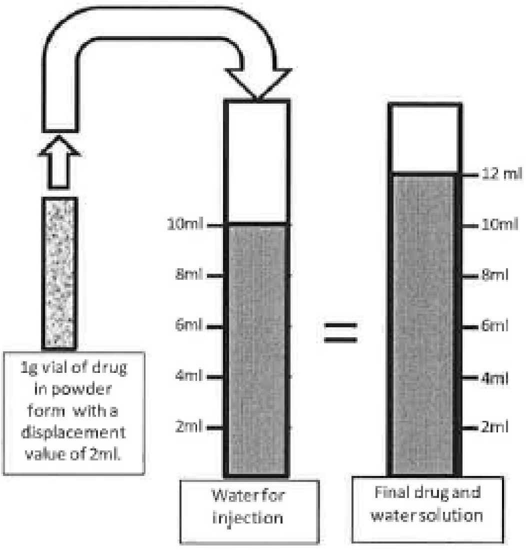
This means that the decimal point has moved to be in the position .125

Tidying this up gives 0.125g

Displacement values and drug dosage calculations

Some drugs are available only in powdered form and are required to be reconstituted with diluent before they can be administered as a liquid. The displacement value is the volume of liquid which is displaced by the powder.

The displacement value differs depending on the solubility of the drug concerned. For many injections the displacement value is negligible and therefore does not affect the calculation of drug dosages. However, some drugs, such as amoxicillin, have displacement values which need to be taken into account when calculating drug dosages.



As you can see from the diagram, when a 1g vial of a dry powder with a displacement value of 2ml is reconstituted with a diluent it will increase the volume of the diluent by 2ml, resulting in a final drug solution volume of:

Volume of diluent + displacement value of drug.

A 1g vial of a drug in powder form has a displacement value of 2ml and is to be reconstituted with 10ml of water. What volume would be required to give a dose of 500mg of the drug?

1st step: 10ml + 2ml = 12ml of final drug solution.

2nd step: $\frac{500}{1000}$ x 12ml = 6ml   Answer = 6ml

In some cases, such as in neonatal drug calculations, it may be necessary to calculate the volume of fluid to be added to a vial of a drug in order to achieve a specified final volume of solution.

Volume of diluent needed = final required volume of solution – displacement value of drug

A vial contains 500mg of a drug which has a displacement value of 0.4ml. a) How much water for injection should be added to give a solution of 500mg in 10ml? b) What volume of solution is required to give a dose of 30mg?

a): 10ml – 0.4ml = 9.6ml.

Thus 9.6ml **of water for injection should be added to achieve a solution of 500mg in 10ml**

b): $\frac{30}{500}$ x 10ml = 0.6ml.   On a calculator: 30 ÷ 500 x 10ml = 0.6ml.   Answer = 0.6ml

Finding quantities of substances from percentage concentrations

How much glucose is contained in 400ml of 9% glucose?

This question is asking us to find how many grams of glucose there are in 400ml of a solution of 9% glucose. Note that the answer is required in grams, which is a measure of weight (mass).

Before attempting to solve this question it is best to define what 9% glucose solution actually means. 9% glucose solution means there are **9 grams of glucose in every 100ml** of the solution.

Once we have defined that there are 9g of glucose in 100ml of the solution we need to use this information to find out how many grams of glucose would be in 400ml of the solution. We can do this by dividing 400ml by 100ml and then multiplying the answer by 9g such:

400ml ÷ 100ml x 9g = 36g of glucose. As a formula this looks like: $\frac{400}{100} x$ 9g = 36g

Note: the number before the percentage sign tells us how many grams there are in every 100ml of solution. For example, 0.9% sodium chloride means there are 0.9g of sodium chloride per 100ml of solution.

How much glucose is contained in 25ml of 5% glucose?

5% glucose means 5g of glucose in every 100ml of solution.

Therefore in 25ml of the solution there will be 25ml ÷ 100ml x 5g = 1.25g of glucose

Or this could be written $\frac{25}{100} x$ 5g = 1.25g

Evaluating the diluted concentration of a drug in a solution

An 800mg dose of a drug is diluted in 500ml of 5% glucose. What is the concentration of the drug in the diluted solution?

This question asks us to evaluate the diluted concentration of the drug in the solution, giving the answer in terms of mg per ml (amount of mg of drug in every 1ml volume of solution).

Note: another way of writing mg per ml could be mg/ml. It is helpful to realise this as it tells us that we need to divide the amount of mg by the volume of ml.

Therefore to solve this question we need to divide the amount of the drug (measured in mg) by the given volume of the solution (measured in ml):

800mg ÷ 500ml = 1.6mg/ml.

This means that 1.6mg of the drug is diluted in every 1 ml of the solution, or we could also express this as 1.6mg per ml.

This could also have been written like this: 800mg/500ml = 1.6mg/ml. However when using mg/ml if it is badly written it can be misinterpreted which can lead to errors therefore please use mg per ml.

A 400mg dose of a drug is diluted in 500ml of 5% glucose. What is the concentration of the drug in the diluted solution?

400mg ÷ 500ml = 0.8mg per ml

Don't forget to convert units of measure first if needed:

A 900mg dose of a drug is diluted in 1.2 litres of 5% glucose. What is the concentration of the drug in the diluted solution?

1.2 litres = 1200ml. Therefore 900mg ÷ 1200ml = 0.75mg per ml

Question: 300mg of pethidine is diluted in 500ml of normal saline solution. What is the concentration of the diluted solution?

Answer: 300mg/500ml = 0.6mg per ml

Solving Clinical Calculation Drip Rate and Infusion Pump Problems

To find the **drip rate, in drops per minute (dpm)**, of a quantity of drug prescribed to be administered over a given length of time we may first find the rate of ml per hour. This is done by dividing the prescribed quantity of ml by the given number of hours over which it is to be given. Next we may find the rate of ml per minute by dividing the answer to the previous step by 60. Following this we may find the required drip rate in drops per minute by multiplying the rate of ml per minute by the number of drops per ml.

To find the hourly **infusion pump setting (in ml/hour)** which is required in order to administer a prescribed dosage of a drug over a given length of time we need to divide the quantity of the drug, in ml, by the number of hours.

Question: A prescription asks for 500ml of Sodium Chloride 0.9% over 4 hours.

a) To how many dpm should a standard set giving 20 drops per ml be set?

b) To how many ml per hour should an infusion pump be set?

1st step: $\frac{500ml}{4\ hour}$ = 125 ml per hour. This is the answer to question **b) 125 ml/hour**

2nd step: $\frac{125\ ml\ per\ hour}{60\ minutes}$ x 20 drops per ml = 41.666. So answer to **a)** is **42 dpm**

On a calculator these steps may be performed like this:

500ml ÷ 4 hours ÷ 60 minutes x 20 drops per ml = 41.666... which rounds to 42 dpm.

Note: if a drug is prescribed to be given in less than an hour then in order to find the **drip rate** we may omit the first step. For example, if 70ml is to be given over 20 minutes using a standard giving set:

70ml ÷ 20 minutes x 20 drops per ml = **70 dpm.**

To find the **infusion pump** setting for the same example we can first divide the quantity of drug by the time in minutes to find rate in ml per minute, and then multiply this answer by 60 in order to find the setting of the pump in ml per hour:

70ml ÷ 20 minutes x 60 = **210 ml/hour**

Calculation Practice Questions in Preparation for On Line Calculation Test

There are various types of calculations included in these questions. Please complete the relevant practice section before completing on line calculation test:

Part A- All - basic principles which are used in all calculations

Part B -Adult or children- - is divided into 2 sections with more specific calculations relating to adult or children.

Part C- Neonatal, Babies and Children Only

Please complete Part A and one or both sections of Part B according to your area of practice before you receive training.

You may be unfamiliar with some of the drugs mentioned in these questions. The actual drugs are unimportant, they are simply examples of the type of calculations you may need to complete in practice.

You owe it to yourselves and your patients to be sure that you can perform calculations correctly. Incorrect dosage calculations can result in serious consequences!

Part A- All

1. How many micrograms are there in 0.1mg?

2. How many grams are there in 200mg?

3. How many grams of glucose are there in a 500ml bag of glucose 5%?

4. How many milligrams of adrenaline are there in 10mls of a 1 in 10,000 solution?

5. A prescription asks you to give a 500ml bag of sodium chloride 0.9% over 6 hours.

   What is the required drip rate (in drops per minute) if:

   a) You are using a fluid giving set (20 drops per mL)?

   b) You are using a paediatric or micro drop giving set (60 drops per mL)?

6. What volume of a solution containing 1mg per mL is needed to give a dose of 600mcg?

7. What volume of furosemide (frusemide) injection 20mg in 2mL is required to administer a dose of 40mg?

8. You have been asked to give a 500mg I.V. bolus dose of the new antibiotic *Killomycin*. Each vial of dry powder contains 1g of *Killomycin*. Each vial should be reconstituted with 10mL of Water for Injection.

   a) What volume of reconstituted solution would you withdraw from the vial if Killomycin has a negligible displacement value?

      (See displacement values formula)

   b) If the vial was reconstituted with 10mL water for Injection, but Killomycin had a displacement value of 2mL, what volume would be required to give a dose of 500mg?

Part C- Neonates, Babies and Children Only

1. A child (weight 8.7Kg) is prescribed ceftriaxone 700mg once daily. The standard reference book (Medicines for Children) suggests a maximum dose of 80 mg per Kg body weight.

   a) Is the dose suitable for this child?

   b) The 1g vial is supplied as a dry powder which is reconstituted with 20mls of sodium chloride. What strength in mg per ml is the reconstituted solution?

   c) What volume of solution would you administer to the child to give the prescribed dose?

   d) Would you give the dose as a bolus or by infusion?

20. A baby is prescribed 11.2mg of gentamicin every 24 hours. The vials available contain 20mg in 2ml. The baby weighs 2.8Kg, and the recommended dose is 4mg per Kg every 24 hours.

   a) Is 11.2mg a suitable dose for this child?

   b) What volume of solution would you give?

11. To replace above question, due to changes in recommended doses- Jan 2013:

A 25 week gestation infant weighs 500g and is prescribed gentamicin at 3.5mg/kg/dose.

a) What is the correct dose?

b) How often would you administer the drug if babies equal to and above 32/40 have a daily dose and babies below 32/40 have theirs every 36 hours?

c) How much would you administer from a vial containing gentamicin 20mg in 2 mL?

Part B- Adults Only

12. An elderly patient weighing 50Kg has been prescribed gentamicin 150mg at 1800hrs. The recommended dose is 3mg per Kg once daily. Is this the correct dose for this patient? If not, what should it be?

13. A 65 Kg patient with suspected herpes simplex encephalitis has been prescribed acyclovir 600mg three times a day. The recommended dose is 10mg per Kg three times a day.

    a) Is this the correct dose for this patient? If not, what should it be?

    b) When it has been reconstituted, acyclovir is available as a solution of 250mg in 10mL, or 500mg in 20mL. What volume of solution is needed to give the prescribed dose?

    c) Acyclovir comes in vials of 250mg and 500mg. What vials would you reconstitute to obtain the required dose?

14. Digoxin solution contains 0.05mg per mL. How much solution do you need to give a dose of 100 micrograms (mcg)?

15. A 5mg drug dose diluted in 10 mL of water for injection (WFI) is added to an infusion of 100 mL to be given over 30 minutes. Calculate the drops per minute via a gravity giving set?

16. You have to give 400mL over 4 hours using an infusion pump. What is the infusion rate in mL per hour?

Practice Calculation Assessment Answers

Formulae from this pre-course material:

Question No/ Formulae::	Part A Questions	Part A - Workings Out and Answer
1 Converting between units/ Multiplying and dividing by 1000	**How many micrograms are there in 0.1mg?**	0.1 x 1000 **Or** Move decimal point x3 places to the right**= 100mcgs**
2 Converting between units/ Multiplying and dividing by 1000	**How many grams are there in 200mg?**	200 ÷1000**= 0.2 g** **Or** Move decimal point x3 places to the left**= 0.2 g**
3 Percentage concentration	**How many grams of glucose are there in a 500 ml bag of glucose 5%?**	**Either** Formula says 5g in each 100mls- so 5g x 5 (100ml) **= 25g in 500mL** ***Or*** 500 x5 **= 25g in 500mL** 100
4 One in Concentration	**How many milligrams of adrenaline are there in 10mls of a 1 in 10,000 solution?**	**Either:** 10 mL of 1 in 10,000 solution 10ml x 1000mg = **1mg** 10000ml **Or** 1g of adrenaline in 10,000ml of solution gives 1000mg in 10,000ml Divide each side by 1000 to obtain 10 ml of solution = **1mg in 10mL** **Therefore there is 1mg of adrenaline in 10mL of the solution or 1000mcg in 1 mL of solution**
5 Time and drip rates	**a) A prescription asks you to give a 500ml bag of sodium chloride 0.9% over 6 hours What is the required drip rate in drops per minute)? If: a) You are using a fluid giving set (standard 20 drops per mL)? b) You are using a paediatric or micro drop giving set (60 drops per mL)?**	a) 500 mL x 20 (dpm) =**27.777dpm** 6 hours (6x 60 =360 mins) R**ound up to 28 drops per minute (dpm)** b) 500 = **83.33 mL per hr. - round down to 83dpm** 6 **Or** 6 hrs. x 60 mins = 360 mins 500 x 60 = 83.33 dpm (500 = 1.38 x 60 = 83.33 dpm) 360 360 **Round down to 83 dpm**
Question	**Part A Questions**	**Part A - Workings Out and Answer**

No/ Formulae		
6 Concentration of drug Using Formula ('what you want')	**What volume of a solution containing 1mg per ml is needed to give a dose of 600mcg?**	1000mcg per ml so $\frac{600}{1000} \times 1 =$ **0.6 mL**
7 Concentration of drug Using Formula ('what you want')	**What volume of furosemide (frusemide) injection 20mg in 2mls is required to administer dose of 40mg?**	**Either** 20mg in 2mls So 40 mg in 4mls = **4mL** **Or** $\frac{40}{20} \times 2 =$ **4mL**
8 Displacement values and drug dosage calculations	**You have been asked to give a 500mg I.V. bolus dose of the new antibiotic Killomycin (made up name). Each vial of dry powder contains 1g of *Killomycin*. Each vial should be reconstituted with 10 mL of water for injection.** **a) What volume of reconstituted solution would you withdraw from the vial if has a negligible displacement value?** **b) If the vial was reconstituted with 10mls water for injection, but Killomycin had a displacement value of 2mls, what volume would be required to give a dose of 500mg?**	a) $\frac{500 \text{ mg (IV)}}{1000 \text{ mg}} \times 10 =$ **5mL** b) 2 mL displacement + 10mls =12mls volume for 1000mg dose $\therefore$ 12 mL ÷ 2 = **6mL**
Question No/ Formulae	**Part B1 Questions**	**Part B1 - Workings Out and Answer**
9 Weight related **Concentration**	A child (weight 8.7 Kg) is prescribed ceftriaxone 700mg once daily. The standard reference book (Medicines for children) suggests a maximum dose of 80 mg per Kg body weight. a) Is the dose suitable for this child? b) The 1g vial is supplied as a dry powder which is reconstituted with 20 ml of sodium chloride. What strength in mg per ml is the reconstituted solution? c) What volume of solution would you administer to the child to give the **prescribed** dose? d) Would you give the dose as a bolus or by infusion?	**a)** 80mg per Kg x 8.7 (baby weight) = **696mg** **YES 700mg is the correct dose** b)1 in 20mls solution $\therefore$ $\frac{1000}{20}$ x = **50 mg per mL (mg/mL)** Or $\frac{500 \text{ mg}}{10}$ = **50mg mg/mL concentration** c) $\frac{700}{1000}$ = **14.0 mL** d) **Refer to NNU- would recommend to give as bolus**- BNF stipulates it can be given: by iv infusion only if over 50mg/kg. However most drugs are given via a pump in Paediatric/Neonatal departments. Please discuss this question with your managers.
Question No/ Formulae	**Part B1 Questions**	**Part B1 - Workings Out and Answer**

10 Weight Related Using Formula (‘What you want’)	A baby is prescribed 11.2mg of gentamicin every 24 hrs. The vials available contain 20mg in 2ml. The baby weighs 2.8Kg, and the recommended dose is 4mg per Kg every 24 hrs. a) Is 11.2mg a suitable dose for this child? b) What volume of solution would you give?	a) 11.2mg 2.8 kg (baby’s weight) x 4mg/Kg **=11.2mg** **So- yes this is a suitable dose.** b) 20mg in 2mls so: <u>11.2mg</u> x 2mls = **1.12mL** 20
11 Weight Related Using Formula (‘What you want’)	To replace above question, due to changes in recommended doses- Jan 2013: A 25 week gestation infant weighs 500g and is prescribed gentamicin at 3.5mg/kg/dose. a) What is the correct dose? b) How often would you administer the drug if babies equal to and above 32/40 have a daily dose and babies below 32/40 have theirs every 36 hours? c) How much would you administer from a vial containing gentamicin 20mg in 2 ml?	a) 0.5kg x 3.5mg= 1.75mg per dose b) Every 36 hours as below 32 weeks gestation c) Administer <u>1.75</u> x 2 = **0.175 mL** 20 **Can accept 0.17- 0.18mL as answer**
PART B - ADULTS		
11 Weight related	An elderly patient weighing 50Kg has been prescribed gentamicin 150mg at 1800hrs. The recommended dose is 3mg per Kg once daily. Is this the correct dose for this patient? If not, what should it be?	50 Kg weight & 3mg per Kg- recommended dose- so: **YES** 50Kg x 3mg = **150mg dose**
12 Weight related Using formulae (‘What you want’)	A 65 Kg patient with suspected herpes simplex encephalitis has been prescribed acyclovir 600mg three times daily. The recommended dose is 10mg per Kg three times a day. (TDS) a) Is this the correct dose for this patient? If not, what should it be? b) When it has been reconstituted, acyclovir is available as a solution of 250mg in 10ml, or 500mg in 20ml. What volume of solution is needed to give the prescribed dose? c) Acyclovir comes in vials of 250mg and 500mg. What vials would you reconstitute to obtain the required dose?	a) 65Kg weight at 10mg per Kg- recommended dose- so: 65 x 10 = **650mg TDS= No** **b)** <u>600</u> x 10 = **24mL** 250 = **24ml for prescribed dose of 250mg in 10mL** **Or** <u>600</u> x 20 **= 24ml** 500 **=24ml for prescribed dose of 500mg in 20mL** c) x1, 500mg bottle= 20mL x1 (250mg) =10mL so withdraw only 6mls <u>150</u> x 10 =**6mls** 250 Add 20mls+6mls **= 26mL**
13 Converting between units	Digoxin solution contains 0.05mg per ml. How much solution do you need to give a dose of 100 micrograms (mcg)?	Formula <u>must</u> be in same units Convert mg to mcg – multiply by 1000 or move decimal point 3 places to the right

14 **Time and drip rates (dpm)**	A 5mg drug dose diluted in 10 mL of water for injection (WFI) is added to an infusion of 100 mL to be given over 30 minutes. Calculate the drops per minute via a gravity giving set?	0.05mg per ml = 50mcg per ml $\frac{\text{What you want}}{\text{what you've got}}$ x what it's in = $\frac{100}{50}$ x 1 = **2.0mL** Omit mL per hour step – as time is less than I hour $\frac{110}{30}$ X 20 drops per mL=73.333round down to **73dpm**
15. Pump m/hr.	You have to give 300mls over 4 hours using an infusion pump. What is the infusion rate in mL per hour?	Step 1 – mL per hour 300mls over 4 hours = $\frac{300}{4}$ = **75mL per hour**

Practice Calculation Assessment for the Administration of Intravenous Drugs

There are various types of calculations included in these questions. The questions illustrate basic principles which are used in all calculations. Everyone undertaking IV drug administration must complete a calculation assessment on line.

The aim of this practice assessment is to develop your confidence in performing calculations and prepare you for the formal test.

You may be unfamiliar with some of the drug mentioned in these questions. The actual drugs are unimportant, they are simply examples of the type of calculations you may need to complete in practice.

NB. If you are a neonatal nurse, the formal test will contain questions relating more specifically to your practice area.

You owe it to yourselves and your patients to be sure that you can perform calculations correctly. Incorrect dosage calculations can result in serious consequences!

The use of simple calculators is permitted

Allow yourself a maximum of 60 minutes for the test and check your

answers when you have finished.

1. What volume of a solution containing 1mg per ml is needed to give a dose of 400mcg?

2. What volume of furosemide (frusemide) injection 50mg in 5mls is required to administer a dose of 40mg?

3. A prescription asks you to give a 1 litre bag of sodium chloride 0.9% over 8 hours. What is the required drip rate (in drops per minute) if you are using a standard giving set (20 drops per ml)?

4. Flucloxacillin injection 500mg injection can be reconstituted with 10mls Water for Injection. It has a negligible displacement value. What volume of solution is needed to give a dose of 1g?

5. An elderly patient weighing 55Kg has been prescribed gentamicin once a day at 1800hrs. The recommended dose in 3mg per Kg once daily. What is the correct dose for this patient?

6. A neonate (weight 2.4Kg) is prescribed 9.6mg of gentamicin every 24 hours. The gentamicin solution contains 20mg in 2ml. What volume of solution is required to give the prescribed dose?

7. A child (weight 11Kg) is prescribed ceftriaxone once daily. The suggested maximum dose is 80mg per Kg body weight. What is the maximum dose suitable for this child?

8. The reconstituted solution of ceftriaxone contains 50mg per ml. What volume of solution would you administer to a child to give a dose of 500mg? (Please note - 500mg is <u>not</u> the answer to question 7).

9. You have a 500ml bag of glucose 5% containing 500mg of Sodium Fusidate (Fucidin). It has to be given over 6 hours using a micro drop (paediatric) giving set (60 drops per ml). What is the correct rate of administration (drops per minute)?

10. Sodium Valproate injection is reconstituted with the solvent provided in the pack. This gives a final solution containing 95mg per ml. What volume of solution is required to give a dose of 400mg?

Nick Butler, February 2003

Adult Calculation Test Answer Sheet		
Name:		
Ward Base/Site		
Date:		
Mobile Number:		
Question No:	Notes / Workings Out	Answer
1		
2		
3		
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7		
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Gloucestershire Hospitals NHS
NHS Foundation Trust

Practice Calculation Assessment

ANSWER SHEET

QUESTION	ANSWERS/WORKINGS
1 Converting between units/Multiplying and dividing by 1000	400mcg ÷1000mcg = **0.4mL**
2 Concentration of drug 'what you want'	40mg ÷ 50mg x 5ml = **4mL**
3 Time and drip rates	1000ml ÷ 8 hours =8 hrs. x 60 mins= 480 mins 1000 ÷ 480 mins x 20 drops per mL = **41.66666 dpm** **Or** 1000 ÷ 8 =125 mL/hr. 125 x 20 ÷ 60 = **41.66666 dpm** **round up to 42 dpm**
4 Concentration of drug 'what you want'	1000mg ÷ 500mg x 10ml = **20mL**
5 Weight related	3mg x 55kg = **165mg OD**
6 Giving the dose/Using division	9.6mg ÷ 20mg x 2ml = **0.96 mL** **Do not round up or down for neonatal doses**
7 Weight related	11kg x 80mg= **880mg**
8 Concentration of drug 'what you want'	500mg ÷ 50mg x ml = **10mL**
9 Time and drip rates	500 ÷ 6 hours = 6 hours x 60 mins = 360 mins 500 ÷ 360 x 60 = **83.333 dpm** **Or** 500 ÷ 6 hours = **83.333 dpm** **Round down to 83 dpm**
10 Concentration of drug 'what you want'	400mg ÷ 95 mg x 1 ml = **4.210ml** **Or** 400mg ÷ 95mg= **4.210mL** **Round down to 4.2 mL**