NHS Fife

Acute Services Division

Preparation and Administration of Medication by Infusion

PRE-COURSE WORK

It is a pre-requisite for attending the above study day that you work through this pack. You must be comfortable with units of measurement so that you are able to understand calculations demonstrated on the day **and complete a calculation test.**

Please bring this pre-course workbook and a calculator along to the study day as an aid for the calculation test.

	Pages

FIFE ACUTE HOSPITALS

IV STUDY DAY

STANDARD FOR DRUG CALCULATION TEST

The Drug Calculation Test will be carried out on the day of attendance and the **pass mark** for this component is **100%**. In the event that you the practitioner is unsuccessful in attaining the pass mark, you will be required to attend the following Drug Calculation Resit session or alternatively the morning of the next I.V study day.

You will be notified of your drug calculation test result within ONE WEEK of attending the I.V study day.

Practitioners who do not pass the third drug calculation test will not become an I.V Trained Practitioner.

You must COMPLETE this PRE-COURSE WORK prior to attending the IV STUDY DAY. If not you will be sent back to your clinical area and advised to book onto the next IV Study day.

UNITS AND EQUIVALENCES

All doses and volumes are measured in Standard International Units (SI units) which come in many different units. When drug calculations are carried out the unit of measurement must be the same; therefore you must have a knowledge of units to ensure that the correct answer is achieved.

Standard International Units (SI units) of weight and volume

Units of weight

1 kilogram (kg)	= 1000 grams (g)
1 gram (g)	= 1000 milligrams (mg)
1 milligram (mg)	= 1000 micrograms (mcg or μg)
1 microgram (mcg or μg)	= 1000 nanograms (ng)

To avoid error micrograms or **nanograms** should be written in full.

Units of volume

1 litre (L or l)	= 1000 millilitres (ml)
1 millilitre (ml)	= 1000 microlitres (mcl or μl)

To avoid error **microlitres** should be written in full and a capital L is often used for litre so as not to confuse a small l with a number 1.

Unit of substance

1 mole (mol)	= 1000 millimoles (mmol)
1 millimole (mmol)	= 1000 micromoles (mccmol or μmol)

To avoid error **micromoles** should be written in full.

Conversion from one unit to another unit

In drug calculations, it is best to work in whole numbers, i.e. 125 mcg and not 0.125mg, as fewer mistakes are then made. It is always best to work with the smaller unit to avoid decimals and decimal points. 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 1,000.

In general

To convert from a **larger** unit to a **smaller** unit, **multiply** by 1,000

To convert from a **smaller** unit to a **larger** unit, **divide** by 1,000

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

Multiplication and decimal points

To multiply by	**Move the decimal point**		
10	1 place right	e.g. 1.0 ↺	= 10.0
100	2 places right	e.g. 1.0 ↺↺	=100.0
1000	3 places right	e.g. 1.0 ↺↺↺	=1000.0

Division and decimal points

To divide by	**Move the decimal point**		
10	1 place left	e.g. 1.0 ↶	= 0.1
100	2 places left	e.g. 1.0 ↶↶	=0.01
1000	3 places left	e.g. 1.0 ↶↶↶	=0.001

It is important to note that, when converting from a very large unit to a much smaller unit (or vice versa), the conversion may involve two steps.

e.g. you wish to convert from kilograms to milligrams. Therefore to convert 0.005kg to milligram, first convert to grams:

0.005kg = 0.005 x 1,000 = 5g

next convert to milligrams:

5g = 5 x 1,000 = 5,000mg

Therefore it is important to look at the units carefully; converting from one unit to another may involve two steps.

N.B. When converting, the amount remains the same, only the unit changes. Obviously, it appears more when expressed as a smaller unit, but the amount remains the same.

Examples

1 Convert 0.5g to mg
You are going from a larger unit to a smaller unit
Therefore you have to multiply by 1,000 i.e. 0.5g x 1,000 = 500mg

(Decimal point moves three places to the right: 0.500 = 500.0)
↺↺↺

2 Convert 2,000g to kg
You are going from a smaller unit to a larger unit
Therefore you have to divide by 1,000 i.e. 2,000g = $\frac{2,000}{1,000}$ = 2kg
↻↻↻
(Decimal point moves three places to the left: 2000.0 = 2.0)

3 Convert 1.45 L to ml
You are going from a larger unit to a smaller unit
Therefore you have to multiply by 1,000 i.e. 1.45 L x 1,000 = 1,450ml

(Decimal point moves three places to the right: 1.450 = 1,450.0)
↺↺↺

S.I. prefixes

When the S.I. unit is inconveniently large or small, prefixes are used to denote multiples or sub-multiples. In practice, it is preferable to use multiples of a thousand, e.g. gram, milligram, microgram.

The main prefixes you may come across in your clinical area may be:

mega	=	a unit expressed in terms of millions
milli	=	a thousandth of a unit
micro	=	a millionth of a unit
nano	=	a thousand-millionth of a unit

Therefore in practice, drug strengths and dosages can be expressed in various ways, e.g.

1 Benzylpenicillin - sometimes expressed in terms of mega units (1-mega-unit means 1 million units of activity). Each vial contains benzylpenicillin 600mg, which equals 1 mega unit.

2 Liquids are often expressed in millilitres (ml) which are used to describe small volumes, e.g. lactulose, 10ml to be given three times a day.

3 Drug strengths are usually expressed in milligrams (mg), e.g. frusemide 40mg tablets.

4 When the amount of drug present is very small, strengths are expressed as either micrograms (mcg) or even nanograms (ng), e.g. digoxin 125 mcg tablets, alfacalcidol 250ng capsules.

N.B. For the purposes of writing prescriptions the word 'micrograms' should be written in full; when an abbreviation is necessary the British Pharmacopoeia recommends that 'mcg' be used.

SI BASE UNITS

Quantity	Name of unit	Unit symbol
Weight	Kilogram	kg
Volume	Litre	L or l
Amount of substance	Mole	mol

EQUIVALENCES

As has already been stated, S.I. units are too large for everyday use, so they are subdivided into multiples of 1,000.

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

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	mccmol

MEMORISE

1 gram (g)	=	1,000 milligrams (mg)
1 milligram (mg)	=	1,000micrograms (mcg)
1 litre (L)	=	1,000 millilitres (ml)

UNITS AND EQUIVALENCES - SUMMARY

To convert a larger unit to a small unit - multiply by 1,000

To convert a smaller unit to a larger unit – divide by 1,000

PERCENTAGES

Calculation of the volume of injection required where the dose of a drug is stated as a percentage. When a drug concentration is expressed in percentage terms, the percentage needs to be qualified to show if it relates to weight or volume.

Percentage relates to parts per hundred. Therefore 1% is 1 part in 100 parts.

Weight in weight (w/w) solid preparations

This expresses the weight of drug in grams per 100g of base.

1% w/w = Solid 1 part by weight
Solid 99 parts by weight

e.g. **2%w/w = 2g of solid in 100g of solid preparation**

Volume in volume (v/v) solutions

This expresses the volume of drug in mls per 100ml of solution.

1%v/v = Liquid 1 part by volume
Liquid 99 parts by volume

e.g. **10%v/v = 10ml of liquid in 100ml of solution**

Weight in volume (w/v) solutions

This expresses the weight of drug in grams per 100ml of solution.

1% w/v = Solid 1 part by weight
Liquid 99 parts by volume

e.g. **5%w/v = 5g of solid in 100ml of solution**

Examples of 2 injections with concentrations expressed as a percentage.

Calcium Gluconate 10%w/v, the injection contains 10g Ca gluconate in 100ml

Potassium Chloride 15%w/v, the injection contains 15g KCl in 100ml

So:-

If Calcium Gluconate 10%w/v injection contains	10g Ca gluc		in	100ml
Then	1g	is	in	10ml
And	**0.1g**	**is**	**in**	**1ml**
Or	**100mg**	**is**	**in**	**1ml**

And if Potassium Chloride 15%w/v injection contains	15g KCl		in	100ml
Then	1.5g	is	in	10ml
And	**0.15g**	**is**	**in**	**1ml**
Or	**150mg**	**is**	**in**	**1ml**

RATIOS

Calculation of the volume of injection required when the dose is stated as a ratio.

When a drug concentration is expressed as a ratio, the ratio indicates that 1 gram of drug is present in the stated amount of solution.

e.g. Adrenaline 1:100 contains 1g in 100ml
Adrenaline 1:1000 contains 1g in 1000ml
Adrenaline 1:10.000 contains 1g in 10,000ml

Examples of 2 injections with concentrations expressed as a ratio.

So:-

If Adrenaline 1:1000 contains	1g of Adrenaline		in	1000ml
Therefore	1000mg	is	in	1000ml
Then	100mg	is	in	100ml
And	10mg	is	in	10ml
And	**1mg**	**is**	**in**	**1ml**

And if Adrenaline 1:10,000 contains	1g of Adrenaline		in	10,000ml
Therefore	1000mg	is	in	10,000ml
Then	100mg	is	in	1000ml
And	10mg	is	in	100ml
And	1mg	is	in	10ml
And	**0.1mg**	**is**	**in**	**1ml**
Or	**100mcg**	**is**	**in**	**1ml**

NOW TRY THE EXAMPLES PROVIDED

CONVERSION EXERCISES

1 Convert 0.0125 kilograms to grams

2 Convert 250 nanograms to micrograms

3 Convert 3.2 litres to millilitres

4 Convert 0.0273 moles to millimoles

5 Convert 3,750 grams to kilograms

6 Convert 0.05 grams to micrograms

7 Convert 25,000 milligrams to kilograms

8 You have an ampoule of digoxin 0.5mg in 2ml
How many mcg/ml?

9 You have a 2ml ampoule of fentanyl 0.05 mg/ml
How many micrograms are there in a 2ml ampoule?

10 Convert 250mg in 5ml to mg in 1ml

11. Convert 5%w/v to grams in 1ml

12. Convert 20%w/v to mg in 10ml

13. Convert 1 in 10,000 to grams in 100ml

14. Convert 1 in 1000 to mgs in 10ml

Remember

Look at the units carefully: converting from one unit to another may involve two steps.

YOU WILL FIND THE ANSWERS TO THE ABOVE CONVERSIONS OVERLEAF

ANSWERS TO CONVERSIONS ON PREVIOUS PAGES

1 12.5 grams

2 0.25 micrograms

3 3,200 millilitres

4 27.3 millimoles

5 3.75 kilograms

6 50,000 micrograms

7 0.025 kilograms

8 Convert milligrams to micrograms. You are going from a larger unit to a smaller unit, therefore multiply by 1,000: 0.5 mg x 1,000 = 500 mcg
Thus you have 500mcg in 2ml. Therefore to find out how much is in 1ml, divide by 2:

Answer: 250mcg in 1ml

9 Convert milligrams to micrograms. You are going from a larger unit to a smaller unit, therefore multiply by 1,000: 0.05 mg x 1,000 = 50 mcg
Thus you have 50 mcg in 1 ml. Therefore to find out how much is in a 2ml ampoule, multiply by 2:

Answer: 100 mcg in a 2ml ampoule.

10 50mg in 1ml

11 5g in 100ml = 0.5g in 10ml = 0.05g in 1ml

Answer = 0.05g in 1ml

12 20g in 100ml = 2g in 10ml = 2000mg in 10ml

Answer = 2000mg in 10ml

13 1 g in 10,000ml = 0.1g in 1000ml = 0.01g in 100ml

Answer = 0.01g in 100ml

14 1g in 1000ml = 1000mg in 1000ml = 100mg in 100ml = 10mg in 10ml

Answer = 10mg in 10ml

DRUG CALCULATIONS

Giving drugs to patients is a part of the everyday life of a practising nurse, and you probably have little difficulty working out the required doses of the common drugs in use on your ward.

Problems could arise, however, if you moved to a ward dealing with specialist drugs such as those used in cancer therapy. An even greater danger lies with the familiar drugs, because the suppliers sometimes alter the strength of their medications. You must be aware of this and know how to calculate the new dosage.

Fortunately calculating drug doses can be simple, as you will see!

Let's begin by looking at a perhaps obvious example before we even consider looking at I.V. calculations.

EXAMPLE

A doctor prescribes 600mg of aspirin 4 hourly as required for headaches.

Aspirin is available as tablets, each containing 300mg.

You need to work out how many tablets the patient needs.

He needs 2 tablets - EASY!

THE QUESTION TO BE ASKED IS HOW DID YOU GET YOUR ANSWER? EXPLAINING THAT MIGHT BE A LITTLE MORE DIFFICULT!

To do any drug calculation you need to know 3 things, turn over to find out what these are!

There is one simple rule that will enable you to calculate **ANY** dose on **ANY** drug, however unfamiliar.

To do any drug calculation you need to know 3 things:

1	What has the doctor prescribed?	-	What do you **WANT?**
2	What dose is available?	-	What do you **HAVE?**
3	How is the dose 'packaged'?	-	What is the **AMOUNT?**

In the previous example:

The doctor prescribed 600mg aspirin	-	You **WANT** 600mg
The available dose is 300mg	-	Your **HAVE** 300mg
The package is 1 tablet	-	The **AMOUNT** is 1 tablet

Lets look at another example

Prescribed 170mg Aminophylline injection

Aminophylline is available as ampoules of 250mg in 10ml

Remember the 3 things we need to know -

Prescribed 170mg Aminophylline	-	You **WANT** 170mg
The available dose is 250mg	-	You **HAVE** 250mg
The package is 10ml	-	The **AMOUNT** is 10ml

Turn over the page to look at the simple rule that will allow you to calculate the correct dose

THE RULE

DOSE = WANT X AMOUNT

HAVE

Work out examples 1 and 2 using the rule and write your answers below:

Example 1

The doctor prescribed 600mg aspirin	-	You **WANT** 600mg
The available dose is 300mg	-	You **HAVE** 300mg
The package is 1 tablet	-	The **AMOUNT** is 1 tablet

YOUR CALCULATIONS:

Example 2

Prescribed 170mg Aminophylline	-	You **WANT** 170mg
The available dose is 250mg	-	You **HAVE** 250mg
The package is 10ml	-	The **AMOUNT** is 10ml

Your Calculations:

ANSWERS TO EXAMPLES 1 AND 2

Example 1

The doctor prescribed 600mg of Aspirin	-	**WANT**	**=**	600mg
The aspirin tablets contain 300mg	-	**HAVE**	**=**	300mg
The 'package is 1 tablet'	-	**AMOUNT**	**=**	1 Tablet

The **RULE** gives:

DOSE = WANT X AMOUNT
HAVE

= 600mg X 1 tablet
300mg

= 2 tablets

Example: Calculation of the volume of injection containing the required dose.

Prescribed 170mg Aminophylline	-	**WANT**	=	170mg
The ampoules contain 250mg	-	**HAVE**	=	250mg
The 'package' is 10ml	-	**AMOUNT**	=	10ml

The **RULE** gives:

DOSE = WANT X AMOUNT
HAVE

= 170mg X 10ml
250mg

= 6.8ml

Turn over to have a look at two checks that you can do

Let's take the previous example a stage further.

There are 2 simple checks that you can do on your calculations to help satisfy yourself that you have a 'sensible' answer.

DOSE = $\frac{170mg}{250mg}$ X 10ml

1st CHECK: cancel the units

DOSE = $\frac{170\cancel{mg}}{250\cancel{mg}}$ x 10ml

This check ensures that you do not confuse the **'HAVE'** and the **'AMOUNT'**. Notice also that the unit left, ml, is the unit of the answer.

Then we continue:

DOSE = $\frac{170}{250}$ X 10ml

= $\frac{1700}{250}$

= 6.8ml

2nd CHECK: Compare the prescription with the ampoule

Since 170mg is less than 250mg the answer must be less than 10ml

Turn over to look at an example that you can work out for yourself

Calculation of the volume of injection containing the required dose.

You are required to give a patient 250mg of Clarithromycin intravenously. You have 500mg vial that should be reconstituted with 10ml of water for injections

How much of the reconstituted solution are you required to give?

YOUR CALCULATIONS

Now turn over to check your calculations and answer

ANSWER

Prescribed 250mg Clarithromycin	**-**	**WANT**	**=**	**250mg**
The vial contains 500mg	**-**	**HAVE**	**=**	**500mg**
The 'package' is 10ml	**-**	**AMOUNT**	**=**	**10ml**

The RULE gives:

$$\text{DOSE} = \frac{\text{WANT}}{\text{HAVE}} \times \text{AMOUNT}$$

$$= \frac{250\text{mg}}{500\text{mg}} \times 10\text{ml}$$

$$= 5\text{ml}$$

Turn over now to look at the next type of drug calculation that you may be asked to calculate.

Calculation of Flow Rate

i.e. Calculation of flow rate in ml/hr where the dose is given as mg (or micrograms)/min.

Example 1

Calculate the rate of infusion required to give patient Glycerin Trinitrate infusion at 10 micrograms/minute. You have prepared a syringe containing 50mg in 50ml.

Begin by changing dose/min to dose/hr by multiplying by 60

DOSE per hour	**=**	**10 micrograms x 60**
	=	**600 micrograms**
	=	**0.6 mg**

Now use your **RULE**

The doctor prescribed Glycerine Trinitrate - Infusion at 10 micrograms/min (0.6mg/hr) — You **WANT** 0.6mg

The available dose is 50mg — You **HAVE** 50mg

The package is 50ml — The **AMOUNT** is 50ml

The **RULE** gives:

DOSE (ml/ hr)	**=**	**WANT X AMOUNT / HAVE**
	=	**0.6mg x 50ml / 50mg**
	=	**0.6ml/hr**

Turn over to remind yourself of the 2 checks

Lets now carry out the 2 checks we have now learned about.

DOSE	**=**	**0.6mg X 50ml**
(ml/hr)		**50mg**
1st CHECK:		**Cancel the units**
	=	**0.6~~mg~~ X 50ml**
		50~~mg~~

This check ensures that you do not confuse the **'HAVE'** and the **'AMOUNT'**. Notice also that the unit left, ml, is the unit of the answer.

Then we continue:

DOSE	**=**	**0.6 X 50ml**
(ml/hr)		**50**
	=	**30** **50**
	=	**0.6ml/hr**

2nd CHECK: Compare the prescription with the prepared syringe

Since the dose you **WANT** is less than the dose you **HAVE** the answer must be less than one (i.e. the numerator is less than the denominator)

Turn over to look at an example that you can work out for yourself.

Example 2

Calculation of flow rate in ml/hr where dose is given as mg (or micrograms)/min.

Calculate the rate of infusion required to give a patient GlycerineTrinitrate infusion at 15 micrograms/minute. You have prepared a syringe containing 50mg in 50ml.

Your Calculations

Now turn over to check your calculations and answer

ANSWER

Begin by changing dose/minute to dose/hour by multiplying by 60

Dose per hour = 15 micrograms X 60

= 900 micrograms

= 0.9mg

Now use your RULE

The doctor prescribed Glycerine Trinitrate infusion at 15 micrograms/min (0.9mg/hr) — You **WANT** 0.9mg

The available dose is 50mg — You **HAVE** 50mg

The 'package' is 50ml — The **AMOUNT** is 50ml

The RULE gives:

DOSE (ml/hr) = WANT X AMOUNT
HAVE

= $\frac{0.9\cancel{mg}}{50\cancel{mg}}$ X 50ml

= $\frac{45}{50}$

= 0.9ml/hr

N.B.

Since the dose you **WANT** is less than the dose you **HAVE** the answer must be less than one
(i.e. the numerator is less than the denominator)

Calculation of Flow Rate when including Patient's body weight.

Calculation of flow rate ml/hr when dose is given as mg (or micrograms)/kg/min.

Example 1

Calculate the rate of infusion required to give a patient (weight 70kg) Dobutamine infusion at ***5micrograms/kg/min (WANT)***

You have prepared a syringe containing ***250mg (HAVE)*** in ***50ml (AMOUNT)***

Step 1

First workout what you ***WANT***,

Now working from ***left*** to ***right*** workout the answer in three simple steps

5micrograms/kg/min

1. 5micrograms x 70kg (Patients body weight) = 350micrograms
2. 350micrograms x 60 (60mins in 1 hr) = 21,000micrograms
3. 21,000micrograms Divide by 1,000 = 21miligrams.

Now you have what you,

WANT = 21mg (From step 1)

HAVE = 250mg (Drug in syringe)

AMOUNT = 50ml (Volume of syringe)

$$\text{DOSE (ml/hr)} = \frac{\text{WANT} \times \text{AMOUNT}}{\text{HAVE}}$$

$$= \frac{21\text{mg} \times 50\text{ml}}{250\text{mg}}$$

$$= \frac{1050}{250}$$

= 4.2ml/hr

Turn over to see the checks being carried out on these calculations.

Application of CHECKS to previous example.

$$\text{DOSE (ml/hr)} = \frac{21\text{mg} \times 50\text{ml}}{250\text{mg}}$$

1st CHECK: Cancel the units

$$\text{DOSE} = \frac{21 \times 50\text{ml}}{250}$$

This check ensures that you do not confuse the HAVE and the AMOUNT. Notice also that the unit left is that of the answer.

Continue:

$$\text{DOSE (ml/hr)} = \frac{21 \times 50}{250}$$

$$= \frac{1050}{250}$$

$$= 4.2\text{ml/hr.}$$

2nd CHECK: Compare the prescription with the prepared syringe.

Since 21mg is less than 250mg the answer must be less than 50ml.

Now turn over to work out an example for yourself.

Example 2

Calculation of flow rate ml/hr when dose is given as mg (or micrograms)/kg/min.

Calculate the rate of infusion required to give a patient (weight 65kg) Dopamine infusion at 10 micrograms/kg/min. You have prepared a syringe containing 200mg in 50ml.

Your Calculations

Turn over to check your calculations and answer.

ANSWER

Begin by changing dose/min to dose/hour by multiplying by 60.

DOSE per Hour = 10 micrograms x 60 minutes

= 600micrograms

= 0.6mg/hr.

First calculate what you WANT

Since the patient weighs 65kg and the doctor orders 0.6mg/kg/hr we must multiply 65 x 0.6 to get WANT

Then continue as before: WANT = 39mg
HAVE = 200mg
AMOUNT = 50ml

DOSE (ml/hr) = $\frac{\text{WANT}}{\text{HAVE}} \times \text{AMOUNT}$

= $\frac{39\text{mg}}{200\text{mg}} \times 50\text{ml}$

= 9.75ml/hr.

Displacement Value (DV)

This describes the volume the dry powder in a vial takes up, when diluted.

This has importance when less than the whole vial is needed for the prescribed dose, and is particularly significant when administering drugs to neonates, paediatrics or the elderly.

Example

You are required to give a patient 200mg of Amoxicillin intravenously. You have 250mg vial that should be reconstituted with 10ml of water for injections. Amoxicillin has a displacement value (DV) of 0.4ml.

How much of the reconstituted solution are you required to give?

Example 1

Prescribed Amoxicillin 200mg	WANT	=	200mg
The vial contains Amoxicillin 250mg	HAVE	=	250mg
The package is 10.4ml (10ml + displacement of 0.4ml)	AMOUNT	=	10.4ml

Use the Rule

$$\text{Dose(ml)} = \frac{\text{WANT}}{\text{HAVE}} \times \text{AMOUNT}$$

$$= \frac{200\text{mg}}{250\text{mg}} \times 10.4\text{ml}$$

$$= \frac{2080}{250}$$

$$= 8.32\text{ml}$$

This volume would be difficult to draw up and not accurate, therefore example 2 is another way that the Amoxicillin could be prepared.

Example 2

9.6ml of water for injection to be added to vial to compensate for the 0.4ml displacement value (DV) of Amoxicillin.

Prescribed Amoxicillin 200mg	WANT	=	200mg
The vial contains Amoxicillin 250mg	HAVE	=	250mg
The package is 10ml	AMOUNT	=	10ml

Use the Rule

$$\text{Dose(ml)} = \frac{\text{WANT}}{\text{HAVE}} \times \text{AMOUNT}$$

$$= \frac{200\text{mg}}{250\text{mg}} \times 10\text{ml}$$

$$= 8\text{ml}$$

The dose required in this example is a lot easier to draw up.

Example 3

You are required to give a patient 800mg of Ceftazidime intravenously. You have 1000mg vial, which should be reconstituted with 10ml of water for injections. 1000mg Ceftazidime has a displacement value (DV) of 0.5ml.

How much of the reconstituted solution are you required to give?

Your Calculation

ANSWER

Displacement value (DV) is 0.5ml

So: 10ml (Water) + 0.5ml (DV) = 10.5ml

Prescribed Ceftazidime 800mg	WANT	=	800mg
The vial contains Ceftazidime 1000mg	HAVE	=	1000mg
The package is 10ml (10ml + 0.5ml)	AMOUNT	=	10.5ml

Use the Rule

$$\text{Dose (ml)} = \frac{\text{WANT}}{\text{HAVE}} \times \text{AMOUNT}$$

$$= \frac{800\text{mg}}{1000\text{mg}} \times 10.5\text{ml}$$

= 8.4ml

Or

10ml (Water) – 0.5ml (DV) = 9.5ml

Therefore 9.5ml of water for injection should be added to the vial to compensate for the 0.5ml displacement value (DV) of the Ceftazidime.

Prescribed Ceftazidime 800mg	WANT	=	800mg
The vial contains Ceftazidime 1000mg	HAVE	=	1000mg
The package is 10ml (9.5ml + 0.5ml)	AMOUNT	=	10ml

Use the Rule

$$\text{Dose (ml)} = \frac{\text{WANT}}{\text{HAVE}} \times \text{AMOUNT}$$

$$= \frac{800\text{mg}}{1000\text{mg}} \times 10\text{ml}$$

= 8ml

Pump Assisted Infusion

When a very precise control of the rate at which a fluid is infused is required then an infusion pump should be used ideally any volume with drug added should be infused via an infusion pump. However infusion pumps are not calculators and it is important to know how to use them.

Once the calculation has been made the results can then be entered into the pump along with the infusion fluid volume

Calculating the flow rate

Example**,**

$$\text{Flow Rate} = \frac{\text{Total Volume (ml)}}{\text{Duration (Hrs)}}$$

If you want to infuse 500ml of Sodium Chloride 0.9% over 6 hours what would you set the pump rate at?

Total volume to be infused = 500ml
Duration of infusion = 6 hours

$$\frac{500\text{ml}}{6\text{hrs}} = 83.33\text{ml}$$

The rate is therefore 83ml/Hr (Remember round to the nearest whole number)

Now turn over the page and try a couple of examples

Example 1

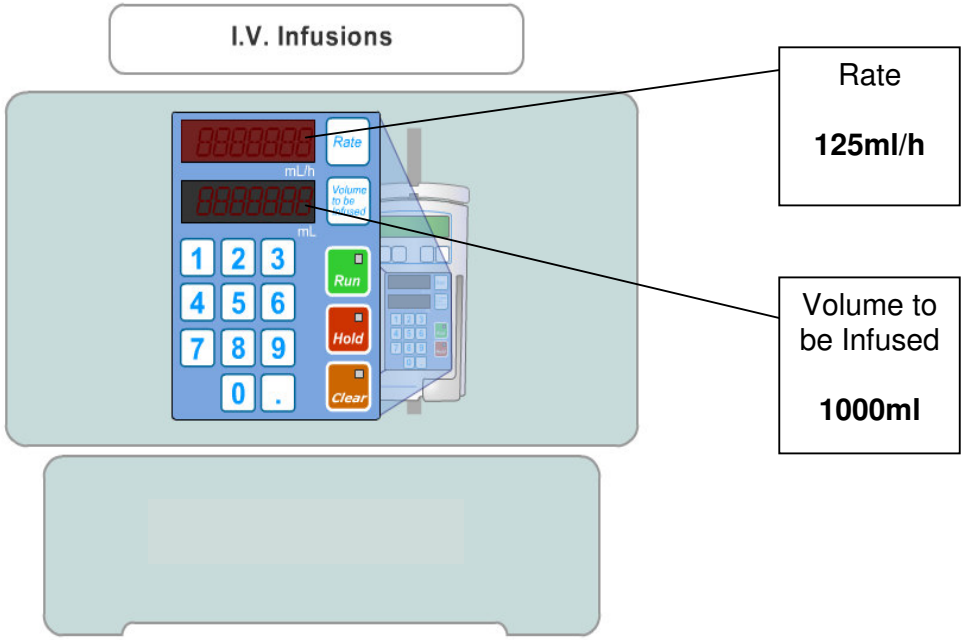
You are required to infuse 1000ml of Sodium chloride 0.9% over 8 hours through and infusion pump, what will the pump rate be set at?

Flow rate = $\frac{\text{Total volume (ml)}}{\text{Duration (Hrs)}}$

Total volume = 1000ml
Duration = 8 Hrs

$\frac{1000\text{ml}}{8\text{Hrs}} = 125\text{ml}$

Therefore the pump rate should be set at 125mls/Hr, and total infusion volume would be 1000ml.

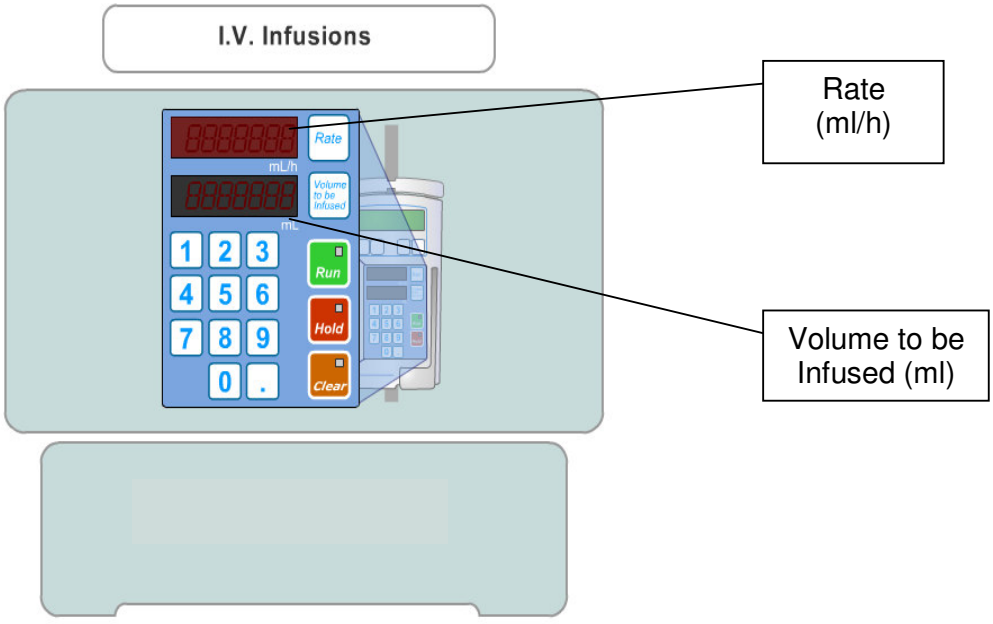


Turn over the page and try an example for yourself.

Example

You are required to infuse 250mls of Glucose 5% over 4 hours, what would you have to set the pump rate at?

Your Calculation



Answer over the page

Answer

You had to infuse 250ml of Glucose 5% over 4 Hours

Flow rate = $\frac{\text{Total volume (ml)}}{\text{Duration (hrs)}}$

Total volume = 250ml
Duration = 4 Hrs

$\frac{250\text{ml}}{4\text{Hrs}}$ = 62.5ml, or 63ml/Hr (rounded to the nearest whole number)

Gravity Assisted Infusions - Drop Rates

The last section we learned to calculate the infusion rate for a pump. To set up a manually controlled infusion accurately by eye, you need to be able to count the number of drops per minute. To do this, you have to work out the volume to be infused in terms of drops. This in turn depends upon the giving or administration set being used

Giving sets, there are two types:

- **The standard giving set (SGS) which has a drip rate of 20 drops/ml** – for clear fluids (glucose or saline).

- **The blood giving set which has a drip rate of 15 drops/ml.**

The drip rate of the giving set is always written on the wrapper if you are not sure.

In all drip rate calculations, you have to remember that you are simply converting a volume to drops (or vice versa) and hours to minutes.

Drop Rate Equation

$$\text{Drops/min} = \frac{\text{Total volume of infusion(mL) X Drops/mL of giving set}}{\text{IV fluid administration time duration (minutes)}}$$

Example

You are required to give a 1000ml of sodium chloride 0.9% to a patient over 8hrs.

What drip rate is required using a standard giving set at 20 drops/ml to administer this fluid to the patent?

Step 1

First convert the number of drops. To do this multiply the volume of the infusion (1000ml) by the number of drops /ml of the giving set (standard giving set 20drops/ml).

1000(ml) x 20 (drops) = 20,000 drops

It takes 20,000 drops to infuse 1000ml of sodium chloride 0.9% using the 20 drops/min giving set.

Step 2

Now convert hours to minutes. To do this multiply the number of hours the infusion is to be given by 60 (60minutes =1 hour). In this case the infusion is to be given over 8 hours.

8 hours = 8 x 60 = 480 minutes

Now we have converted everything to drops and minutes. This is all we need to work out our final answer.

Step 3

To remind yourself, write down what you have just calculated in the previous two steps.

20,000 drops in 1000ml sodium chloride 0.9%.

480 minutes = eight hours

Step 4

Now you can calculate the number of drops per minute by dividing the number of drops by the number of minutes

$$\frac{\textbf{Number of drops}}{\textbf{Number of minutes}} = \textbf{drops/min}$$

$$\frac{\textbf{20,000 drops}}{\textbf{480 min}} = \textbf{41.67 drops/min or 42 drops/min}$$

Round up or down to the nearest whole number e.g.

If the answer is 41.67 drops/min round up to 42 drops/min

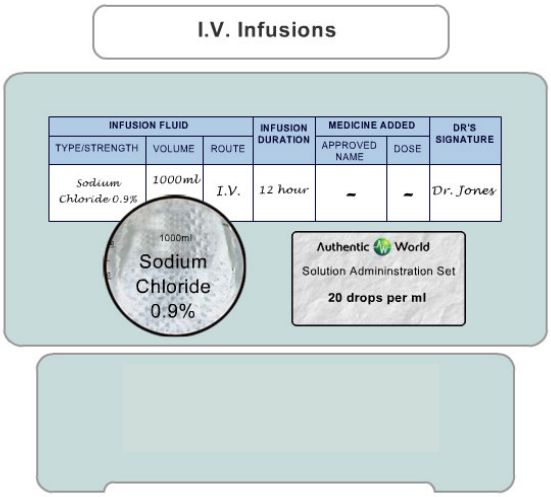
If the answer is 41.33 drops/min round down to 41 drops/min

Answer

So to give 1000ml of sodium chloride 0.9% over 8 hours the drop rate will have to be 42 drops/min using a standard giving set of 20 drops/ml.

Turn over and try some examples yourself

Example 1



You are asked to administer 1000ml of sodium chloride 0.9% infusion over 12 hours. Work out the drip rate in drops/min using a standard administration set with a drop rate of 20 drops/ml.

Your calculations

Turn over to check your calculations and answer.

Answer

Using the formula work out the answer

This time we have,

- Giving set = 20 drops/ml.
- Volume of the infusion = 1000ml.
- Number of hours infusion has to run = 12 hours.

THE FORMULA

$$\text{Drops/min} = \frac{\text{Total volume of infusion(mL) X Drops/mL of giving set}}{\text{IV fluid administration time duration (minutes)}}$$

$$\text{Drops/min} = \frac{1000\text{ml} \times 20\text{ drops/ml}}{12\text{hrs} \times 60\text{ min}}$$

$$= \frac{20{,}000\text{ drops}}{720\text{ min}}$$

$$= 27.77$$

$$= 28\text{ drops/min (round up)}$$

Example 2

You are asked to administer 500ml of sodium chloride 0.9% infusion over 4 hours. Work out the drip rate in drops/min using a standard administration set with a drop rate of 20 drops/ml.

Your calculations

Turn over to check you calculations and answer

Answer

Using the formula work out the answer

This time we have,

- Giving set = 20 drops/ml.
- Volume of the infusion = 500ml.
- Number of hours infusion has to run = 4 hours.

THE FORMULA

$$\text{Drops/min} = \frac{\text{Total volume of infusion(mL) X Drops/mL of giving set}}{\text{IV fluid administration time duration (minutes)}}$$

$$\text{Drops/min} = \frac{500\text{ml} \times 20\text{ drops/ml}}{4\text{hrs} \times 60\text{ min}}$$

$$= \frac{10{,}000\text{ drops}}{240\text{ min}}$$

$$= 41.67$$

= 42 drops/min (round up)

You have now worked your way this far through your package, learning how to apply your rule to various examples and then having a go at working out an example for yourself.

Over the page are a series of questions and a case study that you should attempt, referring back to previous examples in the book when necessary

You have now worked your way this far through your package, learning how to apply your rule to various examples and then having a go at working out an example for yourself.

Over the page are a series of questions and a case study that you should attempt, referring back to previous examples in the book when necessary.

GOOD LUCK !

CALCULATION EXERCISES

(1) You wish to give a patient 200mg of Gentamicin intravenously. The ampoules available contain 80mg in 2ml. What volume are you required to withdraw (in ml) to prepare your infusion?

(2) You have been asked to prepare a syringe of Isosorbide Dinitrate. The doctor has prescribed this infusion to initially run at 100 micrograms per min.

(a) Calculate the dose of Isosorbide Dinitrate the patient should receive per hour (in mg/hr)?

(b) You have already prepared a syringe at a concentration of 25mg in 50ml, calculate the rate (in ml/hr) that this dose is equivalent to?

(3) A patient is prescribed a Heparin infusion of 50,000units in 50ml.

The Heparin stock on the ward is 5ml vials of 5000units/ml

(a) What volume (in ml) from the stock on the ward would you be required to use to prepare the 50ml syringe?

(b) The doctor has prescribed this Heparin infusion to run at 2000units/hr. Using your prepared syringe of Heparin 50,000u in 50ml, what rate (in ml/hr) would your infusion run at?

(4) A 65kg patient is prescribed dopamine 2.4microgram/kg/min for 10 hours. A 5ml dopamine ampoule contains 40mg/ml. What volume (in ml) is required to treat this patient?

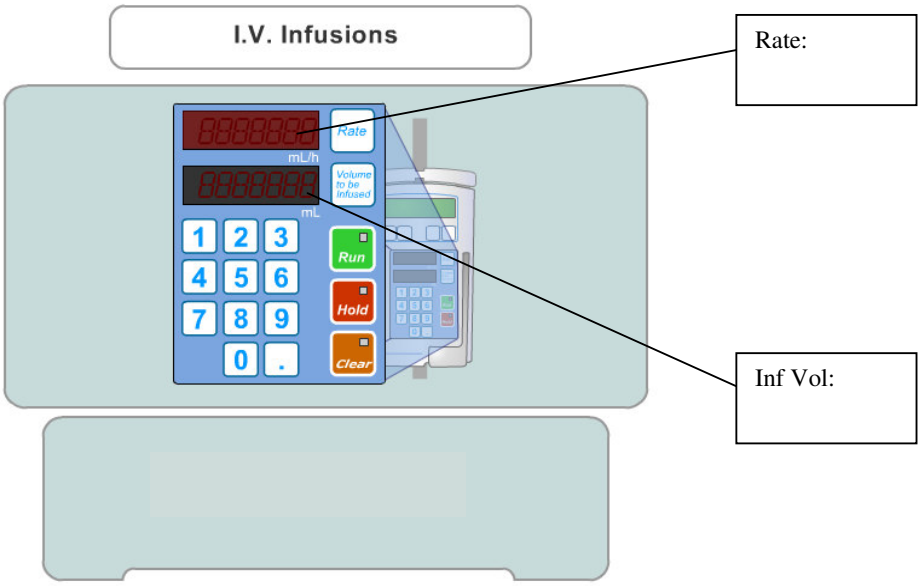
(5) You are required to give a patient with eclampsia an infusion of 3g Magnesium Sulphate every four hours. What volume of Magnesium Sulphate 50% w/v injection would you need to add to infusion bag to make one dose?
(Each ampoule of Magnesium Sulphate 50% injection is 2ml in volume)

(6) At a cardiac arrest you are required to draw up 1mg of Adrenaline into a syringe. What volume (in ml) of adrenaline 1 in 10,000 is required?

(7) Amoxicillin 1g injection should be reconstituted with 19.2ml of water to give a final volume of 20ml.

How much of this solution would you require to give a dose of 850mg?

(8) (a) You are required to administer by infusion pump 1000mls of Sodium chloride 0.9% over 8 hours, what would the flow rate be ml/hr?



(b) To administer this infusion by gravity feed, calculate the drip rate for this infusion using a standard giving set of 20drops per ml.

YOU WILL FIND THE ANSWERS OVER THE PAGE

CALCULATION ANSWERS

1. Volume required = $\frac{200mg}{80mg} \times 2ml$

= **5ml**

2.(a) 100 micrograms in 1 minute

Begin by changing dose per minute to dose per hour by multiplying by 60.

DOSE per hour = 100 x 60

= 6000 micrograms/hr

= **6mg/hr**

(b) The syringe contains 25mg in 50ml

DOSE (ml/hr) = $\frac{WANT}{HAVE} \times AMOUNT$

= $\frac{6mg}{25mg} \times 50ml$

= $\frac{300}{25}$

= **12ml/hr**

3.(a) VOLUME(ml) = $\frac{WANT}{HAVE} \times AMOUNT$

= $\frac{50,000u}{5,000u} \times 1ml$

= **10ml**

3.(b) Prepared syringe = 50,000u in 50ml

WANT = 2000ml/hr

DOSE(ml/hr) = $\frac{\text{WANT}}{\text{HAVE}} \times \text{AMOUNT}$

= $\frac{2000}{50{,}000} \times 50\text{ml}$

= **2ml/hr**

4. Begin by calculating total mg required.

DOSE per hour = 2.4 x 60 = 144mcg

DOSE for 65kg = 144 x 65 = $\frac{9360}{1000}$mcg = 9.36mg

DOSE for 10 hours = 9.36 x 10 = 93.6mg

DOSE (ml/hr) = $\frac{\text{WANT}}{\text{HAVE}} \times \text{AMOUNT}$

= $\frac{93.6\text{mg}}{40\text{mg}} \times 1\text{ml}$

= $\frac{93.6}{40}$

= **2.34ml**

5. Begin by converting the percentage to mg per ml.

Magnesium Sulphate 50% injection contains - 50g in 100ml

= 5g in 10ml

= 0.5g in 1ml

DOSE (ml) = $\frac{\text{WANT}}{\text{HAVE}} \times \text{AMOUNT}$

= $\frac{3\text{g}}{1\text{g}} \times 2\text{ml}$

= $\frac{6}{1}$

= **6ml**

6. Begin by converting the ratio to grams per ml.

Adrenaline 1:10,000 = 1g in 10,000ml

= 1000mg in 10,000ml

= 100mg in 1000ml

= 10mg in 100ml

= **1mg in 10ml**

7. Volume required = $\frac{850mg}{1000mg} \times 20ml$

= 17mls

8. Pump Rate = $\frac{1000ml}{8Hrs}$

= 125ml\Hr

b. Drop rate = $\frac{1000ml \times 20 \text{ drops\ml}}{480 \text{ mins}}$

= $\frac{20000drops}{480mins}$

= 41.6drops\min

= 42drops\min (rounded to nearest whole number)

IV CALCULATION FLOW CHART