South Tees Hospitals NHS
NHS Foundation Trust

Drug Calculations Workbook

Drug Calculations Workbook
Registered nurses & Operating department practitioners

Introduction

Practitioners administering medicines must be aware of their own accountability within a framework of legislation and professional regulation and guidance.

- The Code (NMC 2015)
- Professional guidance on the safe and secure handling of medicines (2018)
- The Health and Care Professional Council (2016) Standards of conduct, performance and ethics for allied health professional
- The Health and Care Professional Council (2014) Consultation on proposed profession-specific standards of proficiency for operating department practitioners

A golden rule of any calculation that you have to carry out is to have some idea of what a sensible answer should be (Hutton 2005).

Numeracy Skills

Weights

When administering drugs the amounts given to patients are relatively small. Doses are often measured in grams, milligrams and sometimes nanograms.

Converting Units

To convert big to little: Multiply.
To convert little to big: Divide:

From	To	Do This
Kilograms	grams	Multiply by1000
Grams	milligrams	
Milligrams	micrograms	
Micrograms	nanograms	
Nanograms	micrograms	Divide by 1000
Micrograms	milligrams	
Milligrams	grams	
Grams	kilograms	

To change grams to milligrams x **by 1000 (**OR **move the decimal point 3 places to the RIGHT)**

eg: 1.0g = 1000 milligrams
4.2g = 4200 milligrams
0.07g = 70 milligrams

To change milligrams to grams (g) ÷ by 1000 (OR **move the decimal place 3 points to the LEFT)**

eg: 100milligrams = 0.1g
62,000milligrams = 62g
35milligrams = 0.035g

These calculations demonstrate this**:**

500 milligrams	=	500/1000	=	0.5 grams
1250 micrograms	=	1250/1000	=	1.25 milligrams
0.25 grams	=	0.25 x 1000	=	250 milligrams
0.05 milligrams	=	0.05 x 1000	=	50 micrograms

Drug Calculations – Questions I

Please answer the following:

1. Convert 350 milligrams to grams
2. Convert 0.5g to milligrams
3. Convert 300 micrograms to milligrams
4. Convert 50 ml to litres
5. Convert 0.125g to milligrams

Dosage Calculations for Medication

Formula is:

The number of tablets = <u>What You Want</u>
What You've Got

eg. Patient is prescribed 120 milligrams of Verapamil, tablets available as 40 milligrams each.

<u>120 milligrams</u> = 3 tablets
40 milligrams

But suppose a patient is prescribed 1.5g of a drug that is available in 500 milligrams tablets. How many tablets do you give now?

A very important point about performing drug calculations is that the prescribed amount and the dose available must be in the same units. In this case we could either convert the 500 milligrams into grams, or we could convert the 1.5 grams into milligrams.

It is probably easier to convert the milligrams 1.5g is the same as 1500 milligrams. So the problem is now 1500 milligrams divided by 500 milligrams = **3 tablets**

Drug Calculations – Questions II

Please answer the following:

1. 500 milligrams is prescribed, tablets are 250 milligrams each: how many tablets will you give?

2. 50 milligrams is prescribed, tablets are 12.5 milligrams each: how many tablets will you give?

3. 1 milligram is prescribed, tablets are 500 micrograms: how many tablets will you give?

4. 625 milligrams prescribed, tablets are 1.25 g each: how many tablets will you give?

5. 3 tablets each contain 250 milligrams. What is the total dose in milligrams?

Drugs in Liquid Form

When drugs are in liquid form, the available dose is given in terms of the concentration of the solution or suspension. As an example, pethidine hydrochloride is available as 50milligrams/ml. This means that 50 milligrams of pethidine hydrochloride are dissolved in every millilitre of liquid.

The formula to be used is:

Volume Needed = What You Want x Volume it's in
What You've Got

e.g. A drug is available as 25 milligrams/ml and 75 milligrams are required. What volume would be given?

A. $\frac{75 \times 1}{25} = 3\text{ml}$

Drug Calculations – Questions III

Please answer the following:

1. An injection of morphine 8 milligrams is required. Ampoules available contain 10 milligrams in 1 ml. What volume is drawn up for injection?

2. Digoxin ampoules available contains 500 microgram in 2ml. What volume is needed when 350 microgram is prescribed

3. A patient is prescribed 250 milligrams of gentamicin by IV injection. Stock ampoules contain 80milligrams in 2 ml. What volume is needed for the injection?

4. A patient is to be given erythromycin 120 milligrams by injection. Stock vials contain 300 milligrams/10 ml. Calculate the required volume.

5. Stock heparin has strength of 5000 units per ml. What volume must be drawn up to give 6500 units?

6. A patient is to receive Frusemide 80mg IV, the preparation available is Frusemide 250mg in 25mls. Calculate the volume required.

7. A patient is prescribed bumetanide 0.8 milligrams IM. Stock ampoules contain 2 milligrams/4 ml. What volume would be drawn up

IV Drip Rates

The rate of flow down intravenous infusion lines must be regulated and this is often controlled by a device known as an infusion controller or volumetric pump.

A volumetric infusion pump receives fluid from a giving set. The pump has an adjustable ***rate*** of flow and converts fluid into very fine drops, within the machine before delivering the fluid to a patient.

An infusion pump can be accurately set and is designed to maintain a steady flow rate. However, the patient receiving the infusion must still be checked at regular intervals.

Flow Rate (When duration is given in HOURS)

$$\frac{\text{Volume in mLs}}{\text{Duration in hours}}$$

e.g. If a patient requires 250 ml in 6 hours, the flow rate is

$$\frac{250}{6} = 41.67 \text{ ml/hr}$$

Flow Rate (When duration is given in MINUTES)

$$\frac{\text{Volume in mLs}}{\text{Duration (in minutes)} \div 60 \text{ minutes}}$$

Example: A patient is to be given 100 ml of medication over 15 mins. What is the flow rate using an infusion pump? (It is advisable to work out Duration in Minutes divided by 60 first).

15 ÷ 60 =0.25.

100 ÷ 0.25 = 400 Therefore = run the infusion pump at **400 mLs / hour**

Drip Rate Formula

A drip chamber is part of a giving set or administration set. It has a ***fixed*** drop size and an adjustable rate of flow. There are four main types of giving set in general use- these break fluid into either 10, 15, 20 or 60 drops per ml (drop factor).

$$\text{Drip Rate} = \frac{\text{Volume needed (in mLs) x Drop Factor (No. of drops per ml delivered by the set)}}{\text{Duration of the Infusion (in Minutes)}}$$

If a patient is to be given 500 ml by Intravenous Infusion (IVI) using a drip factor of 20 drops/ml over 6 hours

(it is advisable to convert hours to minutes first)

Therefore 6x 60= 360 minutes

Drop rate = $\frac{500 \times 20}{360} =$ 27.77 or 28 drops/min to nearest decimal place

Calculations – Questions IV

Please answer the following:

Drip Rates

1. A patient is to receive half a litre of dextrose 5% over 4 hours. The giving set delivers 20 drops/ml. Calculate the required drip rate in drops/min

2. If a patient is to be given 750ml by IVI using giving set with a drip factor of 20 drops/ml over 12 hours, what would you set the drip rate to (round to the nearest number)?

3. 750ml of normal saline is to be given to a patient over 9 hours using a giving set which emits 10 drops/ml. Calculate the required drip rate in drops per min.

4. 300 mls of blood is to be transfused over 4 hours using an administration set which gives 10 drops/ml. Calculate the drip rate in drops/min

Flow Rates

5. A patient requires 1000 mls in 12 hours what is the **flow rate**.

6. 500 mls of Hartman's solution is to be given to a patient over 7 hours. What is the flow rate?

7. Over the next 15 hours, a patient is to receive 2 litres of dextrose 5%. What is the flow rate?

8. A patient is to receive 500 ml of normal saline. The drip chamber is adjusted to deliver 25 ml/h. How long will the fluid last?

9. A patient is to receive half a litre of fluid IV over 6 hours using an infusion pump. At what rate (in ml/h) should the pump be set?

10. Calculate the required flow rate of an infusion pump-one litre of fluid to be given over 4 hours.

Drug Calculation – Question V

The formula to calculate the concentrations of drug per ml

$$\frac{\textbf{Amount of Drug (in grams/milligrams/units etc)}}{\textbf{Volume of Solution}}$$

Example: Midazolam 5 milligrams is drawn up in 5 mls

What is the concentration of midazolam per ml?

$$\frac{\textbf{5 (milligrams)}}{\textbf{5 (mls)}} = \textbf{1} \quad \textbf{(Answer is 1mg/ml)}$$

1. Morphine is supplied in a syringe containing 20 milligrams of Morphine in 50 mls of solution. What is the concentration (milligrams/ per ml) of morphine in the syringe?

2. The drug Aminophylline is supplied in a syringe containing 500 milligrams of Aminophylline in 50 ml of solution. What is the concentration (milligrams/ per ml) of Aminophylline in the syringe?

3. Heparin is supplied in a syringe containing 10,000 units of Heparin in 50 ml of solution. What is the concentration (milligrams/ per ml) of heparin?

4. Insulin is supplied in a bag containing 50 units of Regular Insulin in 100 ml of solution What is the concentration (units/ per ml) of insulin in the bag?

Mixed Bag of Questions

Please answer the following:

1. Calculate the volume to be given when the prescribed dose is penicillin 500 milligrams and dose available is syrup 125/5 ml

2. Calculate the volume to be given when the prescribed dose is chloramphenicol 750 milligrams, and the available dose is a suspension of 125 milligrams/5 ml

3. An infusion pump is to be used to give 1 litre of fluid over 11 hours. At what rate should the pump be set?

4. Aminophylline 0.5 milligrams/kg/hr is prescribed for an 80 kg man; 500 milligrams in 500 ml infusion is prepared. At what rate should the infusion run (in ml/hr.)?

5. A patient is to receive a litre of Hartmann's solution over 12 hours. Calculate the drip rate if the administration set gives 15 drops/ml

6. A patient is to be given 180 milligrams of paracetamol. Stock elixir contains 120 milligrams/5 ml. Calculate the volume to be given orally.

7. A patient is prescribed penicillin 400 milligrams orally. Stock syrup has strength of 125 milligrams/5 ml. Calculate the volume of mixture to be given.

8. A patient weighing 70kg is prescribed Acetylcysteine 150mg/kg in 200mLs of 5% Dextrose. The ampules available are 2g in 10mls. What volume of Acetylcysteine must be added to the 200ml bag?

9. A patient is ordered erythromycin 800 milligrams, stock available is a mixture 125 milligrams/5 ml. Calculate the volume to be given.

10. How much morphine must be drawn up for a 10 milligrams dose if a stock ampoule contains 15 milligrams in 1ml.

11. Digoxin ampoules on hand contain 500 microgram in 2ml. What volume is needed for an injection of 275 microgram?

12. A patient weighing 45kg is prescribed intravenous paracetamol 15 milligrams/kg. . How many milligrams of paracetamol are required?

13. Pethidine 85 milligrams is to be given IM. Stock ampoules contain pethidine 100 milligrams in 2 ml. Calculate the volume of stock required.

Answers to Drug Calculations – Questions I

1. Convert 350 milligrams to g — 0.35 g
2. Convert 0.5 g to milligrams — 500 milligrams
3. Convert 300 micrograms to milligrams — 0.3 milligrams
4. Convert 50 ml to litres — 0.05 litre
5. Convert 0.125 g to milligrams — 125 mg

Answers to Drug Calculations – Questions II

1. 500milligrams is prescribed, tablets are 250 milligrams each: how many will you give? 2
2. 50 milligrams is prescribed, tablets are 12.5 milligrams each: how many will you give? 4
3. 1 milligram is prescribed, tablets are 500 micrograms: how many tablets will you give? 2
4. 625 milligrams prescribed, tablets are 1.25 g each: how many will you give?
   = Half a tablet
5. 3 tablets each contain 250 milligrams. What is the total dose in milligrams?
   = 750 milligrams

Answers to Drug Calculations – Questions III

1. An injection of morphine 8 milligrams is required. Ampoules on hand contain 10 milligrams in 1 ml. What volume is drawn up for injection? 0.8 ml
2. Digoxin ampoules on hand contain 500 microgram in 2 ml. What volume is needed to give 350 microgram? 1.4 ml
3. A patient is prescribed 250 milligrams of gentamicin by IV injection. Stock ampoules contain 80 milligrams in 2 ml. What volume is needed for the injection? 6.25 ml
4. A patient is to be given erythromycin 120 milligrams by injection. Stock vials contain 300 milligrams/10 ml. Calculate the required volume. 4 ml
5. Stock heparin has strength of 5000 units per ml. What volume must be drawn up to give 6500units? 1.3 ml
6. A patient is to receive Frusemide 80mg IV, available is Frusemide 250mg in 25mls. Calculate the volume required. 8ml
7. A patient is prescribed bumetanide 0.8 milligrams IM. Stock ampoules contain 2 milligrams/4 ml. What volume would be drawn up? 1.6 ml

Answers to Drug Calculations – Questions IV

1. A patient is to receive half a litre of dextrose 5% over 4 hours. The giving set delivers 20 drops/ml. Calculate the required drip rate in drops/min

   42 drops/min
   500 ml x 20 drops/ml
   4h x 60
   = 500x20 = 125 drops/min = 41 and 2/3rds = 42 drops minutes
   4x60 3

2. If a patient is to be given 750 ml by IVI using a controller with a drip factor of 20 drops/ml over 12 hours, what would you set the drip rate to (round to the nearest number)

   = 20x750 = 20.88 = 21 drops/min
   12x 60

3. 750 ml of normal saline is to be given to a patient over 9 hours using giving set which emits 10 drops/ml. Calculate the required drip rate in drops per min.

   = 10x 750 = 13.88 = 14drops/min
   9x60

4. 300 mls of blood is to be transfused over 4 hours using an administration set which gives 10 drops/ml. Calculate the drip rate in drops/min

   = 10x300 = 13 drops/min
   4x 60

Flow rates

5. If a patient requires 1000 mls in 12 hours what is the **flow rate** (give your answers to two decimal places)

   = 1000 = 83.333 = 83 mls/hr
   12

6. 500 mls of Hartmann's solution is to be given to a patient over 7 hours. What is the flow rate?

   = 500/7 = 71ml/hr

7. Over the next 15 hours, a patient is to receive 2 litres of dextrose 5%, what is the flow rate?

   = 15/2000 = 133ml/hr.

8. A patient is to receive 500 ml of normal saline. The drip chamber is adjusted to deliver 25 ml/h. How long will the fluid last?

= 500/25 = 20hrs

9. A patient is to receive half a litre of fluid IV over 6 hours using an infusion pump. At what rate (in ml/h) should the pump be set?

   = 500/6 = 83.3333ml/hrs. = 83 mls

10. Calculate the required flow rate of an infusion pump- one litre of fluid to be given over 4 hours

    = 1000/4 = 250 mls/hr

Answers to Question V

1. Morphine is supplied in a syringe containing 20 milligrams of Morphine in 50 mls of solution. What is the concentration (milligrams/ per ml) of morphine in the syringe?

   = 20 milligrams/50 mls = 0.4 milligrams in 1 ml

2. The drug Aminophylline is supplied in a syringe containing 500 milligrams of Aminophylline in 50 ml of solution. What is the concentration (milligrams/ per ml) of Aminophylline in the syringe?

   = 500 milligrams/ 50mls = 10 milligrams in 1ml.

3. Heparin is supplied in a syringe containing 10,000 units of Heparin in 50 ml of solution. What is the concentration (milligrams/ per ml) of heparin?

   = 10,000 units/ 50mls = 200 units in 1ml.

4. Insulin is supplied in a bag containing 50 units of Regular Insulin in 100 ml of solution. What is the concentration (units/ per ml) of insulin in the bag?

   = 50 units /100 mLs= 0.5units in 1ml

Answers to Mixed Bag of Questions

1. Calculate the volume to be given: ordered penicillin 500 milligrams, on hand syrup 125/5 ml

   = 20 ml

2. Calculate the volume to be given: ordered chloramphenicol 750 milligrams, on hand suspension 125/5 ml

   = 30 ml

3. An infusion pump is to be used to give 1 litre of fluid over 11 hours. At what rate should the pump be set?

= 1000/11 = 91 mls

4. Aminophylline 0.5 milligrams/kg/hr is prescribed for an 80 kg man; 500 milligrams in 500 ml infusion is prepared. At what rate should the infusion run (in ml/hr.)?

   To find the dose required = 0.5 (mg) x patient weight (kg)
   = 0.5mg x 80 = 40mg
   Available Aminophylline is 500mg in 500 mLs = 1mg in a mL

   To find rate = $\frac{40 \times 500 \text{ mL}}{500}$ **OR** $\frac{40\text{mg} \times 1\text{ml}}{1\text{mg}}$ = 40mLs/hour

5. A patient is to receive a litre of Hartman's solution over 12 hours. Calculate the drip rate if the administration set gives 15 drops/ml

   = 15 x 1000/ 12 x 60 = 20.8333 = 21 drops/min

6. A patient is to be given 180 milligrams of paracetamol. Stock elixir contains 120 milligrams/5 ml. Calculate the volume to be given orally.

   = 180x5/120 = 7.5mls

7. A patient is prescribed penicillin 400 milligrams orally. Stock syrup has strength of 125 milligrams/5 ml. Calculate the volume of mixture to be given.

   = 400x5/125 = 16 ml

8. A patient weighing 70kg is prescribed Acetylcysteine 150mg/kg in 200mL of 5% Dextrose. Ampules available are 2gram in 10mls. What volume of Acetylcysteine should be added to the 200ml bag?

   First calculate the required dose (weight in kg x dose per kg)
   = 70 x 150 = 10500 mg
   Then convert the total dose into grams = (10500/1000) = 10.5grams
   Then calculate the volume required use formula ($\frac{\text{what you want}}{\text{what you have got}} \times \text{mLs}$)

   = $\frac{10.5 \text{ grams}}{2 \text{ grams}} \times 10 \text{ mLs}$ = 52.5 mLs

9. A patient is ordered erythromycin 800 milligrams, on hand mixture 125 milligrams/5 ml calculate the volume to be given

   = 800x5/125 = 32 mls

10. How much morphine must be drawn up for a 10milligrams dose if a stock ampoule contains 15 milligrams in 1 ml?

    = 10x1/15 = 0.666, therefore 0.67mls

11. Digoxin ampoules on hand contain 500 microgram in 2 ml. What volume is needed for an injection of 275 microgram?

    = 275x2/500 = 1.1 ml

12. A patient weighing 45kg is prescribed intravenous paracetamol 15 milligrams/kg. . How many milligrams of paracetamol are required?

    = 15milligrams x 45kgs = 675mg

13. Pethidine 85 milligrams is to be given IM. Stock ampoules contain pethidine 100 milligrams in 2 ml. Calculate the volume of stock required.

    = 1.7 ml

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