East Suffolk and North Essex NHS Foundation Trust

DRUG CALCULATIONS WORKBOOK

A Programmed Approach

- All Registered Nurses are required to undertake a drug calculation test as part of the trust's recruitment process.
- This workbook is to help you prepare for this test. It is recommended that you read and work through this workbook prior to your drug calculation test.
- This pack provides you with all the information & formulae needed to answers questions in the test
- The test comprises of 10 questions, which cover a variety of drug calculations
- You will be given 30 minutes in which to complete the test
- Calculators can be used
- You must achieve 100% to pass the test

Introduction

Registered Nurses (RN) are increasingly required to perform complex, mathematical, drug-related calculations.

This package is designed to assist the nurse to become competent in making drug calculations and can also be used as a reference guide.

A) Conversion of milligrams and micrograms

Drug dosage is generally given in grams (g) or fractions of a gram, milligrams (mg) or micrograms (mcg):

1g = 1000mg
1mg = 1000mcg

Therefore, to convert grams to milligrams, you MULTIPLY by 1000: milligrams to micrograms MULTIPLY by 1000. Conversely, to change from micrograms to milligrams DIVIDE by 1000, and milligrams to grams DIVIDE by 1000.

Thus, to MULTIPLY by 1000, the decimal point must be moved 3 places to the right.

Example: Digoxin 0.25mg = 250mcg

To DIVIDE by 1000, the decimal point must be moved 3 places to the left:

Example: Aspirin 300mg = 0.3g

Now try these examples:

Questions
1. Digoxin 0.0625mg How many micrograms?
2. Digoxin 125mcg How many milligrams?
3. Paracetamol 0.5g How many milligrams?
4. Thyroxine 0.05mg How many micrograms?

B) Drug dosage

For some drugs the dosage required is calculated on a body weight basis. Body weight is measured in kilograms (kg) and so this dose is usually quoted as mg per **kg.**

Therefore, for an individual patient, dosage required is obtained by MULTIPLYING the number of milligrams by that patient's weight.

Example: 70kg man is to have gentamicin 2mg per kg.
Dose required: 70 x 2 = 140mg

Now try these examples:

Questions
5. An 85kg patient requires Lorazepam 25mcg/kg. How many mcg?
6. 45kg woman requires gentamicin 2mg/kg. How many mg?

C) Calculating drip rates

Fluids are generally administered via a volumetric pump and you will only be required to calculate an hourly rate. For example: The prescription states 1000ml 0.9% Saline over 8 hours- 1000 divided by 8 = 125mls per hour.
However you may be required to administer fluids gravity fed (without a volumetric pump) so it is essential you understand how to calculate drip rates which can be in done I two ways:

Method 1

A standard IV giving set administers 20 drops per ml.

Blood giving sets administer 15 drops per ml of blood.

The formula to work out drop per minute is: -

$$\frac{\text{ml per hour}}{\text{Minutes per hour (60)}} \times \text{drops per ml} = \text{drops per minute}$$

Example: We have 1 litre of 5% Glucose which is prescribed over 8 hours

Work out the number of ml per hour = I litre i.e. 1000 ml divided by 8= 125 ml per hour

$$\frac{125}{60} \times 20 = 42 \text{ drops per minute}$$

Or 300 ml of blood is to be given over 3 hours. I.e. 300 divided by 3 =100

$$\frac{100}{60} \times 15 = 25 \text{ drops per minute}$$

Method 2

You may find this is an easier method using the Drop Rate Denominator (DRD)

The most common DRD you will use are:
20 drops per ml= 3 DRD Standard IV fluids
15 drops per ml= 4 DRD Blood products

<u>Volume (mls)</u> ÷ drop rate denominator = drops per minute
Hours

Example: We have 1 litre of 5% Glucose which is prescribed over 8 hours

1000÷8= 125mls/hr
125÷3 DRD= 41.6 or 42 drops per minute.

***O**r* 300 ml of blood is to be given over 3 hours.

300÷3=100mls/hr
100÷4= 25 drops perm minute.

Now try these examples via both methods:

Questions
7. 1 litre bag of Compound Hartman's Solution is to be infused over 12hours. How many drops per minute is this?
8. 300mls of blood is to be infused over 2 hours. How many drops per minutes is this?

D) Drug Concentration

i) mg per ml

There are various ways of quoting the strength of drugs in liquid solutions for oral or parenteral administration. The most usual way is by the number of *mg* of drug per *ml* of liquid, i.e. mg/ml. The formula for making such calculations is thus:

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

Example: We want to give 30mg of a syrup containing 25mg in 5ml:

$$\text{Volume needed} = \frac{30\text{mg}}{25} \times 5\text{ml}$$

So, to give a patient 30mg, we must give 6ml.

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

Now try these examples:

Questions
9. Amitriptyline syrup 25mg in 5ml. Patient prescribed 20mg, How many ml?
10. Pethidine injection 100mg in 2ml. Patient prescribed 75mg. How many ml?
11. Gentamicin injection is 80mg in 2ml. Patient prescribed 20mg. How many ml?

(ii) Percentage concentration

Drug concentration may also be measured as percentage % (w/v). Percentage means the number of grams of drug dissolved in *100ml* solution, i.e. *g* per *100ml*. This is irrespective of the size of the vial or bottle of fluid: e.g. Dextrose 5% infusions means that there are 5 grams of Dextrose dissolved in each 100ml of fluid, and this will remain the same if we have a 500ml infusion bag or a 1 litre infusion bag.

Thus, if we had to give a patient 25g of Dextrose, we would use the same formula as before:

$$\frac{\overset{5}{\cancel{25}}}{\underset{1}{\cancel{5}}} \times 100 = 500\text{ml}$$

Therefore, we would have to give 500ml of fluid.

Now try these examples:

Questions
12. Calcium Chloride 10% injection in a 10ml ampoule. How much is needed for a patient prescribed 2g?
13. Dextrose 50% injection in a 25ml vial. Patient prescribed 20g. How many ml?

(iii) One in ….. concentration

This final type of concentration method is used only occasionally, e.g. tuberculin, adrenaline. 1 is stated as 1 in 100, 1 in 10,000, etc, and means grams in ml.

Thus: 1 in 100 means 1g in 100ml

1 in 1000 means 1g in 1000ml

1 in 10,000 means 1g in 10,000ml

Therefore, it can be seen that 1 in 1000 is a WEAKER strength that 1 in 100, and 1 in 10,000 is WEAKER than 1 in 1000.

Example: We want to give 1mg tuberculin using 1 in 1000 strength solution.

$$\frac{\text{What you want}}{\text{What you've got}} \times \text{Volume its in}$$

$$\frac{1}{\underset{1}{\cancel{1000}}} \times \overset{1}{1000} = 1\text{ml}$$

Now try these examples:

Questions
14. Give 1mg of epinephrine using the 1 in 10,000 solution.
15. Give 5mg tuberculin using 1 in 100 solution.

E) Calculating the rate of infusion pumps

An infusion my be prescribed as a total volume of fluid to run over a specified time in hours e.g. 1000ml Sodium Chloride 0.9% to be infused over 10 hours. Most infusion pumps are set in ml / hour, so you will need to establish what rate per hour is required.

Total volume of fluid required	÷	Number of hours to be infused over	=	ml per hour required

Example: The prescription reads 1000ml of 5% Dextrose to be infused over 8 hours. At what rate should you set the pump?

1000 ml	÷	8 hours	=	125 ml/hr

An infusion may also be prescribed as a dose in a given amount of fluid to run at ‘x’ mg / hour e.g. 50mg Pethidine in 50mls of Sodium Chloride 0.9% to run at 4mg / hour. Most infusion pumps are set in ml / hour so you need to establish what rate is required.

Dose of drug you want / Dose of drug you’ve got	x	Total volume of drug	=	ml per hour required

Example: The prescription reads 100mg of morphine in 50ml of water to run a 5mg / hour. At what rate should you set the pump?

$$\frac{5mg}{100mg} \times 50mls = 2.5ml/hr$$

Now try these examples:

Questions
16. The prescription reads 50 units of insulin in 50ml 0.9% sodium chloride to run at 2 units per hour. What rate will you set the pump?
17. You have 50mg of GTN in 50ml total volume. You want to give 0.6mg/hr. What rate will you set the pump?

Ensure you translate both sides of the equation into the same units of measurement

F) Calculations related to body weight

A number of drugs such as Aminophylline are calculated according to patient’s body weight.

Example:
An infusion of Aminophylline is to run at 500mcg per kg per hour. The patient weighs 70kg. The drug is to be diluted in 1 litre of N/saline. The drug comes as 720mg. At what rate should the pump be set?

Apply the formula:

Dose of drug you want / Dose of drug you’ve got	X	Total volume of drug	=	ml per hour required

Step 1

The dose we *want* is 500mcg/ kg / hour =

$$\frac{500 \times 70 \times 1 \text{ (Dose x weight x hour)}}{\text{Dose of drug you've got}} = 35000mcg$$

Step 2

The dose we *have* is 720mg or 720000mcg
Remember; translate both sides of the equation into the same units.

Step 3

$$\frac{\underline{35000mcg}}{720000mcg} \quad X \quad \begin{matrix}1000ml \\ (N/saline)\end{matrix} \quad = \quad 48.6ml / hour$$

So, to summaries your equation will look like this:

$$\frac{500x70 \times 1}{720000} \quad X \quad 1000ml \quad = \quad 48.6ml / hour$$

G) Further infusions rates, which are weight related

A number of drugs such as inotropes, which may have a profound effect on the patient's cardiovascular status, are often prescribed in relation to body weight to prevent potential overdose. As a result, they are prescribed as:
mcg per kg per minute (mcg / kg / min)

Example:

An infusion of 200mg of dopamine in 50mls of 5% glucose is to run at 3mcg / kg / min. The patient weighs 80kg. At what rate should the pump be set?

Apply the formula:

$$\frac{\text{Dose of drug you want}}{\text{Dose of drug you've got}} \quad X \quad \text{Total volume of drug} \quad = \quad \text{ml per hour required}$$

Step 1

The dose we *want* is 3mcg / kg / minute =

$$\frac{3 \times 80 \times 60 \text{ (Dose x weight x min)}}{\text{Dose of drug you have got}} \quad = \quad 14400mcg$$

Step 2

The dose we *have* is 200mg or 200000mcg
Remember; translate both sides of the equation into the same units.

Step 3

$$\frac{14400mcg}{200000mcg} \quad X \quad 50ml \quad = \quad 3.6ml / hour$$

So, to summaries your equation will look like this:

$$\frac{3 \times 80 \times 60}{200000} \quad X \quad 50 \quad = \quad 3.6ml / hour$$

Now try these examples:

Question
18. A 60kg patient is to have 10mcg / kg / min of Dobutamine. Dobutamine is prescribed as 250mg in 250ml. What rate will you set the pump?
19. A 80kg man is prescribed 3mcg / kg / min of Dopamine. The Dopamine is to be made up as 800mg in 500ml. What rate will you set the pump?

Remember:
Ensure you translate both sides of the equation into the same units of measurement

(I) The Drug Calculation Test Paper

This consists of 10 questions, which you are required to answer within half an hour.
Four questions have been listed below to help prepare you for the format of the test paper.

These are just examples of questions you may come across in the test paper.

Answer sheet

1. **0.0625mg=62.5mcg**
2. **125mcg=0.125mg**
3. **0.5g=500mg**
4. **0.05mg=50mcg**
5. **85x25= 2125mcg (2.125mg)**
6. **45x2= 90mg**

7. **1000 ÷ 12 hrs= 83.3mls per hour**
   83.3 ÷60 x 20 = 27.7 or 28 drops per minute.
   OR
   1000
8. **300 ÷2 = 150mls/hr**
   150 ÷ 60 x 15= 37.5mls or 38 drops per minute.
9. **20 ÷ 25 x 5 = 4mls**

10. **75 ÷ 100 x 2 = 1.5mls**

11. **20 ÷80 x 2 = 0.5mls**

12. **10% = 10g in 100mls**
    2 ÷10 x 100= 20mls

13. **50% = 50g in 100mls**
    20 ÷50 x 100 = 40mls

14. **1 in 10000**
    = 1g in 10,000 ml
    = 1000mg in 10,000 ml
    1 ÷1000 x 10,000 = 10ml

15. **1 in 100**
    = 1g in 100ml
    =1000mg in 100ml
    5 ÷1000 x 100 = 0.5ml

16. **2 ÷50 x 50 = 2mls per hour**

17. **0.6 ÷50mg x 50 = 0.6mls per hour.**

18. **10mcg x 60kg x 60 mins = 36000**

    250mg x 1000 = 250,000mcg
    3600 ÷ 250,000 x 250mls = 36mls per hour.

19. **3mcg x 80kg x 60 mins = 14400**
    800mg x 1000 = 800,000 mcg
    14400 ÷ 800,000 x 500ml = 9mls per hour.