Pharmaceutical calculations in pharmacy practice

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Each pharmacist must be competent in these calculations for patient care and safety. Some of the necessary calculations are discussed below. Aliquot method: This method allows the pharmacist to carry out measurements of powders or liquids at the time of the acceptable error (usually 5%). The method is based on knowledge of the balance sensitivity requirement (powders) or the deviation value of the measuring device (for liquids). This, in turn, makes it possible to calculate the minimum level at a predetermined error rate. Density factor (DF): Determination of the density factor is necessary to accurately prepare the candles in the pharmacy. It is defined as the weight of the drug in grams, which occupies the same volume as 1 g of base (usually cocoa butter). The lab method of the paddock is often used to determine the DF value. Miequivalent (mEq): the concept of mill equivalent refers to ions in a solution. When edi interact with each other in a solution, they do so, 1 equivalent weight 1 equivalent weight. For example, 1 equivalent calcium weight always reacts with 1 equivalent chloride weight in the solution. Otherwise, 20 g of calcium reacts with 35,5 g chloride to form $CaCl_2$. Note that calcium chloride weighs 2 equivalent to each calcium and chloride (containing 40 g of calcium and 71 g of chloride). Milligrams per cent (mg %): This unit of concentration is similar to % w/v, except that it expresses the number of milligrams of the product in a 100 ml preparation. Molality (m): If the drug solution is labelled as 1 m, it means that the solution contains 1 mole of drug per kilogram of solvent. For example, a pharmacist added 3 g of sucrose (342.3 g/mol) to 100 g of water. Commission 201 solution can be labelled as 0.09 molal. [(3 g) × (1000 g/kg)/(342,3 g/mol) × (100 g)] Molarity (M): It is defined as the number of moles of the drug one liter of solution. For a hydrochloric acid solution with a concentration of 1 M, one mole of HCl is contained in each litre solution. [(100 ml) × (36.5 g)/(1000 ml)=3.65 g] Normality (N): these units of concentration are based on the number of grams of medicinal product equivalents in a single litre solution. Normality is associated with molarity with the following equation. [Molarity = (Valence) × Normality] For example, sulphuric acid valence is 2 equivalents/mole. Thus, the 1 M sulphuric acid solution is 2 N (or 2 equivalent/l). Since one equivalent sulphuric acid weight is [(98 g/mol)/(2 equivalents/mol)=49 g), the 2 N solution contains (2 × 49 g=98 g sulphuric acid/l). Share per million (ppm): This unit of concentration is designed for solutions that include ions in a much diluted form. It is defined as the number of parts of the dissolved solution in one million part of the solution. If the water is a solvent (density = 1 g/ml), part per million refers to the number of grams of dissolved solution per million ml of solution. Suppose the patient needs a solution containing 5 ppm fluoride ion (19 g/mole). During the preparation of this solution, the pharmacist may use sodium fluoride (42 g/mol). The amount of NaF required for 1 litre of solution is 11 mg (containing 5 mg/l fluoride ions). Percentage by volume (%v/v): This unit of concentration determines the number of millilitres of the medicinal product found in 100 ml of the solution. If the pharmaceutical solution is labelled as 4% (%v/v) of glycerol, i.e. it contains 4 ml of glycerol in each 100 ml preparation. If the pharmacist measures 20 ml of this solution using a graduated cylinder, he should expect to have 0,8 ml of glycerol in that volume. This calculation is also performed in proportion [(20 ml) × (4 ml)/ (100 ml)=0.8 ml]. Percent by weight (%w/w): This is the number of grams of drug gifts in 100 g of preparation. For example, 2% salicylic acid ointment contains 2 g of salicylic acid in each 100 g. One ounce of ointment (30 g) is 0,6 g of salicylic acid. This shall be done on a pro rata basis [(30 g) × (2 g)/(100 g)=0,6 g]. Percentage by volume (% w/v): For liquid formulations, this concentration unit describes the number of grams of the medicine available in each 100 ml preparation. If the syrup preparation is labelled as 50% sucrose (% w/v), it shall contain 50 g of sucrose in each 100 ml syrup. When a pharmacist uses this preparation to sweeten the elixir, he can take a volume of 5 ml of the syrup obtained and add it to 95 ml of elixir Assuming that the volume is an additive (100 ml of total volume), the amount of sucrose in the final composition is 2,5 g. It is calculated from a ratio [(5 ml) (50 g)/(100 ml)=2,5 g]. If the sucrose concentration in the final amount of elixir in w/v is to be indicated, this shall be indicated as 2,5 %. Hydrophile Lipophile Balance System (HLB): The HLB system is a way to perform emulsion-related calculations. In this system, HLB values are assigned to emulsifiers and oils/oil-like substances. As a general rule, the HLB values for more hydrophilic compounds are higher than 10 and the HLB values for lipophilic materials are 10 or lower. The system uses the appropriate technique when selecting the best emulsifying agent for the emulsion, simply matching the required value of oil phase HLB with the emulsifier value. If no exact compliance is found, the pharmacist shall use two emulsifiers with their proportions in the final case of emulsion, determined by alligation calculations. Tonicity Correction Calculations: There are four different methods for calculations to adjust the tonicity solution. All of these methods depend on the principle of collimation properties solutions. The tonic of the solutions is improved by the addition of an inert substance, usually sodium chloride or boric acid. The first method is based on the knowledge of the freezing point of the adjusted solution. The second method depends on the value of a parameter called sodium chloride equivalent (E). The E value allows the pharmacist to convert the amount of any medicinal product into a solution to its osmotic equivalent in sodium chloride solution. The third and fourth methods are also based on E-value. They allow the pharmacist to dilute the amount of product with the calculated amount of water to perform the initial isotonic solution, followed by diluting the resulting solution with another isotonic solution (saline solution) to the desired final volume of the product. The concentration units that characterise the tonic of the solutions are osmolarity and osmolality. They are similar in molarity and molality, respectively, except for replacing the number of moles in the solution with the number of osmals. Sodium chloride chloride is 2 osmoles, as 1 NaCl molecule produces 2 ions in water after complete dissociation. The saltphysiological solution is often referred to as 308 mOsmol/l, because the concentration of NaCl in the solution is 154 mEq/l (using the equation-[mOsmol/L=(mEq/L) × (Number of ions created)/(Valence)=(154 mEq/L) × 2/ (1 Equivalent/mol)=308)] [1-4]. In general, pharmaceutical calculations are extremely important for a practising pharmacist to accurately prepare and dispense formulations for patients. The application of appropriate calculations and methods to the operation of a pharmacy serves as an essential component of the provision of pharmaceutical care. Reference Al-Achi Gupta MR, Stagner WC (2013) Integrated pharmacy: applied reformulation, product design and normative science. Wiley, NJ, USA. Allen LV (2016) Pharmaceutical mixture art, science and technology. American Pharmacists Association, DC, USA. Amiji, MM, Cook TJ, Mobley WC (2014) Applied Physical Pharmacy. McGraw-Hill Education/Medical. Shrewsbury RP (2015) Applied pharmacy in the form of modern mixtures. Morton Publishing Judith Rees - Senior Lecturer, School of Pharmacy, Keele University; Ian Smith – Lecturer in Pharmacy Practice, Keele University; Jennie Watson – Boots Teacher Practitioner, University of Central Lancashire Introduction to Pharmaceutical Calculations is your comprehensive guide to successfully performing pharmaceutical calculations. Now in its fourth edition, this popular book covers everything you need to know to pass these all important pharmacy calculation exams. Each chapter contains learning objectives, examples and role models and is fully updated. Brand new features include: Introduction (including expert advice on approaching calculations) Dosages for children 8 short videos (to help you understand some key concepts) that include: Simple Dilution Proportional Sets Of Conversion Units Concentration Mixing Two Concentrations Without End Volume Transfer Values Parenteral Doses Moles More Images and Diagrams Written by experienced pharmacy trainers and teacher, this book will help you address all sorts of pharmaceutical calculations and is ideal for both students and pre-regs. We recommend using it in conjunction with a companion in the Pharmaceutical Calculations Workbook to practice and improve your calculation skills. Good luck to your exams! Save money by buying our special calculation package. Videos that demonstrate calculation concepts can be viewed with a book password. Introduction Rational numbers Unit system Concentration Dilutions Formulations Dose calculation Dosages for children Density, volume volume and displacement values Calculations related to molecular weight Parenteral solutions and isotonicity Measurement accuracy Calculations related to the retrieval of information Annex 1: Metric precepts Appendix 2: Appendix 3: Multiplication and division factor Appendix 4: Atomic element weight Appendix 5: Body surface area for children

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