**IQRA NATIONAL UNIVERSITY**

**DEPARTMENT OF ALLIED HEALTH SCIENCES**

**Final-Term Examination (summer 2020)**

**Course Title: Basic Lab Calculation (MLT 1st) Instructor: Mr Adnan Ahmad**

**Max Marks: 50**

1. How to prepare solution by using parts and percent concentration?
2. Define basic unit, derived units, suspension, ionic solution and super saturated solution.
3. Write a note on dilution ratio and concentration of dilution with example.
4. How to calculate serial dilutions?
5. Explain pH and pOH with scale and examples.

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BS MLT SEC A

PAPER: BASIC LAB CALCULATION

SIR ADNAN

ANS 1:

solution

**Solutions** are homogeneous mixtures containing one or more **solutes** in a **solvent**. The solvent that makes up most of the solution, whereas a solute is the substance that is dissolved inside the solvent.

Now we are going to finds the concentration of the solution by the two ways

1. Part
2. percentage

Dilute Concentrations Units

Sometimes when solutions are too dilute, their percentage concentrations are too low. So, instead of using really low percentage concentrations such as 0.00001% or 0.000000001%, we choose another way to express the concentrations. This next way of expressing concentrations is similar to cooking recipes. For example, a recipe may tell you to use 1 part sugar, 10 parts water. As you know, this allows you to use amounts such as 1 cup sugar + 10 cups water in your equation. However, instead of using the recipe's "1 part per ten" amount, chemists often use *parts per million*, *parts per billion* or *parts per trillion* to describe dilute concentrations.

* **Parts per Million**: A concentration of a solution that contained 1 g solute and 1000000 mL solution (same as 1 mg solute and 1 L solution) would create a very small percentage concentration. Because a solution like this would be so dilute, the density of the solution is well approximated by the density of the solvent; for water that is 1 g/mL (but would be different for different solvents). So, after doing the math and converting the milliliters of solution into grams of solution (assuming water is the solvent):

1 g solute1000000 mL solution×1 mL1 g=1 g solute1000000 g solution(4)(4)1 g solute1000000 mL solution×1 mL1 g=1 g solute1000000 g solution

We get (1 g solute)/(1000000 g solution). Because both the solute and the solution are both now expressed in terms of grams, it could now be said that the solute concentration is 1 part per million (ppm).

1 ppm=1 mg Solute1 L Solution(5)(5)1 ppm=1 mg Solute1 L Solution

The ppm unit can also be used in terms of volume/volume (v/v) instead (see example below).

* **Parts per Billion**: Parts per billion (ppb) is almost like ppm, except 1 ppb is 1000-fold more dilute than 1 ppm.

1 ppb=1μg Solute1 L Solution(6)(6)1 ppb=1μg Solute1 L Solution

* **Parts per Trillion**: Just like ppb, the idea behind parts per trillion (ppt) is similar to that of ppm. However, 1 ppt is 1000-fold more dilute than 1 ppb and 1000000-fold more dilute than 1 ppm.

1 ppt=1 ng Solute1 L Solution

PERCENTAGE CONCENRTATION

There are two types of [percent concentration](http://socratic.org/chemistry/solutions-and-their-behavior/percent-concentration): percent by mass and percent by volume.

**PERCENT BY MASS**

Percent by mass (m/m) is the mass of [solute](http://socratic.org/chemistry/solutions-and-their-behavior/solute) divided by the total mass of the solution, multiplied by 100 %.

Percent by mass = mass of solutetotal mass of solution × 100 %

**Example**

What is the percent by mass of a solution that contains 26.5 g of glucose in 500 g of solution?

Solution

Percent by mass =

mass of glucosetotal mass of solution×100%=26.5g500g × 100 % = 5.30

**PERCENT BY VOLUME**

Percent by volume (v/v) is the volume of solute divided by the total volume of the solution, multiplied by 100 %.

Percent by volume = volume of solutetotal volume of solution × 100 %

**Example**

How would you prepare 250 mL of 70 % (v/v) of rubbing alcohol

Solution

70 % = volume of rubbing alcoholtotal volume of solution×100% × 100 %

So

Volume of rubbing alcohol = volume of solution × 70 %100 % = 250 mL × 70100

= 175 mL

You would add enough water to 175 mL of rubbing alcohol to make a total of 250 mL of solution.

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ANS 2:

**SI base units**

The SI is founded on seven *SI base units* for seven *base quantities* assumed to be mutually independent, as given.

**Table 1.  SI base units**

| **Base quantity** | **Name** | **Symbol** |
| --- | --- | --- |
| length | meter | m |
| mass | kilogram | kg |
| time | second | s |
| electric current | ampere | A |
| thermodynamic temperature | kelvin | K |
| amount of substance | mole | mol |
| luminous intensity | candela | Cd |
|  |  |  |

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**SI derived units**

Other quantities, called*derived quantities*, are defined in terms of the seven base quantities via a system of quantity equations. The*SI derived units* for these derived quantities are obtained from these equations and the seven SI base units. Examples of such SI derived units are given in Table 2, where it should be noted that the symbol 1 for quantities of dimension 1 such as mass fraction is generally omitted.

|  |  |  |
| --- | --- | --- |
| **Table 2.  Examples of SI derived units** | | |
|  | **SI derived unit** | |
| **Derived quantity** | **Name** | **Symbol** |
| Area | square meter | m2 |
| volume | cubic meter | m3 |
| speed, velocity | meter per second | m/s |
| acceleration | meter per second squared | m/s2 |
| wave number | reciprocal meter | m-1 |
| mass density | kilogram per cubic meter | kg/m3 |
| specific volume | cubic meter per kilogram | m3/kg |
| current density | ampere per square meter | A/m2 |
| magnetic field strength | ampere per meter | A/m |
| amount-of-substance concentration | mole per cubic meter | mol/m3 |
| luminance | candela per square meter | cd/m2 |
| mass fraction | kilogram per kilogram, which may be represented by the number 1 | kg/kg = 1 |

### Suspensions

A **suspension** is a mixture of liquids with particles of a solid which may not dissolve in the liquid.

* The solid may be separated from the liquid by leaving it to stand, or by filtration

#### Examples

* sand in water

Ionic compounds

are [compounds](https://www.chemicool.com/definition/compound.html) consisting of [ions](https://www.chemicool.com/definition/ion.html).

Two-element compounds are usually ionic when one [element](https://www.chemicool.com/definition/element.html) is a metal and the other is a non-metal.

Examples include:

* sodium chloride: NaCl, with Na+ and Cl- ions
* lithium nitride: Li3N, with Li+ and N3- ions
* magnesium oxide: MgO, with Mg2+ and O2- ions
* calcium phosphide: Ca3P2, with Ca2+ and P3- ions

Ionic compounds can be more complicated than the two-element ones listed above. Examples of polyatomic ionic compounds include

**supersaturated solution**

A **supersaturated solution**is a solution that contains more than the maximum amount of solute that is capable of being dissolved at a given temperature. The recrystallization of the excess dissolved solute in a supersaturated solution can be initiated by the addition of a tiny crystal of solute, called a seed crystal. The seed crystal provides a nucleation site on which the excess dissolved crystals can begin to grow. Recrystallization from a supersaturated solution is typically very fast.

Example can be

A supersaturated solution is a more solute solution than can be dissolved by the solvent. If you haven’t learned what a solute / solvent is, the material that is dissolved in the solution, such as salts but not restricted to salts, is a solution. The most popular example is sodium acetate which is supersaturated.

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ANS 3:

**Dilution ratio**

In [chemistry](https://en.wikipedia.org/wiki/Chemistry) and [biology](https://en.wikipedia.org/wiki/Biology), the **dilution ratio** is the ratio of solute to solvent. It is often used for *simple dilutions,* one in which a unit volume of a liquid material of interest is combined with an appropriate volume of a solvent liquid to achieve the desired concentration. The diluted material must be thoroughly mixed to achieve the true dilution.

For example, in a 1:5 dilution, with a 1:5 dilution ratio, entails combining 1 unit volume of solute (the material to be diluted) with 5 unit volumes of the solvent to give 6 total units of total volume.

DIFFERENCE

This is often confused with "dilution factor" which is an expression which describes the ratio of the aliquot volume to the final volume. Dilution factor is a notation often used in commercial assays.

CONCENTRATION OF DILUTION

 If a worker trying to find the dilution, a worker will need to change the concentration of a solution by changing the amount of solvent. Dilution is the addition of solvent, which decreases the concentration of the solute in the solution. Concentration is the removal of solvent, which increases the concentration of the solute in the solution. (Do not confuse the two uses of the word concentration here!)

In both dilution and concentration, the amount of solute stays the same. This gives us a way to calculate what the new solution volume must be for the desired concentration of solute. From the definition of molarity,

molarity = moles of solute / liters of solution

we can solve for the number of moles of solute:

moles of solute = (molarity)(liters of solution)

A simpler way of writing this is to use M to represent molarity and V to represent volume. So the equation becomes

moles of solute = MV

Because this quantity does not change before and after the change in concentration, the product MV must be the same before and after the concentration change. Using numbers to represent the initial and final conditions, we have

M1V1 = M2V2

as the dilution equation. The volumes must be expressed in the same units. Note that this equation gives only the initial and final conditions, not the amount of the change. The amount of change is determined by subtraction.

EXAMPLE

If the stock solution is 10.0% KCl and the final volume and concentration need to be 100 mL and 0.50%, respectively, then it is an easy calculation to determine how much stock solution to use:

(10%)V1 = (0.50%)(100 mL)  
V1 = 5 mL

Of course, the addition of the stock solution affects the total volume of the diluted solution, but the final concentration is likely close enough even for medical purposes.

Medical and pharmaceutical personnel are constantly dealing with dosages that require concentration measurements and dilutions. It is an important responsibility: calculating the wrong dose can be useless, harmful, or even fatal.

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ANS 4:

SERIAL DILUTION

In serial dilution you multiply the original concentration by the dilution factors for each dilution.

#### Explanation:

A **serial dilution** is any dilution in which the concentration decreases by the same factor in each successive step.

In serial dilutions, you multiply the dilution factors for each step.

The dilution factor or the dilution is the initial volume divided by the final volume.

DF=ViVf

For example, if you add a 1 mL sample to 9 mL of diluent to get 10 mL of solution,

DF=ViVf = 1mL10mL=110. This is a 1:10 dilution.

**Example 1**

What is the dilution factor if you add 0.2 mL of a stock solution to 3.8 mL of diluents?

Vf = 0.2 mL + 3.8 mL = 4.0 mL

DF=ViVf = 0.2mL4.0mL=120. This is a 1:20 dilution.

**Example 2**

If you did the above dilution four times, what would be the final dilution factor?

**Solution 2**

Remember that serial dilutions are always made by taking a set quantity of the initial dilution and adding it successively to tubes with the same volume. So you multiply each successive dilution by the dilution factor.

You would transfer 0.2 mL from Tube 1 to 3.8 mL of diluents in Tube 2 and mix. Then transfer 0.2 mL from Tube 2 to 3.8 mL of diluents in Tube 3 and mix. Repeat the process until you have four tubes.

The dilution factor after four dilutions is

DF=120×120×120×120=1160000 = 1:160 000

If the concentration of the original stock solution was 100 µg/µL, the concentration in Tube 4 would be

100 µg/µL × 1160000 = 6.25 × 10⁻⁴ µg/µL

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ANS 5: pH AND pOH SCALE

**Introduction**

In aqueous solution, an acid is defined as any species that increases the concentration of \text{H}^+(aq)H+(*aq*)start text, H, end text, start superscript, plus, end superscript, left parenthesis, a, q, right parenthesis, while a base increases the concentration of \text{OH}^-(aq)OH−(*aq*)start text, O, H, end text, start superscript, minus, end superscript, left parenthesis, a, q, right parenthesis. Typical concentrations of these ions in solution can be very small, and they also span a wide range.

### pH

pH is a measure of how acidic/basic water is. The range goes from 0 to 14, with 7 being neutral. pHs of less than 7 indicate acidity, whereas a pH of greater than 7 indicates a base. pH is really a measure of the relative amount of free hydrogen and hydroxyl ions in the water. Water that has more free hydrogen ions is acidic, whereas water that has more free hydroxyl ions is basic. Since pH can be affected by chemicals in the water, pH is an important indicator of water that is changing chemically

**The pH scale**

The **pH scale** is used to rank solutions in terms of acidity or basicity (alkalinity). Since the scale is based on pH values, it is logarithmic, meaning that a change of 1 pH unit corresponds to a ten-fold change in H^++start superscript, plus, end superscript ion concentration. The pH scale is often said to range from 0 to 14, and most solutions do fall within this range, although it’s possible to get a pH below 0 or above 14. Anything below 7.0 is acidic, and anything above 7.0 is alkaline, or basic.

pOH

pOH is a measure of hydroxide [ion](https://www.thoughtco.com/definition-of-ion-604535) (OH-) [concentration](https://www.thoughtco.com/definition-of-concentration-605844). It is used to express the [alkalinity](https://www.thoughtco.com/alkaline-definition-in-chemistry-606367) of a [solution](https://www.thoughtco.com/definition-of-solution-604650).

[Aqueous solutions](https://www.thoughtco.com/definition-of-aqueous-solution-604370) at 25 degrees Celcius with [pOH less than 7](https://www.thoughtco.com/poh-calculations-quick-review-606090) are alkaline, pOH greater than 7 are [acidic](https://www.thoughtco.com/definition-of-acid-and-examples-604358) and pOH equal to 7 are [neutral](https://www.thoughtco.com/definition-of-neutral-solution-604577).

## How to Calculate pOH

pOH is calculated based on pH or hydrogen ion concentration ([H+]). Hydroxide ion concentration and hydrogen ion concentration are related:

[OH-] = Kw / [H+]

Kw is the self-ionization constant of water. Taking the logarithm of both sides of the equation:

pOH = pKw - pH

An approximation is that:

pOH = 14 - pH

While the approximation works well in many settings, there are exceptions for which the pKw value should be used instead.

THE END

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