Welcome students.

Program name is Bachelor of Science, third year in the subject of chemistry, semester 5, paper code CHC 105, paper title physical chemistry.

The title of the unit is unit 2, quantum chemistry, module name is mathematical concepts - Exponential functions, module number 20.

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Outline of today's module. In this module we are going to see about the introduction to functions, types of functions, definition of exponential function, graph of exponential function, and applications of Exponential functions used in chemistry.

Learning outcomes, at the end of this module, the students will be able to understand functions and types of functions. The students will be able to plot a graph of exponential function. The students will be able to cite examples of exponential functions used in chemistry.

So coming to what are functions. In mathematics a function is an expression or a rule that defines a relationship between two or more variables that is independent variable and dependent variable. Functions are extensively used in mathematics and are essential for formulating physical relationships in the Sciences. So if a variable Y is so related to a variable X that whenever a numerical value is assigned to X there is a rule according to which a unique value of Y is determined and we say that Y is a function of the independent variable X. Now this relationship can be symbolized as Y is equal to F of X. Here X is known as the independent variable and Y is known as the dependent variable, which depends on the value of X. Besides F of X there are other abbreviations used for the functions like we can use G of X, H of X, P of X, etc.

There are various types of functions that we come across In mathematics such as polynomial functions, exponential functions, trigonometric functions, inverse trigonometric functions, and so on. In this module, we're going to deal with the exponential functions.

So what are exponential functions? An exponential function is an equation in which a variable occurs in the exponent. For example, y is equal to five raised to X is an exponential function because the exponent over here is the variable X. Whereas Y is equal to X raised to 5 is not an exponential function. Because the exponent over here is a number and not a variable. The general form of an exponential function is Y is equal to A into B raised to X. Here A & B are constants. And X & Y are variables. The constant A is known as the initial value and the constant B is known as the base value.

The value of B that is the base value has some restrictions. The constant B cannot be equal to 1 and it must be greater than zero. So if B is equal to 1 then Y is equal to A for all the values of X. Similarly, if B is

equal to 0, then Y will become equal to 0. Both this will give a straight line. If B is less than zero, then some values of X will result in values of Y that are not real. We will get a complex number, so the commonly used values of B are 10 and an exponential number, which is. Approximately equal to 2.718, which is a non terminating and non repeating number.

Here we can see the graph of an exponential function. If we plot a graph of exponential function versus X, we obtain a curve. So the exponential functions can be classified as exponential growth function and exponential decay function. Y is equal to e raised to X is an example of exponential growth function because the value of Y increases exponentially as the value of X increases. Similarly, Y is equal to e rasied to minus X Is an example of exponential decay function. This is because the value of Y decreases exponentially as the value of X increases. So in the figure the blue color graph represents the exponential growth function and the red color graph represents the exponential decay function.

Coming to the applications of exponential functions in chemistry, The radioactive decay in nuclear chemistry is the best known example of a process which is described by an exponential function. The number of radioactive nuclei present after time T is given by the equation. N is equal to N 0 into e raised to minus Lambda T. Here, N zero represents the number of radioactive nuclei initially present at time T is equal to 0. The constant Lambda is known as the radioactive decay constant.

Another example that I would like to cite over here is the Arrhenius equation that we use in chemical kinetics. Arrhenius equation gives the relationship between the rate constant K and the temperature. Arrhenius equation is given by. K is equal to A into e raised to minus Ea uppon R into T. Here K is the rate constant. Capital A is known as the arrhenius constant. EA is the activation energy. Capital R is the gas constant and capital T is the absolute temperature in Kelvin. So besides these two examples, there are many more examples. In chemistry, wherein the exponential function is used,

So here are the references for this material.

Thank you.