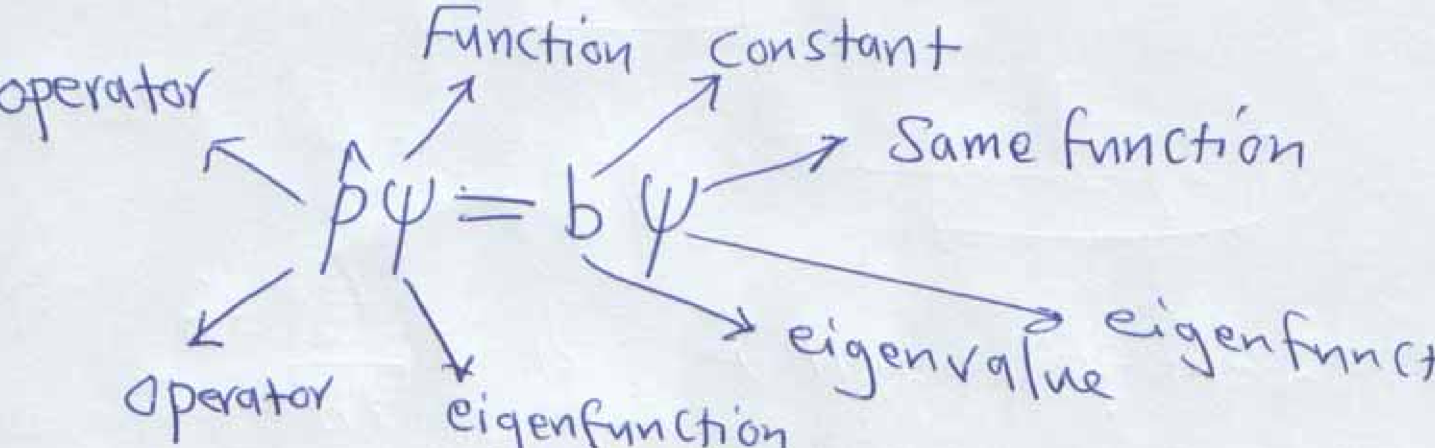
There are equation of The form

$$\hat{p}\,\psi = b\,\psi$$

Where $\hat{p}$ is an operator and b is a numbe[illegible]



Thus ψ is called eigenfunction and b [illegible] called eigenvalue. Eigenvalue equation [illegible] very important in Quantum mechanics where $\hat{p}$ is usually a differential operato[illegible] and Therefore, The eigenvalue equation is a [illegible] differentiated equation. The major problem in Quantum mechanics is to find The eigen [illegible]

Show That The function ae^{-bx} is an eigenfunction of The operator $\frac{d}{dx}$ and of The operator $\frac{\partial^2}{dx2}$. What is The eigenvalue in each case.

$$\hat{P}\psi = b\psi$$

$$\frac{d}{dx}(a e^{-bx}) = -b(a e^{-bx})$$

$\therefore$ ae^{-bx} is an eigenfunction of The operator $\frac{\partial}{dx}$ and The eigenvalue $= -b$

$$\frac{d^2}{dx2}(a e^{-bx}) = \frac{\partial}{dx}(-abe^{-bx}) = b^2(a e^{-bx})$$

$\therefore$ ae^{-bx} is an eigenfunction of The operator $\frac{\partial 2}{dx2}$ and The eigenvalue $= b^2$.

Basic assumptions of classical mechanics

1- The accuracy with which one or more dynamical variables (i.e. properties) of a system can be measured is limited only by the precision of measuring device.

2- There is no restriction on the number of dynamical variables that can be measured simultaneously, e.g. position, velocity energy, momentum can be measured simultaneously.

3- There are no rustications on the values that can a dynamical variables can have. We shall see that when very small particles are involved, all three assumptions break down.

Failure of classical mechanics at the molecular and atomic levels

Classical mechanics which is based on Newton's laws has been very successful in giving accurate results when applied to phenomena related to macroscopic objects astronomical phenomena included. However, towards the end of nineteen (19th) century and the beginning of twentieth (20th) century three observations made it apparent that classical (physics) mechanics could not give correct results when applied to molecular and atomic phenomena. These three observations are

i- ***atomic spectra***

ii*-black body radiation*

iii-***photoelectric effect***

Atomic spectra :

Atomic spectra had the following striking features:

1- Very sharp spectral lines.

2- The spectrum of each type of atom was very characteristic and no two different atoms had the same spectrum

3-(a) Balmer showed that the wavelength of the series of hydrogen spectral lines which he discovered could be calculated from the following empirical relationship: $1/\lambda=R(1/22-1/n2)$, $n=3,4,5,6,\ldots\ldots$

Where R is the Rydberg constant 109677.581 cm-1

(b) Later several other series of hydrogen spectral lines were discovered and the lines of each series were correlated using relationship similar to the previous relationship. Classical mechanics could not explain these findings on the basis of Rutherford planetary model