Study of the properties of electrical discharge

Purpose of the experiment-:

(Find the electric field strength)

Theory-:

Gases consist of electrically neutral atoms and molecules. Under normal conditions, they represent insulating materials. Electrical conduction appears in gases when they are ionized, that is, when electrons are removed from their atoms. In this case, the atoms turn into negative ions, which are produced when neutral atoms or molecules combine with free electrons.

Gas ionizes as a result of an external effect, such as intense heating, exposure to Rottingen radiation, radiation activity, or also when gas molecules or atoms are bombarded with electrons. The intensity of ionization is measured by the number of pairs of emitted particles that appear per unit time, and the electric current in the gas is called (sequential gas discharge). If the electrical conduction results from external particles. At small values of voltage, the current density is proportional to the field strength E.

where :-

I=en

u= Movement of positive ions

u = movement of negative ions

n = movement of pairs, electrons and monovalent positive ions produced per unit volume.

where-:

N = saturation current of monovalent ion pairs.

e=absolute value of electron charge.

Both u and u are inversely proportional to the gas pressure from the pressure range from 10 to 10 atmospheres. As the field strength continues to increase, the concentration of ions in the discharged gas decreases and represents the linear relationship between the current strength and the voltage.

How to work-:

1-Turn on the device (power supply) and start with the lowest voltage value, so you can still be a hawk.

2-Take different voltage readings.

3- Take a value for the current for each of your readings from v.

4-Write your readings in the table.

5-Measure the length of the electric discharge tube (cm.(

6-Find the value of ( ) from the graph by finding the discharge point.

Results and calculations-:

Tube length 20cm(neon(

True value=90VOLT/CM

Questions-:

1-What is the electrical discharge in this experiment?

2-What are the factors that affect electrical discharge?

3-What are the uses of electrical discharge?

4-Does electric discharge satisfy Ohm's law?

5-Define electrical discharge and how it occurs in this experiment?

Calibration of linear spectra using a spectrometer

Devices used :-

Diffraction grating , spectrometer , light source with two-elements

Theory

When light of wavelength **(** λ) falls on a diffraction grating , considering that the grating constant is equal to (**d**) , it may deviate from its path and the light intensity is as high as possible. This happens When the diffraction angle is achieved , if we consider that (θ) refers to the diffraction angle , then The condition is indicated by the equation :

$$n\lambda = d \sin\theta$$

The table below shows the wavelengths of the helium (He) spectrum.

Colour	λ(nm)
Red	**667.8**
Yellow	**587.6**
Green	**501.9**
Green ishblum	**492.2**
Bluish green	**471.3**
Blue	**447.1**
Violet	**407.8**

How to work :

1- Look through the telescope tube and move the tube holding the sample in and out until you see the two crossed hairs clearly and make one of the hairs vertical by rotating the sample tube if possible, otherwise take the point of intersection of the two hairs as a basis for measurement .

2- Point the collimator towards the glowing helium lamp and make the telescope in line with the collimator, then move the collimator tube using the axial screw connected to it until the image of the slit appears clear and sharp and the vertical hair is aligned with one of the edges of the image of the slit without distortion (if the image of the slit is wide, use the axial path connected to it to narrow it to the smallest possible to obtain a thin image of the slit)

Results and calculations : -

Calibration of atomic spectra

θ = He

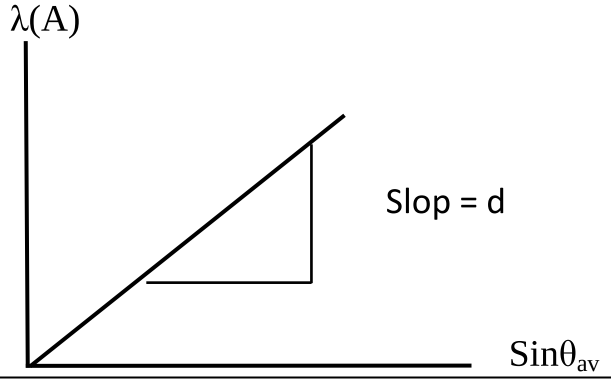
Colour	λ(A)	θ_1	$\theta_{av} = \theta_1 - \theta_2$	$Sin\theta_{av}$
Violet				
Blue				
Bluish green				
Green				
Yellow				
Red				

$n\lambda = d \sin\theta$

n=1

$d = \frac{\lambda}{sin\theta}$

$d = \frac{1}{570}$ the truth



Verifying the inverse square law using a Kaiker counter

Theory :-

Assume that s is a point source of radiation that emits in all directions A of particles per second. Assuming that these particles are not absorbed by the air, they will spread away from the source in the form of balls. The intensity of the rays I (defined as the number of particles passing perpendicular to the unit area per second) at a point P that is a distance d from the source will be equal to:

$$\mathbf{I=A/4\pi d^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\mathbf{(1)}$$

Where **4πd**: is the surface area of the sphere ,

A : is the efficiency of the source and assuming that there is a Kayker counter at the location of point **P** with an internal grid radius **R** , then the rate **N** per second is equal to :-

$$\mathbf{N = I\,\pi\,R^2 = AR^2/4d^2}$$

If **πR** : is the area of the grid of the counter using a specific detector, then **R** will remain constant and assuming that the half-life of the source is very large , then the efficiency of the source **A** will remain constant and thus it will become clear that the counting rate **N** is inversely proportional to the square of the distance between the radiating source and the counter and this is what is called the inverse square law of radiation .

How to work :-

1- Set the operating voltage of the Kaiker meter to the value you obtained.

2- Place the source at a distance of **2m** and find the counting rate for **40sec**.

3- Move the source away from the meter to **4, 6, 8,10 cm** , recording the counting rate each time .

4- Draw a curve between the counting rate as a function of the distance between the source and the meter to get a curve that shows the inverse relationship between the counting rate and the distance.

5- Calculate the slope of the straight line to calculate the source efficiency using equation (1) .

Questions :-

1- Can the inverse square law of radiation be achieved without the influence of external work ? And how ?

Inverse square law

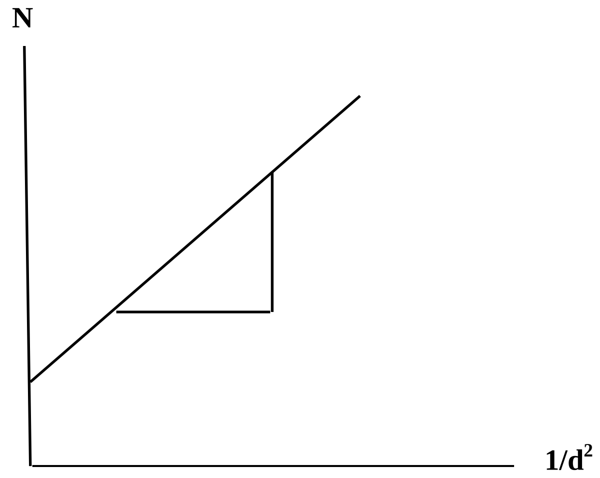
Number of shelves	D (cm)	$N_1 \ \frac{count}{40\ sec}$	$N_2 \ \frac{count}{10\ sec}$	$N_{ave} \ \frac{count}{4\ sec}$	$N = \frac{N_{ave}}{40}$	d^2	$1/d^2$
1							
2							
3							
4							
5							
6							

r = 1.1 cm

$N = Ar^2 / 4d^2$

$A = 4Nd^2 / r^2$

$A = 4 * slope / r^2$



1. Absorbance Equation (Lambert-Beer's Law):

$$A = N \cdot X = \ln\left(\frac{I^0}{I}\right)$$

- A is the absorbance.
- I^0 is the incident light intensity.
- I is the transmitted light intensity.
- N is the concentration of the absorbing substance.
- X is the path length (thickness of the sample).

2. Transmitted Light Equation:

$$I = I^0(1 - e^{-2.3\cdot\alpha\cdot N\cdot X})$$

- α is the absorption coefficient.
- The other symbols remain the same as in the first equation.

3. Absorption Coefficient Calculation:

$$\alpha = \frac{2.303 \cdot A}{X}$$

- α is the absorption coefficient.
- A is the absorbance.
- X is the path length of the sample.

These equations are used to analyze absorbance in spectrophotometry, helping determine the concentration of light-absorbing substances in a sample.

Theory:

The electromagnetic spectrum extends from ultraviolet rays (200-400 nm) to infrared rays (500-570 nm). Each region has its own spectroscopic approach for study, depending on the transitions caused by the interaction of light with matter. When studying the visible and ultraviolet regions, this means discussing the length of electronic transitions. On the other hand, in the infrared region, the discussion revolves around vibrational and rotational transitions.

For each spectral region, a specific cell is used to contain the material intended for spectroscopic study. For instance, in the case of infrared rays, a container made of **KBr** or **NaCl** is used. For visible and ultraviolet rays, containers made of quartz are preferred.

When electromagnetic radiation falls on a specific material, it undergoes a series of changes depending on the type of material, its concentration, and its thickness. The radiation is divided into absorption, reflection, or transmission, depending on the nature of the interaction. In the case of high transmittance, absorption and reflection processes are minimal (as in the case of low concentrations). Thus, the total processes can be represented as:

$$R + T + A = 1$$

Lambert-Beer's Law - It is a law that defines the relationship between the concentration of a substance and the absorbance of light.

Using optical devices, such as a spectrometer, light beams are separated after spectral analysis, and absorbance A is measured using the following relationship:

$$A = N \cdot X = \ln\left(\frac{I^0}{I}\right.$$

$$A = N \cdot X = \ln\left(\frac{I^0}{I}\right.$$

Where:

- $\frac{I^0}{I}$: The ratio between the incident light intensity and the transmitted light intensity.
- X: The path length of the light passing through (thickness).
- N: The concentration of the dissolved substance.

From this, the transmitted light intensity can be calculated using the following equation:

$$I = I^0 \left(1 - e^{-2.3\cdot\alpha\cdot N\cdot X}\right)$$

Thus, the absorption coefficient can be calculated from the following equation:

$$\alpha = \frac{2.303\cdot A}{X}$$

Method of Operation:

.1 Turn on the device.

.2 When studying wavelengths (less than 600 nm), place the disc at this number, and do the same for wavelengths (greater than 600 nm).

3. The samples (cells) are placed in their locations, the wavelength disk is moved, and the readings are fixed in the table.

A graph is plotted showing A versus λ, and from the graph, we extract the maximum value of A and find λ corresponding to it, with each measured in electronvolt units.

$$E = hf =$$

$$E = hf = h\frac{c}{\lambda}$$

Questions:

.1 If you have a material with more than one absorption wavelength and another material with a single wavelength, how can permeability be calculated for it?

.2 Which provides better information about the material's permeability, or absorption?

.3 How is energy converted from joules to electronvolts and from there to cm^{-1}?