2021 –2022

رئاسة الجامعة المستنصرية

عمادة كلية الطب

فرع علم وظائف الأعضاء

مختبر الفيزياء الطبية / المرحلة الاولى

((نرحب بالطلبة الجدد اجمل الترحيب ,راجيين لهم سنة دراسية موفقة ونتاج علمي وافر))

تعليمات عامة

1- يدخل الطالب الى مختبر الفيزياء الطبية بالزي الجامعي الموحد والصدرية البيضاء.

2- يجلب الطالب الملزمة للاستعانة بها حين اجراء التجارب العملية.

3- يكون تحضير التجارب قبل الوصول الى المختبر وستقام امتحانات قصيرة فجائية في درس العملي عن مادة الاسبوع المنصرم والحالي.

4- يدخل الطالب المختبر في الوقت المحدد بالجدول المعلن ولايسمح بالتأخير...اما في الحالات الاضطرارية فيراجع الطالب الاستاذ المشرف قبل دخول المختبر.

5- لايسمح للطلبة من مجاميع اخرى الدخول الى المختبر اثناء درس العملي ولايسمح للطلبة بمغادرة المختبر والعودة اليه.

Introduction

Practical work in physics is intended to teach the student how to select and set up apparatus skillfully. Furthermore, it makes careful observations and precise measurements while at same time realizing the limitations of the measuring instruments employed. Also, it uses the experimental results obtained to the best advantage.

Conducting the experiment

The student should follow the gives instructions, both what to do and when to do it.

First, should understand what the experiment is about, what it is intended to measure and the exact form in which the result is to be stated.

Second, applying the method outlined and the experimental details mentioned in the text. With regard to the latter, student should be train how to get the best out of the apparatus that are available, what sort of things to lookout for and concentrate upon, what to eliminate and where to improve.

Writing the account of the experiment

1- Title: This should be a clear statement of the objects of the experiment
2- The aim of experiment
3- Theory: A brief descriptive of theoretical and background information
4- Methodology: It indicate the procedures of the experiment
5- Measurements or Reading: These should be recorded where possible in tabular form, this method being both compact and easy to follow. Record measurements in the most convenient unit.

6- Result: A clear statement for the result of an experiment is as essential as an accurate title to indicate its objective.

7- Calculation: It is at this stage that conversion of all measurements to the appropriate SI unit should take place before any working out is begun or substitution made in any formula that may be given.

8- Discussion and errors: writing of an experiment should always content the discussion of the sources of inaccuracy in the experiment, the possible errors involved in the various measurements taken and the problem error in the final result.

9- Medical application: The experiment should always end with a medical application.

<u>**Types of graph**</u>

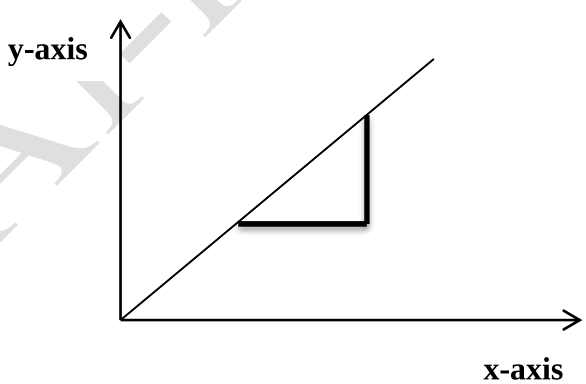
- Straight line relationship:

where: X = x axis

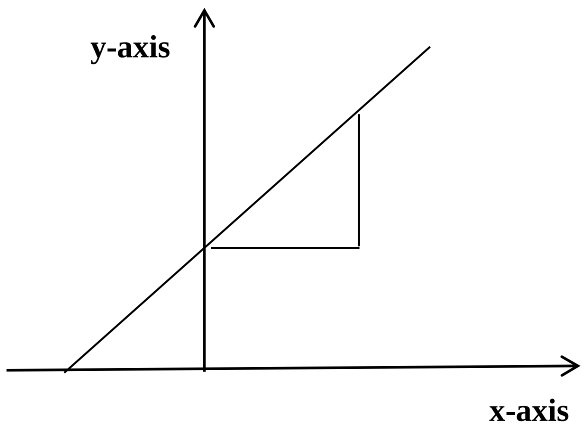
Y= y axis

Slope (m) = $\frac{y_2 - y_1}{x_2 - x_1}$

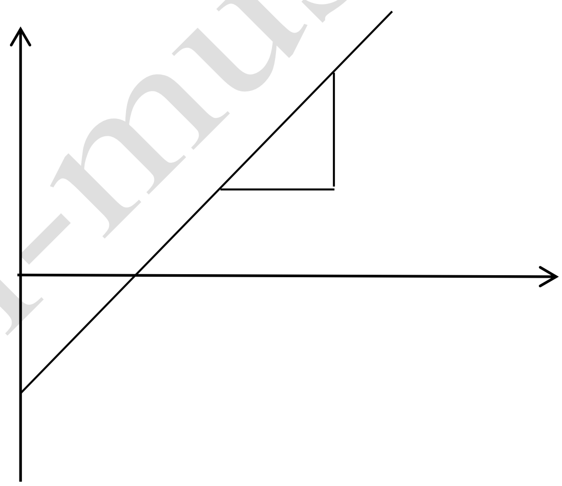
1- Y = mX (Through origin point)



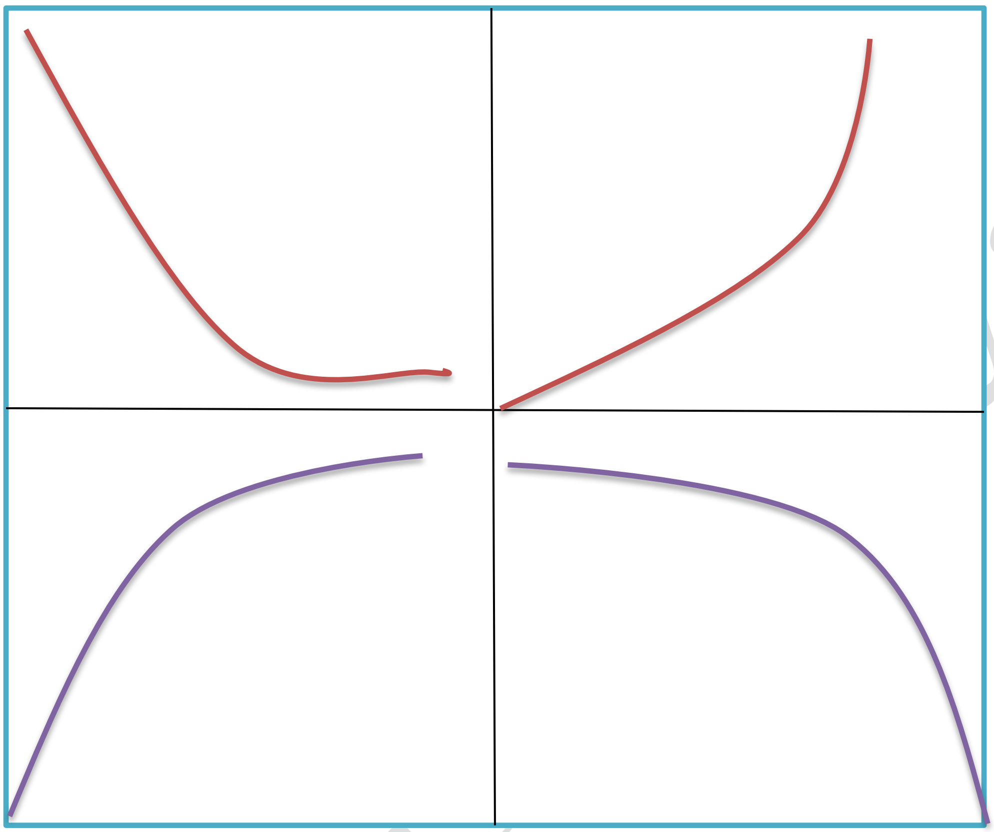
2- Y = mX + C (positive intercept)



3- Y = mX – C (Negative intercept)

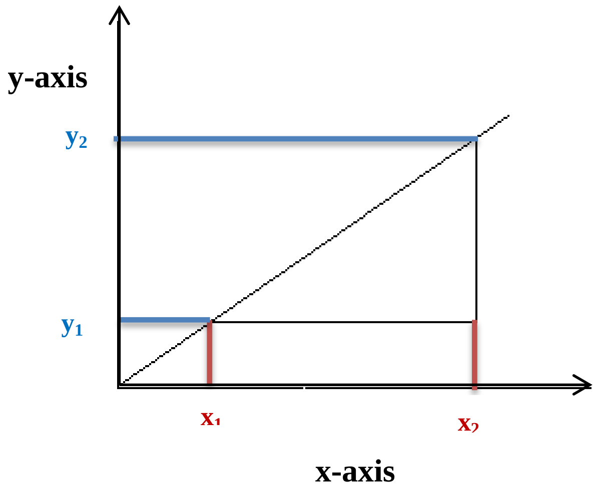


Curve relationship



<u>The slope measurements</u>

Slope (m) = $\frac{y_2 - y_1}{x_2 - x_1}$



The errors

1- The error in any particular measurement is an estimate:

a- The error in any scale is taken to be half the distance between adjustment scale marking for example:

The current measured on an ammeter whose scale divisions is 0.1 apart is judged to be 2.7A.

The possible % error is $\frac{0.1}{2.7} \times 100\% = 3.7\%$

b- Error may be lessened taking several observations of the same reading.

Some quantities are difficult to measure accurately and so we seek to improve the accuracy of their measurement by taking several additional readings the measurement of the diameter of a wire is an obvious Example:

Let us suppose the six readings of the micrometer screw gauge are 1.22, 1.25, 1.24, 1.22, 1.26 and 1.24 mm

$$\textbf{Mean} = \frac{\mathbf{1.22 + 1.25 + 1.24 + .22 + 1.26 + 1.24}}{\mathbf{6}} = \mathbf{1.24}\ \boldsymbol{mm}$$

In order to calculate the most likely error in this mean, first evaluate the deviations of the reading. These are the differences without regard to sign between each reading and the mean, then calculate the mean of the deviations (0.02, 0.01, 0.0, 0.02, 0.02, and 0.0)

The mean of the deviation is:

$$\textbf{Mean} = \frac{\mathbf{0.02+0.01+0.0+0.02+0.02+0.0}}{\mathbf{6}} = \mathbf{0.01}\ \boldsymbol{mm}$$

This is the likely error in the mean reading of 1.24 mm which should now be stated 1.24 ± 0.01 mm.

2- The effect on the final result when several independent measurements are involved. Most experiments at this stage of practical physics involve a calculation base on equation such as those in the following example:

$$V = \frac{(4II)L^2.b.h}{C} + D$$

Where: 4II is constant

% error in V=2(%error in L) +% error in b + % error in h +% error in C + % error in D

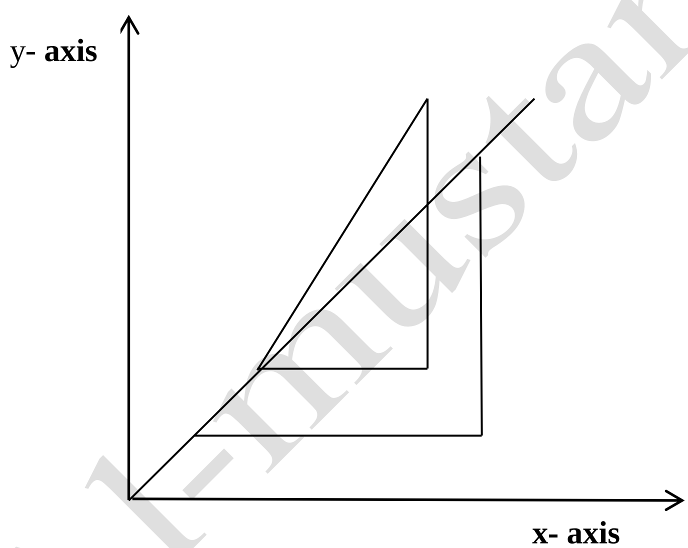
3- The error in any graphs is calculated via the following:

★ The first step: Draw the line with a ruler to have the best straight line. This line should be passing through most of the measurement points.

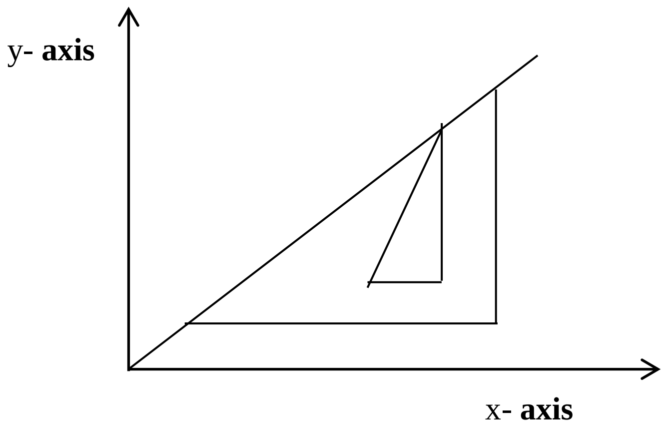
- The second step: Estimate the centroid of the this line
- The third and final step: Pivot a ruler about the centroid and then dot in the lines of greatest and least slope that can be drown from these three lines. The maximum possible error in the slope can be found by the slope of the best straight line (m), the slope of the greatest (m_1) and the least slope through the centroid are (m_2).

The possible % error in the slope is:

$$\% \text{ error (greatest)} = \frac{(m1 - m)}{m} \times 100\%$$



$$\% \text{ error (least)} = \frac{(m2-m)}{m} \times 100\%$$



The SI system of units

Physical quantity	Unit	Symbol
Length	Meter	M
Mass	Kilogram	Kg
Time	Second	Sec
Electric current	Amper	A
Electric voltage	Voltage	V
Electric resistant	Ohm	Ω
Energy	Joule	J
Force	Newton	N
Power	Watt	W
Electric capacitance	Farad	F
Inductance	Henry	H
Frequency	Hertz	Hz
Viscosity	Newton meter^{-2}second	Nm^{-2}s
Pressure	Millimeter mercury	mm Hg
Electric charge	Coulomb	C
Temperature	Degree/ Kelvin	K
Magnetic flax density	Tesla	T

التجارب العملية لمادة الفيزياء الطبية

EXP.NO. (1)

Laser Application for Measuring Multi Slit

The aim of experiment

1) Observe Fraunhofer diffraction and interference from multiple-slit (a diffraction grating)
2) Calculate the slit spacing of a diffraction grating.

Apparatus:-

Helium-Neon laser, Multi slit (grating), Screen, Ruler.

Theory:-

Diffraction occurs when a portion of a wave passes through a slit. Interference occurs when two or more coherent waves overlap. (Coherent means that the waves have a fixed phase relationship.) Constructive interference takes place at certain locations where two waves are in phase (for example, both waves have maximum). Destructive interference takes place where two waves are out of phase (for example, one wave has maximum, the other has minimum). In the case of a single-slit, diffraction is the only effect present. In the case of two or more slits, two effects are present: a) diffraction from each individual slit; b) if the incident light is coherent and the diffraction patterns of each slit overlap, then interference takes place in the region of the overlap, (i.e., inside the diffraction envelope). The simplest diffraction and interference patterns involve plane waves (collimated or parallel light beams). Diffraction patterns associated with plane waves are called Fraunhofer patterns, named after the German scientist who first explained the effect. In this experiment, we will use a laser as our light source. A laser produces collimated and coherent light beams at one wavelength.

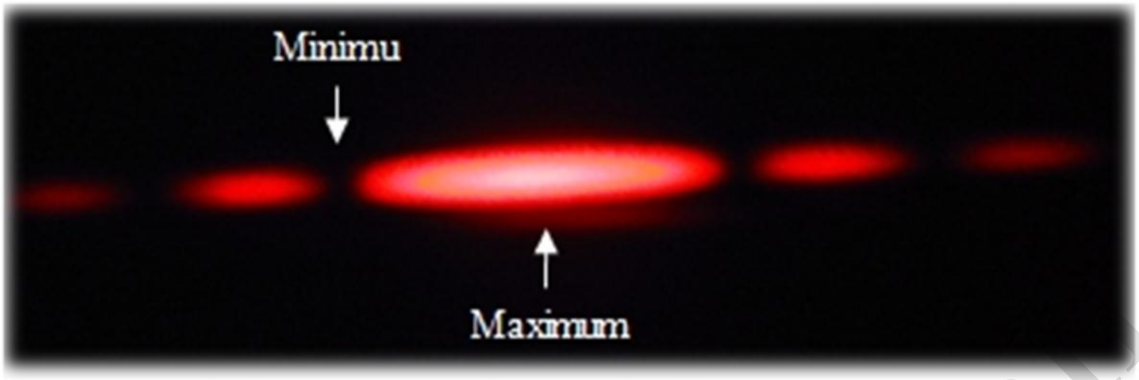


Figure 1 : the bright spots are the maxima. The dark spots between them are the minima

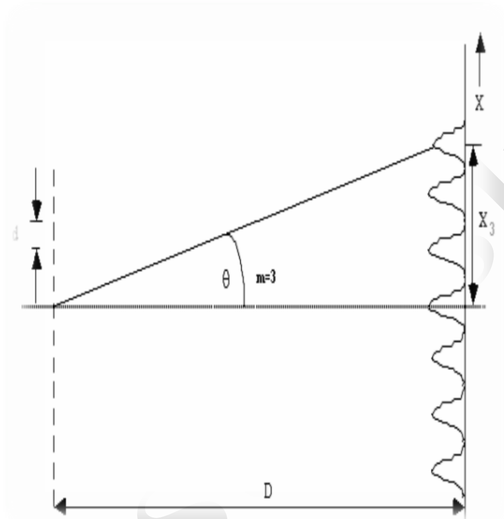


Figure 2: Intensity distribution of a diffraction grating

A multi-slit grating is commonly referred to as a diffraction grating, a more appropriate name for it is an interference grating. The phenomenon that is observed is interference and not as its name suggests diffraction. The condition here for interference maximum is the same as for double-slits, but the pattern may be very different because *d* (the slit spacing) for gratings is very small.

$$d \sin \theta_m = m\lambda$$

EXPERIMENTAL PROCEDURE

The wavelength (λ) of He-Ne laser used in this experiment is(632.8) nm
a) Place the grating in the laser beam (close to the screen, not far away).
b) Measure the distance from the plane of the grating to the screen (D) and record it in an Excel spreadsheet.
c) Record the labeled ruling density (grooves/mm) in your Excel spreadsheet.
d) Tape a piece of paper across the screen. Mark carefully the positions of the principal maximum and the interference maxima. Remove the paper from the screen and attach it to your lab report.
e) Measure the distance of each interference maximum from the principal maximum (X_n) and record them in your Excel spreadsheet. 1^{nd} fringe (X_1), 2^{nd} fringe (X_2) ………as follows:

n (number of diffraction)	X
n_1	X_1
n_2	X_2
n_3	X_3

And plot a graph between number of diffraction (n) and X_n
f) Apply slop (n/x). $\lambda =$ d/D
Where d is the width of slit

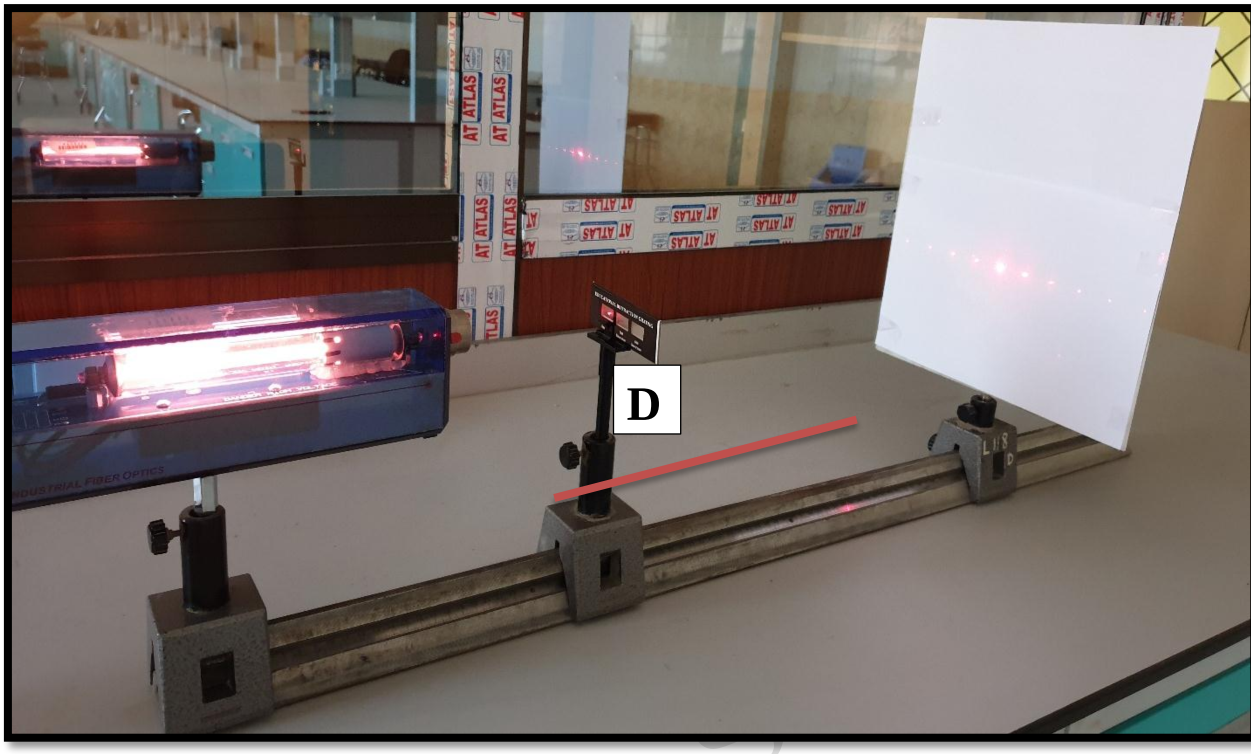


Figure 3: Set up the experimental

CAUTION: Even though the lasers used in the laboratory are of low power and do not require special eyewear, serious injury may still occur. The following precautions MUST be observed at all times:

- **keep the laser turned off when not in use;**
- **do not move the laser around when it is on;**
- **do not mount the laser at eye level;**
- **do not look head on at the beam or at its reflection from a mirror or other shiny surfaces;**
- **Never aim a laser at another person.**

EXP.NO.(2)

Flow of water through a capillary tube

The aim of experiment

a-To show that the flow rate of water is proportional to the applied pressure
b-To deduce the viscosity of water

Theory:-

Viscosity is the quantity that describes a fluid resistance to flow. Poiseuille's law states that the flow through a tube depends on the pressure difference from one end to the other, the length of the capillary tube (L), the radius of the tube (r) and the viscosity (η). The flow rate varies inversely with the length of capillary tube (L) and the viscosity (η) while, directly proportional with pressure (ρhg) and the radius of the tube (r) parameters.
Where:
ρ: is density of water =1000 kgm^{-3},
h :represent the distance between the water level in the container and the level of the capillary tube.
g :is the gravity = 10 ms^{-2}
The value of the viscosity can be calculated from the following equation:

$$\eta = \frac{\pi r^4 \rho g}{8L} \cdot \frac{h}{v/t}$$

η = ……..Nsm^{-2} at…..C

Apparatus:-

Glass capillary tube of internal radius 0.04 cm and length 4cm, stop watch, a graduated cylinder, ruler, thermometer and rubber tube.

Methodology

1-Connect the rubber tube to a tap water and see the surplus water discharges into the sink as shown in Figure 1.
2-When the water start flow through the capillary tube, make sure that there is no air bubbles in the tube.
3- When the flow of water is steady, hold the capillary tube horizontally in the clamp .
4-measuer the temperature of the water.
5-Measure the height between the level of water and the horizontal capillary tube , record the height in the table .

6-Hold the stop watch in one hand and the beaker in the other, collect the water in the beaker for a time of 30 second.
7-Read the volume of water and record as shown in Table 1.
8-Change the height by increase it 5 cm , and go back to step 5and repeat it 5 times.

Table 1:The change of flow rate with the distance between water level and capillary tube

h/cm	**Volume/cm^3**	**Time/sec**	**Rate of flow v/t cm^{3}s^{-1}**
30 **.** **.**			

9-Plot a graph between the values of h/cm on the X axis against the corresponding values v/t cm^{3}s^{-1} on the Y axis
10-The slope of the plotted graph represent the flow rate value h/(v/t) cm^{2}s^{-1}

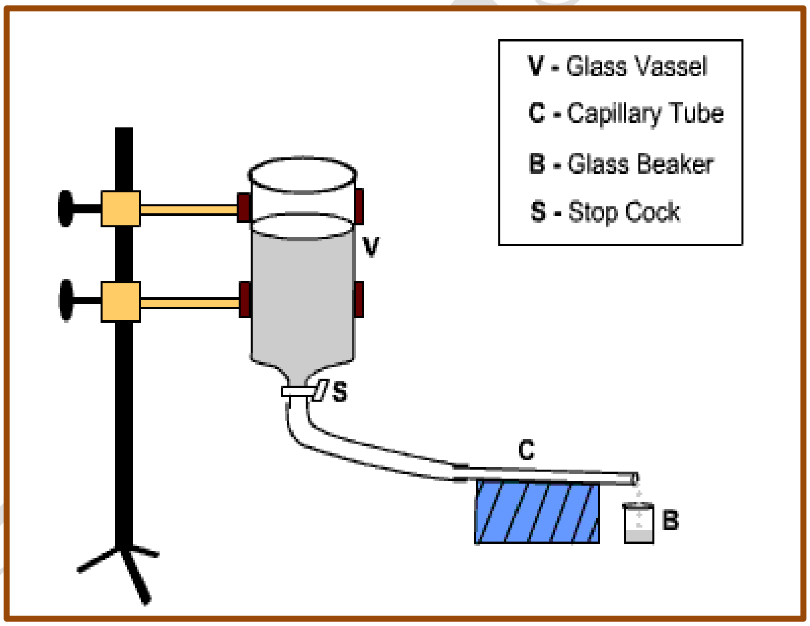


Figure 1: The flow rate devices

<u>Medical application</u>

1-blood and nutrition transfusion .
2-Sickle cell test (which is screening test for sickle cell anemia).
3-Studying hematocrit , fibrinogen level .
4-Studying or test plasma viscosity .

EXP.NO. (3)

Falling ball viscometer

The aim of experiment

-To determine the viscosity of glycerin
-To determine how the viscosity of a liquid varies with temperature

Theory

Viscosity is resistance to flow. For liquids, typically the larger the intermolecular forces the higher the viscosity. The other factors that affect viscosity are temperature and the shape of the molecule. The viscosity of liquids decreases when the temperature increases, while the viscosity of gases increases with the increase of temperature. This is due to reason that the viscous forces in a fluid are due to cohesive forces and molecular momentum transfer. Dynamic viscosity is the force needed by a fluid to overcome its own internal molecular friction so that the fluid will flow.

A body that moves in a fluid is affected by a fractional force in the opposite direction of its velocity. The magnitude of this force depends on the geometry of the body, velocity and the internal fraction of the fluid .**The dynamic viscosity (η)** is calculated using the following equation:

$$\eta = K\,(\rho_1 - \rho_2).\,t \quad \text{------------(1)}$$

Where: K= Ball constant =0.007 mpa.cm^3/g
ρ_1= Density of ball=2.2 g/cm^3
ρ_2 = Density of glycerin is 1258.6 Kg/ m^3
t = Falling time of the ball in seconds

The kinematic viscosity (**ν**) of a fluid is the ratio of the viscosity of the fluid to the density. Mathematically, it is expressed as:

$$\nu = \frac{\eta}{\rho} \quad \text{-------------(2)}$$

ν= Kinematic viscosity [cm^2/s]
η = Dynamic viscosity [mpa.s]
ρ = Density of the liquid sample [g/cm^3]

Dynamic viscosity for some common liquids at temperature *37°* are indicated below:

Fluid	Absolute Viscosity (Ns/m^{2}, Pas)
Glycerine	0.950
Heptane	0.000376
Mercury	0.0015
Distal water	0.00089
Blood	0.003-0.004

Apparatus

- Cylindrical measuring tube, spherical glass ball .

-The measuring tube is positioned slightly inclined about 10^{0} to the vertical position surrounded by outer glass tube which can be filled with temperature controlled water. The assemblies is pivoted can be turned upside down as shown in Figure 1

-Water bath and stop watch.

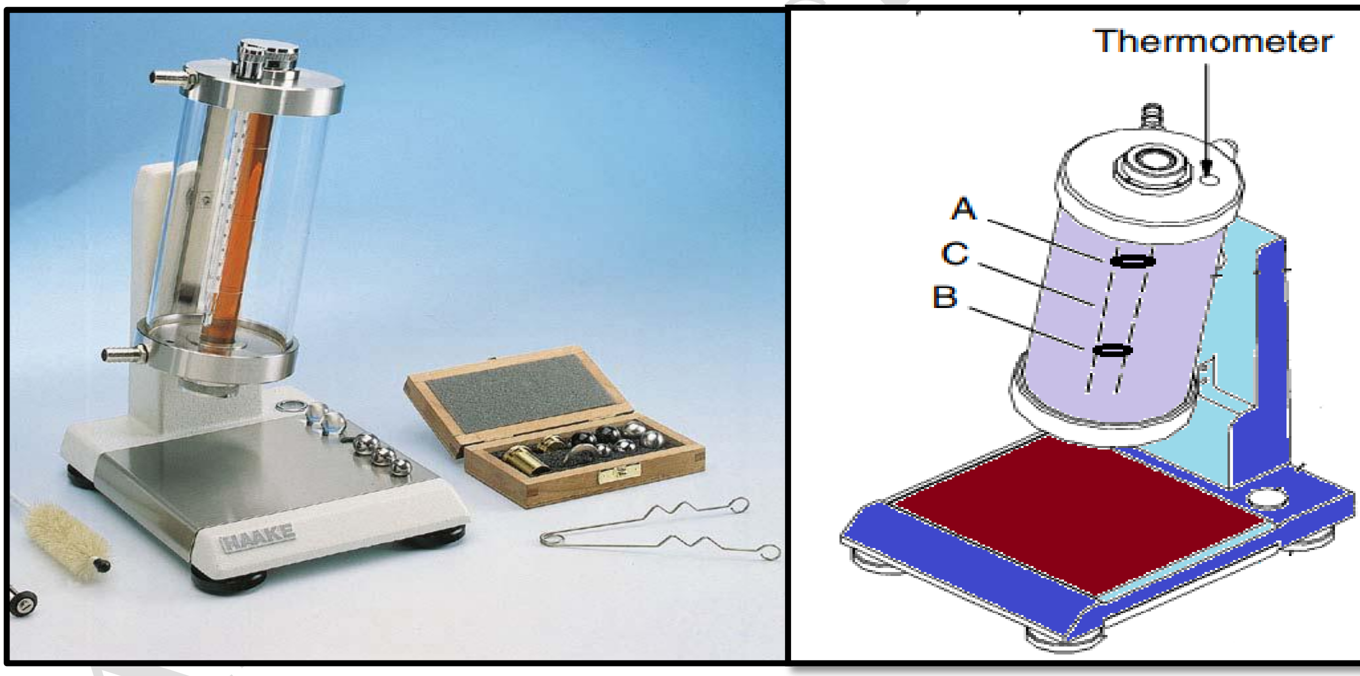


Figure (1): a. Viscometer instrument b. Schematic viscometer measuring tube

Methodology

1- Determine the viscosity of the glycerin

* Fill the measuring tube with glycerin
*Put down the ball in the measuring tube
*Determine the falling time of the ball from ring A to ring B by using stop watch
*The time period starts when the lower periphery of the ball touch the ring A, and the falling time end when the lower periphery of the ball touch ring B.
*Turn the tube 180^0 again the ball return to its start position.
*Falling time repeated three time at room temperature and then determine the average value of measuring results.
*Find the viscosity of glycerin from the equation (1 and 2).

2- Change the viscosity of a liquid according to various temperatures

*Switch on the thermostat and set temperature at 40^0c
*Wait until temperature stabilizes then measure the ball falling time
*Repeat the previous step at different temperature and then write results as shown in table 1
*After completing the experiment, set the temperature on the thermostat near the room temperature and turn off the power supply.
*Tabulate the reading

Table 1: the relation between temperature and falling time

T.C^0	t/sec

*Plot a graph between the temperature and the time.
*Discuss the result.

Medical application

Viscosity is of critical importance in medicine as fluids are introduced into the body intravenously:

1-measurement of blood viscosity before and after dialysis.
2-Plasma viscosity measurement , amniotic and synovial fluid .
3-measuring the viscosity of bile .
4-Determining the sedimentation rate of RBC_s (ESR) .

EXP.NO. (4)

X-ray Detection by using ionization chamber

The aim of experiment

-To investigate the relationship between the saturation ionization current and the tube high voltage V at constant emission current I

Theory:-

X-ray is an ionizing electromagnetic radiation with approximate wavelength range (0.001nm-10 nm) and photon energies range of(100ev – 1Mev) . In this experiment , the photons energy range of (5Kev -35 Kev).

The most frequent method of generating X-ray radiation is based on the use of " hot cathode "X-ray tube . Which is vacuum device containing two electrodes the positive electrode is the anode and the negative electrode is cathode and a high voltage applied between the two electrodes . the cathode is heated to emit electrons from its surface . The emitted electrons are accelerated by the mentioned voltage and strike the surface of the anode . The interaction of the fast electron with the material of anode which is (Molybdenum Mo) in this experiment causes the emission of X-rays from the anode .

The X-ray beam passes through the capacitor plates ionizing part of the air volume in the capacitor , when we apply voltage V_c to the capacitor the electron or ions are collected at its plates . the current generated at the capacitor correspond to an ionization current I_c in the outer circuit that can be measured using a measuring amplifier. At low voltages V_c ,fewer and fewer charges recombine in the gas volume as V_c increases more charge carries and collected at the capacitor plates . Thus the ionization current I_c increases with the voltage V_c .

When V_c is increased beyond a certain point ,I_c ultimately reaches a saturation value , as all of the charges carries formed by the incident radiation per unit of time are captured .

This saturation value is an indicator for the intensity of the incident X-radiation.

The capacitor function is storing charges onto its plates , the amount of electrical charges known as its capacitance value and depends upon three main factors

-The surface area , of the two conductive plates, the larger surface area the greater the capacitance.

-The distance (d) between the two plates the smaller the distance the greater capacitance.

-Dielectric material the type of material separates the two plates , the higher permittivity of the dielectric the greater the capacitance

Apparatus:-

-X-ray unit consist of

-control panel contains number of key to set the parameters such as X-ray tube voltage ,emission current which appear on adisplay filed , adjust knob enables you to set the desired values , select the operating mode and on/off switch .

-Tube chamber with X-ray tube Mo .

-Experimental chamber

-Plate capacitor , which is connected to electrometer amplifier , power supply

-Electrometer amplifier , fitted with resistor 1 GΩ to measure ionization current , because the amplitude of ionization current in the capacitor I_c is too small to be measured by stander galvanometer, an electrometer amplifier (which is high sensitive electronic voltmeter) indirectly measure current by sensing the voltage drop a cross the resistor .

-Voltmeter $V \leq 300$ V , Voltmeter $V\leq 10$ V

Method:-

1- Set the emission current I = 1 mA

2- Set the capacitor voltage $V_c \geq 150$ V.

3- Increase the tube high voltage V in steps from 5 Kv to 35 Kv and determine the corresponding ionization current I_c write down your measurement results as shown in the table .

V_{tube} (Kv)	V_r (V)	$I_c = V/R$ (A)

4- plot the graph between I_c on Y axes and V_{tube} on X axes .
5-Discuss the results .

Note : the value of the resistance $R = 10^9\ \Omega$

Medical application

1-For checking Brocken bone (fracture) , bone cancer and osteoporosis (DXA) device .
2-Mammography technique which is use to look for Brest cancer .
3-Chest X-ray which is used for detecting conditions affecting the lungs .
4-To view some swallowed item

EXP.No. (5)

Measuring the wavelength of light using diffraction grating

The aim of experiment

Determination of the wavelength of the light

Theory

Light is that part of electromagnetic spectrum which can we see. Visible light is emitted by excited atoms and molecules and by very hot solid. The wave length of the visible light between 700nm from red light to 400 nm violet light. The speed of light in vacuum approximately 3x 10^8 m/sec.

When a light from light tube is observed with spectrometer, the colored images of the entrance grating appear as bright lines separated by dark regions, each gas emits a particular set of spectral lines and its own characteristic spectrum, because every element is clearly defined by its atomic number (Z) in the periodic table of elements. The binding energy or the energy levels are different and characteristic for every element as a result of varying atomic number.

Spectrometer: - is an instrument used to observe and measure the angular deviation of light due to deviator system as prisms and diffraction gratings.

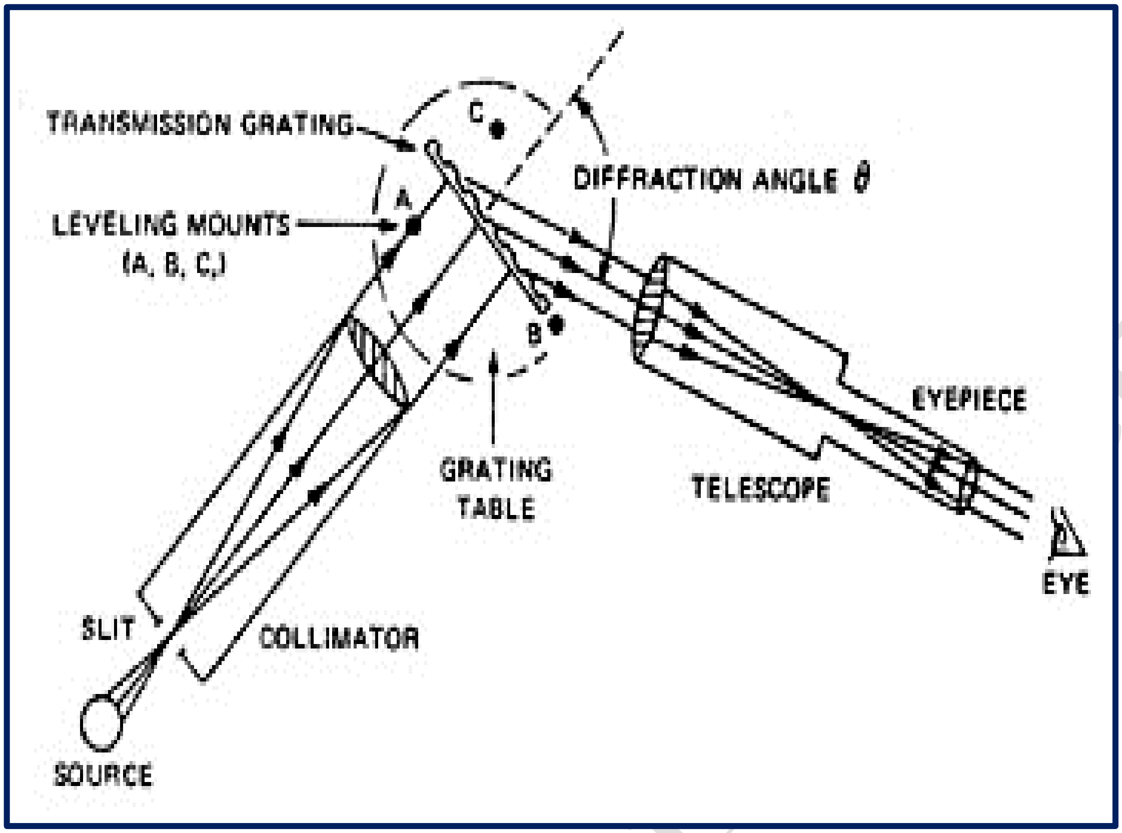
It consists essentially of three parts:

1. The collimator: which provides parallel beam of light from the source . It consists of chromatic lens at one end and adjustable slit at the other .

2. Diffraction grating: is a diverging device that deviated light according to wavelength .It separates the light into its component colors.

3. The telescope: which receives the dispersed light from the grating . Its provided with an eyepiece fitted with cross-hairs.

The optical axes of the collimator and the telescope meet on the axis of rotation of table carrying the grating as shown in figure below



Apparatus

Spectrometer , diffraction grating , lamp.

Methodology

a) Experiment should be performed in dark room.

b) Place a light source in front of the collimator and turn it on .

c) Place the telescope in front of the collimator, look through the telescope and close the slit of collimator to the light source until the image of slit is clearly seen in the center of the vision field .

d) Fix the grating on the table of spectrometer with its plane perpendicular to the optical axis .

e) Rotate the telescope until the cross-hair matches the center of the line .

f) Read the veneer's scales with magnifying glass .

To read the angle, first find where the zero point of vernier's scale. Then, read the value which is located directly below the zero point on the graduated plate. If the zero point locates in between two values, depend the lower value.

Calculation:-

Read the telescope vernier angles ($\alpha_{R} - \alpha_{L}$) when the center of cross hairs coincides with each of the first-order diffracted image.
The difference between ($\alpha_{R} - \alpha_{L}$) is equal to twice the angle θ of the order diffraction.
Final equation:

$$\mathbf{S \sin \theta = n \lambda}$$

where S is grating spacing = 1/ N , where N is the number of lines per cm , n= number of order.

Medical application

1-For glucose monitoring in diabetic patents .
2-To measure changes in chemicals and enzymes ,as it is very difficult to monitor these aspects of human body.
3- Use wavelength near IR to analyzed metabolites and proteins .
4-Tt is used to identify cancerous liver cells.

EXP. No. (6)

The focal length of convex lens by graphical method

The aim of experiment

Determination the focal length of the convex lens by graphical method

Theory:-

Focal length :-Is the distance between center of the lens and the focal point of the lens. This point produce from the meeting of parallel rays of light .
A lens is a transparent curved surface that is used to refract light. It is usually made from glass. There are two different types of lenses.

Convex lenses :- They are thick at the middle. The rays of light that pass through the lens are brought closer together (light converging). The image formed by a convex lens is real and inverted and can be bigger or smaller than the object as shown in Figure 1.

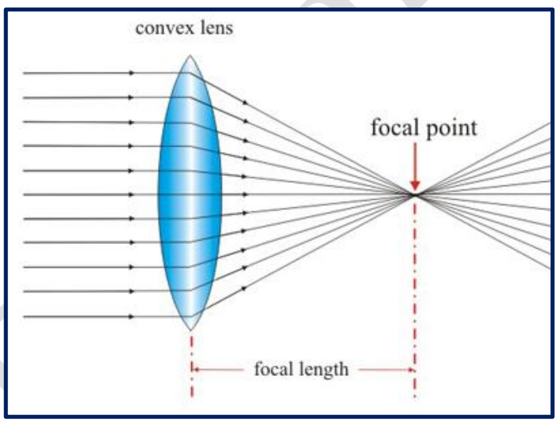


Figure 1: Convex lenses

Concave lenses:- They are thin in the middle and thicker at the edges. A concave lens is also called a diverging lens. A concave lens will disperse light and make an image that is always virtual, upright and smaller than the object as shown in Figure 2.

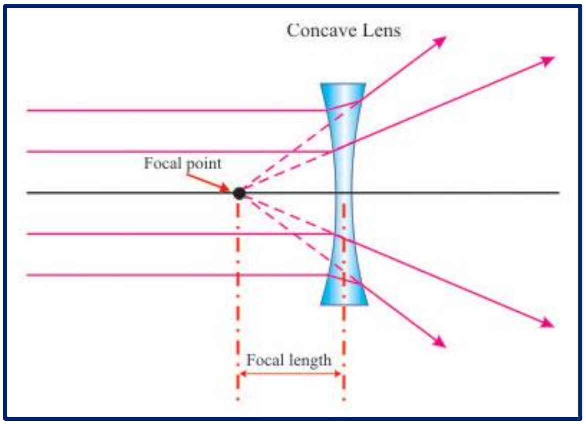


Figure 2: Concave lenses

The lenses are used in making of medical glasses to treat the vision defects

Long sight:-

A person who has a long sight vision can focus clearly on distant objects but cannot focus on near objects. This is because the eyeball is too short. Light from near objects is focused at a point behind the retina resulting in a blurred image. This defect can be corrected by wearing a convex (converging) lens.

Short sight :-

A person sees near objects clearly while distant object is formed in front of the retina
This may be caused due to elongated eyeball or excessive curvature of the cornea .
This defect can be corrected by using a concave (diverging) lens.
It's known that there is length formula used to determine the focal length of the lens:

$$\frac{1}{F} = \frac{1}{U} + \frac{1}{V}$$

which stated the relationship between the object distant (u/cm) , image distant (v/cm) and the focal length of spherical convex lens (F/cm).
Where:
U= the distance of an object from the lens
V= the distance between the lens and the image
F= the focal length of the convex lens

Apparatus :-

Convex lens , Meter scale , Source of light (lamp) ,White screen , Object , Two holders for lens and object .

Methodology:-

First obtained a rough value for the focal length of the lens by focusing the image of the window panes on the screen

1-Place the object pin between the lamp and the lens .

2-Move the lens away from the object slowly to the place where the sharpest image is formed on the screen , record the distance between the object and lens and the distance between lens and the screen .

3-Increase the distance of the object (3cm) and move the lens until the sharp image formed on the screen record the distance of object and image .

4-Repeat step 3 at least 5 times, every time you should change the position of the screen and move the lens until the formation of the sharp image.

5-Record the readings as in the table below:

Distance of object from lens U cm	Distance of image from lens V cm	1/U cm^{-1}	1/V cm^{-1}
. .			

6. Plot a graph of 1/U cm^{-1} against 1/V cm^{-1}

Calculation:-

From the graph the intercept of both axes represent $\frac{1}{F_1}$, $\frac{1}{F_2}$

The focal length of lens is $F = \frac{F_1+F_2}{2}$

Medical application:-

1-To diagnose and treat eye defects such as long sight and short sight.

2-To diagnose and treat the Astigmatism.

3-It is used in medical and biological devices like microscope, endoscope.

EXP.NO. (7)

A.C. Circuit with Inductance and Resistance

The aim of experiment:- Measuring the inductance

Theory:-

Electricity plays an important role in medicine. There are two aspects of electricity and magnetism in medicine: electrical and magnetic effects generated inside the body.
For each value of current (I/A) calculate the impedance in ohm**:**

$$Z = \frac{V}{I}$$

$$I = \frac{V}{Z} = \frac{V}{\sqrt{R^2 + X^2}} \dots\dots\dots\dots (2)$$

Where X_L is the inductive reactance of the coil
Since:

$$Z^2 = R^2 + X^2_L$$

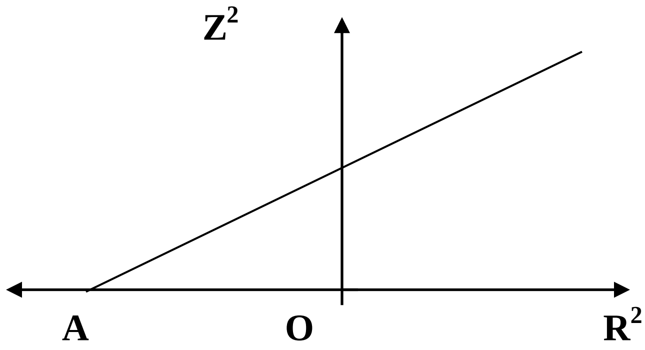
A graph of Z^2 against R^2 will yield a straight line . The intercept (OA) gives the value of X^2_L (see diagram below)

Thus:

$$X^2_L = OA = (2\pi f L)^2$$

And from this the inductance (L) of the coil can be determined

$$L = \frac{\sqrt{OA}}{2\pi f} \dots\dots\dots\dots\dots\dots Henry$$



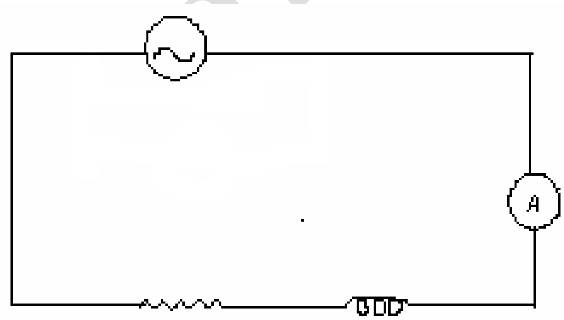
Apparatus:-

Low voltage A.C. source, fixed inductance, Resistance box, A.C. ammeter.

Methodology:-

1-Feed the low-voltage output into the circuit connected as shown in the diagram.

2-Vary R and record the circuit current I as read on the A.C. ammeter at each stage.



3-Tabulate the readings:

V= 6 Volt

R/Ω	I /A	Z=V/I	R^2	Z^2
0 10 30 . .				

4-plot the graph between Z^2 and R^2
5-Find the slope.

Medical application:-

1-handheld blood analyzes, glucose monitors, and blood pressure monitors, which require switching regulators to operate at high efficiency with low –load current.

2- Capacitor series which are used in MRI application.

3- X-ray machines and laser systems, inductance combined with capacitor and resistors in high voltage circuit.

EXP.NO. (8)

Radiation Detection

The aim Of experiment:-

-To distinguish among alpha, beta and gamma radiation
-To verify inverse square relationship between the distance and the intensity

Apparatus:-

The radiation detector (Geiger- Muller counter (GM)) is a simple device which is used using for measuring radioactivity. It consists of a metal tube called cathode, containing inert gas at low pressure and a wire along its central axis called anode. One of the end tube usually has a very thin window made of some low-atomic mass material, such as mica or beryllium, through which radiation can easily enter as shown in Figure 1. When the ionizing radiation enters to the GM tube. It is ionizing the inner gas and producing ions and free electrons. The flow of charge causes a pulse current and this current amplified and detected by external counter. Radioactive sources are (Ɣ-source Co-60) and (Cs-137), α source (Am-241), β- sources (Ti-204) and Sr-90). Also, the sheets of aluminum and lead used in this experiment

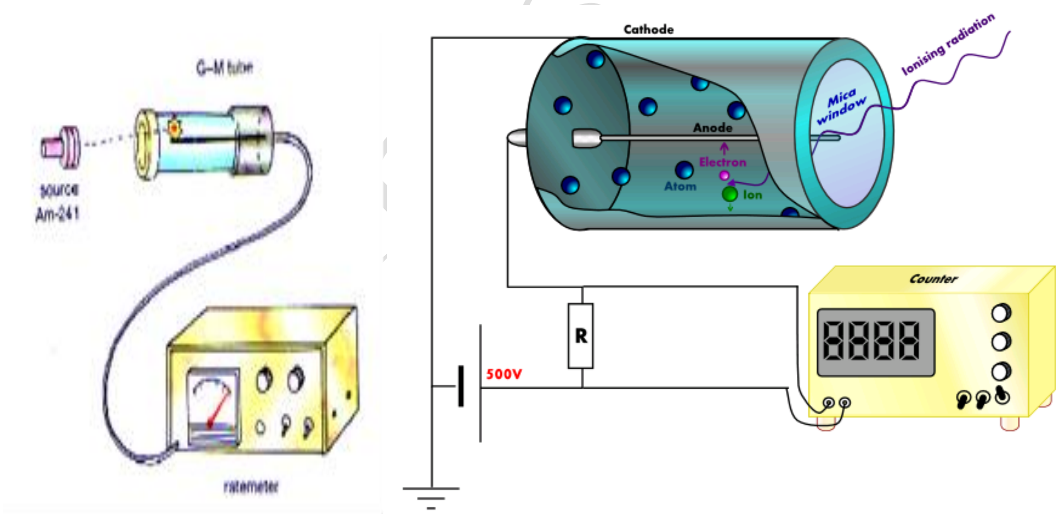


Figure 1: The description of Geiger- Muller counter device

Theory:-

Alpha α, Beta β particles and Gamma Ɣ rays are nuclear radiation emitted by radionuclide. Each kind of these radiations has certain characteristics which depend on mass, charge and wave or particle nature as explain in Table 1 .The penetrating power of these rays varies widely among them and is found to be a way of distinguishing among them based on their absorption in matter. Radioactive materials emit radiation uniformly in all directions and its obeys to the inverse law as shown in Figure 2.

Table 1: Explain the Characteristics of α,β and Ɣ rays

Radiations	Composition	Mass	Charge	Penetrating Power	Ionizing Power
Alpha (α)	2 protons + 2 neutrons	Approx. 4 amu (6.6×10^{-24}g)	+ 2*(3.2×10^{-19}c)	2 to 7 cm in air	Very large
Beta (β)	Electron	About 1.1837 of hydrogen atom (9.1×10^{-28}g)	- 1*(1.6×10^{-19} C)	Several meters in air	Less than 1/100 that of the particle
Gamma (γ)	Electron magnetic	Zero	Zero	Very high	Very Low

Inverse square law in general it's a physical law can applied to many sources such as electrical field, light, sound and radiation. The radiation intensity proportional to the square of distance from the source of that physical quantity as follow the equation 1.

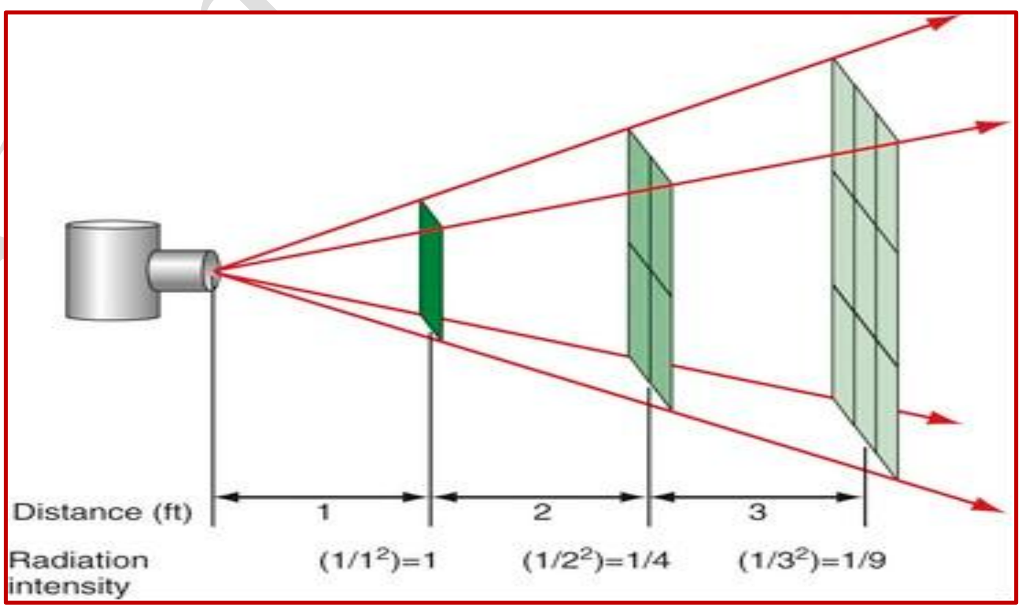
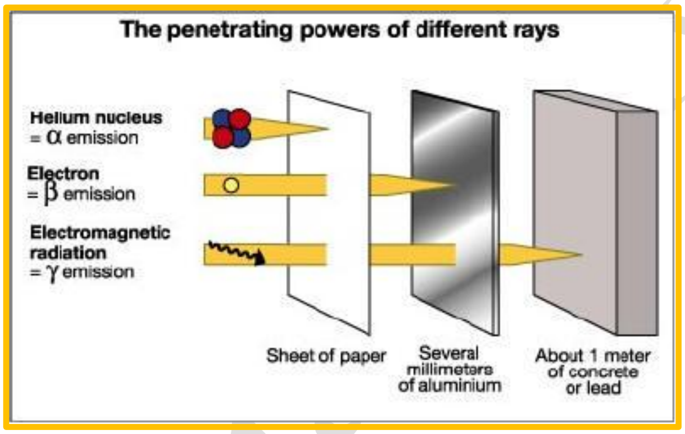


Figure 2 : The radiation emit from radioactive materials

Methodology:-

1- Distinguish among alpha, beta and gamma radiation

- Take one radioactive source and set it on the holder.
- Set GM-tube in front of the source.
- Set up the source at fixed distance (10 cm) from GM-tube.
- Turn on the counter.
- Place sheet of paper between the source and the GM-tube, regard the counter if not stop use thin sheet of aluminum and regard the counter if not stop then use sheet of lead. As shown in Figure 3.
- Explain the results.



Figuer3: Sheet of paper, aluminum and lead

2- Verify inverse square relationship between the distance and the intensity

- Determine the background count by measuring number of particles entering the tube without source. Background radiation comes from cosmic ray, natural radioactive material in rocks, soil and in bricks of building.
- Take radioactive source e.g. beta source and set it on the holder.
- set GM-tube in front of the source.
- Place the source at distance (1 cm) away from the tube.
- Turn on the counter set the counting time at 60sec.
- Record the count rate.
- Repeat step 6 with distance 2, 3,4,….,10 .
- Tabulate the results as shown below.

Distance cm (d)	Square distant (d^2)	Intensity count/sec	Background count/sec	Actual intensity intensity-background

★ Plot the graph between square distance and actual intensity.

★ Discuss the results.

Medical application:-

Alpha particles:-

1-To treat various form of cancer by inserting tiny amount of α –particles into cancerous mass, such as brain tumor, pancreatic, ovarian and melanoma cancers.

2- α-particles are used for treating bone cancers.

3-Treating leukemia: which may involve bone marrow transplant by kill the defective bone marrow by lethal dose of radiation before being replaced with healthy bone marrow.

Beta particles:-

1-To treat thyroid disorder by using Iodine 131.

2-Treating eye disease.

3-Treating skin cancer.

Gamma rays:-

1-Gamma photons are used in treating cancer by irradiating cells that need to be kill.

2-It is used in diagnoses by using radioisotopes emitter ɣ rays off sufficient energy to escape from the body and it have short half-life to decay away soon after imaging is completed.

3-It is used in sterilizing medical products such as syringes, gloves, clothing and instruments.