**Biomedical instrumentation**

**Final Term**



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**Question No.01:**

Define the following terms:

1. PH Meter
2. Vortex Mixer
3. Balance
4. Water still
5. Deionizer

**Answer:**

**PH Meter:**

**History:**

The PH Meter was invented in 1934 by an American chemist **Arnold O Beckman** to measure the sourness of lemon.

**Definition:**   
It is a device used for the measurement of PHO solution.

* A simple and speedy device to measure the acidy and basicity of the fluid.

**Applications:**

PH Meter is used to check the PH of a wide range of solution and substances.

* Laboratory chemicals
* Water
* Beverages
* Washing powder etc.

**Vortex Mixer:**

Vortex mixer is a simple device used commonly in laboratories to mix small vials of liquid.

**Modes:**

1. Continuous
2. When down pressure is applied it starts

**Uses:**

* Used to mix different reagents or samples.
* Vertox mixer is relatively simple device used in microbiology, Biochemistry and Analytical laboratory setting.

**Balance:**

Weighting scale is a device for measuring weight.it measure the mass of an object and are used in science.

**Uses:**

* Analytical balances throughout most laboratories
* They are mostly used to weight substances and samples between 0.01 – 500ml.
* An analytical balance measures masses to within 0.0001g
* Use these balance when you ned this high degree of precision

**Water still:**

It is an instrument used in laboratory for purification of water.

**Uses:**

* The water still uses the same concepts as a basic distillation apparatus but on a much larger scale still have been used to produce perfume.
* It also uses to produce medicine
* Water for injection
* It is always used in pharmaceutical companies
* It is generally used to separate and purify different chemicals and to produce distilled beverages containing Ethanol

**Deionizer:**

It is an instrument used in laboratory for purification of water.

Deionization is a process by which both positively charge and negatively charged (Cations & Anion) respectively are removed from water

**Uses:**

* A cost effective means to Achieve high purity water
* Used as a part of multi treatment system
* Removes total dissolved solids and minerals
* Utilizes ions exchange

**Question NO: 02**

Describe electrophoresis and its importance?

**Answer:**

**Electrophoresis:**

* Term means Migration with Electricity
* Involves the separation of component of a sample by differential rate of Migration in the presence of electric field

**Father of electrophoresis:**

**Arnetiselius (Sweden 1902-1971)** the noble prize in chemistry 1948

“For his research on electrophoresis and adsorption analysis especially for his discoveries concerning the complex nature of a serum protein”

**Principle:**

Molecules moves with the speed depending on their charge shape and size and get separated in the presence of an electric field

**Component:**

* Gel casting assembly
* Buffer container or electrophoresis tank
* Power supply
* Glass plat to hold the gel
* Comb to load sample in gel before solidification

**Operation:**

Gel s prepared by adding powder agarose to liquid boiling the mixture.

Comb is already placed which creates rows of well for sample loading

The agarose is then poured into costing tray and allow the solidified at room temperature

Gel is solidified and comb is removed and load standards and samples in wells

Apply desired voltage to initiate electrophoresis

Separated products can be seen by placing the gel on UV trans illuminator and calculated by comparing in standards

**Applications:**

* Separation of proteins DNA & RNA and other macromolecules
* Purification and analysis of vaccine and anti-biotic
* Serum protein electrophoresis
* Lipoprotein analysis
* Diagnosis of hemoglobinopathies phenotypes and microhydrogenetics
* Genotyping of proteins e.g. ApoE Analysis of Alzheimer disease
* Small molecules (drugs or steroids )
* CSF analysis
* Urine analysis

**Question No: 03**

Write a note on flow cytometery?

Answer:

**Definition:**

Flow cytometery is technology used to analyze physical and chemical characteristic of particle in a fluid and it passes through at least one laser.

Upto thousands of particles per second can analyze as they pass through liquid stream

Example of properties measured include particle relative granularity size and florescence intensity as well as its internal complexity

**Components of flow cytometery:**

1. **Fluidics:**

Purpose of the fluidics system is to transport the particle in a stream of fluid to laser beam where they are interrogated

* If cells are from solid tissue they require disaggregation before they can be analyzed
* Although cells from animal plants bacteria yeast or algae are usually measured other particles such as chromosomes or nuclei can be examined
* Some particles such as marine algae are naturally florescent but in general florescent labels are required to take components of the particles
* Section of fluid stream that contain particle is referred as sample core

1. **Optics system :**

Laser which illuminate particle present in stream as they pass through and scared light from laser.

* Florescent molecules that are on particle emit florescence which is detected by carefully positioned lenses
* Light scattered from up to 6 or more florescence is determined for 2 different angles
* Optical filters and beam splitter then direct light signals relevant detectors which emit electronic signal that hit them
* Data collected on each particle are event and characteristic .Those events or particles are determined bases on their florescent and light scattering properties

1. **Electronic system :**

Used to change light signals detected into electronic pulses that a computer can process

* Data can be studied to ascertain information about a large number of cells over a short period
* Information on the heterogeneity and different subsets within cell population can be identified and measured
* Some instrument have a sorting feature in electronic system that can be used to charge and deflect particles so that certain cell population can be sorted for further analysis
* Data are usually present in the form of single parameter histogram or as plots of correlated parameter which are referred to cytogram
* Cytogram may display data in the form of dot plot a contour plot or density plot

**Application of flow cytometery**:

* Molecular biology , pathology , immunology
* Specially in transplantation hematology , tumor immunology and chemotherapy prenatal diagnosis and genetics
* Extensively used in the research for detection of DNA damage
* flow cytometery is routinely used in the diagnosis of health disorder specially blood cancer
* it is also used in protein engineering used in conjunction with yeast display and bacterial display to identify cell surface protein variants with desired properties

**Question NO: 04**

What do you know about beer’s lambert law?

Answer:

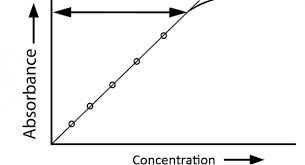
**Beer’s law:**

When a monochromatic light pases through a colored solution amount of light transmitted decreases exponential with increase in concentration of colored substance:

I.e. the amount of light absorbed by a colored solution is directly proportional to the concentration of a substance in the color solution

**Lambert law:**

The amount of light transmitted decreases exponantionaly with increase in path length (diameter ) of cuvette or thickness of colored solution through which light passes i.e. the amount of light absorbed on the colored solution depend on path length of cuvette or thickness or depth of the color solution



**Principle:**

When a monochromatic light passes through a color solution same specific wavelength of light are absorbed which is related to color intensity.

The amount of light absorbed or transmitted by a color solution is in accordance with two law **Beer’s and Lambert Law.**

The measurement of a color intensity of a color solution by photometry s governed by two law **Beer’s and Lambert Law**

**Uses of Beer’s and Lambert law:**

* it is widely used in the laboratory hospital for estimation of biochemical samples like plasma ,serum ,CSF and Urine
* it is also used to quantities estimation of serum components as well as glucose protein and other various biochemical compounds
* they are widely used by the food industry and by manufactures of paints and textiles

**For Example:**

Example include the determination of bilirubin in blood plasma samples the spectrum of pure bilirubin is known thus the molar absorbance is known measurements are made at one specific wavelength almost unique for bilirubin and another measurement at a second wavelength to interferences or deviation can be eliminated or corrected .

Generally it can be used to determine concentration of a particular substance or determine the molar absorptivity of a substance.

**Question No: 05**

Explain Autoclave its uses and components?

Answer:

**Autoclave** is a pressure chamber used for the sterilization

* the instrument is also termed as sterilizer
* the instrument was first developed in its crewed form by Dr Denis papin and named it as stream digester
* the stream digester was the forefuner of laboratory
* Autoclave invented in 1879 by Dr Charles Chamberland

**Definition:**

It is pressurized device designed to heat aqueous solution above their boiling point at normal atmospheric pressure to achieve sterilization

**Note:**

**Auto=**self and **Clevis=**locking device

**Uses:**

* Surgical instruments
* Plastic sharp container
* Glassware
* Plastic tubes and pipette tips
* Solution and water
* Animals food and bedding
* Biohazards wastes
* Use in microbiology
* Medicine
* Vetenery science
* Dentistry
* Metallurgy
* Sterilized contaminated material

**Components:**

* Heating elements
* Temperature controller
* Pressure sensor
* Chamber
* Door gasket
* solenoid valve
* water level sensor
* stream generator
* vacuum pump

**Major Components:**

* A metal chamber that can withstand high pressure
* A stream jacket surrounding the chamber
* A stream generator
* A capillary thermometer and two pressure gauges to monitor temperature and pressure respectively
* Recording mechanism