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**COURSE TITLE: PROCESS INSTRUMENTATION**

**COURSE CODE: CHE 312**

**QUESTION 1**

a) **Instrumentation** is a branch of science that is involved in measurement and control of process variables within a production or manufacturing area. Process variables include pressure, temperature, humidity, flow, pH, force and speed.

1. In gas chromatography, the **mobile phase** (or "moving phase") is a carrier gas, usually an inert **gas** such as helium or an unreactive gas such as nitrogen. ... The gaseous compounds being analyzed interact with the walls of the column, which is coated with a stationary phase.
2. The **stationary phase** (or "fixed phase") is a microscopic layer of liquid or polymer on an inert solid support, inside a piece of glass or metal tubing called a column (a homage to the fractionating column used in distillation).

c) The reason for moisture measurement in process industries;

Pipelines and natural gas production

- To Ensures no corrosion of pipe, decrease in flow capacity which leads to blockage or equipment damage.

Furnace metal treating

- To avoid poor meatal quality for production and potential equipment failure.

Air separation and ozone purification

- It helps in monitoring and controlling dew points of feed gas so that it remains sufficiently dry to extend the life of the generator.

Semi-conductor manufacturing

- To prevent contamination of materials and to eliminate electricity

Methods of moisture measurements include;

- Absolute measurement method
- Relative humidity
- Capacitance method
- Oxide sensor

## QUESTION 2

1) Reasons for measuring process variable include;

- To attain the actual measured value of the variable being measured.
- To compare the value with a reference or desired value.
- Achieving measurable growth.
- Improves accuracy and good quality.

2) Applications of magnetic flow meter in process industries include;

- Magnetic flowmeters are used in water treatment plants to measure treated and untreated sewage, process water, water and chemicals. Mining and mineral process industry applications include process water and process slurry flows and heavy media flows.
- With proper attention to materials of construction, the flow of highly corrosive liquids (such as acid and caustic) and abrasive slurries can be measured. Corrosive liquid applications are commonly found in the chemical industry processes, and in chemical feed systems used in most industries. Slurry applications are commonly found in the mining, mineral processing, pulp and paper, and wastewater industries.
- Applications for dirty liquids are found in the water, wastewater, mining, mineral processing, power, pulp and paper, and chemical industries. Water and wastewater applications include custody transfer of liquids in force mains between water/wastewater districts. Magnetic flow meters are used in water

treatment plants to measure treated and untreated sewage, process water, water, and chemicals. Mining and mineral process industry applications include process water and process slurry flows and heavy media flows.

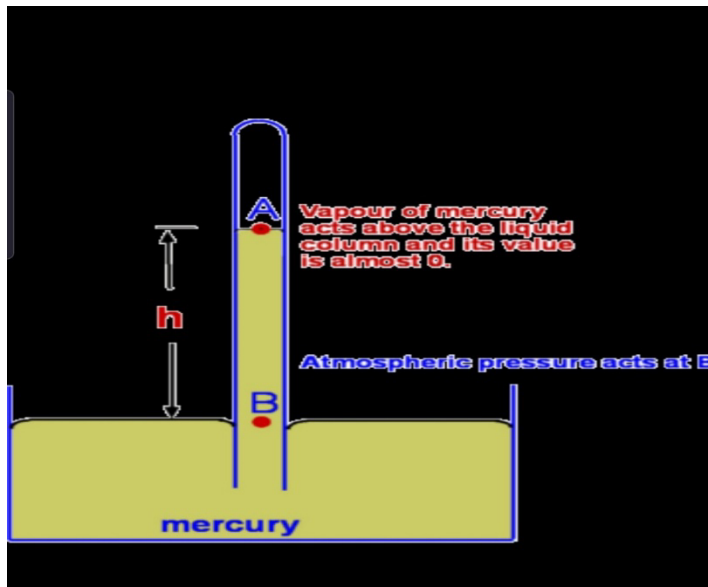
### 3) Diagrams of pressure measurement devices and their working principle

**i) Barometer:** it was invented by Torricelli in 1634. It measures gauge pressure with mercury having standard value 760mmHg pressure.

#### Working principle

To find pressure mercury is taken in a tube with no air in it, it is inverted in a tube of mercury level to retain itself at the level of 760mmHg after its falling.

#### Diagram



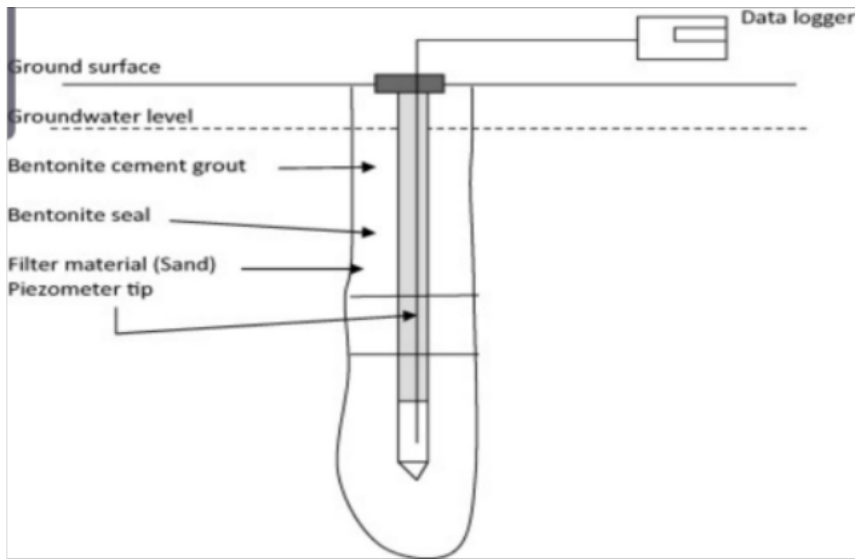
It is based on atmospheric pressure that acts on tube and retains mercury tube.

**ii) Piezometer:** it is a manometer which is a simple one also, fluid whose pressure is to be measured is taken in a tank and connected with a tube of height which is L in shape.

#### Working principle

It depends upon fluids whose pressure is to be measured and poured into a piezometer, through the rise of height in tube, pressure is measured, which its drawback also that it cannot measure negative pressure.

## Diagram



iii) **Differential manometer:** it's a structure which its different in this manner that both ends of this manometer are connected to fluids tanks whose pressure are to be measured, pressure calculated is actually compared to value of zero.

## Working principle

It depends upon internal pressure of both fluids contained in a tube. Three fluids are contained in a vessel tube, two whose pressure is to be measured, one taken as a standard whose movement will show pressure. This phenomenon is known as pressure difference.

## Diagram

