NapC

Q. 1. Describe and explain the working of a Geiger-Muller (G.M.) tube.

Ans. Introduction-

when radioactive isotopes are used in medical research work particularly in human subjects it is very important that the amount of radioactive material given is as small as possible, in order that there should be minimum harmful radiations. Hence a very sensitive instrument is necessary to measure the radioactivity of materials.

Geiger and Muller developed a 'particle detector' for measuring 'ionizing radiation' in 1928. They named it as 'Geiger muller counter'. Ever since then it has been one of the most widely used nuclear detectors in the developmental days of nuclear physics. The particle detector developed by Geiger and Muller is a gas filled counter. The main difference between 'proportional counter' and 'Geiger-muller counter' is in the formation of the avalanche. In the proportional counter, the avalanche is formed only at a point whereas in Geiger-Muller counter it is formed in the central wire. Therefore, in GM counter amplification is independent of initial ionization produced by the ionizing particle.

Geiger counter is also called as Geiger tube. This instrument is actually used for detecting and measuring ionizing radiation like alpha particles, beta particles, and gamma rays. A Geiger-Müller counter can count individual particles at rates up to about 10,000 per second and is used widely in medicine and in prospecting for radioactive ores.

Construction of Geiger-Muller counter

It consists of a hollow metal case enclosed in a thin glass tube. This hollow metal case acts as a cathode. A fine tungsten wire is stretched along the axis of the tube and is insulated by ebonite plugs. This fine tungsten wire acts as anode.

The tube is evacuated and then partially filled with a mixture of 90% argon at 10 cm pressure and 10% ethyl alcohol vapours at 1cm pressure. sten

The fine tungsten wire is connected to positive terminal of a high tension battery through a resistance R and the negative terminal is connected to the metal tube.

The direct current voltage is kept slightly less than that which will cause a discharge between the electrodes.

At one end of the tube a thin window of mica is arranged to allow the entry of radiation into the tube.

Principle of Geiger-Muller counter

The basic principle of the Geiger Muller counter can be understood as follows. when an ionizing particle passes through the gas in an ionizing chamber, it produces a few ions. If the applied potential difference is strong enough, these ions will produce a secondary ion avalanche whose total effect will be proportional to the energy associated with the primary ionizing event.

If the applied potential difference is very high, the secondary ionization phenomenon becomes so dominant that the primary ionizing event loses its importance. In other words, the size of the final pulse produced depends only on the triggering off of ionization by an ionizing particle but independent of the energy of this particle.

A high energy particle entering through the mica window will cause one or more of the argon atoms to ionize. The electrons and ions of argon thus produced cause other argon atoms to ionize in a cascade effect. The result of this one event is sudden, massive electrical discharge that causes a current pulse. The current through R produces a voltage pulse of the order of 10v. An electron pulse amplifier accepts the small pulse voltage and amplifies them to about 5 to 50 v. The amplified output is then applied to a counter. As

each incoming particle produces a pulse, the number of incoming particles can be counted.