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Mam:
Radiobiology Radiation protection

Question 1:-

Different between Deterministic and Stochastic effect of Radiation?

Deterministic effect Deterministic effect of Radiation exposure are produced by high Radiation Doses.	Stochastic effect Stochastic effect of Radiation exposure are the Result of low Doses delivered over a long time period.
Deterministic effect are also called non-stochastic effect.	Stochastic effect is those effect which occurs when a person Receives a high dose of Radiation.

⇒ These effect depend on time of exposure, doses, type of Radiation.	Does not depend on magnitude of absorbed doses these effect occurs
⇒ It has a threshold ~~may be very~~ of Does below which the effect does not occurs the threshold may be vary from person to person.	by chance usually without threshold level of dose have no level of Radiation Dose effect arises from injury to one or a few cell.
⇒ All Early effect and most tissure late effect is determinstic.	Stochastic effect is probabilistic in nature and is proportional to Dose Received.
⇒ Determinstic effect include ① Acute Radiation Sickness ② chronic Radiation Sickness	Two types ① Somatic stochic effect ② Genetic effect The main stochastic effect is Cancer.
⇒ Determinstic effect generally Result from the Receipt of a Relatively high dose over a	Examples:- Hereditary effect and Cancer Incidence are

Short time period
Result from cell
loss or Damage
eg
moist
desquamation from
interventional
Cardiology
May occur a
few hours or day
after exposure
eg
Early
(Skin Reaction)
or may Require
months or years
before expression
eg
(Cataract of
the eye lenes)

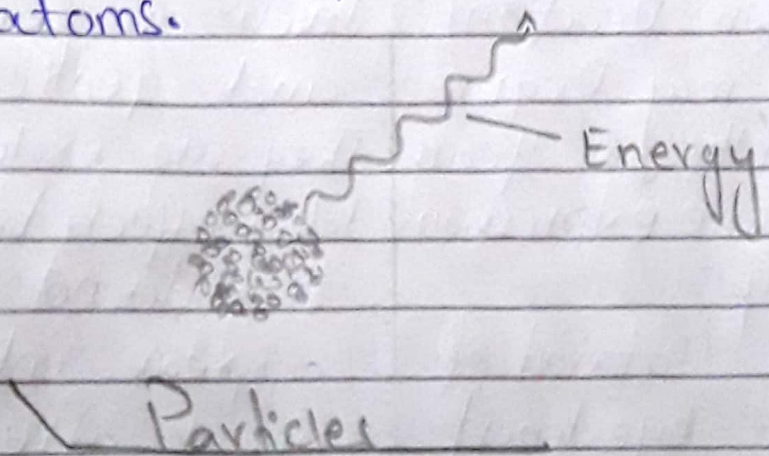
examples of
Stochastic effects
- As Dose increase,
the probability of
Cancer increases
linearly.
- The Severity of
an effect is not
a Function of Dose
- The major
Stochastic effect of
Concern at typical
Diagnostic Radiology
levels are Cancer
and gentic effects
They are exclusively
late effects because
they do not
appear untill
year after
Radiation
exposures.

Question 2:-

Explain briefly following terms Radiation,

① Radioactivity:-

Radioactivity is the spontaneous emission of energy and particles due to the breaking down (disintegretaing) of the Nuclei of unstable atoms.



Three types of Radioactivity

① Alpha:- These are fast moving helium atoms.

② Beta:- These are Fast Moving electrons

(3) Gamma:- These are photons, just like light, except of much higher energy, typically from several kev to several Mev.

(2) Non-Ionizing Radiation:-

- Non-ionizing Radiation is any kind of Radiation in the electromagnetic spectrum that does not have enough energy to Remove an electron from an atom and turn it into an ion. This Contrasts with ionizing Radiation like x-rays, gamma xrays and alpha particles, which come from the other end of the spectrum and are unstable and Reactive. Non-ionizing Radiation can generate heat, which is how food is cooked in a microwave oven. Humans and other organisms can see some types of non-ionizing Radiation, such as visible light and infrared light.

* Examples:-
  - Ultraviolet

- Visible light
- Infrared
- Microwaves
- Radio Frequencies
- Lasers

(3) Ionizing Radiation:-

- The Radiation whath has very high energy is called ionizing Radiation. it is Dangerous and leaves bad impact on human body. Alpha, Beta, x-ray are some example of ionizing Radiation. it has high energy and displace electron from there orbit. creating charge atom and create DNA Damage, outright cell death. ionization Radiation is Radiction with enough energy so that during an interaction with an atom it can Remove tightly bound electron from orbit. Causing the atom to become charged or ionized.

(4) Harmful Radiation:-

⇒ Gamma rays are the most harmful external hazard Radiation. Beta particles can partially penetrate skin, causing "beta burns" Alpa particles cannot penetrate intact skin. Gamm and x-ray can pass through a person damaging cell in their path.

⇒ Radon emits alpha particles, and is therefore ionizing Radiation and dangerous to human health.

Question 3:-

What are Features for Radiation protection design? Explain briefly?

Radiation Protection Features:-

1:- **Protective X-ray tube Housing:-**

Protective housing to Reduce leakage Radiation must be less then 100 mR/hr at a distance of 1m from protective housing.

2:- **Control Panel:-**

All X-ray beam on must be positively and clearly indicated to the Radiologic technologist.

- must show exp. conditions and when tube is energized
- Beam ON must be clear to techs.

3:- **SID Indicator:-**

indicator must

Present (tape measure or Readout) must be accurate within 2% of the indicated SID

4. **Collimation:-**
- Light Field, variable aperture x-ray beam and light fieled must coincide within 2% of SID.

5. **PBL - Positive Beam Limitation:-**
- Auto Collimation circa 1974-1994 must be accurate within 2% of SID

6. **Beam Aligment:-**
How do we know the tube is aligned with the image Receptor.

7. **Filtration:-**
- Inherent plus added
Total must be at least 2.5mm abve 70 kvp

8. **Reproducibility:-**
- Constant output of varied mA Radiation intensity

should not exceed 5% through same technique.

9- **Linearity:-**
Constant output for varied mA settings while time is adjusted to keep mAs the same.
Max variation is 10% from one mA to adj. mA station

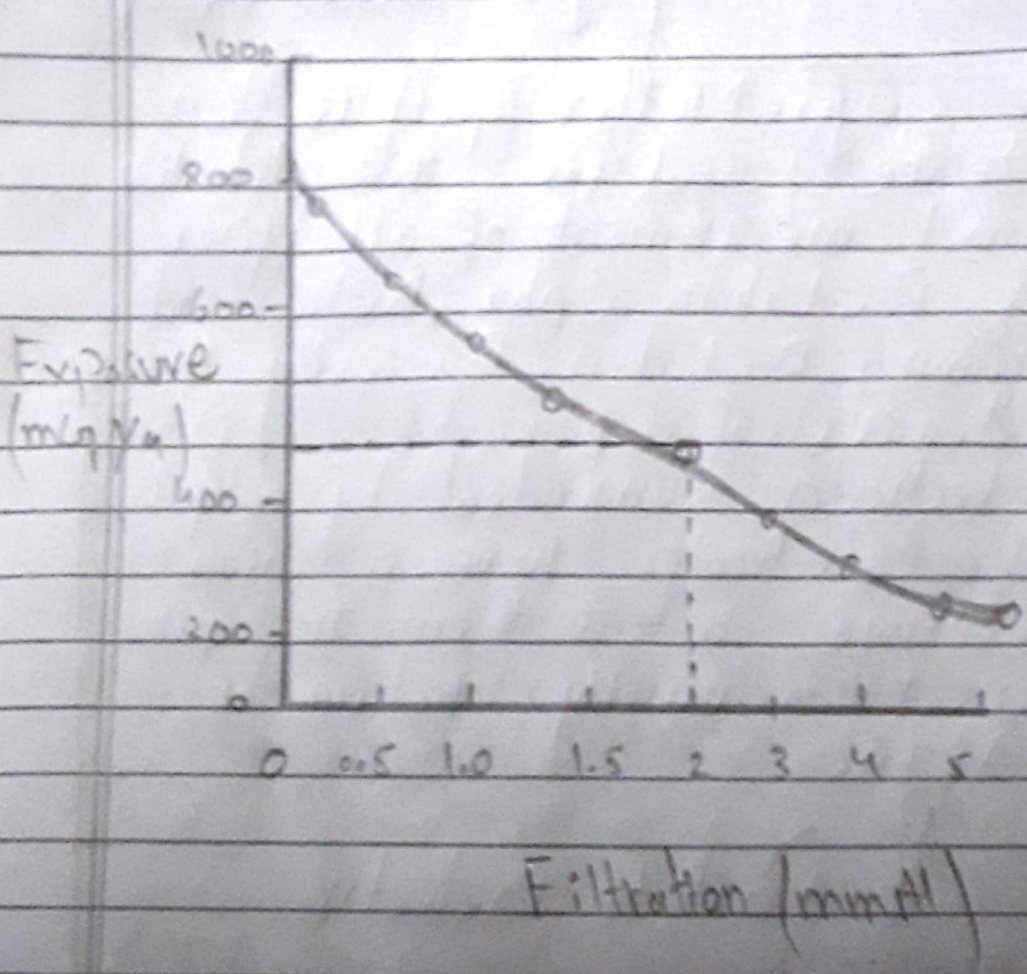
10- **Reproducibility:-**
The variation in x-ray intensity should not exceed 5%.

11:- **Mobile x-ray imaging System:-**
A protective lead apron should be assigned to each mobile x-ray imaging system. The exposure switch of such a imaging system must allow the operator to Remain at least 2m from the x-ray tube during exposure. of course, the useful beam must be directed away from the Radiology technologist while positioned

at the this minimum distance.

12- **Operator Shield:-**

- It must not be possible to expose in a room outside of the operator booth
- Portable x-ray must have >2m tether for exposure.



Question 4:-

what is GM Counter, how it can be used as a Radiation protection device?

GM Counter:-

GM means
Geiger-Muller (GM).

A Geiger-Muller (GM) is a device used for the detection and measurement of all types of Radiation, alpha, Beta and gamma Radiation. Basically it Consists of a pair of electrodes surrounded by a gas. The electrodes have a high voltage across them. The gas used is usually helium or Argon.

Uses:-
Particle Detector

Inventor:-
Hans Geiger
walther Muller

Related items:-

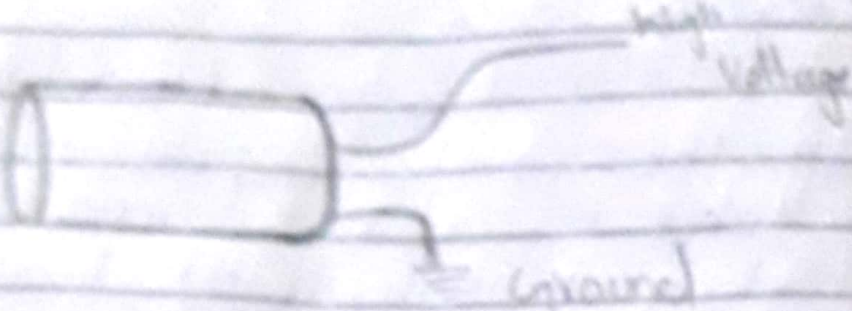
Geiger-Muller tube

⇒ In the G-M Region the voltage across the ionization Chamber is sufficiently high that, when a single ionizing event occurs,

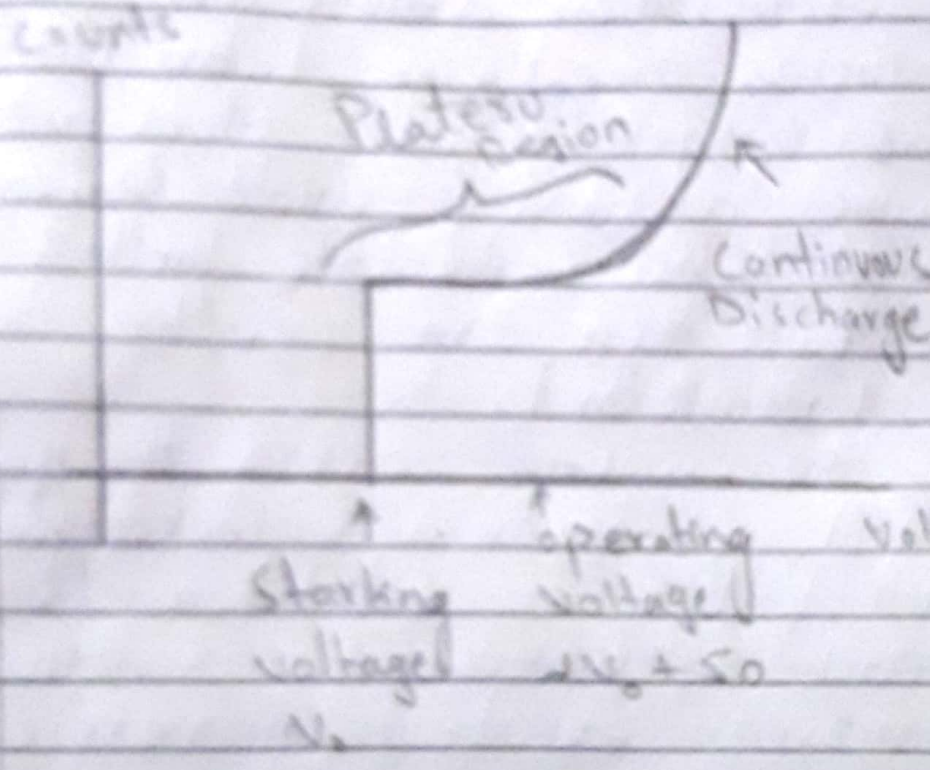
⇒ Geiger Counters are used for Contamination control in Nuclear medicine laboratories

⇒ The Geiger Counter does not have a very wide Range. most instruments are limited to less then 1 m Gy/a/hr (100mR/hr).

⇒ If the voltage across the gas filled chamber is increased still further, a Condition is Reached whereby a single ionizing event Completely discharges the chamber, as in operation in the GM Region. Because of the high voltage, however, electrons Continue to be stripped from atoms of the filling gas, producting a Continuous Current or signal from the Chamber.



Geiger-Mueller Tube



⇒ The GM Counter can count about 5000 particles/sec. The counting Rate depends upon the dead and Recovery time of GM Counter. After dead time the tube takes another 200 sec to

Regian the original working condition. This time is called Recovery time of the GM Counter.

=> The principle of working of GM Counter.

The ionizing particle passing through the tube ionies the Gas and electrons so produced move towards Anode. They velocity is quite high and they later produce secondary electrons after Repeated collisions with the particles of the Gas.

Helium and Argon Gas is vesed.

=> The GM tube has a thin window made of mica at one end.

=> The Geiger operating voltage varies significantly from tube to tube. Some operate as low as 280 volts, while some Soviet tubes Require 1600 volts, most seen to operate at around 900 volts.

Question 5:-

write two basic Principle of Radiation protection?

* ## ALARA

ALARA Stands for "as low as" Reasonably achievable.

You Can use three basic protective measures in Radiation Safety, time, Distance and shielding.

Cardinal Principles

1. Time
2. Distance
3. Shielding

1. Time :-

Radiation exposure Can be accumulated over the time of exposure. In C-arm fluoroscopy guided interventions, the time spent

checking the C-arm fluoroscopy is Related to the Radiation exposure. The longer the exposure time, the more Radiation exposure to the pain physician. Therefore, it is important to Reduce the useage time of C-arm fluoroscopy. For ~~ex~~ Reducing the usage time, the physician has to improve his skill in intervention and the Radiographer has to check the x-ray at the correct location, and at the right moment without blurred imeage.

② **Distance:-**

A Greater distance from the Radiation Sources can Reduce Radiation exposure. The amount of Radiation exposure is not inversely proportional to the distance from the Radiation Sources, but is

inversely proportional to the square of the distance. This means that double the distance from the Radiation source can reduce the Radiation exposure not to 1/2 but to 1/4. Therefore, maintaining a greater distance from the x-ray generator is a very effective method of Radiation Safety. In a previous study of Radiographers, two steps behind the mobile support structure can decrease the exposure of the Radiographer by about 80%. In another study, being only 20cm farther from the center of the x-ray field can decrease the Radiation exposure by about 73%.

(3) **Shielding :-** There are many shielding device such as caps, lead glasses, thyroid protectors, aprons,

Radiation Reducing gloves, and so on, for Radiation Safety during C-arm fluoroscopy guided interventions.

Even though the protective effect is enough for Radiation Safety, no use of the device cannot protect the physician from Radiation.

The Radiation Shielding device are expensive and the use of shielding device can be uncomfortable. However, when a physician uses these device, they can be protected from Radiation exposure.

B Part :-

write down the Names of the Radiation protection Device ?

Radiation Protection Device :-

Radiation Protection Aprons
Apron Accessories
Gloves
Glasses
Thyroid Shields
Apron Racks
Drape Shields
Table Shields

Patient Radiation Protection
Veterinary Radiation protection