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Edited podcast transcription:

There are two general types of radiation detectors that I want to discuss. The first type to remember is the gas detector and the second type is the scintillation detector.

Gas Detectors:
In terms of gas detectors, what I'm talking about are radiation detectors that are filled with gas and within that gas you have ionization events as radiation passes through. By applying a voltage across the detector, you end up creating ions that drift and are measurable. Depending on the voltage that is applied, you can have an ion chamber which is a lower voltage or a Geiger Mueller counter, which is higher voltage.

With the lower voltage ion chamber type detector, you have a few advantages that you should keep in mind. The first advantage is that the amount of charge the detector ends up reading is directly proportional to the number of ionization events within the detector, meaning that your detection is proportional to the energy that is deposited within the detector. So, ion chambers can directly measure the intensity level of radiation exposure such as air kerma and rad.

The first ion chamber that I'll discuss is the dose calibrator. Remember that the dose calibrator is an ion chamber. That differs from a well counter which is a scintillation-based detector.
What other ion detectors do we have?

Another is an ionization chamber detector called the cutie pie. A cutie pie or ion chamber detector can measure a large flux of radiation. So, if you wanted to measure the radiation coming directly out of a CT scanner—the air kerma—you would use an ion chamber like a cutie pie.

If you increase the voltage beyond the ion chamber levels, you end up getting a Geiger Muller detector. Basically, as you increase the voltage the detector gets super sensitive so that even an extremely low radiation rate incident upon the detector will cause a large cascade event in the detector. As a result, these tend to be our survey meters which we commonly known as the Geiger Mueller meter. Remember the Geiger Mueller meter does not directly measure exposure, but you can calibrate it within a selected energy range to give you a reading of mrem per hour. I would look at an image of the Geiger detector. Understand how on the detector there are different sensitivity levels one can select using a switch. Know that if they give you an image of a reading on a Geiger Mueller detector that you may have to multiply the reading by a factor such as 10 or 100 to get the correct level depending on the switch settings that are displayed.

The Geiger Mueller meter is commonly used to survey for contamination, and you also use this detector to survey radiopharmaceutical packages that may be delivered.

For the Core Exam remember dose calibrators and ion chambers such as Geiger Mueller detectors are gas-filled detectors.

Scintillation detectors
Scintillation detectors are those that use a sodium iodide crystal. Sodium iodide crystals are also used in a gamma camera. I assume you understand scintillation events where the radiation hits the crystal and

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causes light production. A detector then converts that light into a signal to detect the radiation. Certain detectors create images from this process, such as a gamma camera. Other detectors do not create images, but still detect the radiation, and we use that information in other ways than image formation.

The two main scintillation detectors I would know for this episode are the thyroid probe and the well counter. These are both non-imaging devices that still use scintillation-based sodium iodide crystals. The well counter is a sodium iodide crystal that has a hole in the center of it that you can put test tubes in it. This is used for purposes such as a wipe test. The well counter is very sensitive. Do not confuse the well counter with the dose calibrator. That is a common mistake, but they are different.

A dose calibrator is a gas-filled ion chamber, and it can measure extremely high radiation levels. The well counter is crystal-based and used to test for much smaller amounts of radiation, such as in the wipe test, where you are wiping a surface to see if there are minute amounts of radiation present. The reason this works is because the scintillation process is so sensitive, and we can detect even minute amounts of light coming off the crystal detector. The well counter is an extremely sensitive measurement device. We also use the well counter to assay small amounts of radioactivity in other ways. One example is after you administer Technetium-99m DTPA for calculation of GFR wherein you measure the amount of radioactivity in a small amount of blood.

A thyroid uptake probe also uses a scintillation crystal that you place at a small distance from a patient's thyroid. You also measure the background radiation levels in the room, as well as the administered dose or radioiodine, and you then can calculate the uptake percentage of radioiodine in the thyroid.
The main point for now is to remember the thyroid uptake probe is a scintillation crystal-based device.