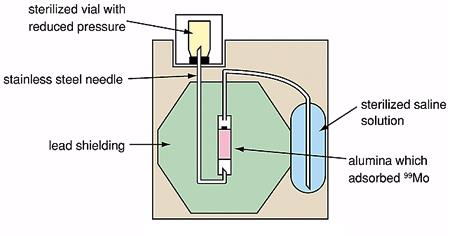
**TAQ-1**

**2. Describe the production of two different radioisotopes for medical imaging purposes.** 200

**ANS**

Technetium(**90mTc**) is the most commonly used radionuclide. Molybdenum(99Mo) is its parent nuclide, which spontaneously undergoes beta decay and produces the technetium in excited state. Technetium production can be represented by the following equation,

**9942Mo → 0-1𝛃 + 9943Tc**



As shown in the diagram, an Mo adsorbed alumina container is placed in the Tc generator. The 99Mo undergoes beta decay and produces technetium which gets dissolved into the saline solution being passed through the alumina. Due to the pressure difference this solution is continually sucked up by the sterilized vial. The filled vial now contains a saline solution with only technetium dissolved in it.

Two radioisotopes of Iodine, namely 123I and 131I are used as tracers in medical imaging. I-131 is a reactor-produced radionuclide of Tellurium target. The production of 131I can be shown by the following equations,

**13052Te → 10n + 13152Te**

13152Te then undergoes beta decay to produce 131I.

**13152Te → 0-1𝛃 + 13153I**

The produced 13153I is then washed away and separated by passing an alkaline solution through the beta decaying Te. The alkaline solution absorbs only the 131I particles.

References:

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**En.wikipedia.org. (2017). Technetium-99m. [online] Available at: https://en.wikipedia.org/wiki/Technetium-99m#Production [Accessed 21 Aug. 2017]**

**Dr Tomislav Me&#353;trovi&#263;, P. (2017). Radioiodine Production. [online] News-Medical.net. Available at: https://www.news-medical.net/health/Radioiodine-Production.aspx [Accessed 21 Aug. 2017]**

**3. State and explain the key biological and radiological properties of radioisotopes used in medical imaging by comparing the two isotopes that you described in 2) above. 200**

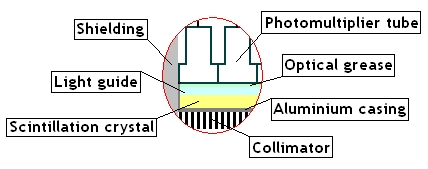
ANS

**TAQ-2**

**1. Describe the process of producing a gamma camera image including the preparation of the patient and how the gamma camera works. You will need to include a fully labelled diagram of the gamma camera and refer to it in your answer. 250**

ANS

A radionuclide is administered into the patient's body in the form of a radiopharmaceutical (also called as tracer). It can be in any state of solid, liquid or gas depending on the tracer used. This is then followed by a wait interval which allows the tracer to accumulate in some part of the body for a short period of time. The substance emits gamma radiation while it is in the desired part of the patient’s body. A gamma camera captures these emitted gamma rays and forms an image using a computer.



A gamma camera has a detector plane(crystals) which is optically coupled with an array of photo-multiplier tubes(PMT). The collimator is a lead plate with drilled holes in it. It makes sure that only the gamma rays travelling vertically upwards reach the detector plane(scintillator). As the gamma ray falls on the scintillator, it produces a tiny flash which is too low in energy to be detected by a film. These tiny flashes of photons is then guided via a light guide and the fall on the PMT. The bottom layer of PMT is of photocathodes. When the photon falls on it, an electron is emits an electron which is then accelerated to higher levels of energy by step voltages in the second part of the PMT. This high energy electron collides with other atoms and starts the Avalanche effect which eventually generates enough electrons to produce a small current which is detected by an amplifier. The amplifiers pass on the signal to a computer system which uses this data to generate a diagnostic image.

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**(ACR), R. (2017). Nuclear Medicine, General. [online] Radiologyinfo.org. Available at: https://www.radiologyinfo.org/en/info.cfm?pg=gennuclear [Accessed 21 Aug. 2017]**

**En.wikipedia.org. (2017). Gamma camera. [online] Available at: https://en.wikipedia.org/wiki/Gamma\_camera [Accessed 21 Aug. 2017]**

**2. Give an example of a typical imaging process for a particular condition and state what radioisotope would be used. 150**

ANS

**TAQ-3**

**1. Explain the advantages in the use of radiopharmaceuticals for treatment, as opposed to irradiation using external sources of Radiation. 250**

**TAQ-4**

**1. Describe the effects of alpha, beta and gamma radiation on living Cells. 180**

ANS

Alpha particles are very low energy particles, hence they are not able to penetrate the skin. But they can enter the body via oral ingestion, inhalation or adsorption into the bloodstream. Inhaled alpha particles mostly stay in the lungs and can damage the tissue cells and develop cancer. It can also damage the kidneys if it enters the body through blood or liquid ingestion. Prolonged presence of alpha particles in the body can lead to DNA damage too.

Beta radiation is high energy particle and hence it has more penetrative power. It can damage tissue when exposed and even increases the risk of cancer. Inhalation or ingestion of beta particle can cause cell mutation and changes in cell functioning. It is also capable of inducing hair loss, skin burn and weakness.

Gamma radiation is energetic enough to break bonds in genetic material and DNA molecules. It is also capable of altering cell component structures. Prolonged exposure to gamma radiation can lead to diarrhea, headache, hair loss and skin burns along with higher risks of cancer and cataract.

References:

**Sites.google.com. (2017). Biological Effects - Gamma Radiation. [online] Available at: https://sites.google.com/site/smrichardsgammaradiation/biological-effects [Accessed 21 Aug. 2017]**

**Orfano, F. (2017). Learn about the Effects of Alpha Radiation on Humans. [online] Bright Hub. Available at: http://www.brighthub.com/environment/science-environmental/articles/85643.aspx [Accessed 21 Aug. 2017].**

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**TAQ-5**

**1. Distinguish between the effects that radiation can have on an adult and those which can result as a consequence of a foetus being exposed to a significant dose of radiation. 180**

ANS

Effects of radiation exposure on adults includes, hair loss because the radiation damages the hair roots and renders them unable to grow more hair. Skin redenning (like sunburn) because of high energy transfered to the skin tissue from radiation particles. Breakdown of the intestinal lining due to tissue damage. All of the above mentioned effects of radiation exposure on adults depends on the dose and the duration of exposure.

Exposure to radiation on foetuses are, great tissue damage which leads to miscarriage, DNA damage which results in birth defects and mental retardation. Leukemia is also caused by radiation poisoning.

The effects of radiation exposure on foetuses depends upon the gestational age and the dose of radiation.