

HOUSEHOLD QUESTION

Some 25-30% of food harvested is lost as a result of spoilage before it can be consumed. This problem is particularly prevalent in hot, humid countries. Food irradiation is the process of exposing foodstuffs to gamma rays to kill bacteria that can cause food-borne disease, and to increase shelf-life. It has the same benefits as when food is heated, refrigerated, frozen, or treated with chemicals, but does not change the temperature or leave residues. What radionuclide would you use for this purpose and why?

HOUSEHOLD QUESTION

One of the most common uses of radioisotopes today is in household smoke detectors. Smoke detectors work by a radionuclide emitting particles which ionises the air and allows a current to flow between two electrodes. If smoke enters the detector it absorbs the particles and interrupts the current, setting off the alarm. Which is the best radionuclide to use for this purpose and why?

HOUSEHOLD QUESTION

Certain radionuclides release particles during decay, triggering a chemical reaction upon contact with other materials. This reaction creates a 'glow' as perceived by the human eye. These properties – known as radioluminescence – make the isotopes useful for providing 'light' in the absence of electricity. You are travelling on a research expedition to the Arctic Circle where it is dark 22 hours of the day in winter. Due to the cold temperatures and length of expedition batteries are impractical. You require a compass that can be read easily, which radionuclide would you use for this purpose and why?

MEDICINE QUESTION

Diagnostic techniques in nuclear medicine use radiopharmaceuticals (or radiotracers) which emit particles or rays from within the body. These tracers are generally short-lived isotopes. Dependent on the type of examination, radiotracers are either injected into the body, swallowed, or inhaled in gaseous form. The emissions from the radiotracers are detected by the imaging device, which provides pictures and molecular information. A patient needs to have the gas exchange in their lungs investigated, what radionuclide would you use to carry out these investigations and why?

MEDICINE QUESTION

Nuclear medicine is also used for therapeutic purposes. What radionuclide would you use to treat a cancerous tumour affecting the thyroid gland? Please explain your choice!

MEDICINE QUESTION

Radionuclide therapy has progressively become more successful in treating persistent disease and doing so with low toxic side-effects. With any therapeutic procedure the aim is to confine the radiation to well-defined target volumes of the patient. Many of these therapeutic procedures are palliative, usually to relieve pain. For instance, there are several radionuclides that are used for the relief of cancer-induced bone pain. Which radionuclides would you use to target cancerous growths in the bone and why? *Hint what is bone mostly made out of?

NUCLEAR POWER QUESTION

Radioisotope Thermoelectric Generators (RTGs) have been the main power source for space work since 1961. The high decay heat and short range of particle emissions of certain radionuclides allows them to be used as an electricity source in the RTGs of spacecraft. RTGs are safe, reliable and maintenance-free and can provide heat or electricity for decades under very harsh conditions. You are in charge of selecting an appropriate radionuclide to power a 50 year satellite Mars mission, which radionuclide do you choose to power your satellite and why?

NUCLEAR POWER QUESTION

Advanced gas-cooled reactors (AGRs) are the second generation of British gas-cooled reactors, using a graphite moderator and carbon dioxide as a primary coolant. These reactors, like other nuclear technology, use the energy released by splitting atoms of certain elements. What is the best radionuclide to use as a fuel for an AGR and why?

NUCLEAR POWER QUESTION

Nuclear power is particularly suitable for vessels which need to be at sea for long periods without refuelling, or for powerful submarine propulsion. Over 160 ships are powered by more than 200 small nuclear reactors. Most are submarines, but they range from icebreakers to aircraft carriers. Which radionuclide would you chose to power a submarine and why?

SCIENTIFIC QUESTION

Efficient use of fertilisers is a concern to both developing and developed countries. It is important that as much of the fertiliser as possible finds its way into plants and that a minimum is lost to the environment. Fertilisers 'labelled' with a particular isotope, provide a means of finding out how much is taken up by the plant and how much is lost, allowing better management of fertiliser application. Which radionuclide would you use for this purpose and why?

SCIENTIFIC QUESTION

Analysing the relative abundance of particular naturally-occurring radioisotopes is of vital importance in determining the age of rocks and other materials that are of interest to geologists, anthropologists, hydrologists, and archaeologists, among others. What radionuclide would you use to measure the age of wood and why?

SCIENTIFIC QUESTION

The ability to use radioisotopes to accurately measure thickness is widely used in the production of sheet materials, including metal, textiles, paper, plastics, and others. They measure the amount of radiation from a source which has been absorbed in materials. What radionuclide would you use to measure the thickness of an extruded metal pipe for constructing a new research reactor, why did you choose this radionuclide?