The chemistry essay

SUMMARYNuclear equations for production of radioisotopesUnderstanding of term transuranic element and methods of productionTransuranic elements are elements with an atomic number above that of uranium with atomic number Z= 92. Most only exist for a short time as they are radioactive and spontaneously decay.

Only three of the transuranic elements, those with atomic numbers 93, 94 and 95, have been produced in nuclear reactors.? * When U-238 is bombarded with neutrons it can be converted to U-239 that undergoes beta decays to produce neptunium and plutonium. * ? * Pu-239 is changed to americium by neutron bombardment. * ? Americium-241 is used in most house smoke alarms. Transuranic elements from atomic number 96 and up are all made by accelerating a small nucleus (such as He, B or C) in a charged particle accelerator to collide with a heavy nucleus (often of a previously made transuranic element) target. eg meiterium and hassium.

In accelerators, Hassium produced by bombarding lead with iron208Pb + 58Fe 265Hs + 1nIn nuclear reactors, Neptunium (Z= 93) is obtained by neutron bombardment of plutoniumAmericium is obtained by neutron bombardment of plutoniumConditions under which a nucleus is unstable and the types of radioactive decay? All elements heavier than bismuth (Bi-83) (and some lighter) exhibit natural radioactivity and thus can “ decay” into lighter elements. Nuclear reactions result in the transmutation of one element into a different isotope or a different element altogether as it seeks for stability. There are three common types of radiation and nuclear changes: Alpha Radiation (?) is the emission of a high energy alpha particle from an unstable atoms nucleus. Even thought an alpha particle is emitted at a high energy, it loses energy quickly as it travels through the air, due to its mass and therefore cannot travel long distances. It is able to be stopped by a sheet of paper/ outer layers of human skin.

Usually the product of heavier elements. An ? particle contains two protons and two neutrons (). When an atom emits a particle, the atoms atomic mass will decrease by four units and the atomic number (z) will decrease by two units. The element is said to “ transmute” into another element.. An example of an a transmutation takes place when uranium decays into the element thorium (Th) by emitting an alpha particle, as depicted in the following equation: 238 92| U | | 4 2| He | + | 234 90| Th| Beta Radiation (?) is the transmutation of a neutron into a proton and an electron, it occurs in elements with more neutrons than protons.

(followed by the emission of the electron from the atoms nucleus: (). Beta particles have a greater penetrating power than alpha particles and need aluminium foil to stop it. When an atom emits a ? particle, the atoms mass will not change, however the atomic number will increase by one.

An example of this is the decay of the isotope of carbon named carbon-14 into the element nitrogen: 14 6| C | | 0 -1 | e | + | 14 7| N| Gamma Radiation (?) involves the emission of electromagnetic energy from an atoms nucleus. No particles are emitted during gamma radiation, and thus gamma radiation does not itself cause the transmutation of atoms, however ? radiation is often emitted during and simultaneous to, ? or ? radioactive decay. X-rays, emitted during the beta decay of cobalt-60, are a common example of gamma radiation. The penetrating abilityof gamma rays are much greater than that of alpha or beta particles. They can only be stopped by several centimeters of lead or more than a meter of concrete.

In fact, gamma rays can pass right through the human body. Gamma rays often accompany other processes of decay such as alpha or beta. An example of this was our previous representation of an alpha particle process. It is a way for the nucleus to release excess energy. The ratio of neutron to proton for light elements should be 1: 1, for heavy elements it should be 1. 5: 1. Too high (excess neutron) beta decay. Too low(Excess proton) positron decay.

The size of the actual atom, too large and it becomes unstable. Electrostatic forces of repulsion within the atom and the nuclear force of attraction if out of balance, causes instability. Alpha decayUse of a radioisotope used in medicine * Technetium-99m (Tc-99m) is used in a wide range of medical applications, such as pinpointing brain tumours. * Technetium-99m (Tc-99m) is used in over half of the current nuclear medicine procedures, such as pinpointing brain tumours. Tc-99m can be changed to a number of oxidation states. This enables production of a wide range of biologically active chemicals.

The Tc-99m is attached to a biological molecule that concentrates in the organ to be investigated. Is used in the diagnosis of disease. It is injected and the low energy gamma rays it emits can be detected externally.

Use to show blood abnormalities, heart defects, and the size and location of cancerous growths. Attachable to a range of biological carriers and can concentrate in a number of different types of tissue and organs. * Tc-99m is used because: * it has a very short half-life of 6 hours * it emits low energy gamma radiation that minimises damage to tissues but can still be detected in a persons body by a gamma ray sensitive camera * it is quickly eliminated from the body (readily excreted-minimum exposure) * Technetium is reasonably reactive; it can be reacted to form a compound with chemical properties that leads to concentration in the organ of interest such as the heart, liver, lungs or thyroid. * Attachable to a range of biological carriers and can concentrate in a number of different types of tissues and organs. * Made when and where needed from molybdenum-99 in a transportable generator. Benefits and problems associated with radioisotopesBenefits for industry-ability to make monitoring equipment more sensitive, precise and reliable than earlier equipment, more efficient and reliable eg sterilisation, things that were no otherwise possible eg. Examine buildings and machinery for weld and structural faultsBenefits medicine- created a range of non-invasive diagnostic procedures, otherwise inpossible eg on the heart, brain, kidney, thyroid.

Introduction to radiation terapy to treat many forms of cancer, most effective treatment. Problems- radiation for radioisotopes is harmful to people. Alpha , beta and gamma radiation from radioactive substances can cause undesirable reactions in living tissue. Tissue damage-look like skin burns, nausea(mild exposure), radiation sickness lead to death (high exposure).

Cancer-do not show up until 10-20 years after exposure. Genetic damage-deformities in offspring. To avoid harmful effects of radiation a set of safety precautions must be followed. Addresses specific radioisotopes for suitable use in medicineTechnetium-99 (an isotope of the artificially-produced element technetium) is a radioisotope widely used in nuclear medical procedures. Technetium-99 decays by an isomeric process which emits gamma rays and low energy beta particles (electrons). Mixed with some blood serum and injected into a patients blood stream, its distribution in the body is measured with a scintillation counter and used to detect blood clots, constrictions and other circulation disorders. In a different for it can be taken up by the heart tissue, to assess the damage after a heart attack, also used to detect brain tumours. Short half life, 6hrs, rapidly decays, minimal damage to patient.

Used to diagnose thyroid abnormalities. Internal radiotherapy involves the introduction of a radioisotope as a radiation source. Iridium-192 implants emit both gamma and beta rays that destroy surrounding target tissue. In low dose forms, strontium-89 has been used to relieve cancer-induced bone pain. Not all radioisotope techniques involve restricted sites, in the treatment of some diseases requiring bone marrow transplants the malfunctioning marrow is killed with a massive dose of radiation before the introduction of healthy marrow. Cancer treatment-cobalt 60.

One way of treating cancer is to irradiate the affected areas of the body with gamma rays which kill cancer cells and some good cells. Cobalt-60 is used in radiation therapy. Gamma rays that accompany this beta emission attack the cancer because they are able to penetrate quite deeply into the body tissue.

Used as the gamma rays carry a suitable amount of energy to destroy certain biological molecules. Suitable half life, sufficiently long for the radiation source to have a reasonable lifetime in the equipment (4-6yrs) but short enough for the source to emit reasonable intensity of radiation. The selection of radioisotopes for medical use is governed by several important considerations involving dosage and half-life. Radioisotopes must be administered in sufficient dosages so that emitted radiation is present in sufficient quantity to be measured. Ideally the radioisotope has a short enough half-life that, at the delivered dosage, there is insignificant residual radiation following the desired length of exposure.

Regardless, the use of radioisotopes allows increasingly accurate and early diagnosis of serious pathology (e. g. tumors) and earlier diagnosis often results in more favorable outcome for patients. Recent discovery of elementsFirst element to exist only in the laboratory was technetium (Z= 43), created in 1937 by bombarding molybdenum with deuterium nuclei.

During and after WW2 an American team led by Glenn Seaborg created 10 new elements in an accelerator, including neptunium, first element heavier than uranium, and plutonium, the element used in the atomic bomb. Since 1970s synthesis of heavier new elements was dependent on the new generation of particle accelerators. Last decade, many new elements have been produced artificially eg hassium. Many recent discoveries are elements that only exist for a fraction of a second. Use of radioisotope in industry * Cobalt-60 (Co-60) is used in a process called industrial radiography, to inspect metal parts and welds for defects.

* Cobalt-60 is used in industrial radiography to inspect metal parts and welds for defects. Beams of radiation are directed at the object to be checked from

a sealed source of Co-60. Radiographic film on the opposite side of the source is exposed when it is struck by radiation passing through the objects being tested. More radiation will pass through if there are cracks, breaks, or other flaws in the metal parts and will be recorded on the film. By studying the film, structural problems can be detected. * Co-60 is used because it is an emitter of gamma rays which will penetrate metal parts.

Co-60 has a half-life of 5. 3 years and can be used in a chemically inert form held inside a sealed container. This enables the equipment to have a long lifetime and not require regular maintenance.

Ease of transport as no power is needed, useful in remote areasBibliography Textbook Author| Title| Date of publication| Place of publication| Publisher??™s name| Marchment. W| Excel revise HSC chemistry core in a month| 2001| Glebe NSW| Pascal Press ??“ Vivienne Pertris Joannou| Hogan. MSchell.

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htm| Nuclear stability and radioactive decay| Cruising Chemistry| N/A| Ed Hsiu| 28/11/10| http://www. chem. duke. edu/~jds/cruise_chem/nuclear/stability. html| Radioisotopes in medicine| Radioisotopes in medicine| 2001| Uranium Information Centre Ltd| 29/11/10| http://albert-cordova. com/ans/medical-radiso. pdf| ReliabilityThe reliability of secondary sources depends on the sources originating from a reputable institution or reputable author, the information being current, and being consistent across all sources. The secondary sources used in my research task are deemed reliable as the meet the above criteria.

The information obtained from the sources in the bibliography has all been consistent. Some of the sources go into more depth than other sources in different areas of nuclear chemistry. Most of the sources come from either reputable institutions or reputable authors. For example HSC online is a reputable source as the information on the website is endorsed by reputable institutions like the Board of Studies and the Charles Sturt University. All of the sources used in this research task were all updated and published in the past ten year, so they are current information. Therefore the secondary sources used in this research task are reliable.