NUCLEAR CHEMISTRY PROBLEMS

Honors Chemistry
CHS/Dooner

1. One of the radioactive nuclides formed in nuclear power plants is hydrogen-3, called tritium, which has a half-life of 12.26 years. How long before a sample decreases to 1/8 of its original amount?

2. Cobalt-60, which is the most common nuclide used in radiation therapy for cancer, undergoes beta emission. Write the nuclear equation for this reaction.

3. Carbon-11 is used in PET brain scans because it emits positrons. Write the nuclear equation for the positron emission of carbon-11.

4. Mercury-197 was used in the past for brain scans. Its decay can be detected, because this nuclide undergoes electron capture, which forms an excited atom that then releases a gamma photon that escapes the body and strikes a detector. Write the nuclear equation for the electron capture by mercury-197.

5. Phosphorus-32, which is used to detect breast cancer, undergoes beta emission. Write the nuclear equation for this reaction.

6. Write the nuclear equation for the positron emission of potassium-40.

7. Radioactive selenium-75, used to determine the shape of the pancreas, shifts to a more stable nuclide via electron capture. Write the nuclear equation for this change.

8. Nitrogen-containing explosives carried by potential terrorists can be detected at airports by bombarding suspicious luggage with low energy neutrons. The nitrogen-14 absorb the neutrons, forming nitrogen-15 atoms. The nitrogen-15 atoms emit gamma photons of a characteristic wavelength that can be detected outside the luggage. Write a nuclear equation for the reaction that forms nitrogen-15 from nitrogen-14.

9. Nuclear wastes must be isolated from the environment for a very long time because they contain relatively long-lived radioactive nuclides, such as technetium-99 with a half-life of over 210,000 years. One proposed solution is to bombard the waste with neutrons so as to convert the long-lived nuclides into nuclides that decay more quickly. When technetium-99 absorbs a neutron, it forms technetium-100, which has a half-life of 16 seconds and forms stable ruthenium-100 by emitting a beta particle. Write the nuclear equations for these two changes.

10. Phosphorus-32, which is used for leukemia therapy, has a half-life of 14.3 days. What fraction of the sample is left in 42.9 days?