Sample: Nuclear Physics - Atomic Energy Problems

Atomic Energy Problems

1) In a conventional explosion, when each molecule of high explosive chemically reacts, it produces about 4 x 10^{-18} J (joules) of energy. If each molecule of high explosive weighs as much as a single uranium 235 atom, and each uranium atom releases about 4 x 10^{-11} J in a fission explosion, what is the ratio between the number of joules of energy produced by one kg of uranium 235 in a nuclear fission explosion and the energy produced by a kg of high explosive blowing up? Your answer should be a unitless ratio (energy from uranium) ÷ (energy from high explosive).
Answer:

Solution:
Take 1 kg capable of splitting uranium-235. To calculate contained therein cores (equal to the number of atoms), it is necessary to divide the mass of all substances on its molar mass and multiply by Avogadro's number NA = 6.02 • 1023 1/mol:

$$N = \frac{6{,}02 \cdot 10^{23}\ \left(\frac{1}{mol}\right) \cdot 1(kg)}{0.235\ (kg)} = 2.56 \cdot 10^{24}\ (atoms)$$

The energy produced by one kg of uranium 235

$$E_{1kg}^{U} = 2.56 \cdot 10^{24} \cdot 4 \cdot 10^{-11} = 1.016 \cdot 10^{14}\ (J)$$

If each molecule of high explosive weighs as much as a single uranium 235 atom
the energy produced by a kg of high explosive blowing up

$$E_{1kg}^{HEB} = 2.56 \cdot 10^{24} \cdot 4 \cdot 10^{-18} = 1.016 \cdot 10^{7}\ (J)$$

So $\frac{E_{1kg}^{U}}{E_{1kg}^{HEB}} = \frac{1.016 \cdot 10^{14}\ (J)}{1.016 \cdot 10^{7}\ (J)} = 10^{7}$

Answer: 10^{7}

2) Label as **true** each of the following processes that are considered destructive to cells of a living organism (like you!). Label as **false** if they are not considered significantly destructive to cells of a living organism.

a) A slow neutron combines with a Hydrogen nucleus in a living cell. Hint: this one is more difficult than the others. Think about what must happen during and after they combine.
True
Explanation: The new nucleus is unstable and will emit radiation later.

Answer (either True, the process is considered destructive to cells of a living organism; or False, the process is considered significantly destructive to cells of a living organism) and Explanation:

b) A highly energetic beta particle goes through the cell and interacts with many electrons and protons.
True
Explanation:
Beta radiation is more penetration power. Odometer beta-particles in the air can reach several meters and a few centimeters of tissue. Since running electrons with 4Mev inair is 17.8 m, and 2.6 cm of tissue.

Answer (either True, the process is considered destructive to cells of a living organism; or False, the process is considered significantly destructive to cells of a living organism) and Explanation:

c) A highly energetic neutron passes through the cell without hitting any nuclei.

Answer (either True, the process is considered destructive to cells of a living organism; or False, the process is considered significantly destructive to cells of a living organism) and Explanation:
False
Explanation: For fast neutrons to 90% of the energy lost by elastic tissue interaction. In this crucial scattering of neutrons by protons. Further energy release occurs as a result of ionization of the medium recoil protons.

d) The cell absorbs 10,000 photons that each have 0.1 eV (electron Volts) of energy.

Answer (either True, the process is considered destructive to cells of a living organism; or False, the process is considered significantly destructive to cells of a living organism) and Explanation:
False.
Explanation: Photons relating to the infrared region of the spectrum. Therefore, the destructive effect they will not bring. 0.1eV is a low energy. photons, which do cause damage have an energy of a few eV

e) An atomic nucleus, produced by fission explosion, has a 10,000 year half-life for alpha tunneling decay. This fission by-product is absorbed into a living cell. Recall that an alpha particle is two protons and two neutrons, which is simply a Helium nucleus.
False
Explanation: With a 10,000 year half life, the increased risk in cancer is sligh

Answer (either True, the process is considered destructive to cells of a living organism; or False, the process is considered significantly destructive to cells of a living organism) and Explanation: