1. Indicate whether the following statements are true (T) or false (F).

(  ) Most of the volume of an atom contains only electrons.

(  ) Isotopes of an element have the same number of neutrons.

(  ) If 0.001 u of mass disappears in a nuclear reaction, more than 1 MeV of energy is released.

(  ) One gram of gold and one gram of silver contain the same number of atoms.

(  ) A relativistic proton and a relativistic electron, both with the same speed, have the same percent increase in mass.

(  ) The scattering of a photon by an electron (Compton scattering) demonstrates that electrons have wave-like properties.

(  ) The binding energy of a nucleus increases as the number of nucleons in the nucleus increases.

(  ) Heavy nuclei with \( Z > 83 \) are radioactive because the repulsive electrostatic forces between the protons are greater than the attractive nuclear forces between the nucleons.

(  ) A daughter produced by \( \beta^+ \) radioactive decay has more protons in its nucleus than does the parent.

(  ) A sample of a radionuclide with a half-life of 1 hour that had an initial activity of 60 mCi will have an activity greater than 1 mCi after decaying for six hours.

(  ) The initial kinetic energy of the heavier fission fragment is greater than that of the lighter fission fragment.

(  ) The temperature in the center of a red giant is greater than that in the center of a younger hydrogen burning star.

(  ) A nuclear reactor that consumes 2.8 kg of \( ^{235}\text{U} \) every day has an average thermal power greater than 2000 MW.

(  ) Radioactive \( ^{40}\text{K} \) is a product of a primordial decay chain.

(  ) The fission of an atom of \( ^{235}\text{U} \) releases twice as much energy as the fission of an atom of \( ^{239}\text{Pu} \).
2. What is the relativistic mass, in atomic mass units, of an electron with a kinetic energy of 10 MeV?

3. How much energy is released when a neutron is absorbed by a nucleus of $^{15}$O? In what form is this energy released?
4. Neutrons incident on a lithium sample can produce the following (n,d) reaction: $^6\text{Li} + ^1\text{n} \rightarrow ^3\text{He} + ^1\text{H}$. This reaction has a $Q$-value of -2.725 keV. (a) What is threshold energy for this reaction? (b) What is the total kinetic energy of the reaction products at the threshold?

5. The radionuclides in a radioactive sample have a mean lifetime of 12 h and decay to a stable daughter. The activity of the sample after decaying for 1 day is found to be 1.5 MBq. (a) What was the initial sample activity (in Bq)? (b) How many radionuclides were initially in the sample? (c) How many daughter atoms were produced during the one-day decay period?