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

( ) The isotopic abundance of $^{18}$O is greater than 0.01.

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

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

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

( ) The energy of an electron bound to an atom has less energy than a free electron.

( ) Fusing two nuclei is an exoergic reaction.

( ) Generally, a more stable nucleus is produced if the number of neutrons is odd.

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

( ) More different radionuclides are produced by cosmic rays than by the decay of primordial radionuclides.

( ) In the reaction $x(X, Y)y$, the kinetic energies of the products $Y$ and $y$ depends on only the masses $m_y$ and $m_Y$ and the Q-value of the reaction.

2. If a neutron has a 0.2% relativistic increase in mass, what is the kinetic energy of the neutron in MeV?
3. A radionuclide source has an initial activity of 0.25 mCi. One week later the activity has dropped to 0.5 µCi. (a) What is the half-life (in hours) of this radionuclide? (b) How many atoms of the radionuclide were there initially in the sample?

4. Consider the following nuclear reaction.

\[ ^1p + {}^{28}\text{Si} \rightarrow {}^4\alpha + {}^{25}\text{Al} \]

(a) What is the Q-value for this reaction?
(b) What is the kinematic threshold energy of the proton for this reaction?
(c) What is the Coulombic threshold energy of the proton for this reaction?