7. In the triple alpha process, three _____ fuse under the action of the _____ to form _____ and a burst of _____.
   A) hydrogen atoms, gravitational force, ^{3}Li, neutrinos
   B) deuterium nuclei, electromagnetic force, ^{6}Li, neutrinos
   C) helium nuclei, strong nuclear force, ^{12}C, radiative energy
   D) helium nuclei, gravitational force, ^{12}C, positrons
   E) carbon atoms, strong nuclear force, ^{18}F, radiative energy

C

8. Consider the cross-section of a 33 $M_\odot$ star immediately **prior** to going supernova. The central core is predominantly _____ and, moving **upward** from the core, successively _____ elements are being fused _____.
   A) iron, heavier, in shells surrounding the core
   B) iron, lighter, in shells surrounding the core
   C) lead, lighter, on the star's surface
   D) lead, heavier, on the star's surface
   E) silicon, heavier than uranium, at the interface between the core and the lowest shell

B

9. Interstellar dust constitutes ~ _____ percent of the total visible mass in space and the dust particles are approximately the same length as _____. When starlight passes through a dusty cloud on its way to earth, the star appears _____ to us than it truly is.
   A) 1, blue wavelengths, redder
   B) 99, household dust, bluer
   C) 1, red wavelengths, bluer
   D) 25, household dust, redder
   E) 25, blue wavelengths, redder

A

10. Consider the set of three nuclear reactions that constitute the proton-proton chain. The sum of all the nuclear masses on the left hand side (the original reacting masses) _____ the sum of all the nuclear masses on the right hand side (the final products) because _____.
   A) is greater than, chemical reactions **absorb** heat energy, but energy is equivalent to mass. Thus, mass is lost (absorbed) on the right hand side.
   B) is identical to, chemical reactions create heat energy but there is no mass loss
   C) is less than, the energy from their collisions is converted into **more** mass ($m = E / c^2$) on the right hand side
   D) is identical to, the particles bump into each other, creating heat energy from the collisions, but there is no mass loss
   E) is greater than, some of the original mass has been converted to energy which appears on the right hand side

E

11. A star whose absolute magnitude M is +2.2 is seen to have an apparent magnitude, when viewed from Earth, of m = +5.2. The distance to this star is ~_____ pc.
   A) 40
   B) 8.2
   C) 1000
   D) 350
   E) 1.6

39.8

$d = 10^{(m - M + 5)/5}$

A

12. The luminosity of a star is _____.
   A) the energy output at visible wavelengths from one square meter of the star's surface
   B) its overall brightness on the side facing Earth
   C) its total energy output per unit time emitted from all over the star at all wavelengths into all space
   D) its brightness when measured from a distance of 10 parsecs
   E) its energy output per second that is received on one square meter of the Earth's surface