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38.1
44

1. The most likely places in which stars and planetary systems are forming are in _____ and these objects are best studied _____.
   A) dust-free regions of very hot helium gas (~10 x 10^6 K) in the spiral arms of galaxies, at infrared wavelengths which can penetrate Earth's atmosphere
   B) dense centers of spiral galaxies, at x-ray wavelengths from the proto-stellar disks surrounding young condensates
   C) gas and dust clouds (nebulae), at infrared wavelengths which can easily emerge from the obscuring cloud
   D) gas and dust clouds (nebulae), at ultraviolet wavelengths which are characteristically emitted by hot, young stars
   E) outer space between galaxies, at visible wavelengths

C

2. A particular giant molecular cloud has a **total** mass of approximately 400 000 solar masses (= 400,000 $M_\odot$). The mass of **helium** in this cloud is approximately _____ solar masses.
   A) 4000
   B) 200 000
   C) 392 000
   D) 100 000
   E) There is no helium in giant clouds in space.

D

3. At what wavelength have astronomers mapped the spiral arms of the Milky Way...AND... searched for signals from extraterrestrial civilizations?
   A) long radio wavelengths, greater than 210 meters
   B) light which is optically visible to humans using photography
   C) ultraviolet because the clouds in the spiral arms are very hot
   D) 21 meters
   E) 21 centimeters

E

4. The major source of energy in the **pre**-main-sequence life (i.e., the protostar stage) of a star is _____ and the major source of energy in the main sequence phase is _____.
   A) gravitational contraction, fusion of hydrogen nuclei in the core
   B) nuclear fusion of light elements, fusion of hydrogen nuclei in the core
   C) chemical burning of carbon atoms, nuclear fission of light elements
   D) nuclear fission, convection cells carrying hot energetic material from the core to the surface of the star
   E) gravitational contraction, fusion of helium nuclei in a shell around the core

A

5. Mostly carbon is produced by helium "burning" in the core of a star, but some ^{4}He combines with ^{12}C to form ^{16}O ...AND... some ^{4}He combines with ^{16}O to produce _____
   A) ^{22}Na (light isotope of sodium)
   B) ^{20}Ne (regular isotope of neon)
   C) ^{18}O (heavy isotope of oxygen)
   D) ^{24}Mg (regular isotope of magnesium)
   E) an unusual isotopic form of water in which helium has replaced hydrogen

B

6. What makes a red giant star so large during its **first** red giant phase?
   A) The iron-rich core has expanded, pushing the overlying layers of the star outward.
   B) These stars are always >33$M_\odot$ and therefore much bigger than normal stars.
   C) Red giants are rapid rotators and centrifugal force pushes the surface of the star outward.
   D) The helium-burning core and hydrogen-burning shell are heating the interior and making the star expand.
   E) Helium-based nuclear reactions on the surface of the star propel its atmosphere outward.

D