

1. The sun generates heat by _____.

- (A) burning with hydrogen gas with oxygen
- (B) turning hydrogen gas into helium gas**
- (C) burning oxygen gas into heavy metals
- (D) splitting apart atoms of uranium

Hint: The sun fuses four atoms of hydrogen into an atom of helium.

In the past four and a half billion years, the sun has burned through so much hydrogen that only about 72% of the sun is currently made of hydrogen.

In a few billion years so much hydrogen will have been burned that life on earth will be impossible.

2. The sun is hot enough (millions of degrees) that everything in the sun is a gas. Why doesn't the gas blow off into space?

- (A) Gravity holds the gases together.**
- (B) The gases possess an electrical charge that pulls all the gas molecules together.
- (C) The super cold temperature of space repels the sun's gases back into the sun.
- (D) Electromagnetic radiation from every burning molecule generates an electrical force field.

Hint: The sun is so massive that gravity alone started the sun started burning by causing the sun to collapse inward.

The intense pressure raised the sun's temperature enough to start nuclear fusion.

3. Neutrons added to the nucleus allow the protons to remain near each other. The most stable nucleus is _____. Nuclei larger than this will spontaneously release protons, neutrons, electrons, and radiation in order to become more stable.

- (A) neon
- (B) gold
- (C) diamond
- (D) iron**

Hint: The best ratio of neutrons to protons is found in iron 56, the most common isotope of iron, which has 26 protons and 30 neutrons.

4. Nuclear decay occurs in the follow ways except _____.

- (A) alpha radiation (release of a helium nucleus)
- (B) beta radiation (release of an electron)
- (C) gamma radiation (release of electromagnetic radiation)
- (D) delta radiation (release of a neutron)**

Hint: To reduce their energy level, nuclei will release an electron, a photon of electromagnetic radiation, or even a helium nucleus of 2 protons and 2 neutrons.

5. The mass of the sun is decreasing because the sun's mass is being _____.

- (A) used up to create heavy metals
- (B) slowly released into outer space
- (C) converted into the energy**
- (D) recycled into hydrogen gas

Hint: Mass and energy are interconvertible according to Einstein's famous formula: $E = mc^2$.

The sun's generation of energy is at the expense of its mass.

6. Elements heavier than iron are made _____.

- (A) when stars die and then explode**
- (B) by stars in the process of running out of hydrogen
- (C) in the heated interior of active stars
- (D) when elements undergo radioactive decay

Hint: The force needed to squeeze protons and neutrons together into a sizeable nucleus is provided by nuclear explosions occurring in dying stars.

The stars are dying because they are running out of hydrogen to burn.

7. After three half-lives, you can expect to find _____.

- (A) 1/16 of the material you started with
- (B) 1/8 of the material you started with**
- (C) 1/4 of the material you started with
- (D) 1/2 of the material you started with

Hint: After 1 half-life of a substance, one-half is left.

After another half-life, one-half of the one-half is left, or one-fourth of the original substance.

After three half-lives, one-half of the previous one-fourth is left, or one-eighth of the original substance.

8. Carbon dating is only accurate for the past _____.

- (A) 50,000 years**
- (B) 500,000 years
- (C) 1,000,000 years
- (D) 1,000,000,000 years

Hint: For the past 50,000 years, the ratio of carbon-14 to all other isotopes of carbon has been constant.

Once a living organism dies, carbon-14 begins decaying and ratio of carbon-14 to carbon's other isotopes drops with a half-life of 5730 years.

9. Carbon dating _____.

- (A) only works for things that once lived**
- (B) works on any substance so long as it was exposed to the air
- (C) will not work for things submerged in water
- (D) has provided evidence for the evolution of dinosaurs

Hint: Because living organisms continually ingest carbon-14, the ratio of carbon-14 to other carbon isotopes remains constant until the animal dies.

Hint: (Continued)

At that point, no more carbon-14 is ingested and the only carbon-14 left in the organism is the carbon-14 that hasn't decayed.

10. Mass spectrometry separates a mixture of atoms based on their _____.

- (A) number of protons
- (B) number of neutrons
- (C) molecular weight**
- (D) molecular number

Hint: The heavier an atom is, the more momentum it has and the wider a circle it forms when traveling through a magnetic field.

The weight of an atom is made up of its protons and neutrons, depicted by its molecular weight.

11. In order for a nucleus to emit a beta particle or an alpha particle, _____.

- (A) there must be an unequal ratio of protons and neutrons in the nucleus
- (B) two protons in the nucleus must be outside the strong force
- (C) the nucleus must be unstable**
- (D) there must be a disturbance of the nuclear ground state

Hint: Only nuclei with excess energy undergo radioactive decay in order to shed themselves of the excess energy.

Excess energy makes a nucleus unstable.