READING ACTIVITIES (Answer key)

2.7. About the Big Bang theory:

a. How and when did the Universe form according to the Big Bang theory?

The Universe was formed **13,700 million years ago**.
In the beginning, all the components of the Universe, matter, energy and the fundamental forces (gravity, electromagnetic force, strong nuclear force and weak nuclear force) were forming a **singularity.** A **singularity** is a non-material infinitely dense and hot point, with a non-existent radius, in such extreme conditions that Physics cannot describe accurately yet. In the middle of the most absolute nothing, the singularity exploded (Big Bang). In this instant, space and time were created and the universe was formed. Since then, it is expanding and cooling down.

b. What chemical elements were formed just after the Big Bang?

The simplest chemical elements, **Hydrogen**, **Helium** and a little amount of **Lithium**, were formed just after the Big Bang.

c. When did first atoms appear?

First atoms (H, He and Li) started to form when the Universe was **1 second old**, during the ***atoms and radiation era*** and they continued forming during the following 300,000 years.

d. How was possible the conversion of energy into matter?

It was possible thanks to the **decrement of temperature** due to the inflation.

e. Why has antimatter not detected in the Universe?

It is because **all antimatter was destroyed** during the *electroweak or quark era* by annihilation with matter. The slight difference between the amount of matter and antimatter made possible that some matter particles survived to the destruction.

f. What subatomic particles were formed from the quarks?

The subatomic nuclear particles (**hadrons**), protons and neutrons, were formed by association of quarks when temperature decreased enough for the strong nuclear force acted over quarks as it were powerful glue.

g. What is the nucleosynthesis? When did it take place?

The nucleosynthesis is the process of **formation of atomic nuclei**. This took place **1 second after the Big Bang** and finish when the Universe was 3 minutes old, during the *nucleosynthesis era*. This process also occurs in the nucleus of stars and in the explosion of supernovae.

h. What stage of the history of the Universe is known as “dark ages”?

Dark ages are the period of the history of the Universe **when light could not travel freely**.

It started during the *atoms and radiation era* (when the universe was 300,000 years old) and it finished with the formation of first stars and galaxies (when the universe was 10^9 years old).

During this period the Universe was formed by **hot plasma** (atomic nuclei and electrons separated) that did not allow photons (light) to circulate, but little by little as atoms were formed and grouped together to form the first stars and galaxies, the universe became transparent. This moment is known as ***first light***.