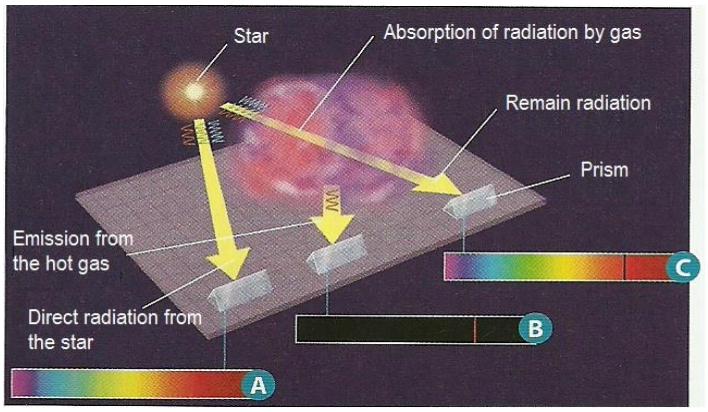
READING ACTIVITIES (Answer key)

2.4. Observe the diagram. It represents the spectra obtained from the electromagnetic radiation of a star.



a. Indicate in each case if it is an absorption spectrum, en emission spectrum or a continuous spectrum.
Spectrum A: Continuous spectrum
Spectrum B: Emission spectrum
Spectrum C: Absorption spectrum

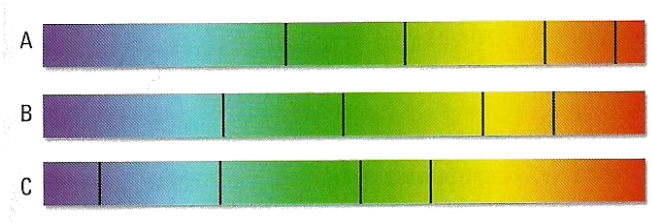
b. Which is the origin of the black line?
Black lines correspond to the **radiation absorbed** by the gas.

Why does it appear in "C"?
It is because spectrum C is obtained from the **light that has crossed the cloud of gas**.

Why is "B" black and the line is coloured?
It is because spectrum B is obtained from the **light emitted by the gas**. The radiation emitted is the radiation absorbed by the gas previously. It is the radiation missing in the spectrum C. The black line in B corresponds to the coloured line in C.

c. How is useful in Astrophysics the study of the electromagnetic spectra?
Electromagnetic spectra study allows physicists find out the **chemical composition** of the celestial bodies and the **relative movement** and **speed** at which they are moving from or to each other.

2.5. Compare the position of the absorption spectral bands of some chemical elements present in galaxies A and B with the spectrum obtained from the same elements in the laboratory (C).



a. Which is the origin of the shift of the lines towards the higher wavelengths (red) in A and B?
It indicates that these **galaxies are moving away from us**. It is due to the **Doppler Effect**. When a wave is emitted by an object in movement, the wavelength perceived by the observer is different than that emitted by the object. The perceived wavelength is bigger if the object is shifting away (the wave stretches) and smaller if the object is approaching (the wave compresses). In the first case we will see a displacement of the lines towards the red (red-shift) and in the second case we will see a displacement of the line towards the blue (blue-shift)

b. Which of both galaxies is farther away from the Earth? Why?
The farthest galaxy is **A**, because the displacement of the lines is bigger. The bigger the displacement, the bigger the distance is.

c. How can we calculate this distance?
We can use the **Hubble's law**. It establishes that the speed at which a galaxy is moving away is directly proportional to its distance.

$$v = H_o \cdot D$$

v is the speed of the galaxy (in km/s)
D is the distance between the Galaxy and the Earth (in megaparsec: Mpc)
$\mathbf{H_o}$ is the Hubble's constant (in 2006 it was estimated in 70 Km/s/Mpc).

2.6. What is the microwave background radiation? And the red-shift?

Both are **evidences** that support **the Big Bang theory**.

Microwave background radiation is a very weak and cold radiation located in the zone of the microwaves that comes from everyplace of the universe. It is interpreted as the remains of the radiation emitted during the Big Bang. It is also known as the “echo” or the “afterglow” of the Big Bang.

The **red shift** is the displacement that suffers the lines of the spectrum when the emission source (galaxy, star, etc) is moving away from the observer. It is due to the Doppler effect.
