

Name _____

**Astronomy 301
Fall 2001
Dr. Frank Bash**

Exam #2

Please write your name on each page, be brief and concise, answer in the space provided, and, if necessary, continue your answer on the back of the sheet on which the question is printed.

1. Why do fewer stars make iron than make carbon?

Both carbon and iron are made in stars. Carbon is made in a nuclear reaction which begins at 100 million °K and iron is made in a nuclear reaction which begins at a much hotter temperature. Indeed, iron is the heaviest element which can be made in a regular nuclear reaction.

The ability of a star to heat its core when it collapses depends on its mass. Only the most massive stars can make iron. There are many more low mass stars than high mass stars thus more carbon than iron.

2. Suppose that there is a single, nearby star whose luminosity and color are known. Can you determine its age?

NO! We can plot the star on an H-R diagram. Suppose that the star is a main-sequence star. If so, we can determine its mass from the mass-luminosity relation and its lifetime from the mass-lifetime relation.

However, if the star is still alive we know that its age is less than its lifetime but we don't know its age.

As an example, a person whose lifetime is 97 years can be six months old.

3. Discuss the importance of gravity in the eventual fate of the Universe.

Gravity will slow down the expanding velocity of the universe. How strong the gravity is determines the rate of slowing down. If the gravity is sufficient to slow down the expansion to a stop in finite time, the universe will contract back to its birth state and may explode again. This is called the "closed" universe theory. If the gravity is not strong enough, the expansion will slow down but will never come to a stop. This is called the "open" universe theory. If the gravity slows the expansion to a stop at an infinite time in the future, it becomes a "flat" universe.

Extra credit was given for explanations based on critical density. The magnitude of the gravity is decided by the density of the universe. The greater, equal, or less case of the density of the universe compared to the critical density corresponds to the "closed", "flat", and "open" universe model.

4. How and why does a star die?

A star dies because it has exhausted its “fuel” and can not sustain the nuclear reaction any longer. This means it has used up the current available elements (such as hydrogen) and its core temperature is not high enough to ignite the next burnable element. So it can't resist its own gravity any more and will collapse and die.

5. How do we determine the age of the Universe from Hubble's Law?

At the beginning of the universe, everything was close together and after the Big Bang, the universe began to expand. Therefore, the distance between us and another galaxy (now) and its velocity of recession can give us an estimate of the age. We can use $t = d/v = 1/H$ to get an estimate of the age of the universe.

6. Which galaxies (Spirals, Ellipticals, Irregulars) will be the last to go dark a long time in the future?

Irregulars go dark last because they are the most inefficient at forming stars. Ellipticals have no gas & dust left to form new stars, so once the current stars die, nothing replaces them. Spirals do still form stars, but at a faster rate than irregulars.