

1. (3 pts.) **Simplicio thinks**, “Penzias and Wilson probably detected the radiation from lots of dust in the plane of the Milky Way Galaxy. The radiation is not from the Big Bang.” What evidence refutes Simplicio's incorrect statement?
2. (3 pts.) **Simplicio thinks**, “Penzias and Wilson probably detected the radiation from the evergreen trees nearby. Their radio antenna will receive signals even when not pointed directly at the trees, just as my satellite dish gets a signal even when not pointed directly at the satellite. The radiation is not from the Big Bang.” What evidence refutes Simplicio's incorrect statement?
3. **The Lives of the Helium Nuclei.** Write a short, short story about the life of a helium nucleus in the center of the sun. Helium can be made in several ways. Assume this helium nucleus was made in the most common way. Include (3 pts.) how it was born, (3 pts.) what it was before birth, and (3 pts.) what it may become when the sun dies.
4. **Production of the light elements (^4He , ^2H , ^7Li) in the Big Bang.** (12 pts.) Some of these effects are key ideas in explaining the production of the light elements in the big bang, and some have nothing to do with it. Explain why each is or is not significant to the production of the light elements in the big bang. Hint: some effects occur after the production of the light elements and thus cannot affect it.
 - a. Protons and electrons combine to form hydrogen atoms
 - b. Helium fuses to form carbon.
 - c. Neutrons decay into protons, electrons, and neutrinos.
 - d. The universe cools with time.
 - e. Formation of the first stars.
 - f. Supernovae.
5. **What if** the sun were born with 50% helium and 50% hydrogen instead of 25% helium and 75% hydrogen? If that were the case, the energy to break apart deuterium would be different.
 - a. (3 pts.) What would the ratio of neutrons to protons be? (The actual ratio is 1 neutron for 7 protons.)
 - b. (1 pt.) Would this ratio of neutrons to protons mean that helium formed earlier or later in the Big Bang? (4 pts.) Explain.