Problem Set #5
Due March 26, 2009

10. **The Closed Box Model:** Assuming a closed box model, determine the metallicity for the following two galaxies, assuming a yield of y = 0.001:

	M_* (M_{sun})	M_{gas} (M_{sun})
Milky Way	1×10^{10}	2×10^{9}
Dwarf Galaxy	6×10^{7}	4×10^{7}

Express your answer in terms of both the metallicity, Z, and the abundance [Fe/H]. The observed metallicity of the Milky Way disk is nearly solar, and for the dwarf galaxy is Z = 0.002. What is the effective yield in these two systems? Give two possible reasons (out of many) why the effective yield is different between the Milky Way and dwarf galaxy. Compare your effective yield to the numbers in Tremonti et al Figure 8 (2004, ApJ 613, 898) and discuss the trend in this plot. Note that the Tremonti yields include the minus sign.

11. **The Baryonic Tully-Fisher Relationship:** The Milky Way and dwarf galaxy above have measured rotational velocities of 220 km/s and 75 km/s. Using the Baryonic Tully-Fisher relationship from McGaugh (2005 ApJ, 632, 859), determine the dynamical mass of these systems. What is the baryon fraction in these galaxies? Compare this to the 'Universal' baryon fraction and discuss two possibilities why the measured and expected fractions are different.

12. **Star Formation Rates:** Observations of two galaxies yield the following:

	L_{UV} (10^{28}erg/s/Hz)	L_{FIR} (10^{44}erg/s/Hz)	M_{gas} (M_{sun})
NGC 1234	1.0	0.5	9×10^{9}
Arp 220	35	45	2×10^{10}

a) What are the current star formation rates (SFRs) as determined in the UV and FIR (using the relationships given in the notes? Explain why these two measures are different and which you would use as the 'true' SFR.

b) If the average star formation rates in the past are the same as the present total SFR, what is the total stellar masses of these galaxy?

c) If the average star formation rates in the future is the same as the present total SFR, when will the galaxies deplete their gas supply (assuming no infall of new gas).

d) Which galaxy would be considered an Ultra-Luminous Infrared galaxy (ULIRG)? Why? Which of these galaxies would be considered a starburst galaxy? Why?