Astronomy 120: Assignment 4, the ISM, star formation and stellar evolution

1. Stars A and B are of the same spectral type and are at the same distance from Earth. However, star A is behind a dust cloud whereas star B is not. Give 2 ways that the stars A and B may appear to differ. You determine a magnitude difference between A and B of 5 magnitudes. How many times brighter is star B than A? [6]

2. Explain how 21 cm radiation is formed. Give 2 advantages of using the 21cm hydrogen line to trace the interstellar medium over ultra-violet lines. [6]

3. Explain the concept of hydrostatic equilibrium. How does the gravitational collapse of a protostar affect its temperature? Think of an everyday situation (other than one given in the lectures) in which gas that is heated will expand and another where cold gas contracts. [6]

4. A Type II Cepheid variable has a period of 30 days. What is its absolute magnitude if it follows the relation in Fig 12-14 of Seeds? If the observed apparent magnitude is +12, what is the distance in parsecs? (Hint, see Table 9.1 in Seeds.). How could interstellar extinction due to dust affect our calculation if it were present? [6]

5. The gas in the bi-polar flow of a Herbig Haro object is travelling at 80 km/s. If the length of the jet is 1 lightyear, how long does it take a blob of gas to travel from the star to the end of the outflow? We see emission due to excited electrons in the hydrogen gas in the jet. What will be the change in wavelength of the H alpha Balmer line (656.3 nm) of gas in the outflow due to Doppler shifting? How will the observed Doppler shift depend on the orientation of the jet (i.e. pointing towards or away from us)[6]