ASTR-3415, *Astrophysics* — Exam 2

Spring 2003

1 April 2003

Name: _____

Useful Constants and Identities

G	=	6.673×10^{-8} dyne cm^2/gm^2	g	=	980 cm/s^2
c	=	2.997925×10^{10} cm/s	σ	=	5.6696×10^{-5} erg/cm^2/s/K^4
h	=	6.6262×10^{-27} erg s	e	=	4.803×10^{-10} esu
$M_{\rm Moon}$	=	7.35×10^{25} gm	$M_\odot$	=	1.99×10^{33} gm
$M_\oplus$	=	5.98×10^{27} gm	$R_\oplus$	=	6.38×10^{8} cm
$R_\odot$	=	6.96×10^{10} cm	$T_\odot$	=	5770 K
1 AU	=	1.496×10^{13} cm	$L_\odot$	=	3.827×10^{33} erg/s
1 ly	=	9.4605×10^{17} cm	1 pc	=	3.0856×10^{18} cm
1 eV	=	1.602×10^{-12} erg	1 eV/hc	=	8065.46 cm^{-1}
1 eV/k_B	=	1.16048×10^{4} K	1 amu	=	1.66×10^{-24} gm
m_e	=	9.109×10^{-28} gm	m_H	=	1.67×10^{-24} gm
R_∞	=	109,737.31 cm^{-1}	$k_B = k$	=	1.3806×10^{-16} erg/K
1 Å	=	10^{-8} cm	1 nm	=	10^{-7} cm

Answer the questions on the space provided below the question and on the additional blank pages supplied after each question. Feel free to use the back of all pages as well. Remember to **show <u>all</u> work!** The answer is of secondary importance, the technique used to determine the answer is of fundamental importance. Answer your problems as I have done in the solutions to Problem Sets 1 and 2 that I have supplied to you. Logic and deductive reasoning are being tested here in addition to number crunching! Also remember to pay attention to units and significant digits.

1. (70 pts) Assume there is a spherical giant molecular cloud with a diameter of 20.0 ly, and is at a temperature of 50.0 K with a uniform particle density of 1.00×10^4 cm^{-3}. The mean molecular weight of the particles that make up this cloud is 0.770.

(a) What is the mass of this cloud in solar masses?

(b) Compare the total thermal energy in the cloud to the gravitational potential energy of the cloud.

(c) Will this cloud expand, collapse, or remain stable? Base your answer on the solution to part (b).

(d) Calculate both the Jeans' length (in light years) and Jeans' mass (in solar masses) of this cloud.

(e) Are these 'Jeans' values consistent with your *cloud expansion/collapse/equilibrium* statement above in part (c)? (Present logical reasons, just don't answer yes or no!)

Problem 1 continued:

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2. (30 pts) Answer the following questions about stellar evolution and its relation to interior structure. A paragraph for each part (containing anywhere between 3 to 5 sentences) is sufficient, but make sure you supply enough details in your answers.

(a) Why does a 0.8 $M_\odot$ star become a red giant whereas a 0.2 $M_\odot$ does not?

(b) What is the core helium flash? Does it occur in both of the two stars mentioned in part (a)? Why or why not?

Problem 2 continued: