ASTRONOMY 1102 – 1

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Study Guide for First Test – Friday September 17, 1999

This test will be based on material we have covered in class. I have followed quite closely the content but not always the order in which this material is presented in "The Cosmic Perspective".

The Sections of the text included in the test: Chapters 1 and 2, all sections; Chapter 3, sections 3.1, 34, 3.5 and 3.6; Chapter 4, sections 4.1, 4.4 and 4.5; Chapter 5, all sections; Chapter 7, sections 7.1, 7.2, 7.3 and 7.4. Some detailed remarks on this last chapter can be found below.

The test will consist of two parts: multiple choice questions: 20 at 3 pts each (for a total of 60 %), and 4 problems (for a total of 40 %). I give below some examples of the type and format of test questions and problems.

Review class notes: do not memorize first, understand first, and then commit to memory only a few basic definitions and laws. Review homework: this is especially important since the homework is considered test practice.

Chapter 7: Light the Cosmic Messenger

Why study the properties of radiation? Information from celestial objects is carried by the radiation they emit. Light is Electromagnetic Radiation (EMR) or Electromagnetic Waves (EMW). Properties of Wave Motion: Understand the meaning of wavelength (λ) and frequency ($f = 1/T$). Material waves and electromagnetic waves: Distinguish what moves or changes (water, air, electric and magnetic fields). Relationships between wavelength, the period, the frequency and the wave velocity c: $\lambda = c/f$ or $\lambda f = c$. Frequency and wavelength are *inversely proportional* to one another: if I double the frequency I am halving the wavelength. Units used: angstroms (Å) and nanometers (nm).

The electromagnetic spectrum: visible light (400 nm $< \lambda <$ 700 nm). Other wavebands of the EM spectrum: Study carefully Fig. 7.5. Recall what we said in class: note the scales of frequency, wavelength, and photon energy.

Sect. 7.4.6: Spectroscopy and Kirchhoff's Laws: basic workings of a spectro scope/graph/meter. Spectral lines, the continuum: identify in Fig 7.6 the continuum and the absorption/emission lines/bands. Fig 7.13 summarizes Kirchhoff's laws, see also homework 2. When do you see lines in emission? When do you see lines in absorption? Which elements produce the lines?

Temperature, origin of the Kelvin scale. meaning of *absolute zero* (refer to Ch. 5). Mathematical Insight 7.2: The laws that govern blackbody radiation: Wien's displacement law $\lambda_{\max} \propto 1/T$ (see how the peak "displaces" to smaller wavelength as T increases in Fig 7.12), Stefan-Boltzmann Law: total power emitted per unit area $\propto T^4$ (see how the "area" below the blackbody curve increases as T increases in Fig 7.12).

The formation of spectral lines, basic concepts of atomic structure. Absorption and emission of a quantum of radiation (photon). The spectrum of hydrogen: Balmer lines.

Putting it all together: understanding Fig. 7.14.

SAMPLE:

Part I – Multiple Choice questions (5 pts/question; total = 60 pts)
Identify the correct answers by placing a check between the brackets [ ]. Check **ALL** correct answers in the questions identified by a *.

1) The power emitted by every square inch of a star twice as hot as another is
   [ ] 2 times larger.
   [ ] 2 times smaller.
   [ ] 4 times larger.
   [ ] 8 times larger.
   [ ] 16 times larger.

2) The correct symbol for an atom with 8 protons, 8 neutrons and 8 electrons is
   [ ] $^{12}C_6^+$.
   [ ] $^{16}C_6$.
   [ ] $^{16}O_8^+$.
   [ ] $^{16}O_8$.
   [ ] $^{14}C_6$.

*3) Some of the waves below are electromagnetic waves
   [ ] sound.
   [ ] light.
   [ ] ripples on a pond.
   [ ] UV radiation.
   [ ] X-rays.

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Part II – Problems (10 pts/problem; total = 40 pts) **NO CALCULATORS!**
Problem 1: Powers of Ten: Show your calculations.

a) There are an estimated 100 billion galaxies in the visible Universe each having an average of 100 billion stars. Estimate the total number of stars in the visible Universe.

b) How many years is 10^{14} s? (1 yr = 3.15×10^7 s)

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Problem 2: Compare the spectra of two blackbodies of the same dimensions placed at the same distance from your spectroscope. One body is at 3000K and the other at 9000K. What do the spectra look like? Which is brighter and by how much? Compare the wavelengths of the peak. Can you sketch the spectra in arbitrary units?