

ASTRONOMY 8300 – FALL 2024
Final Exam – Due by December 16 at noon

1. (10 pts) Write down an expression for the ionization parameter (U) in terms of fundamental parameters. What ratio does U represent? What does U tell us about the physical conditions in the gas?
2. (10 pts) To model the emission-line spectrum of a Seyfert narrow-line region (e.g., with CLOUDY), what input parameters are essential? What other parameters might be needed to obtain a good match between model and observed line ratios? If fine-tuning a model still doesn't work, what else could you try?
3. (10 pts) What is the source of ionization for a typical nova shell? Relative to the recombination lines, are the forbidden UV and optical lines stronger or weaker in nova shells compared to H II regions? Why?
4. (10pts) What is the source of ionization for an old supernova remnant (SNR)? How about for the Crab SNR? What is a diagnostic to distinguish between the different types of ionization?
5. (10 pts) How do the emission-line ratios of the broad-line region (BLR) in an AGN differ from those of a planetary nebula? What are the physical reasons for these differences?
6. Give a brief description or explanation of the following terms (include an equation if necessary). (2 pts each)
 - a. Blister model
 - b. PDR
 - c. X, Y, Z (for elements)
 - d. PAH
 - e. Objective Prism
 - f. WHIM
 - g. CGM
 - h. Lyman-alpha forest
 - i. Classical Nova
 - j. Polar
 - k. Two phases of nova shell ejection
 - l. Type II supernova
 - m. Type Ia, Ib, and Ic supernovae
 - n. Shock front
 - o. Source of AGN's optical/UV/Soft X-ray continuum
 - p. NLR
 - q. ULIRG
 - r. Blazar
 - s. Seyfert 1 vs. Seyfert 2
 - t. FR I vs. FR II
 - u. LINER
 - v. BPT Diagram
 - w. Partially-ionized zone
 - x. $L\alpha/H\beta$ problem
 - y. Fe $K\alpha$ emission