Astronomy Division C Exam

KEY
For questions 1-7 fill in the blank with one of the terms below (some terms are not used, but no term is used twice): (5 points each)

<table>
<thead>
<tr>
<th>Binary</th>
<th>AM CVn</th>
<th>Planetary Nebula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type Ia</td>
<td>Type II</td>
<td>Dwarf Nova</td>
</tr>
<tr>
<td>White Dwarf</td>
<td>Neutron Star</td>
<td>Main Sequence Star</td>
</tr>
<tr>
<td>Red Giant</td>
<td>Blue Giant</td>
<td>Variable Star</td>
</tr>
<tr>
<td>Cosmic Rays</td>
<td>Magnetic Fields</td>
<td>X-Rays</td>
</tr>
<tr>
<td>Gravitational Waves</td>
<td>Molecular Cloud</td>
<td>Globular Cluster</td>
</tr>
</tbody>
</table>

1. J0751/J1741 are most likely AM CVn progenitor systems.

2. Sirius A and B form a Binary system.

3. M15 is a Globular Cluster.

4. Inconsistencies in Magnetic Field most likely caused the shape of Tycho’s SNR.

5. SNR G1.9+0.3 was theoretically a White Dwarf merger.

6. SS Cygni is the prototype for Dwarf Nova.

7. Henize 3-1357 is the youngest known Planetary Nebula.
For problems 8-17 choose the best fitting answer. (5 points each)

8. What type of supernova formed SN 2011fe?
   a. Type Ia
   b. Type Ib
   c. Type Ic
   d. Type IIa

9. What elements seen in SNR 0509-67.5 reveal that it was formed by a Type Ia supernova?
   a. Carbon and Oxygen
   b. Hydrogen and Helium
   c. Silicon and Iron
   d. Lithium and Silicon

10. In which constellation is Tycho's SNR located?
    a. Sagittarius
    b. Cassiopeia
    c. Cygnus
    d. Tycho

11. What system contains the hottest known white dwarf star?
    a. NGC 2440
    b. Sirius A & B
    c. M15
    d. SS Cygni

12. Why are we most interested in studying AM CVn systems?
    a. They are theorized to produce gravitational waves
    b. They are theorized to contain traces of life
    c. They are a progenitor for triple systems
    d. They provide insight into the formation of galaxies
13. What is can cause a binary system to merge?
   a. The region of resonance for an orbiting body
   b. A plume of matter in a x-ray binary system
   c. The two stars exceed the Chandrasekhar limit
   d. Each star overcomes the Roche limit of the system

14. Which wavelength allows us to see the closest known instance to the big bang?
   a. Infrared
   b. X-ray
   c. Microwave
   d. Gamma

15. Which of these objects is typically the oldest?
   a. Open star cluster
   b. The Sun
   c. Red Giant
   d. Globular star cluster

16. Which of the following is a possible AM CVn system?
   a. Red dwarf + neutron star
   b. Red dwarf + red giant
   c. White dwarf + red giant
   d. White dwarf + neutron star

17. What makes it possible to detect a spectroscopic binary?
   a. Doppler effect
   b. Fermi exclusion principle
   c. Line broadening
   d. Emission and absorption lines
For problems 18-21 answer to your best knowledge, and show your work. (15 points each) MUST SHOW WORK!!!

1. Use the distance modulus to determine the distance (in pc) to an object that has a mass of 2 \( M_\odot \) an absolute magnitude of 1.42, and an apparent magnitude of -1.44.

8.5 Ly – 10 Points
2.6 Pc – 15 Points

Tie Breaker: What type of object is this? What object could this be? (+5)
Main Sequence star, Sirius A

2. Use the distance modulus to determine the absolute magnitude of an object that has an apparent magnitude of 9.4, and is 3.8 kLy (1.23 kpc) from earth.

\[
9.4 - 5\log_{10}(1.23 \text{ kPc}) - 1 = -1.04
\]
- 15 Points
*If they use 3.8 kly or do not convert from kpc to pc: subtract 5 points*

Tie Breaker: What object could this be? (+5)
NGC 2440
3. Using Kepler's laws of motion, determine the orbital period (in hours) of a binary system consisting of a 0.6 $M_\odot$ star and a 0.4 $M_\odot$ star.

$6.6 \pm 0.5$ hours – 15 Points

Tie Breaker: What system could this be? (+5)

SS Cygni

4. Use Kepler's laws to determine the approximate separation (in Au) of two equal mass objects in a binary system with a combined mass of 1.8 $M_\odot$ and an orbital period of 4 hours. (HINT: assume a circular orbit)

$$a^3 = T^2(m_1 + m_2)$$

The separation is 0.007 Au - 15 Points

*If not in Astronomical Units subtract 5 points*

Tie Breaker: What system could this be? (+5)

Henize 2-248