Reach for the Stars B – KEY

Bonus (+1) TRAPPIST-1

Part I: Stars, Constellations, and DSOs [50 pts]

1. Kepler's SNR
2. Tycho's SNR

3. M16 (Eagle Nebula)
4. Radiation pressure (wind) from young stars

5. Cas A
6. Extinction (from interstellar dust)

7. 30 Dor
8. [T10] Tarantula Nebula
9. LMC

10. Sgr A*
11. Gravitational interaction with orbiting stars (based on movement over time)

12. M42 (Orion Nebula)
13. [T8] Trapezium
14. (Charles) Messier

15. NGC 7293 (Helix Nebula) –OR– M57 (Ring Nebula)
16. TP-AGB (thermal pulse AGB)
17. Binary system –OR– stellar winds –OR– stellar rotation –OR– magnetic fields

18. Geminga
19. [T4] Jets from pulsar spin poles
20. X-ray

21. NGC 3603
22. Among the most massive & luminous stars known

23. T Tauri
24. FUors (FU Orionis stars)

25. NGC 602
26. Open cluster

27. LMC –AND– SMC
28. Irregular
29. Tidal forces –OR– gravity of MW

30. M1 (Crab Nebula)
31. PWN (pulsar wind nebula)
32. X-ray

33. M17 (Omega Nebula)
34. Omega Nebula –OR– Swan Nebula –OR– Checkmark Nebula –OR– Horseshoe Nebula
35. NGC 6618

36. Zeta Ophiuchi
37. Bow shock (from moving quickly through the ISM)

38. It "wobbles" across the sky (moves perpendicular to overall proper motion)
39. Procyon (α CMi)

40. Mizar –AND– Alcor
41. Mizar

42. Pollux (ß Gem)

43. [T5] High rotational velocity
44. Altair (α Aql) –OR– Regulus (α Leo) –OR– Vega (α Lyr)

45. Polaris (α UMi)
46. Precession

47. Binary with observed Doppler shift of spectral lines
48. Beta Cephei variable (ß Cep)

49. Mass transfer (from the star that is currently less-massive)

50. (Johann) Bayer

Part II: Topics and Calculations [50 pts]

51. Proton-proton chain
52. Low-mass stars burn through their fuel at a much slower rate
53. [T6]
    a. Protostar –OR– pre-main sequence
    b. Red giant branch
    c. Helium flash
    d. Horizontal branch
    e. Asymptotic giant branch
    f. Planetary nebula
    g. White dwarf

54. Carbon –AND– oxygen
55. Type Ia

56. [2 pts] Neutron star, black hole
57. CNO cycle
58. Iron –OR– Fe peak
59. Cannot obtain energy from further fusion (would absorb energy instead)
60. Type II (also technically Ib and Ic)

61. (Ejnar) Hertzsprung –AND– (Henry) Russell
62. Instability strip
63. Up and to the right (cooler and more luminous)
64. Color

65. [T7] Strength of H lines
66. (Annie Jump) Cannon
67. [2 pts] O, M [must be in order]
68. Orange

69. [T1]
    a. 3
    b. 5
    c. 2
    d. 1
    e. 6
    f. 4

70. Spitzer
71. Compton

72. [T9] Can see "through" dust (dust is optically thin at infrared wavelengths)
73. Infrared –OR– radio
74. CO (carbon monoxide)
75. 21-cm line (spin-flip transition)
76. Radio

77. 625 ($10^4/16$) times brighter

78. [T3] 10^{10} (100^5) times more sensitive

79. 4 times smaller

80. 4/9 times as bright
81. 16/9 times as bright

82. +9.83
83. +4.83

84. 81/400 ($(4/5)^2 * (3/4)^4$) $L_\odot$
85. +11.6
86. [T2] 81/100 times as bright