YUSO 2017 Astronomy
Answer Key

Part I: Multiple Choice (1 pt each)

1. b	14. d	27. e	40. a
2. b	15. a	28. a	41. a
3. a	16. b	29. c	42. b
4. b	17. a	30. c	43. a
5. a	18. d	31. a	44. b
6. e	19. a	32. e	45. b
7. d	20. d	33. c	46. a
8. e	21. e	34. b	47. e
9. c	22. b	35. b	48. c
10. b	23. d	36. a	49. d
11. a	24. b	37. e	50. a
12. b	25. c	38. b	51. e
13. b	26. d	39. a	

Part II: DSO Identification (2 pts per subsection)

1. Henize 3-1357 or Stingray Nebula
    a. Hubble Space Telescope
    b. Ara
    c. Oxygen
    d. Nitrogen
    e. Hydrogen
2. Sirius or Sirius A & B
    a. Canis Major
    b. Sirius A
    c. -2.9
    d. A
    e. 20 A.U
3. HM Cancri
    a. 5.4 minutes or 321.5 sec
    b. Cancer
    c. 08h 06m 23.20s; +15° 27’ 30.20”
4. M15 or NGC 7078
    a. Pegasus
    b. Charles Messier
    c. 13.2 billion years old
    d. 112
    e. 9

5. SNR G1.9+0.3
    a. Sagittarius
    b. About 27,700 – 28,000 ly
    c. There was a dusty region of our galaxy that blocked visible light from reaching earth
    d. When was it discovered?
    e. G1.9+0.3 exhibits an extremely asymmetric pattern.
    f. Synchrotron radiation
6. #3
7. Stingray nebula
8. NGC 7078 or M15
9. NGC 2440; nearly 400,000 degrees Fahrenheit or 200,000 degrees Celsius
10. M7 IIIe
11. Tycho's SNR or G120.1+01.4 or SN 1572
12. SN 2011fe or Messier 101
13. SNR 0509-67.5
14. Ripples in space-time will be given off.
15. SS Cygni
16. NGC 2392
17. Henize 3-1357
18. Alpha Centauri system
19. Sirius B; 1930; Subrahmanyan Chandrasekhar

Part III: Short answer (2 pts each)

1. OBAFGKM
2. A & B
3. M
4. Temperature of the star's outer atmosphere; chemical composition of the star's outer layers
5. The orbits of planets are ellipses
6. A line from a planet to the Sun sweeps over equal areas in equal intervals of time.
7. A planet's orbital period squared is proportional to its average distance from the Sun cubed.
8. Main-sequence star
9. Solar masses
10. Lower right to upper left
11. A
12. the width of their spectral lines.
13. quasars
14. using radio waves to get a pulse reflection, parallax, cepheids, brightness, red shifts

Part IV: Math (3 pts per subsection)

Award full points if answer is within 0.1 of the correct answer.

1)

a. 14.7 years $P^2 = a^3 \quad P = \sqrt{6^3} = 14.7 \text{ years}$

b. It takes the same amount of time.

c. Elliptical

2)

a. 55.4 AU $X_{cm} = \frac{(1.00)(0)+(12.0)(60.0)}{(1.00+12.0)} = 55.4\ AU$

b.4.62 AU $X_{cm} = \frac{(1.00)(60.0)+(12.0)(0)}{(1.00+12.0)} = 4.62\ AU$

c. 9.92*10^7 years $T = 2\pi\sqrt{\frac{(60)^3}{(6.67\times10^{-11})(13)}} = 9.92\times10^7\ years$

d. 1.4 solar masses

e. 81 times more

$B: T^4 = T^4$

$A: (3T)^4 = 81T^4$

f. It's 1.27 times greater

$L_A = 4\pi\left(\frac{1}{3}R_B\right)^2\sigma\left(3T_B\right)^4 \quad L_B = 4\pi R_B^2\sigma T_B^4$

$L_A/L_B = \frac{4\pi\left(\frac{1}{3}R_B\right)^2\sigma\left(3T_B\right)^4}{4\pi R_B^2\sigma T_B^4} = \frac{81}{64} = 1.27$

g. Star C&D because the combined mass is greater than A&B.

3)

a. 7.24*10^8 pc $d_{pc} = 10^{\left(\frac{20+19.3+5}{5}\right)} = 7.24\times10^8\ pc$

b. 2.36*10^9 ly $7.24\times10^8 \cdot \frac{3.08\times10^{16}\ m}{1\ pc} \cdot \frac{1\ ly}{9.46\times10^{15}\ m} = 2.36\times10^9\ ly$

Part V: Tiebreaker Questions

Instructions: Break ties in order of tiebreaker questions.

Ex. If Team 1 has answered 2 and 4 correctly, and Team 2 has answered 1 and 3 correctly, Team 2 wins by tie-breaker

1. A distant ninth planet of our solar system.
2. About 2.03 * 10^9 pennies (± 0.1 x 10^9)
3. About 2.03 * 10^7 dollars (± 0.1 x 10^7)
4. Stars are considered black bodies. The color of a blackbody lies on the Planckian locus. The Planckian locus does not pass through green, indigo or violet wavelengths. Stars emit a range of light but the wavelengths of light peak in one color. So a star's blackbody curve can peak at green or purple wavelengths but it's also emitting yellow, blue, red, and/or orange wavelengths. The mixture of wavelengths appears white to human eyes.