Name: KEY Timeslot: KEY

Answer Page: Section A

1. (a) 7
   (b) 1.4 (solar masses)
   (c) -7.1 ± 0.355 (± indicates acceptable interval)

2. (a) 13
   (b) Gravitational Wave Radiation

3. 6, 5, 11, 10 (has to be in this order for credit)

4. (a) Mira Variables, Intrinsic (2 points)
   (b) Red giant (also accept AGB star)

5. (a) 2, Hen 3-1357 (also accept Stingray Nebula)
   (b) White Dwarf

6 (a) D
   (b) A
   (c) C

7. (a) globular cluster
   (b) high mass/luminosity stars have evolved off of the main-sequence

8. (a) 3, SS Cygni
   (b) 20
   (c) Accretion disk pulsates in brightness

9. (a) M101 (also accept Pinwheel Galaxy)
   (b) SN 2011fe
   (c) September 13th, 2011 ± a month
   (d) -19.6 ± 0.5

10. (a) NGC 1846
    (b) Planetary Nebula (also accept White Dwarf)
    (c) Stars in NGC 1846 should all be the same age. The rest of the sun-sized stars are not as evolved.

11. (a) 25
    (b) X-Ray
    (c) Two White Dwarfs
    (d) 300 ± 75 seconds

12. (a) 10
    (b) Heavier Elements

13. (a) Red Giant. The Sun will reach this stage when it fuses all hydrogen gas into helium. (Also accept 5 ± 0.5 billion years)
    (b) The Sun's core as a Black Dwarf

14. SNR G1.9+0.3, 14

15. (a) 17
    (b) Binary star system comprising of two sun-like stars with almost equivalent mass

16. (a) Mass
    (b) Chemical Composition

17. (a) Globular Clusters
    (b) Globular : low metallicity, older, denser, comprised of tens / hundreds of thousands of stars, symmetrical formation, contain more evolved stars (red giants), located in halo / bulge of galaxy
    Open: high metallicity, younger, irregular shape, younger stars (blue giants), located in arms of spiral galaxies
    (Having 3 correct from both categories merits a point. Otherwise, 0 points scored)

18. (a) Pulsar
    (b) Pulsar's rotational inertia increases due to the interior's shift to superfluid as the pulsar cools. (Mention of phase shift in interior awards point)

19. optical/X-ray

20. (a) Sirius A & Sirius B
    (b) Sirius B
    (c) DA2

Name: KEY Timeslot: KEY

Answer Page: Section B

21. (a) 6,840,000 ± 1,500,000 Parsecs

(b) (1.75 ± 0.6) x 10^{36} Watts

(c) 1,500,000 ± 175,000 Kelvin

(d) 67,000 ± 15,000 Solar Radii

(e) White Dwarf and Red Giant

22. (a) 1.92 ± 0.3

(b) 576000 ± 31000 km/s

(c) 8500 ± 850 Mpc

(d) (1.1765 ± .107) * 10^{-10} arcseconds

(e) 10.35 ± 0.4

Tie Breaker # 3 (team who has more on #22)

23. (a) 11,600 ± 500 Kelvin

(b) (1.0895 ± 0.05) * 10^{28} Watts

(c) 1.3202 ± .066 Solar Radii

(d) 7.08 ± 0.35

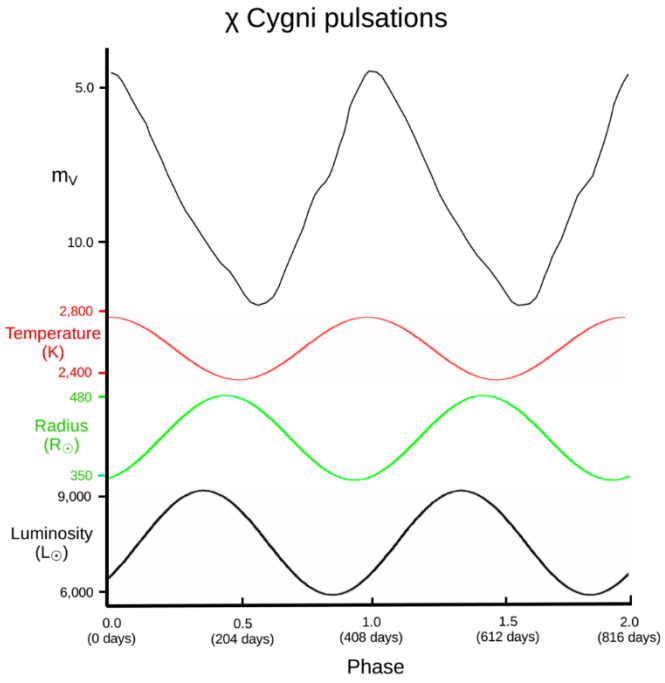
Name: KEY Timeslot: KEY

Answer Page: Section C

24. (a) 408 ± 8 days

(b) 17,000 ± 500 times

(c)



Tie Breaker #1 (c)

25. (a) 0.8667 ± 0.0433 solar masses

(b) 1.5955 ± 0.0798 AU

(c) From Star A: (9.54734 ± .4) * 10^7 Km From Star B: (1.4321 ± .07) * 10^8 Km

(d) Star A: 46.188 ± 0.1 km / s Star B: 69.282 ± 0.1 km /s

26. (a) (7.2 ± 0.36) * 10^{47} Kg * m^2

(b) (9.8 ± 0.49) * 10^{49} Kg * m^2

(c) 3811.11 ± 190.55 Days

(d) 69.58 ± 3.48 Solar Luminosity

Tie Breaker #2 (team who has more on 26)