Astronomy C Key

Science Olympiad North Regional Tournament at the University of Florida

If not stated otherwise, full credit requires exact answer as the one listed here:

1. H I regions are non-ionized, H II regions are ionized. (Have to mention H II ionization for credit)
2. B, A, F, K, M
3. Elliptical galaxies; they are often the result of collisions between galaxies and resulting agitation will cause star formation to increase thus there is a low gas content in the resulting galaxy; this low gas content prevents formation of H II regions. (2 pts for elliptical, 2 for galaxy collision, 2 for increased star formation reducing gas content)
4. 500,000 solar lumens (give credit for an answer within 25,000 solar lumens)
5. Spectral classes K and M, Yerkes class I (or 1) (.5 pts for each spectral class, 1 pt for Yerkes class)
6. S Doradus variables
7. Measuring distances to objects (credit can be awarded for other valid uses)
8. Tolman-Oppenheimer-Volfoff limit (give full credit if students answered TOV limit, and half credit if they put a number between 1.5 and 3 solar masses without mentioning TOV)
9. Type II supernovae will have hydrogen absorption lines in their spectra (also give credit for saying 1b/1c do not have hydrogen absorption lines in their spectra)
   Difference is due to lack of hydrogen within a pre-type Ib or Ic star since they have lost their outer hydrogen layers (must mention lack of hydrogen within the pre-type Ib/Ic stars to receive credit)
10. The core will start to collapse since electron degeneracy pressure from the Pauli exclusion principle won't be sufficient to counteract gravity. As it collapses, neutron degeneracy pressure will suffice, and implosion will rebound and accelerate surrounding stellar material.

    2 pts for iron/nickel core having no fusion, 2 pts for collapse upon Chandrasekhar limit (ok if mention 1.4 solar masses instead), 2 pts for neutron degeneracy halting collapse, 2 pts for collapse being rebounded
11. E (give half credit for either A or C, no credit for other choices)
12. Red supergiants
13. ~1.6 magnitudes (give credit for answers between 1.55 and 1.65)
14. Bolometric luminosity decreases during outbursts
15. Type II supernova; Due to mass, core collapse will occur and probably leave behind a neutron star (give half credit if correct explanation but do not mention neutron star))
16. NGC 6357/War and Peace Nebula; infrared
17. Circinus X-1; x-ray

18. Looking for “very slow rotating neutron star/pulsar” (similar answers receive credit)
19. F (half credit if either A or B are chosen)
20. 55 AU
21. 0 (must be exact for credit)
22. From Wien’s Law, emitted max wavelength is 1000 nm. So, when calculating redshift, z=.01, so v/c is approximately , so v=-3*10^3 km/s. From Hubble’s Law, the distance is then 42.857 megaparsecs (42,857,000 parsecs) (Give credit for answers between 42 megaparsecs and 43.5 megaparsecs, 2 points for Wien’s Law, 2 points for redshift, 2 points for Hubble’s Law)
23. Use the distance modulus to get 4.8 (give credit for answers between 4.74 and 4.86)
24. Use the period luminosity relation -2.81*log_10 (P) -1.43 to get M=-5.2. (give credit for answers between -5 and -5.4). (Also ignore anything in students’ answers dealing with apparent magnitude)
25. Use the magnitude luminosity relation to get 2.512^(4.8-(-5.2))=10004.52 solar lumens. (Give full credit for work if they do 2.512^((#answer from 23)-(#answer from 24)) even if not correct answer)
26. The square of the orbital period is proportional to the cube of the semi-major axis of its orbit. Or: T^2~4pi^2/(G(M_1+M_2)) * a^3 (or something similar as long as there’s a period^2 and axis^3)
27. Possible answers for names: Electron capture, Pair instability, Photodisintegration
    If electron capture, electron capture by magnesium in an O/Ne/Mg core will lead to collapse and oxygen fusion
    If pair instability, sufficient interaction of gamma rays with matter will reduce pressure available to counteract gravity, and collapse will start
    If photodisintegration, energy is removed via photodisintegration as pressure and temperature are reduced; this then causes core collapse
    Note that answering core collapse upon attempting to fuse iron should not receive credit.
28. S Doradus variables/Luminous blue variables/LBVs
29. Pulsing in the X-ray spectrum
30. Prominently broad emission lines of helium and nitrogen or carbon
31. II-L linearly decrease in brightness; II-P have a plateau (2 pts for each)
32. IIb have hydrogen lines at first, then helium; IIn have narrower H lines instead of broad. (2 pts for each)