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Virginia Science Olympiad

2013 Regional Astronomy Test

Do not open this test until instructed.
All testing materials are to be returned.
The use of any banned materials will result in disqualification.

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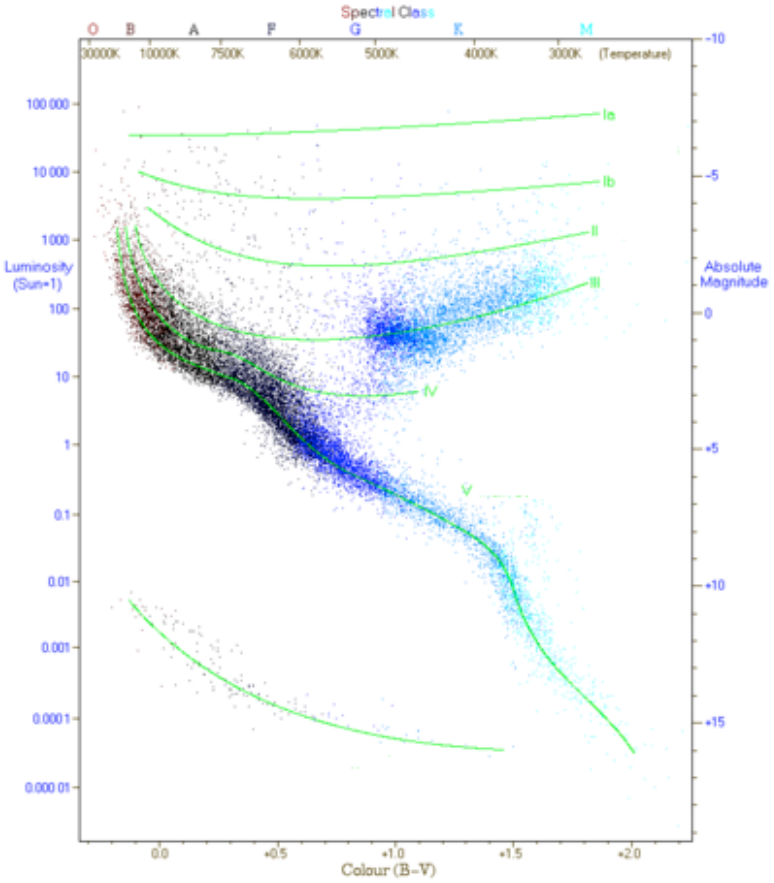
Using the provided HR diagram, classify the following as white dwarf (WD), main sequence (MS), giant (G), or supergiant (SG):



1. Spectral type F, Absolute magnitude -6

2. Spectral type F, Absolute magnitude +4

3. Luminosity 200, Spectral Type K

4. Temperature 20,000, Luminosity 0.01

5. Spectral type B, Luminosity 100

6. Temperature 20,000, Absolute Magnitude 0.

7. The luminosity of a star is classified by the width of the emitted spectral lines. Which class has the widest spectral lines?
   a. Bright supergiant
   b. Supergiant
   c. Bright giant
   d. Giant
   e. Subgiant
   f. Main sequence star

8. Using a spectroscopic parallax and an H-R diagram, find the distance to a KV star with an apparent magnitude of +26.
   a. 15,800 ly
   b. 51,700 ly
   c. 32.6 ly
   d. 59,200 ly
   e. 0.819 ly

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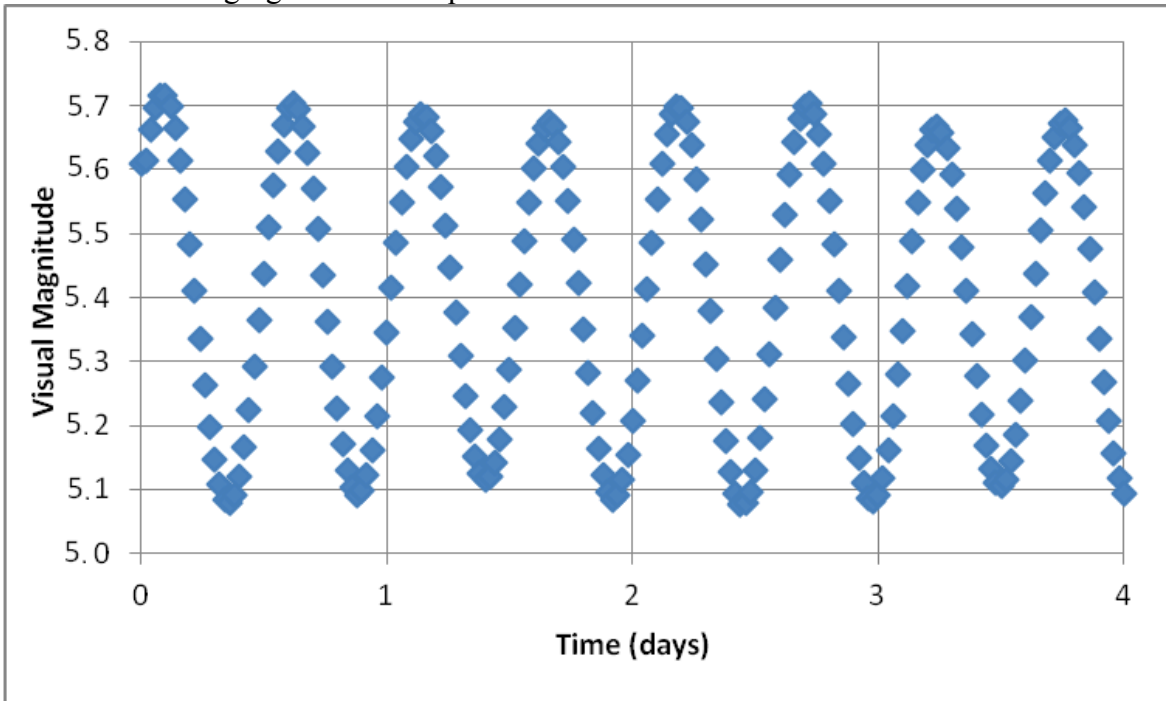
9. Find the temperature of a star that is sixteen times as luminous as the sun with a radius that is three times as large as the sun. Answer in terms of the sun's temperature.
   a. 5.33 x $T_\odot$
   b. 2.30 x $T_\odot$
   c. 1.7 x $T_\odot$
   d. 1.33 x $T_\odot$
   e. 1.15 x $T_\odot$

Use the following light curve for questions 10-12:



10. Find the period of the star's pulsation.
    a. 4 days
    b. 1 day
    c. 0.5 days
    d. 0.25 days

11. Identify the type of variable star.
    a. RR Lyrae
    b. Type I Cepheid
    c. Type II Cepheid
    d. Pulsar
    e. Semiregular Variable

12. Estimate the distance to this variable star.
    a. 10 pc
    b. 100 pc
    c. 16 pc
    d. 25 pc
    e. 63 pc

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13. Which describes the mechanism behind the pulsation of RR Lyrae. **This question has multiple answers, mark all correct answers.**

a. an eclipsing binary companion
b. ionized gas that stores and releases energy
c. changes in the opacity of the star's outer layers
d. changes in the radius of the star

14. As the sun expends its fuel it will become a _____ and then a _____.

a. supernova, black hole
b. supernova, neutron star
c. supernova, white dwarf
d. red giant, white dwarf
e. red giant, neutron star

15. Current estimates expect the sun to have a lifetime of 10 billion years. What is the lifetime of a 0.30 solar mass star?

a. 1.73×10^9 years
b. 3.33×10^9 years
c. 33.3×10^9 years
d. 4.93×10^7 years
e. 2.03×10^{11} years

16. Order these stars from hottest to coldest:

A
B
F
M
O

17. The spectrum from an incandescent object is:

a. a continuous spectrum.
b. a series of bright lines corresponding to the atomic composition of the object.
c. a series of bright lines corresponding to the atomic compositor between the observer and the object.
d. a continuous spectrum with a series of dark lines corresponding to the atomic composition of the object.

18. By observing a(n) _____ spectrum, astronomers can identify the components of a cold cloud of interstellar gas.

a, absorption
b. emission
c. continuous
d. Paschen

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19. Which features of a star can astronomers deduce from spectral lines. **This question has multiple answers, mark all correct answers.**
    a. velocity
    b. rotation
    c. composition
    d. temperature

20. If you were searching for new pulsars, which targets would be best to focus on?
    a. globular clusters
    b. open clusters
    c. interstellar dust clouds
    d. planetary nebula
    e. supernova remnants

21. Cassiopeia A has either a neutron star or a black hole near its center. Which device can best image this feature?
    a. Very Large Array
    b. Arecibo Observatory
    c. Chandra X-Ray Observatory
    d. Spitzer Space Telescope
    e. Hubble Space Telescope

22. The radius of a neutron star is determined by neutron degeneracy. What determines the radius of a White Dwarf?
    a. Proton degeneracy
    b. Electron Degeneracy
    c. Neutrino Degeneracy
    d. Neutron Degeneracy

23. Which events or factors can trigger star formation within a molecular cloud? **This question has multiple answers, mark all correct answers.**
    a. collision with another molecular cloud
    b. nearby supernova
    c. the interstellar magnetic field
    d. the thermal energy of the molecular cloud
    e. ignition of nearby stars

24. Which is NOT one of the 88 officially recognized constellations?
    a. Andromeda
    b. Big Dipper
    c. Lupus
    d. Telescopium
    e. Boötes

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25. Cygnus X-1 was the first widely accepted black hole. Which characteristics that led to its discovery? **This question has multiple answers, mark all correct answers.**
    a. Gravitational lensing warps stars behind it.
    b. It is part of a binary system.
    c. It generates a strong X-Ray signal.
    d. It occults stars behind it.

26. Wolf-Rayet stars, such as WR 136, are distinguished by their
    a. low mass
    b. low temperature
    c. high rate of mass loss
    d. abundance of carbon
    e. abundance of oxygen

27. IGR J17091 is a
    a. stellar mass black hole
    b. magnetar
    c. protostar
    d. semiregular variable star
    e. Cepheid variable

28. An imaginary binary system contains the stars Suiris A and Suiris B. The ratio of their masses (m_A/m_B) is 8/3 and Suiris A orbits the system's center of mass at a distance of 150AU. Find the radius of Suiris B's orbit around the system's center of mass.
    a. 150AU
    b. 400AU
    c. 56.3AU
    d. 267AU
    e. 135AU

29. Spectroscopic binary systems are distinguished from stars by_____.
    a. Apparent motion
    b. Presence of heavy elements
    c. High luminosity
    d. Fluctuating temperature
    e. Doppler shift

30. True or false: the apparent magnitude of the sun, as viewed from Pluto at perihelion is lower than a full moon as it is viewed from Earth.

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Short Answer Section:

31. Which star is closest to Earth? (2 pts)

Match the description to the figure in the provided packet. (2 pts each)

32. V838 Mon-rapidly expanding variable star____

33. α Orionis - supergiant_____

34. SN2010JL – supernova with a shockwave passing through a gaseous layer_____

35. IC1396 – a nebula of gas and dust ionized by a massive star _____

36. The H-alpha line (656.280nm) from a newly discovered star is 656.266nm. Find the velocity of the star in m/s. (2 pts)

37. A star has a parallax of 0.16 seconds of arc. Find the distance to this star in parsecs. (2 pts.)

38. A star has a distance modulus of 6.5. Find its distance in parsecs. (2 pts.)

39. An imaginary binary system, Rizam, consists of a 10 solar mass star and a of 5.6 solar mass star that orbit with an average distance of 36 AU. Find the orbital period in years. (2 pts.)

40. What does the SXP in SXP 1062 stand for? (2 pts.)

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Essay Section:

41. Describe the utility of studying star clusters. (5 pts.)

42. Explain why Cepheid variable stars are key to understanding the distance scale of the universe. (5 pts.)

43. Using the figure (F6) in the provided packet, contrast the bright heat and dark regions. (5 pts.)

44. What is the Rho Ophiuchi Cloud Complex? Describe what it is composed of, its location and the probable cause of the events taking place there. (5pts.)

45. Describe the events leading up to a Type II supernova and the events immediately afterward. Differentiate between a type II-L and a type II-P supernova. (5pts.)

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Answer Sheet:

1.	2.	3.	4.
5.	6.	7.	8.
9.	10.	11.	12.
13.	14.	15.	16.
17.	18.	19.	20.
21.	22.	23.	24.
25.	26.	27.	28.
29.	30.		Total: /30

31.	32.
33.	34.
35.	36.
37.	38.
39.	40.
	Total: /20 This score is the second tiebreaker.

41. _____

Total: /5

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42.

Total: /5

43.

Total: /5

44.

Total: /5

45.

Total: /5

The sum of the essay scores is the first tiebreaker.

Total: /75