

USAAAO 2018 First Round Solutions

February 2018

1. A planet's orbit around a star (Sun) has a semimajor axis of 16 AU . What is the period of the planet's orbit?

Solution: Answer: **C**

Use simplified version of Kepler's Law.

2. Which of the following has the longest wavelength?

Solution: Answer: **C**

3. What is the peak wavelength in Angstroms (\AA) of electromagnetic radiation emitted by a star at a temperature of 10,000 K, assuming a blackbody spectrum? (Wien's constant $\sigma_w \approx 2.9 \times 10^7 \text{\AA} \times K$)

Solution: Answer: **B**

$$\lambda[\text{\AA}] = \frac{2.9 \times 10^7}{T[K]}$$

4. Determine the azimuth of Capella (Aurigae) in its upper culmination seen from geographic latitude of $\phi = +45^\circ 58'$.

Solution: Answer: **C**

5. From which geographic latitude does the star Antares (α Scorpio, $\delta = -26^\circ 19'$) never rise?

Solution: Answer: **B**

6. For the following problem find the range in which the answer lies: on the day of summer solstice, on which geographic latitude is the sun culminating at the angle of $+72^\circ 50'$ north of the equator?

Solution: Answer: **A**

Actual value is $+6^\circ 17'$.

7. For the following problem, find the range in which the answer lies: looking from Greenwich on February 10th ($s_o = 9^h 17^m 486^s$) at what time is Pollux ($\alpha = 7^h 42^m 16^s$) at its upper culmination?

Solution: Answer: **E**

Ans= $22^h 20^m 48^s$

8. What is the main energy transport process in the core of the Sun?

Solution: Answer: **A**

The inner regions of the sun is radiative, and the outer layers are convective.

9. What are the bright regions on the solar photosphere called?

Solution: Answer: **C**

Sunspots are the dark regions, faculae the bright regions.

10. When seen from Earth, what is Venus' phase when it is at greatest elongation?

Solution: Answer: **C**

At greatest elongation the Sun-Venus-Earth system forms a right angle, therefore Venus will be seen from Earth as half illuminated which is a quarter phase.

11. Which planets have primary atmospheres?

Solution: Answer: **A**

Primary atmospheres are formed of accreted gaseous material during the formation of the solar system.

12. Which of the following planets or dwarf planets has not been visited by a spacecraft?

Solution: Answer: **B**

13. Star A has a surface temperature of $10,000K$ while Star B has a surface temperature of $4,000K$. Star B has a radius 10 times larger than that of Star A and its distance from Earth is half that of Star A. What is the magnitude difference between Stars A and B?

Solution: Answer: **D**

$$\Delta m = -2.5 \log \left(\frac{F_1}{F_2} \right) = -2.5 \log \left[\left(\frac{R_1}{R_2} \right)^2 \left(\frac{T_1}{T_2} \right)^4 \left(\frac{d_2}{d_1} \right)^2 \right] = 2.53$$

14. What property of the interiors of stars changes at the Kraft break, around 1.6 Solar masses?

Solution: Answer: **B**

15. Which of the following stages will our Sun not evolve through?

Solution: Answer: **C**

Our Sun is not massive enough to encounter the Cepheid instability strip in the H-R diagram.

16. Which of the following are not high mass stars (relative to the others)?

Solution: Answer: **D**

17. On a Hertzsprung-Russell diagram, where would we find stars that are cool and dim?

Solution: Answer: **B**

18. What do the cores of low-mass and high-mass main sequence stars have in common?

Solution: Answer: **B**

19. The thermal pressure of a gas depends on

Solution: Answer: **C**

20. What happens to the core of a star after a planetary nebula occurs?

Solution: Answer: **C**

21. Find the visual magnitude of the binary star α Pisces, given that the visual magnitudes of each component in the binary system are 4.3 and 5.2. Pick the choice whose range encompasses the right answer.

Solution: Answer: **D**

Ans=3.91

22. Which of the following is not a method used to detect exoplanets?

Solution: Answer: **D**

Gravitational waves are emitted by compact objects orbiting one another, for instance black hole or neutron star binaries, not planets.

23. Which of the following type of planet was the first to be discovered around a Solar-type star?

Solution: Answer: **E**

51 Pegasi b was the first planet discovered around a solar type star, and it's Jupiter sized and very close-in to its host star, hence the name "hot Jupiter."

24. A star of radius 0.72 solar radii experiences a periodic dip in brightness once every 13.8 days, thought to be a result of an orbiting exoplanet. The normalized flux during one of these dips in brightness is 0.98. What is the radius of the exoplanet?

Solution: Answer: **B**

$$\Delta F = 1 - F_{eclipse} = \left(\frac{R_p}{R_s}\right)^2$$
$$R_p = R_s \sqrt{(1 - F_{eclipse})} = 0.102 \text{ solar radii}$$

25. The center of the Milky Way is a part of which zodiac constellation?

Solution: Answer: **B**

26. The youngest stars in the Milky Way are found predominantly in which part of the galaxy?

Solution: Answer: **C**

27. In the 1920s Harlow Shapely estimated the size of the Milky Way galaxy using which of the following?

Solution: Answer: **A**

Shapely used RR Lyrae stars to estimate the size of the Milky Way galaxy.

28. What is the theoretical diffraction limited angular resolution in visible light (5,500 Å) of a typical 20 – cm (8 in) amateur telescope?

Solution: Answer: **B**

$$\Theta[\text{rad}] = \frac{1.22 * \lambda}{\text{Diameter}}$$

29. To improve the angular resolution of a telescope one must:

Solution: Answer: **A**

30. Find the total sum of the binary system of the star Capella, if semi-major axis between them is 0.85AU, and period of 0.285 years.

Solution: Answer: **C**