

1. 23 pc or 75 ly
2. a. 56.7 pc or 185 ly
b. 0.0176"
3. a. 0.0026"
b. 890 pc
4. a. Altair, 26.1 km/s
b. Aldebaran, 54.3 km/s
c. Arcturus, 122.1 km/s
5. Procyon is much closer and therefore *appears* to move further across the celestial sphere in a year even though it moves roughly the same distance in space as Betelgeuse.
6. a. 1.34 "/yr
b. -5.5 km/s (approaching)
c. 17.7 km/s
7. a. 144 L_{\odot}
b. 10 R_{\odot}
c. 0.084 R_{\odot}
d. 0.89 R_{\odot}
8. Occultations and skinny triangle
9. a. 51 W/m²
b. 9000 W/m²
c. 0.88 W/m²
10. B is 3× more distant than A

11. Sun's flux is 16 trillion times greater
12. a. C appears 100× brighter
b. D is 10× more distant
13. 4.94×10^{-6} pc (yes, = 1.02 AU)
14. a. 597 pc
b. 190 pc
15. Deneb is 190,000× brighter
16. Antares is 4.9× brighter than Spica

17. a. $B-V = -0.139$; 15000 K, blue white
b. $B-V = 1.705$; 3000 K, red
c. $B-V = 0.368$; 6900 K, yellow white
18. a. A, B, C, ... in order of strength of hydrogen lines
b. O, B, A, ... in order of decreasing temperature
19. a. main seq: majority of stars are found along this rough diagonal region of HR diagram (upon which luminosity increases with temperature) -0.1 to 10 times the size of Sun
b. blue giant: O & B, $T > 10000$ K, 10 to 1000 R_{\odot}
c. red giant: K & M, $T < 5000$ K, 10 to 1000 R_{\odot}
d. white dwarf: O – F, $T > 7000$ K, 0.01 to 0.1 R_{\odot}
e. red dwarf: M, $T = 3000$ K, 0.01 to 0.1 R_{\odot}

20. a. white dwarf
b. red giant
c. main sequence
d. main sequence
e. blue giant
21. a. 10000 L_{\odot}
b. 0.1 R_{\odot}
c. M, 3000 K
d. A or B, 3 R_{\odot}
e. giant is tens of thousands of times more luminous and thousands of times larger in diameter
22. Brightest stars are visible across great distances while the dimmest stars are visible ONLY if nearby.
23. Red dwarfs are most common but are too dim to be detected at great distances.
24. Ia – Bright Supergiants
Ib – Supergiants
II – Bright Giants
III – Giants
IV – Subgiants
V – Main Sequence

25. G2 V & G2 II are same temperature and color, but the G2 II is around 100 times more luminous and around 10 times greater diameter than the G2 V.
26. A **visual binary** can be discerned telescopically as two stars and orbit can simply be timed; an **eclipsing binary** consists of two stars that periodically pass in front of one another causing a measurable change in brightness; a **spectroscopic binary** has spectral lines that shift back and forth due to the doppler effect as the two stars orbit one another.
27. a. 200 billion years
b. 1 billion years
c. 100 million years