PROBLEM SET 2 SOLUTIONS Physics 2021

- 1. If phases are caused by the Earth's shadow, the curved terminator on the crescent and gibbous moons would indicate that both edges of the Earth are curved. However, at the quarter phases the terminator is straight, and the Earth's curved body could not cast a straight-edged shadow.
- 2a. Full Moon
- 2b. Third Quarter
- 2c. New Moon
- 2d. First Quarter
- **3a.** Third Quarter
- **3b.** New Moon
- **3c.** First Quarter
- 3d. Full Moon

(Hint: There is a 6-hour difference from when the Moon rises to when it is highest in the sky.)

4. The orbital velocity of the Moon is 360 deg in 27.3 days.

a. t = d / v = (0.5 deg) / (360 deg / 27.3 day)

= (0.5 deg / 360 deg) (27.3 day * 24 hr/day) = 0.91 hr

b. d = (0.5 deg / 0.91 hr) (12 hr) = 6.6 deg

5. The Moon covers 360° in one sidereal month

= 27 days 7 hours 43 min = 2.36 x 10⁶ sec Angular Speed = 360^o / 2.35 x 10⁶ sec

Angular Diameter = Angular Speed x Time = (90 sec) (360° / 2.35 x 10⁶ sec)

= 0.0137 deg = 49 arcsec

- 6. Because it takes almost 30 days for the Moon to complete a cycle, it is hard to get 2 Full Moons to fit in months that are only 30 or 31 days long. February cannot have a Blue Moon because it is too short to have even a complete lunar cycle.
- 7. From our perspective as we look up at the sky, we see the Moon always moving from the West toward the East. Therefore, we would see the Moon enter the Earth's shadow from the West side and exit on the East side.
- 8a. If the Moon's diameter were doubled, there would be more total solar eclipses because the opportunity to cover the Sun's disk would be increased.
- 8b. If the Moon's diameter were halved, then there would be no total solar eclipses because the Moon would not be large enough to cover the Sun's disk completely. Each eclipse that is now total would become an annular eclipse.
- 9. To have the maximum duration of totality, you want the Sun to appear as small as possible. Therefore, the distance should be a maximum, i.e., aphelion.