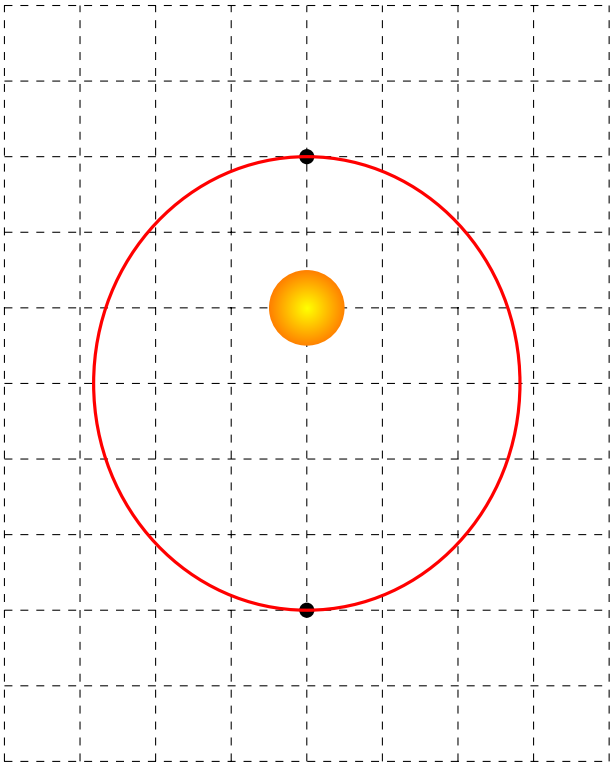
Name: _____

Please answer the following questions in the space provided. In the case of multiple choice questions, please circle your answer clearly. If you run out of room to show work in the space provided, please make a note and continue work on the back. Try to show *all* your work or thoughts, *even on multiple choice problems*, for chances for partial credit! Good luck!

1. (4 points) In the diagram below, the two dots mark the points when a planet is the closest and furthest from the drawn Sun. Sketch in the orbit of the planet. Show your work for full points!



2. (1 point) At 10pm on the 28th of September you look at a sky chart and note that the Right Ascension and Declination of the star Altair are about 20 h and 9° respectively. What is true about the RA and Dec of Altair throughout the rest of the night?

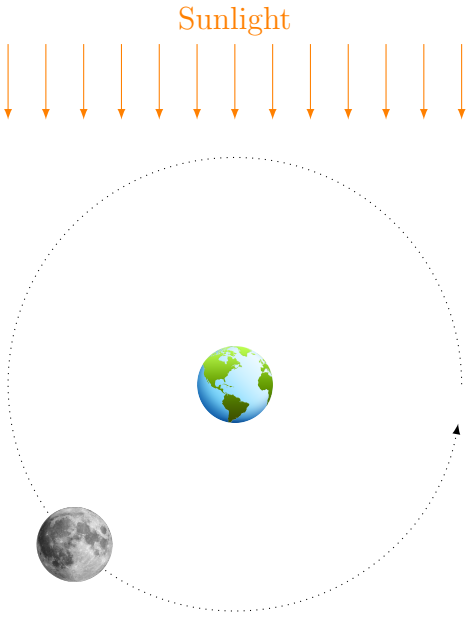
   A. Both RA and Dec will increase throughout the night

   B. The RA will increase through the night but the Dec will stay constant

   C. the Dec will decrease through the night but the RA will stay constant

   D. They do not change

3. (3 points) Given the image of the Moon to the right, determine approximately where in its path around the Earth it is located. Draw it in at that point.

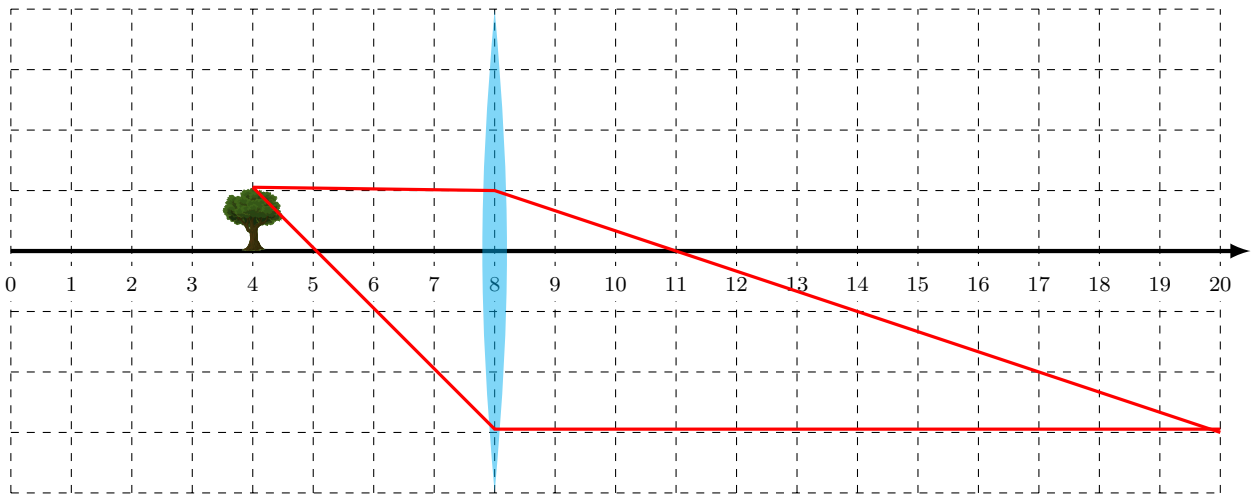


Desired Phase

4. (3 points) Name three distinct properties of a light *source* that you can determine from analyzing the light it gives off.

Solution: Temperature, Composition, Radial Velocity

5. (3 points) The tree below is being imaged using a simple lens. The lens has a focal length of three meters. The image of the tree will be how many times larger than the actual tree?



3 times larger

6. (1 point) You'd like to build a telescope capable of observing dim distant galaxies. What telescope property should you prioritize to ensure the best results?

   A. The angular resolution

   B. The aperture size

   C. The field-of-view

   D. The eye-piece magnification

7. (3 points) Check all of the following that must be true in order for a total solar eclipse to occur.

   ◯ The Earth must be at its closest point to the Sun

   √ **The Moon must be New**

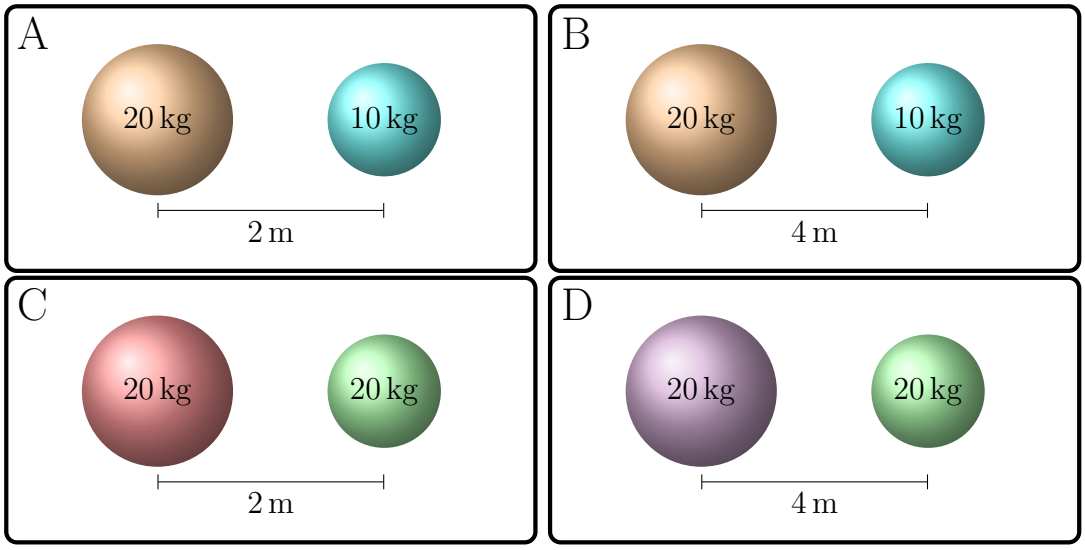
   ◯ The Moon must be Full

   ◯ The Earth must be at its furthest point from the Sun

   √ **Earth must be positioned so that the intersection between Earth and the Moon's orbital planes lies between the Earth and the Sun**

   ◯ the Moon must be at its furthest point from the Earth

8. (2 points) Rank the below situations in order from greatest gravitational attraction to least gravitational attraction.



Greatest **C** **A** **D** **B** Least

9. (1 point) The primary cause Earth's seasons is:

   A. the tilt of the Earth.

   B. the variation in proximity to the Sun from one side of the Earth to the other

   C. the variation in Earth's distance from the Sun.

   D. the variation in the Moon's gravity as it orbits.

10. (1 point) What property of a light wave is responsible for the intensity or brightness of the light?

    A. The wavelength of the wave

    B. The velocity of the wave

    C. The frequency of the wave

    D. The amplitude of the wave

11. (1 point) The stars Vega and Deneb are separated by an angular distance of 24°, while the stars Vega and Altair are separated by an angular distance of 34°. Which of the following statements is true?

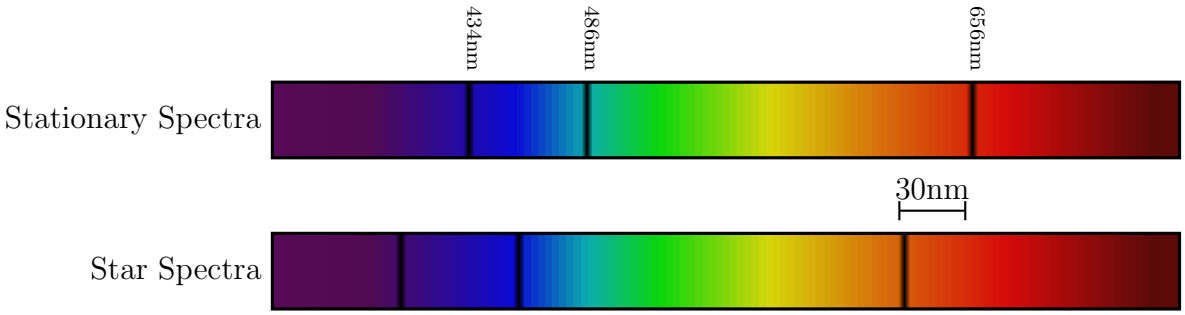
    A. Vega and Deneb are physically separated by more space than Vega and Altair

    B. Traveling between Vega and Deneb would be faster than traveling between Vega and Altair

    C. Vega and Altair appear further apart in the night sky than Vega and Deneb.

    D. Vega and Altair would have only the width of a finger held at arms length between them.

12. You take the below spectra of a mystery star and compare it to a known line spectra at rest. Given the observed shift in wavelength, answer the below questions.



    (a) (1 point) Is the star coming towards us or away from us?

    Solution: Tis blueshifted, so toward us

    (b) (2 points (bonus)) How fast is the star traveling?

Solution:

$$\frac{\lambda_{obs} - \lambda_{rest}}{\lambda_{rest}} = \frac{v}{c}$$

$$\frac{-30\,\text{nm}}{656\,\text{nm}}\left(3 \times 10^8\,\text{m/s}\right) = v$$

$$\Rightarrow v = -1.372 \times 10^7\,\text{m/s}$$

The Equation Page

Constants

$G = 6.67 \times 10^{-11}\,\mathrm{Nm^2/kg^2}$
$c = 3 \times 10^{8}\,\mathrm{m/s}$

$\odot =$ Pertaining to Sun
$M_\odot = 1.99 \times 10^{30}\,\mathrm{kg}$
$R_\odot = 695{,}700\,\mathrm{km}$

$\oplus =$ Pertaining to Earth
$M_\oplus = 5.97 \times 10^{24}\,\mathrm{kg}$
$R_\oplus = 6.37 \times 10^{6}\,\mathrm{m}$

Math Equations

$$A_c = \pi r^2$$
$$A_e = \pi a b$$
$$C = 2\pi r$$
$$f = \sqrt{a^2 - b^2}$$
$$\varepsilon = \sqrt{1 - \frac{b^2}{a^2}}$$

Math Descriptions

$A_c =$ area of circle
$A_e =$ area of ellipse
$a =$ semi-major axis
$b =$ semi-minor axis
$r =$ radius of circle
$C =$ circumference of circle
$f =$ foci of ellipse
$\varepsilon =$ eccentricity of ellipse

Physics Equations

$$\lambda_{peak}(\mathrm{nm}) = \frac{2900000}{T}$$
$$\frac{a_r^3(\mathrm{AU})}{p^2(\mathrm{yrs})} = (M_1 + M_2)_\odot$$
$$F = Ma$$
$$F_g = G\frac{M_1 M_2}{a_r^2}$$
$$L = Mvr$$
$$\frac{v}{c} = \frac{\lambda_{obs} - \lambda_{rest}}{\lambda_{rest}}$$
$$\frac{\theta}{360} = \frac{r}{2\pi d}$$
$$\lambda f = c$$

Physics Descriptions

$T =$ temperature
$\lambda =$ wavelength
$p =$ period
$a_r =$ avg distance between or semi-major axis
$F =$ force
$M =$ mass
$a =$ acceleration
$v =$ velocity
$L =$ angular momentum
$r =$ radius
$\theta =$ angular radius
$d =$ distance to object
$f =$ frequency

SI Prefixes

pico	nano	micro	milli	centi	Base	kilo	mega	giga	tera	peta
10^{-12}	10^{-9}	10^{-6}	10^{-3}	10^{-2}	1	10^{3}	10^{6}	10^{9}	10^{12}	10^{15}