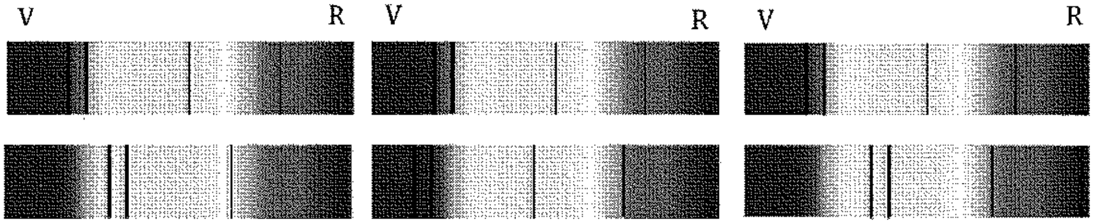
Key

Practice questions for 3/6/17 Astronomy test

1. Describe the Doppler Effect as it pertains to light and the movement of celestial objects

The Doppler effect is the perceived change in wavelength of light due to relative movement of the light source and the observer. If the light source and observer are moving toward each other, the light waves compress and the perceived light is "blueshifted." If they are moving away from each other, the light waves expand and the perceived light is "redshifted."

2. Look at the spectra below and attempt the questions. (In each case the top spectra represents our sun.)



Galaxy A Galaxy B Galaxy C

a. Which of the galaxies are moving towards us? B

b. Which of the galaxies are moving away from us? A, C

c. Which galaxy is moving away at the greatest speed? C

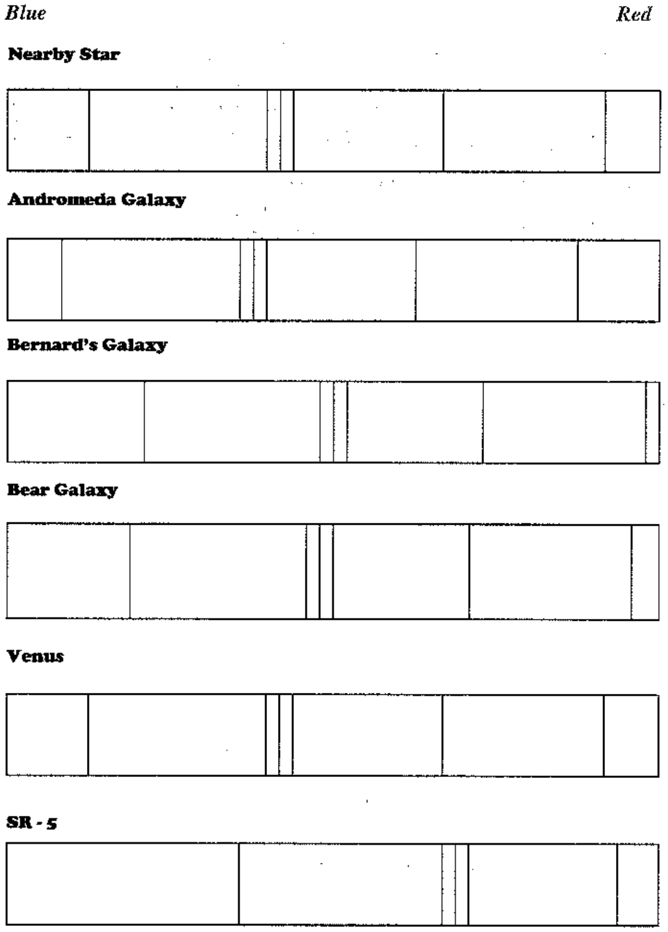
3. What best describes the doppler effect?
- [✓ A.] An apparent change in frequency of a wave due to the relative motion between a wave source and an observer
- B. When sound changes pitch
- C. When light changes color
- D. An apparent change in the amplitude of a wave due to the relative motion between a wave source and an observer.

4. When redshift occurs, the perceived frequency of the wave would...
- A. Increase
- [✓ B.] Decrease
- C. Stay the same
- D. Make bird sounds

5. When blueshift occurs, the perceived WAVELENGTH of the wave would...
- A. Increase
- [✓ B.] Decrease
- C. Stay the same
- D. Make frog sounds

6.

Red shift/Blue shift Practice



1. Which galaxy or planet is moving at the same speed as the nearby star?

Venus

2. What galaxies or planets are moving toward the nearby star?

Andromeda Galaxy

3. What galaxies or planets are moving away from the nearby star?

Bernard's Galaxy, Bear Galaxy, SR-5

4. Is the Andromeda galaxy red or blue shifted?

Blueshifted

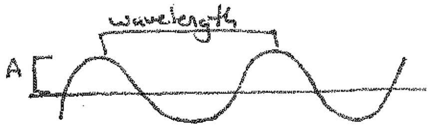
5. According to Hubble's law, which galaxy or planet is moving fastest away from the nearby star?

SR-5 - most shift (direction doesn't matter)

6. Which galaxy or planet is moving the slowest away from the nearby star?

Bear - least shift toward red

7. Describe amplitude and wavelength as they pertain to light waves



Amplitude describes the brightness of light waves, wavelength describes the type of light wave (gamma, visible (color), radio, etc.) and, as such, the frequency and energy of the wave.

8. The Doppler shift method for detecting the presence of exoplanets is best able to detect

[✓ A)] massive planets near the star.

B) massive planets far from the star.

C) low-mass planets near the star.

D) low-mass planets far from the star.

9. How can we determine the distance between an exoplanet and its star?

The distance between an exoplanet and it's ←(oops) star is related to the speed at which the ~~star~~ Planet moves. Fast planets are closer to their stars and slow planets are farther away.

This would be enough - for actual numbers there may be a transit time/orbit distance graph - as on the website - or an equation given.

10. How can we determine the size of an exoplanet relative to its star?

Look at the amount (percent) of light from the star blocked by the planet. If 10% of the stars light is blocked then the area of the planet is 10% of the area of the star. To find the relative radius, ~~to~~ do $\sqrt{\frac{\cancel{\text{radius}}\ \text{Area of planet}}{\text{Area of star}}}$. For this hypothetical planet star system, $\sqrt{\frac{\text{area of planet}}{\text{area of star}}} = \sqrt{0.10} = 0.32$. This means that the radius of the planet is ~32% of the radius of the star (note: Area of circle - πr^2)

11. How can we determine the tilt of an exoplanet's orbit relative to us?

The shape of the brightness curve tells us about the tilt of the orbit. If the brightness curve has relatively vertical sides and a long, flat horizontal part, ~~If~~ the orbit is edge-on, not tilted (). If the brightness curve is more "V" shaped, the planet's orbit is tilted ()

12. Describe the wobble method of exoplanet discovery, how we detect wobble and list the limitations of the method.

The wobble method uses the gravitational pull that a massive planet exerts on its star. As a massive planet orbits, it pulls its star towards itself, resulting in the movement of the star "following" the planet, or wobble. The wobble can be detected by looking for periodic redshift/blueshift (alternating) in the star's spectrum. Cannot detect: small planets, planets with extremely large/extremely ~~[illegible]~~ tilted orbits

13. How could we detect the chemical make-up of an exoplanet's atmosphere?

By looking at the spectrum! An exoplanet's (or any planet's) atmosphere is a layer of gas. It will absorb/emit light just like other gas clouds. The wavelengths of light that the gas absorbs/emits will correspond to the signature patterns of element/ion absorption/emission. By matching the pattern from the atmosphere to the signatures of the elements, you can see what is there.

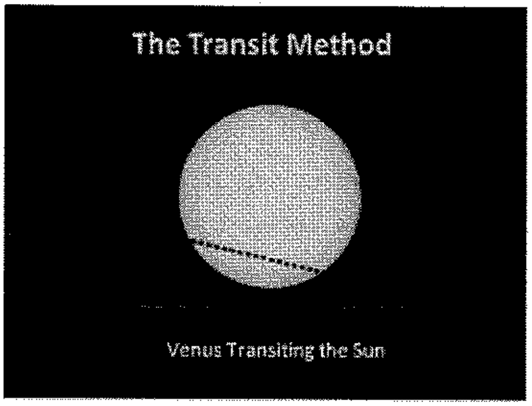
14. Which would be better to use from a land-based telescope: the wobble method or the transit method of exoplanet discovery? Why?

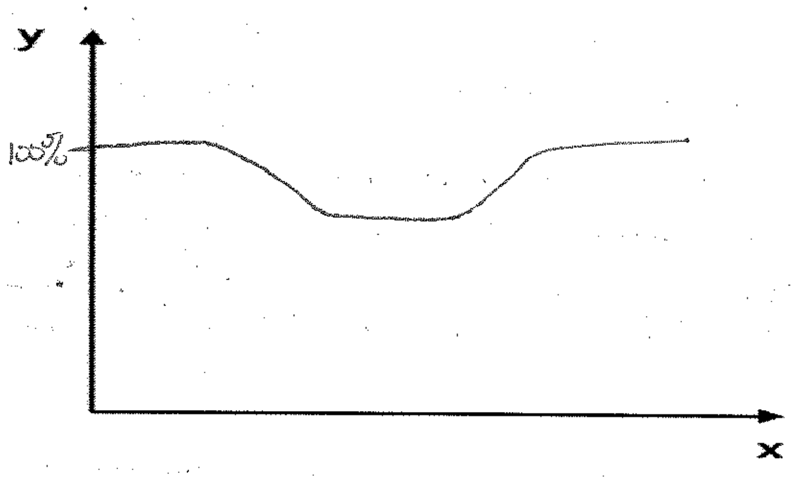
It would be easier to use a land-based telescope for the transit method. We can correct for atmospheric changes/light pollution by looking at dark areas of the sky and comparison stars

15. What is a brightness curve in the context of exoplanet discovery? What does it tell us?

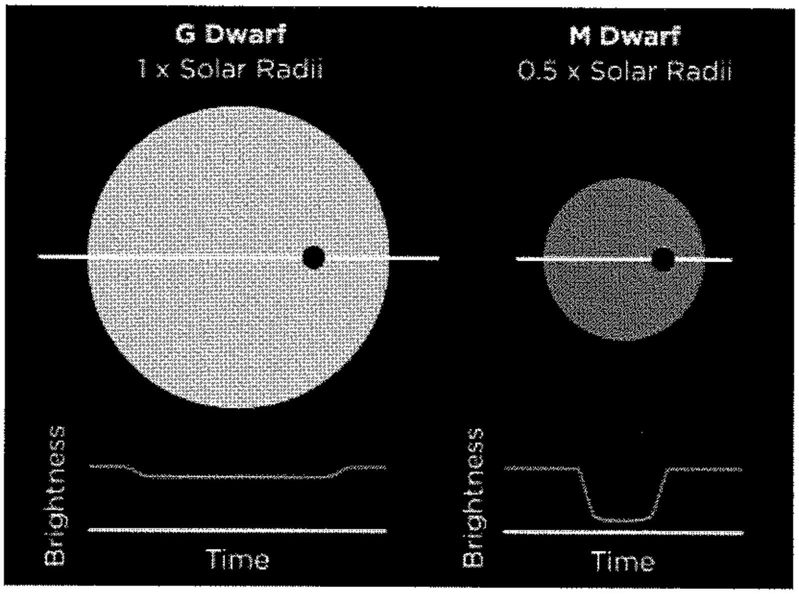
A brightness curve shows how much light is coming from a particular star over the course of time. Each data point represents one picture.

16. Draw a brightness curve from the following picture of venus transiting in front of the sun and describe why you drew it that way:





17. Two stars each have planets of the same size orbiting them. Explain why the brightness curves look different and how to find the relative size of the planet in each case.



The curves look different because even though the planets are the same size, the stars are not. The planet orbiting M Dwarf is bigger relative to its star than the planet orbiting G dwarf. Find the size of the planets by looking at the % of light blocked by the planet. Find the radius by $\sqrt{\frac{\text{area of planet}}{\text{area of star}}}$

18. Using the same diagram as for #17, assume that the brightness goes from 100% to 98% in the case of the G dwarf and from 100% to 85% in the case of the M dwarf. What is the radius of the planet relative to the G dwarf? Relative to the M dwarf?

G Dwarf - 2% of the star's light is blocked. $\sqrt{0.02} = 0.14$

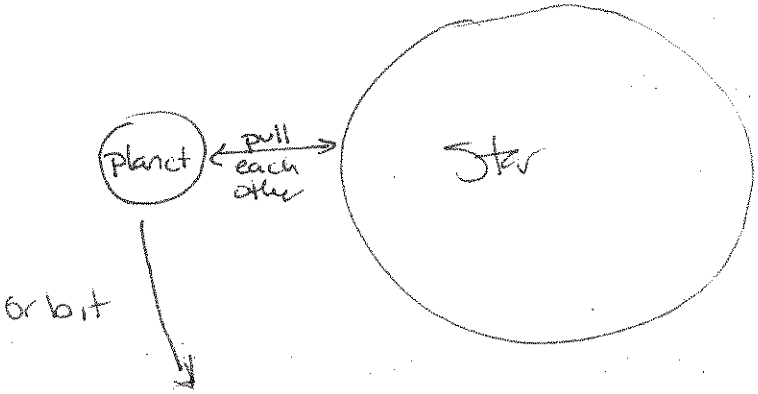
The planet orbiting the G Dwarf has a radius 14% that of the star (this planet is roughly the size of jupiter - YOU DO NOT NEED TO KNOW THE SIZE OF JUPITER/OTHER PLANETS - INFO IN PARENTHESES HERE IS JUST FOR INTEREST)

M Dwarf - 15% of the star's light is blocked. $\sqrt{0.15} \approx 0.39$

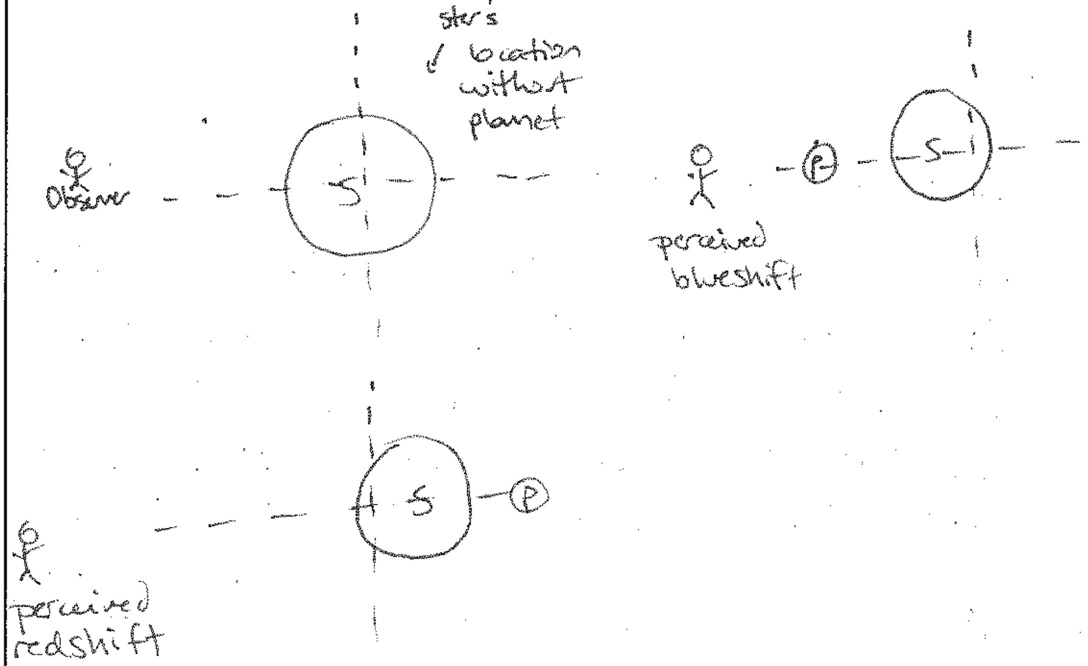
The planet orbiting the M Dwarf has a radius 39% that of its star.

19. Draw a model to describe the wobble method to someone who has never heard of exoplanets or the Doppler effect:

There are a lot of options here



As the planet orbits the star, it pulls on the star



20. Describe how fusion is used to make energy (will not be a major focus on test)

Atomic nuclei normally repel each other because of their positive charge. If, however, you can get them close enough to each other, the repellant force is over powered by the nuclear strong force (the force that holds atomic nuclei together). When that happens (must be at high energy/speed) a neutron is often a waste product of the fusion of 2 nuclei. That neutron has a lot of energy because its moving so quickly. It is also not contained by the magnetic field because it is not positively or negatively charged. It gets absorbed by "blankets" on the walls of the machine and the energy it had is used to heat water, make steam, and turn turbines as in traditional power plants.

Useful graphic: