The following should give you a bit of a sampling of the types of test questions I may ask and serve as a review for the topics we've discussed so far this semester. On the test I will supply you with any tables of data, equations, or constants that you could need to complete the questions. For the sake of this review, I'm assuming you can use your book to look these types of things up. You'll likely want to work these through on your own paper except where you need to draw on an image, as I didn't leave you much room...

1. Dwarf planets generally fail to meet one of the requirements for a planet. Which requirement do they fail?
   A. Orbiting the Sun
   B. Gravitationally squished into a sphere
   **C. Clearing the neighborhood of debris**
   D. Having a molten core

2. Explain (simply) why dust clouds heat up as they contract due to gravity.

   **Solution:** When objects contract due to gravity, they lose gravitational potential energy. Since energy is conserved, they must gain that energy as kinetic energy. The temperature of a system is related to the average kinetic energy of all it's constituent parts, so if the average kinetic energy of the system is increasing as it contracts, so too is its temperature.

3. List all the planets in order of increasing distance from the Sun, and indicate one interesting feature or characteristic of each.

   **Solution:**

   **Mercury:** Largely cratered, geologically dead, has huge temperature swings between it's night and day sides

   **Venus:** Dense atmosphere, incredibly hot, sulfuric rains, spins upside down, spins incredibly slow

   **Earth:** Only known planet with life and water

   **Mars:** Little atmosphere (vanished?), signs of old liquid water but not it's all in ice caps

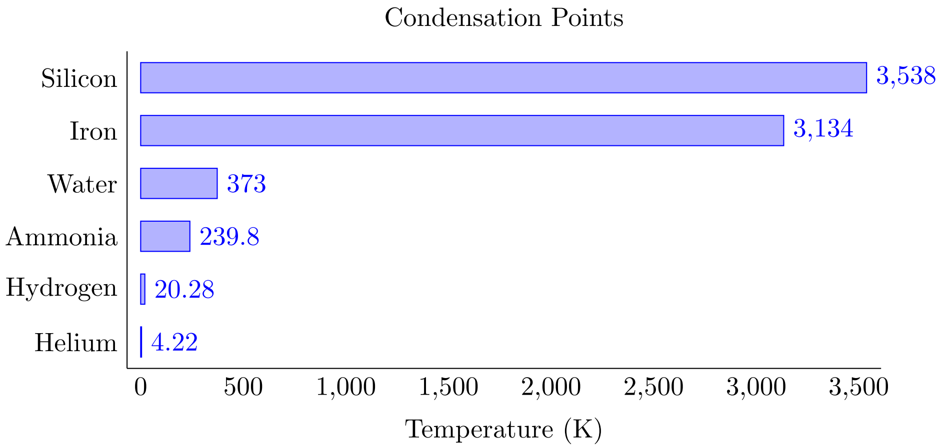
   **Jupiter:** Most massive in the Solar System, Great Red Spot of a storm, spins extremely quickly, strong magnetic fields, large Galilean moons

   **Saturn:** Fanciest rings (duh), very low density (would float in water), has fancy moon Titan with its own atmosphere and methane rain

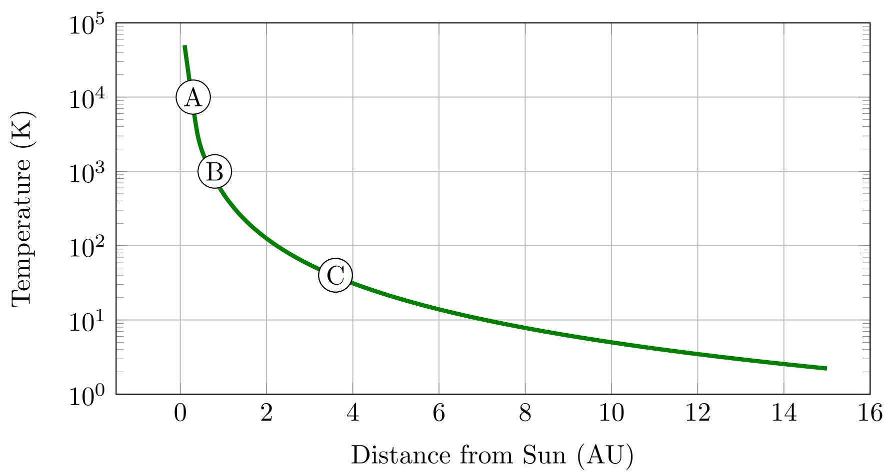
   **Uranus:** Rotates on its side, light blue in color

   **Neptune:** Blue in color, has moon Triton (captured asteroid?), used to have a Great Dark Spot of a storm

4. The below plot shows the condensation points of various elements.




Given the plot below (which is not for our Solar System!), would a planet be able to start forming at the given locations? If so, their cores would be comprised largely of which of the given elements?




**Solution:** The temperature at point A is approximately 10,000 K. This is well above any of the given condensation points, so everything will still be in a gaseous vapor and nothing will be condensing to form a planet.

The temperature at point B is only 1000 K. This is below the condensation points of both Silicon and Iron, indicating that small planetesimals formed from iron and silicon could be present. These could start accreting with other planetesimals, and we could have the formation of rocky, terrestrial type planets.

The temperature at point C is about 40 K. This is now below the condensation points for ammonia and water as well as silicon and iron. Much of the iron and silicon has likely already been accreted into planet B however, leaving mostly frozen water and ammonia out at this range. These could form planetesimals, and accrete together to form small, icy cores. If this core got large enough, it might be possible for it's gravity to start attracting the plentiful hydrogen and helium atoms to start forming a gas giant.

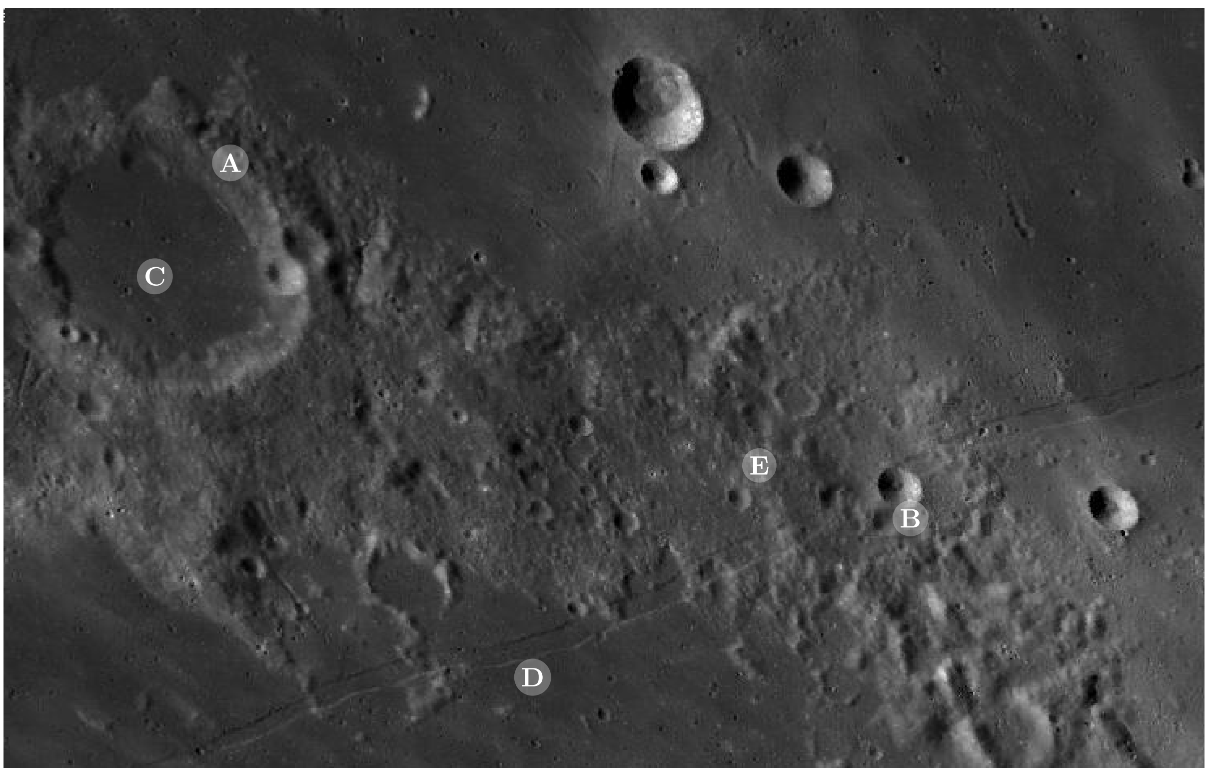
5. An earthquake occurs on Planet A and on Planet B at the same time (oh the chances!). The planets are the same size, and largely comprised of the same material. The one difference is that one of the

planets has a solid, dense core, and the other doesn't. Monitors on the opposite of Planet A detect the earthquake waves 30 s later, while monitors on the opposite of Planet B detect the earthquake waves 45 s later. Which planet has the dense core and why?

**Solution:** Non-light waves travel faster through denser materials (smack a pool of water and a table at the same time if you doubt it!). Because Planet A detected the waves faster, they must have traveled faster, since both planets are the same size. Thus Planet A must at the very least have a more solid and dense core than whatever Planet B has.

6. Order the below labeled features in the below image from oldest to newest.

   A. Large Crater
   B. Small Crater
   C. Lava Flows
   D. Narrow Depression
   E. Mountain Ridge




**Solution:** I'd order these as E,A,C,D,B. My reasoning is:

- $A$ took a chunk out of $E$, so it had to come later
- $A$ has a smoothed bottom, so $C$ had to come afterwards

- $D$ is visible both atop smoothed terrain ($C$) (assuming the smooth terrain in the bottom left was created at the same time as that in $C$) and the mountains ($E$) indicating that it came after both
- $B$ is both not-smoothed on the bottom (came after $C$) and shows no sign of $D$ across it's bottom, indicating it likely punched its dent most recently.

7. What causes the high winds of Jupiter?
   A. The Great Red Spot propagates storms outwards
   **B. The short length of Jupiter's day**
   C. The many gravitational pulls from asteroids in the asteroid belt
   D. The distance of Jupiter from the Sun
8. Identify two of your favorite Galilean moons and interesting fact about each.

**Solution:**

**Io:** Most geologically active body in the Solar System. Tidal forces from Jupiter and nearby moons squeeze and stretch the moon's surface.

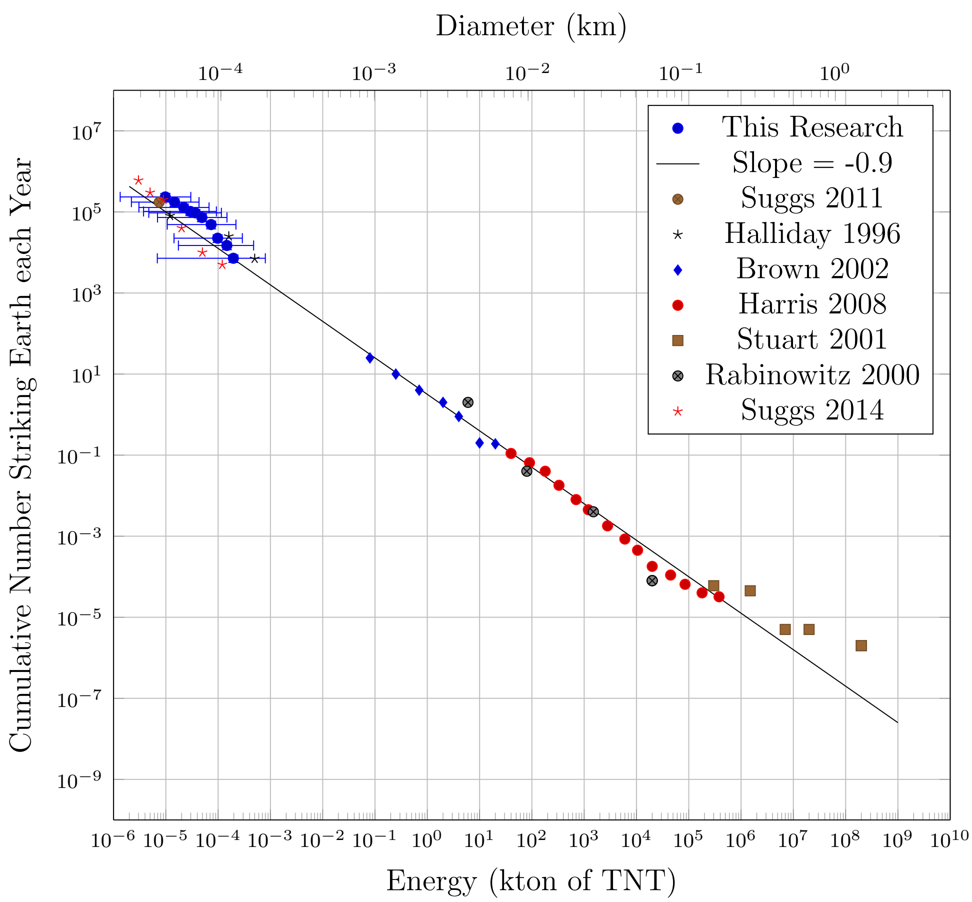
**Europa:** Surface comprised of solid ice, and very likely to harbor a subterranean ocean. Potential for life under the surface?

**Ganymede:** Largest moon in the Solar System, bigger than Mercury, locked in resonance with Europa and Io

**Callisto:** Furthest out of the Galilean moons, largely cratered surface

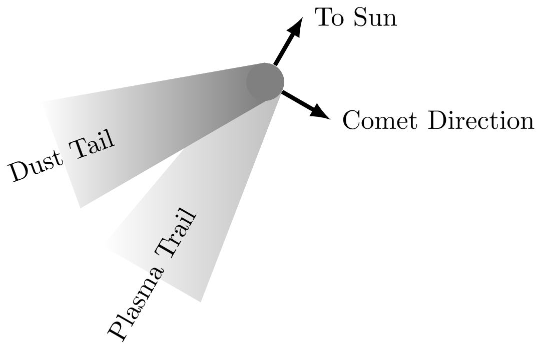
9. The moons of the Jovian planets still show signs of geologic activity. Which of the following is NOT a possible reason why?
   A. Hydrocarbons melt and boil at lower temperatures than rock and metal
   B. Forces from nearby planets or moons stretch and squeeze the moon
   C. "Ice Geology" is possible at lower temperatures than "Rock Geology"
   **D. The moons are not as old and thus still warm enough for geologic activity**
10. True or False? Saturn is the only planet in the Solar System with rings.
   ○ True
   √ **False**
11. The asteroid belt was formed by:
   **A. Jupiter's gravity interfering with planet formation in that region**
   B. A large asteroid smashed one of Jupiter's moons early on in the Solar System's evolution
   C. A region of the Solar System that didn't have enough total mass to collect and form a planet
   D. Comets and asteroids from beyond the Solar System being caught in the Sun's gravity

12. The Tunguska event occurred on June 30, 1908 and was the result of a small asteroid exploding in the area over the Siberian forest. An estimated 2000 $km^2$ of forest was leveled by the 10,000 kton explosion. Given the plot below, in approximately what year should we expect another asteroid of a similar size to impact the Earth?

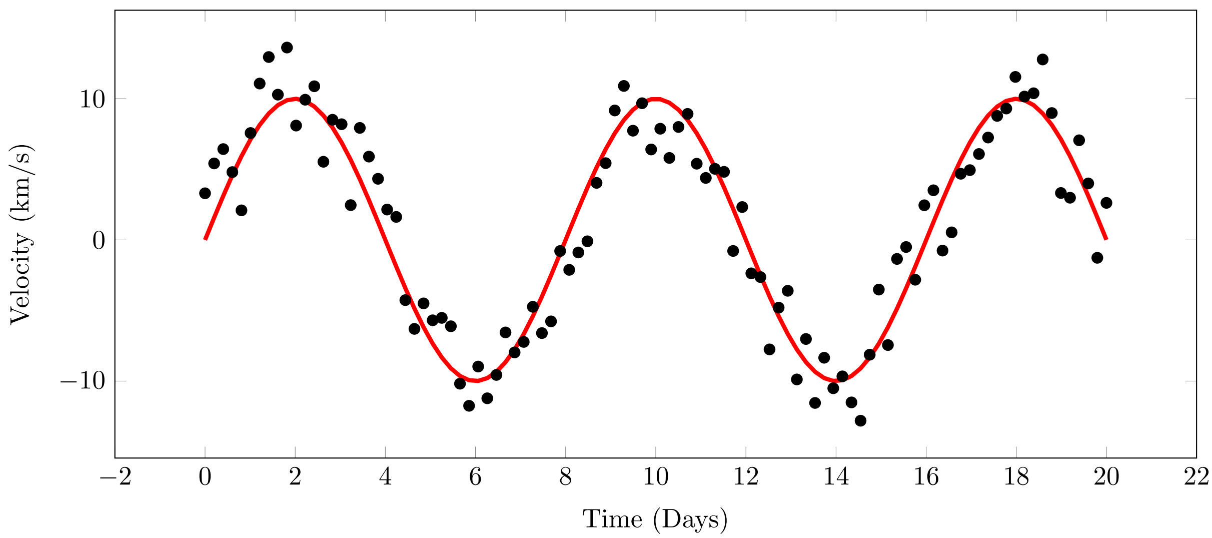



> **Solution:** A 10,000 kton explosion is the same as $10^4$. According to the plot, an impact of this size should only have approximately $10^{-3}$ impacts hitting Earth per year. Taking the inverse of this gets us the number of years between each impact:
>
> $$\frac{1}{10^{-3}} = 10^3 = 1000\,\text{years}$$
>
> So the next time we'd expect an impact of this size would be by around 2908.

13. In the below image of a comet, indicate the direction toward the center of the Solar System. In what direction is the comet traveling?

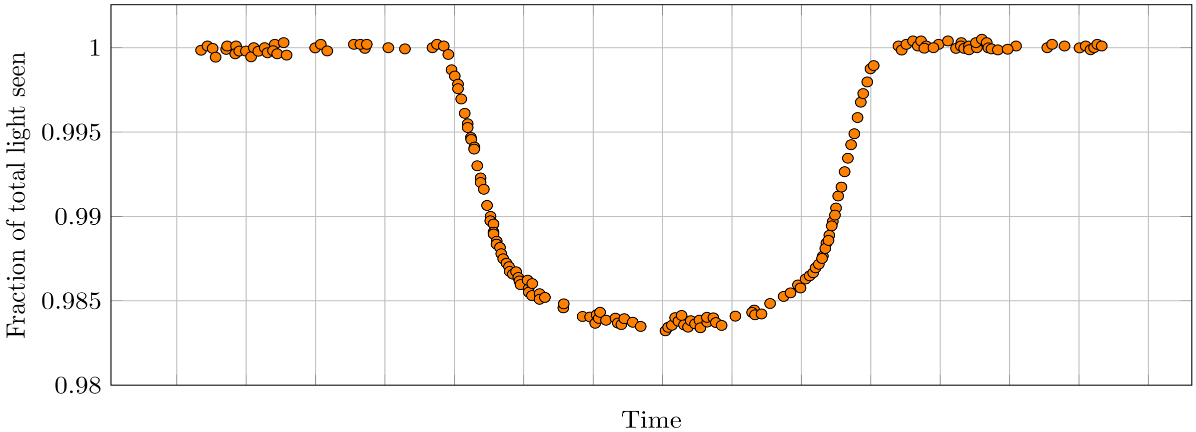



14. You've received the below doppler data for a newly discovered exoplanet. What is the period of the exoplanet's rotation about its star?




**Solution:** The period of the exoplanet's rotation will equal the period of the star's rotation, since they have to keep the center of mass between them at all times. The star's period is the amount of time between repeated orbits. Most obviously to me, there is a trough at 6 days and another at 14 days, indicating an orbital period of 8 days. Pretty darn fast!

15. You've also received the below transit data for a different exoplanet orbiting a star. If the star's radius is 800,000 km, what is the radius of the planet? How does it compare to the size of Jupiter?




**Solution:** The planet seems to be blocking about

$$1 - 0.984 = 0.016$$

of the Sun's light. This is proportional to the relative sizes of the planet and Sun, so:

$$0.016 = \frac{\pi R_p^2}{\pi R_s^2} = \frac{R_p^2}{R_s^2}$$

And thus:

$$\begin{aligned} R_p^2 &= 0.016 R_s^2 \\ &= 0.016\,(800{,}000\,\mathrm{km})^2 \\ &= 1.024 \times 10^{10}\,\mathrm{km}^2 \\ \Rightarrow R_p &= 101{,}193\,\mathrm{km} \end{aligned}$$

Jupiter has a radius of 69,911 km, and so this planet seems to be about 1.45× the size of Jupiter.