Name: _____

Please answer the following questions in the space provided. In the case of multiple choice questions, please circle your answer clearly. Try to show *all* your work or thoughts, *even on multiple choice problems*, for chances for partial credit! Good luck!

(1) 1. Our solar system as we know it is comprised of how many planets (not including dwarf planets here!)?

A. 8

B. 7

C. 12

D. 9

(1) 2. What percentage of the initial cloud the solar system formed from was comprised of Hydrogen and Helium?

A. 50 percent

B. 100 percent

C. 5 percent

D. 98 percent

(3) 3. The solutions below list an element and its condensation temperature. Mark **all** the elements that could form a planetesimal in a region with an ambient temperature of 500 K.

√ **Lead (2023 K)**

◯ Hydrogen (20 K)

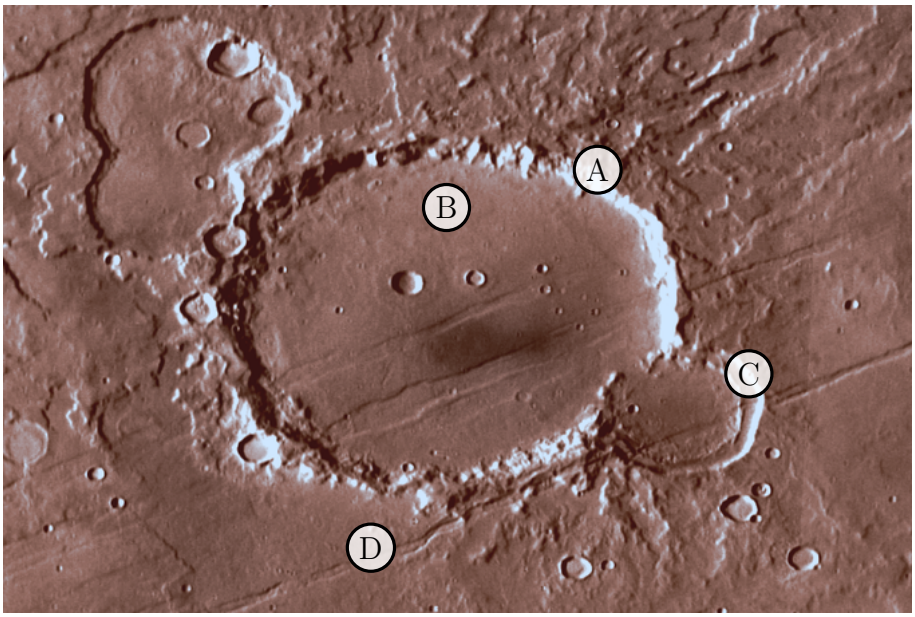
◯ Ethanol (352 K)

√ **Zinc (1183 K)**

◯ Water (373 K)

√ **Iron (3143 K)**

(4) 4. Given the image below, order the labeled elements from oldest to youngest. Explain yourself for full credit!



A Large Crater

B Lava Plain

C Small Crater

D Canyon

Oldest → **A** **C** **B** **D** → Youngest

Explanation:

Solution: C took a bite out of A. B flattened the bottoms of both. D is running atop of B.

(1) 5. What is unusual about Saturn's moon Titan?

A. It is extremely volcanic due to tidal forces

B. It spins extremely rapidly

C. It has liquid methane lakes on the surface

D. It has a crust of frozen ice and subsurface water oceans

(1) 6. Which of the following facts about Venus is incorrect?

A. Its day is longer than its year

B. It has extensive signs of erosion from its sulfuric acid rain

C. It is over 800°F on the surface

D. It rotates backwards

(1) 7. Which of the following *best* explains why many jovian moons are more geologically active than the Moon or Mercury?

A. Because of their great distance from the Sun, the jovian moons receive much less heat energy from the Sun.

B. The jovian moons are considerably larger than the Moon and Mercury and therefore have retained much more internal heat.

C. The jovian moons probably have far more internal heat generated by radioactive decay than do the Moon or Mercury.

D. Jovian moons are made mostly of ice that can melt or deform at lower temperatures than can the rock and metal that make up the Moon and Mercury.

(1) 8. Which of the following is *not* one of the requirements to be a planet?

A. You must orbit the Sun.

B. You must have cleared your "neighborhood" of debris.

C. You must have an atmosphere.

D. You must be spherical in shape.

(1) 9. Which is the following is currently the best scientific theory as to the formation of the Moon?

A. It formed alongside the Earth through slow accretion of rock and dust

B. It formed from a massive collision between Earth and a Mars-sized object

C. It formed from debris thrown up from small impacts on Earth during the heavy bombardment period

D. It was captured into orbit by Earth's gravity

(1) 10. Transit measurements of a planet passing in front of a star can give you all of the following information about the exoplanet orbiting that star except for what?

A. The mass of the planet

B. The distance of the planet from the star

C. The size of the planet

D. The period of the planet's orbit

(1) 11. Why do rings form around some planets instead of additional moons?

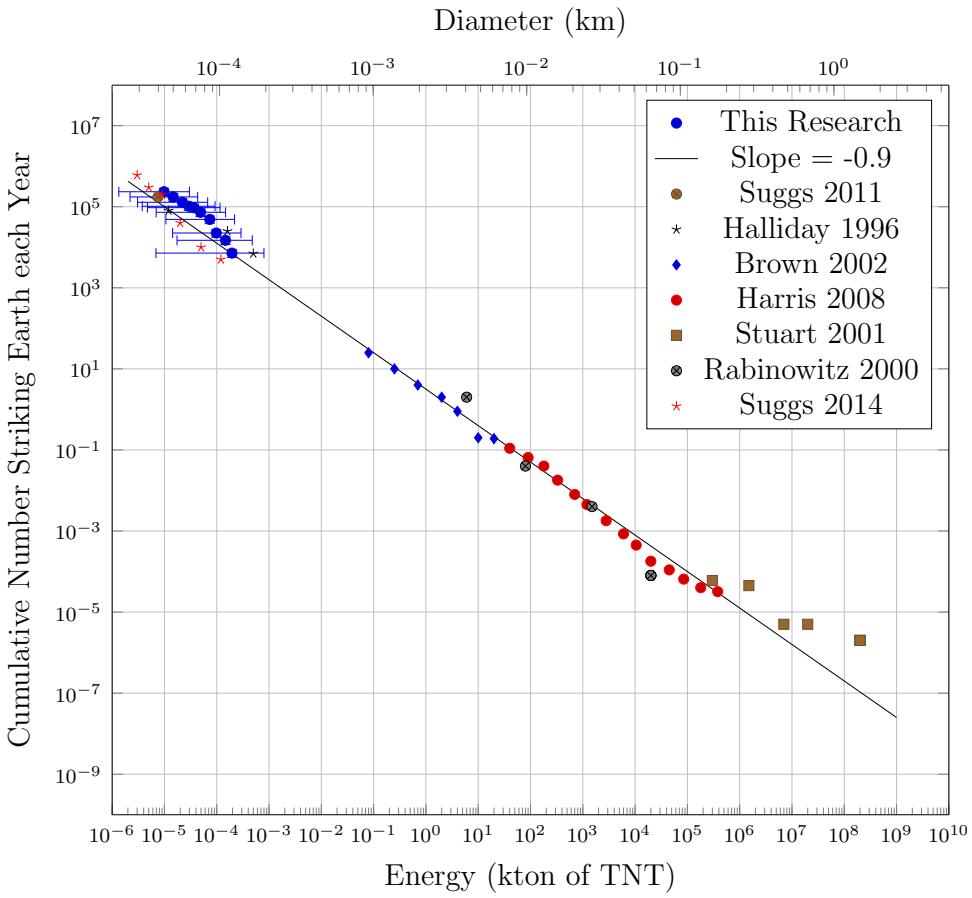
A. Rings spin too quickly to let gravity pull them together into a moon.

B. Tidal forces from the planet would pull apart a larger moon.

C. There is not enough mass in the rings to make even a small moon.

D. Any moons forming in this area end up crashing into the planet.

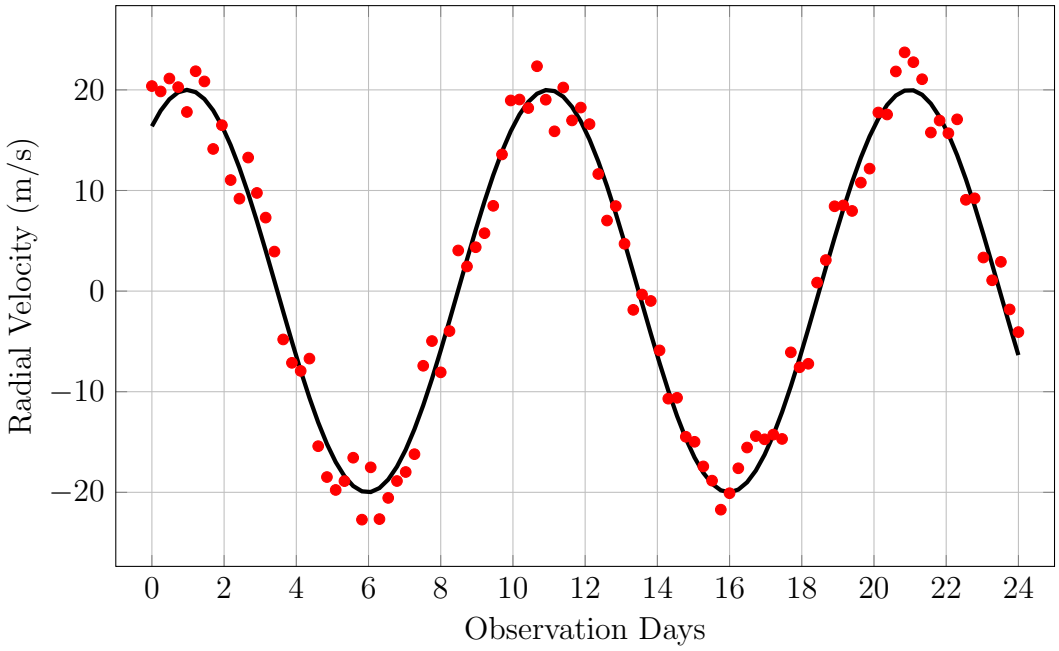
(3) 12. Most of the larger shooting stars we see in the night sky have an energy of approximately 0.001 kton of TNT. How long (in hours) should you expect to wait between observing meteors of this size?



Solution: 0.001 kton of TNT is 1×10^{-3}. Following that up gives us 1×10^{3} strikes per year. We want time per strike, so we'll want one over this, or 1×10^{-3} years per strike. Then it is just a matter of unit conversions:

$$1 \times 10^{-3} \frac{\text{year}}{\text{strike}} \cdot \frac{365\,\text{d}}{1\,\text{year}} \cdot \frac{24\,\text{h}}{1\,\text{d}} = 8.76\,\text{h/strike}$$

13. Use the below doppler plot of a distant star's wobbling motion to answer the following questions:



(1) (a) How many days does it take the star to complete one orbit?

Solution:

$$16 - 6 = 10\,\text{d}$$

(1) (b) How many days would it take an orbiting exoplanet to complete one of its orbits?

Solution: Same time as the Sun to orbit, so 10 d.

(1) 14. The asteroid belt was formed by:

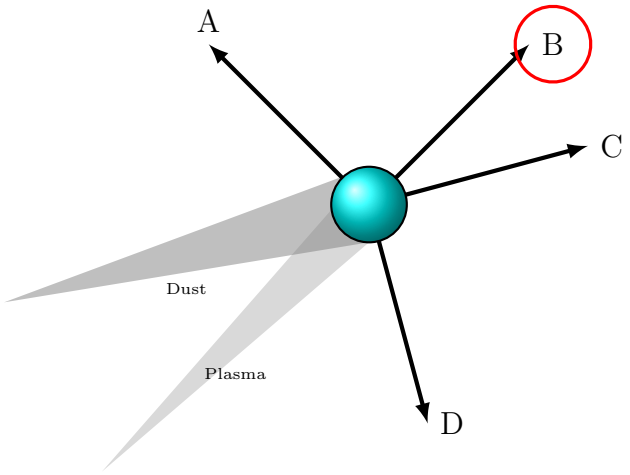
A. A large asteroid smashed one of Jupiter's moons early on in the Solar System's evolution

B. A region of the Solar System that didn't have enough total mass to collect and form a planet

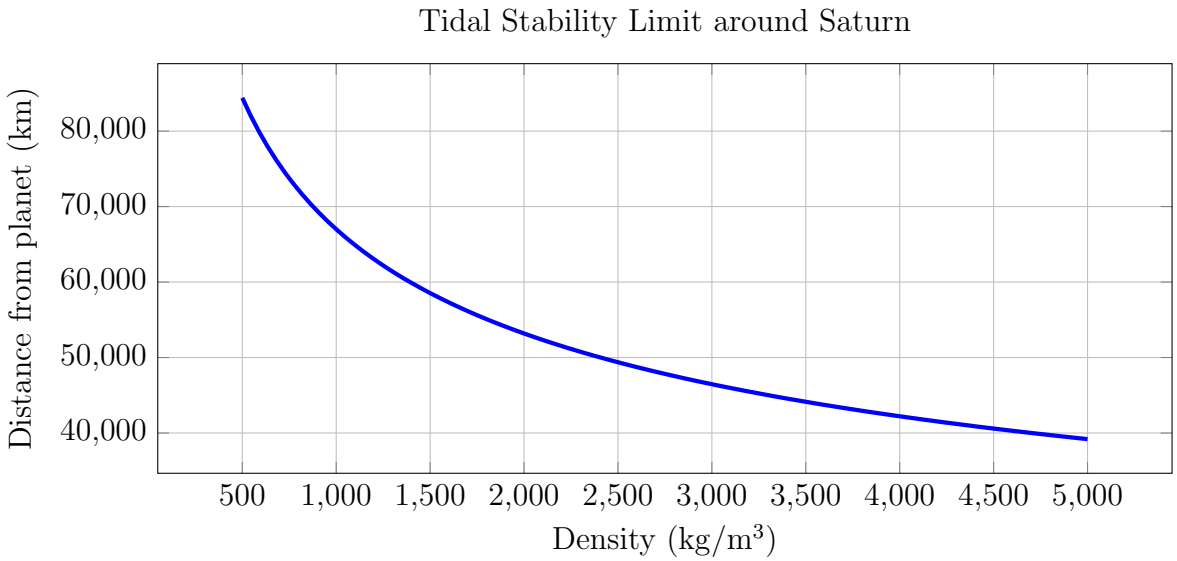
C. Comets and asteroids from beyond the Solar System being caught in the Sun's gravity

D. Jupiter's gravity interfering with planet formation in that region

(1) 15. The comet below has grown tails as it nears the Sun. Based on the position of the tails, which arrow indicates the direction towards the Sun?



(2 (bonus)) 16. A particular moon of Saturn has a density of approximately 1500 kg/m^3. Given the plot below of the tidal stability, would it make sense to observe this moon at a distance of 50,000 km from Saturn? Explain yourself for full credit.



Solution: A density of 1500 kg/m^3 has its tidal stability limit just a smidge under 60,000 km from the planet. Anything closer to the planet than that would be ripped apart by the tidal forces of the planet. So no, it would not make sense to observse this moon at 50,000 km from Saturn. At that distance it should have been ripped apart, unless something else is happening that we haven't accounted for.