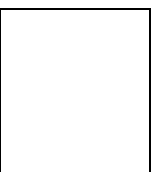


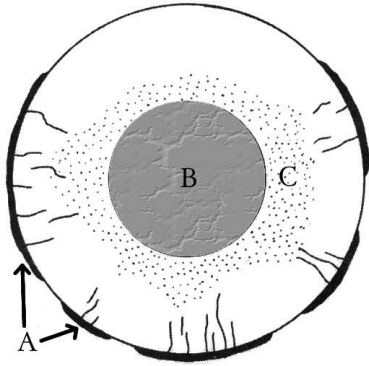
**Answer all questions in the space provided. If you have any questions, raise your hand.
100 points possible. No calculators or electronic devices of any type.**

1 (4 pts) Explain what is means for the orbit of an asteroid to be in resonance with the orbit of Jupiter.

2 (6 pts) Explain why most meteorites we have on the Earth were probably once in resonance with Jupiter.

3 (6 pts) Explain why the orbit of all tidally heated satellites need to be in resonance with the orbit of another satellite.





On the left is a drawing of an idealized cross-section of a differentiated asteroid. Use this drawing to answer the questions on this page.

4 (2 pts) Which type of meteorite originated in the zone of the asteroid labeled **A**?

- (a) Carbonaceous Chondrites
- (b) Achondrites
- (c) Stony-Iron
- (d) Iron

5 (2 pts) Which type of meteorite originated in the zone of the asteroid labeled **B**?

- (a) Carbonaceous Chondrites
- (b) Achondrites
- (c) Stony-Iron
- (d) Iron

6 (2 pts) Which type of meteorite originated in the zone of the asteroid labeled **C**?

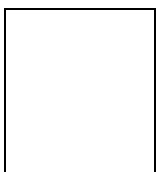
- (a) Carbonaceous Chondrites
- (b) Achondrites
- (c) Stony-Iron
- (d) Iron

7 (6 pts) Which type of meteorite could not have originated from this asteroid?

- (a) Carbonaceous Chondrites
- (b) Achondrites
- (c) Stony-Iron
- (d) Iron

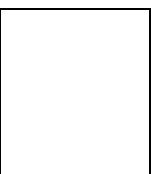
Explain why:

8 (8 pts) Explain why this asteroid is probably greater than 500 km in diameter.



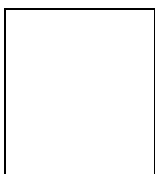
9 (6 pts) Explain what the “snow-line” is.

10 (10 pts) Describe how the types and relative amounts of **solid** material available to build planets, differ inside the “snow-line” as opposed to outside the “snow-line”.



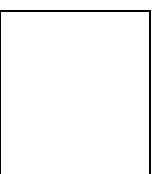
11 (8 pts) If a **short-period** comet loses about 0.1% of its mass every time it orbits the Sun, calculate about how long it will last. [Show your work, you should get an answer in years.]

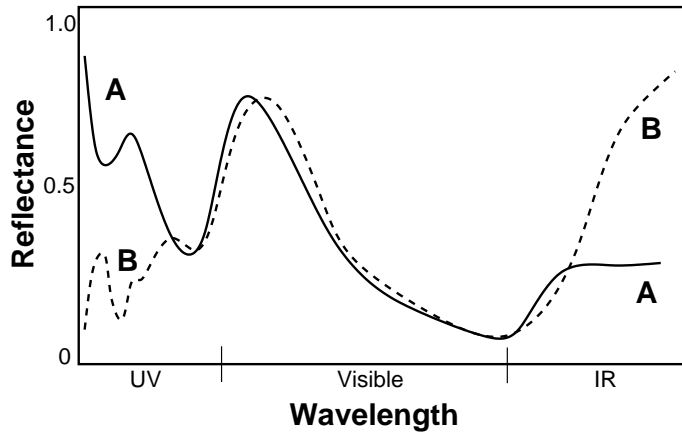
12 (8 pts) Explain how we know the population of impactors is different in the outer solar system than it is in the inner solar system.



13 (8 pts) We have discovered about 200 planets orbiting other stars. Explain (a) why we have never directly observed the planets themselves and (b) how we know they are there.

14 (8 pts) Explain why the amount of volatile material on the surfaces of worlds tends to **increases** as you increase your distance from the Sun.





On the left is the reflectance spectra of two materials that look very similar, A (solid line) and B (dashed line).

15 (6 pts) Describe what each material looks like to the eye.

16 (8 pts) Explain how you would distinguish these two very similar looking materials using images taken through a filter.

17 (2 pts) List the top 100 object in the solar system.

