

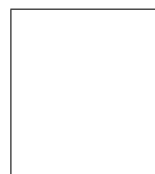
**Answer all questions in the space provided. If you have any questions, raise your hand.
100 points possible. No calculators.**

Assume that you have a Moon-sized world that is composed **entirely** of ROCK.

1 (3 pts) What is the uncompressed density of this world? Be sure to include the units.

2 (5 pts) Explain why the compressed density is nearly the same as the uncompressed density.

3 (8 pts) Explain why the moment of inertia factor of this world would be 0.4 even if it is fully differentiated.



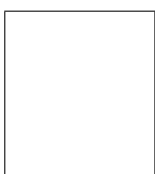


Ceres is the largest asteroid in our solar system. It has a mass of about $1/100$ of the Moon's mass and is about $1/3$ as large as the Moon.

4 (6 pts) Show that the gravity on *Ceres* is about $1/10$ the gravity of the Moon.

5 (6 pts) Explain why you would **not** find a 2.5 billion-year-old piece of basalt on *Ceres* but you could on the Moon.

6 (6 pts) We do not have any good images of the surface of *Ceres*. The little image above is actually the best image available. Based on the data above, describe what the surface of *Ceres* would look like.



7 (8 pts) Explain how you would change the atmosphere of **Venus** so that (1) it can have liquid water on its surface and (2) the liquid water can last for a very long period of time. Assume you can add or remove gasses of any type, but you cannot change the planet's orbit.

8 (8 pts) Explain how you would change the atmosphere of **Mars** so that (1) it can have liquid water on its surface and (2) the liquid water can last for a very long period of time. Assume you can add or remove gasses of any type, but you cannot change the planet's orbit.

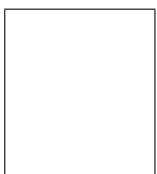


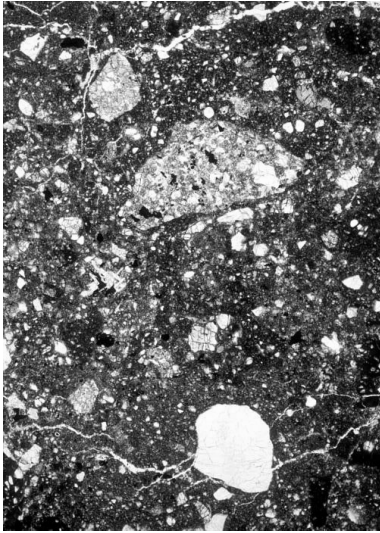
We believe that the highlands on the Moon and the southern hemisphere of Mars have about the same approximately 4 billion-year-old age.

9 (5 pts) How do we determine the age of the lunar highlands?

10 (5 pts) How do we determine the age of the southern hemisphere of Mars?

11 (6 pts) Explain why **all** the rocks on Mars are covered with the same dusty material, but this is not the case on the Moon.





12 (3 pts) On the left is an image of a thin section of a lunar sample. Based on the lunar sample images you looked at in lab, what type of rock is it? (check one)

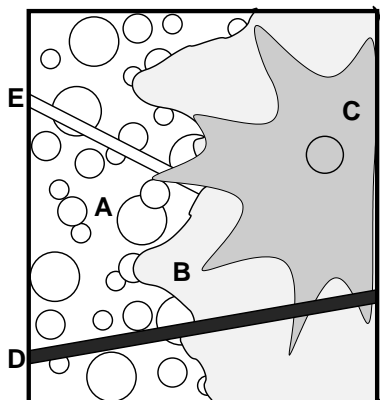
- ☐ Basalt
- ☐ Breccia
- ☐ Regolith
- ☐ Pristine Highland Rock

13 (6 pts) Describe how the parent rock formed. (The parent rock is the rock from which this thin-section was taken.)

14 (8 pts) Explain whether this rock would be rare or common on the surface of the **ancient** Earth and why.



15 (10 pts) The largest impact basin on Venus is only about 1/4 the size of the Imbrium basin on the Moon. This is despite the fact that Venus has been hit 10 times more frequently than the Moon, and the thick atmosphere of Venus is irrelevant for large impact basins. Explain why the largest impact basins on the Moon are bigger than the largest impact basins on Venus. [Hint: Think about when each of the basins formed.]



16 (5 pts) Indicate the **relative** ages of the various landforms from oldest/formed first (1) to youngest/formed last (5).

- A - Cratered Terrain _____
- B - Basalt Flow _____
- C - Crater and Ejecta _____
- D - Straight Rille #1 _____
- E - Straight Rille #2 _____

