ASTRONOMY 150 - MIDTERM Name: _____

November 1, 2001 TA's Name & Section (2 pts): _____

Answer all questions in the space provided. If you have any questions, raise your hand. 100 points possible.

0 (3 pts) Iron has a density of _____ g/cm^3, rocks have a density of about _____ g/cm^3, and water has a density of _____ g/cm^3.

Four planets are orbiting a star that is identical to our Sun. From an orbiting spacecraft we observed these planets and collected the following data:

Planet	Mass [Earth = 1]	Diameter [Earth = 1]	Uncompressed Density [g/cm^3]	Moment of Inertia factor [K]	Average Distance from star [AU]	Surface Pressure [atm]
LOGE	0.4	0.7	5.8	0.39	0.4	...
ERDA	0.6	1.0	3.0	0.36	1.6	1.0
FRICKA	1.2	1.2	3.5	0.30	0.7	...
WOTAN	1.4	1.2	4.0	0.35	1.0	5.0

1 (3 pts) Which of the planets takes the longest time to orbit around the star? [Explain your answer.]

2 (4 pts) If we assume that these planets are made of the same materials as our solar system (ice, rock and iron) what is the most likely composition of the planet LOGE?

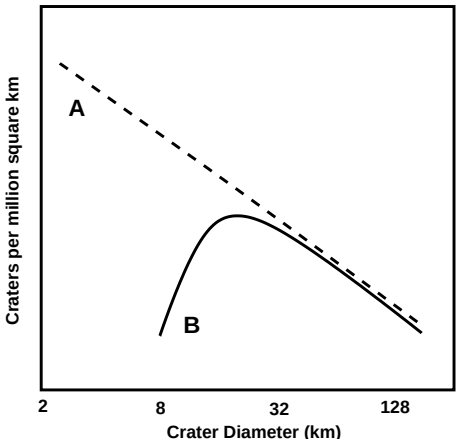
3 (5 pts) Which of the planets is probably the **least** geologically active? [Explain your answer.]

4 (5 pts) How does the gravity on FRICKA compare to the gravity on the Earth? [Show your work.]

5 (3 pts) Explain what it means for a planetary body to be differentiated.

6 (4 pts) Which of the planets is **least** differentiated? [Explain your answer.]

7 (5 pts) I said that the planets in our inner solar system differentiated about 4 billion years ago. How did we determine this date?



Assume that the planets FRICKA and WOTAN have the **same** level of geological activity. On the left is a plot of the average global crater density you measured on the two worlds.

8 (2 pts) Which planet had the global crater density represented by line **A**?

◯ FRICKA
◯ WOTAN

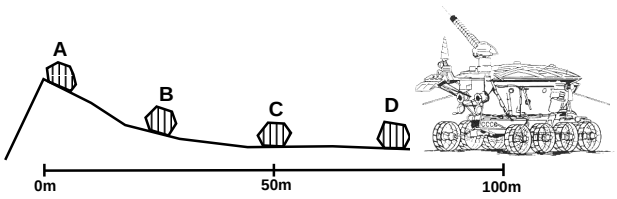
9 (8 pts) Describe the crater size distribution represented by line **A** and justify your answer to the above question.

10 (2 pts) Which planet had the global crater density represented by line **B**?

◯ FRICKA
◯ WOTAN

11 (8 pts) Describe the crater size distribution represented by line **B** and justify your answer to the above question.

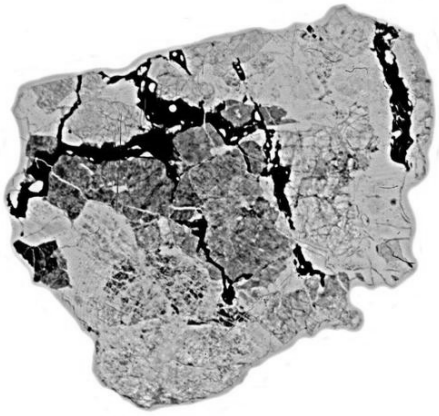
To explore the surface of planet LOGE you send an rover sample-return mission to the surface. Your rover lands outside an impact crater and starts to collect rocks as it approaches the rim of the crater. Back in the lab you determine what type of rocks you found by making thin-sections. The data is shown in the table on the below.



Rock	Distance from Rim (meters)	Rock Type
A	0	Pristine Highland
B	25	Basalt
C	50	Impact Breccia
D	75	Regolith

12 (6 pts) Which rock came from the deepest underground? ◯ A ◯ B ◯ C ◯ D
Justify your choice.

13 (10 pts) Write down a plausible geological history of the area where your rover landed. How did the layers of rocks under the rover get there? Describe the events that put the layers there **and** the order in which they happened.



14 (2 pts) On the left is an image of a thin–section you made of one of the rocks the rover returned. Based on the lunar samples you looked at in lab, what type of rock is it? (check one)

◯ Basalt
◯ Impact Breccia
◯ Regolith
◯ Pristine Highland Rock

15 (5 pts) Describe how the parent rock formed. (The parent rock is the rock this thin–section was taken from.)

16 (8 pts) Explain why this rock would be very rare on the surface of FRICKA or WOTAN.

Use the following excerpt from the January 11, 2001 issue of *Nature* to answer the questions on this page. (Note: 4,000 million years = 4 billion years)

> No crustal rocks are known to have survived since the time of the intense meteor bombardment that affected Earth between its formation about 4,550 million years ago and 4,030 million years ago, the age of the oldest known [rocks] ... But evidence of an even older crust is provided by [crystals found in a rock from] Western Australia. Here we report ... the discovery of a [crystal] with an age as old as 4,404 million years about 130 million years older than any previously identified on Earth. [Analysis of this crystal suggest that it formed from] material that has undergone low-temperature interaction with a liquid hydrosphere. This [crystal] thus represents the earliest evidence for continental crust and oceans on the Earth.

17 (5 pts) If there are no rocks older than 4 billion years, how do we know the Earth was being heavily bombarded at that time?

18 (5 pts) What has happened to most of the rocks that were on the surface of the Earth 4 billion years ago?

19 (5 pts) Intense bombardment 4.4 billion years ago would have made it difficult to keep a water ocean on the surface of the Earth. Where else could this rock have interacted with water. (Hint: think of present–day Mars).