ASTRONOMY 150 - MIDTERM Name: _____

April 26, 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.

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

Planet	Mass [Earth = 1]	Diameter [Earth = 1]	Density [g/cm^3] Compressed	Density [g/cm^3] Uncompressed	Moment of Inertia factor [K]	Average Distance from star [AU]
ERNIE	0.6	0.8	6.0	6.0	0.34	0.3
OSCAR	0.8	0.9	5.5	5.0	0.36	0.7
GROVER	8.0	2.0	5.0	3.0	0.30	1.0
BERT	0.2	0.7	3.0	3.0	0.40	1.5

1 (2 pts) If we assume that these planet are made of the same materials as our solar system (ice, rock and iron) what is the most likely compositions of the planet BERT?

2 (5 pts) Which of the planets is most likely the **most** geologically active? [Explain your answer].

3 (6 pts) Which of the planets is **least** differentiated [Explain your answer].

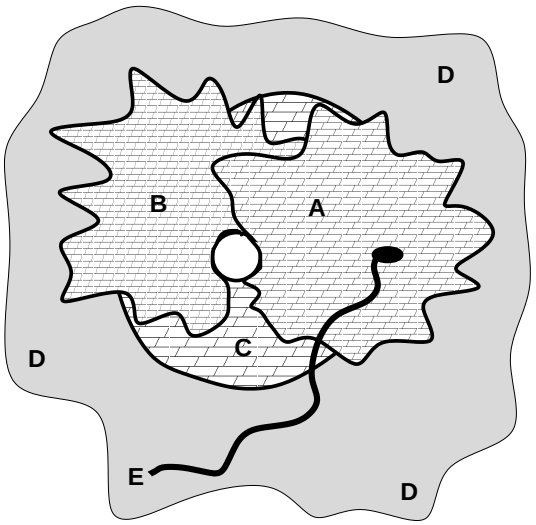
4 (8 pts) How does the gravity on GROVER compare to the gravity on the Earth [show your work].

To explore the planets you send an orbiter/lander sample-return mission to the planetary system. The orbiter collects the following data about the planetary atmospheres:

Planet	Surface Pressure [atm]	Surface Temperature Range [°C]	Composition
ERNIE	...	$-100 \rightarrow 300$	No Atmosphere
OSCAR	1.0	$0 \rightarrow 100$	96% CO_2
GROVER	5.0	$10 \rightarrow 50$	95% CO_2
BERT	...	$-100 \rightarrow -300$	No Atmosphere

5 (6 pts) Hydrogen is the most common gas in the universe, yet none of the planets have and hydrogen in their atmosphere. Explain why this is.

6 (4 pts) Planets OSCAR and GROVER have atmosphere that are rich in CO_2. Where did this CO_2 come from?



7 (5 pts) You create a geological map of this volcanic region on GROVER. Indicate the **relative** ages of the various landforms from oldest (1, formed first) to youngest (5, formed last).

A - Lava Flow A _____

B - Lava Flow B _____

C - Shield Volcano _____

D - Lava Flow D _____

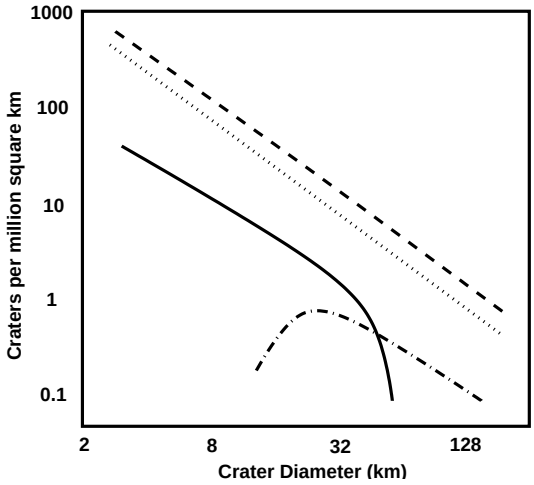
E - Sinuous Rille _____

8 (2 pts) What type of rock would be most common in this region?

9 (6 pts) You already determined how the gravity on GROVER compares to the Earth. Based on this, would expect the volcanoes on GROVER to be smaller or larger than the ones on Earth? [Explain your reasoning]

10 (3 pts) How would you determine the absolute age of this region?

The orbiter images the surfaces of the planetary system. From the images you determine the average global crater density on the four worlds [shown below]:

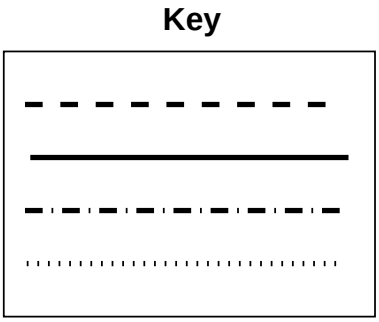


ERNIE

OSCAR

GROVER

BERT



11 (2 pts) Which surface is the oldest? [check one]

◯ ERNIE ◯ OSCAR
◯ GROVER ◯ BERT

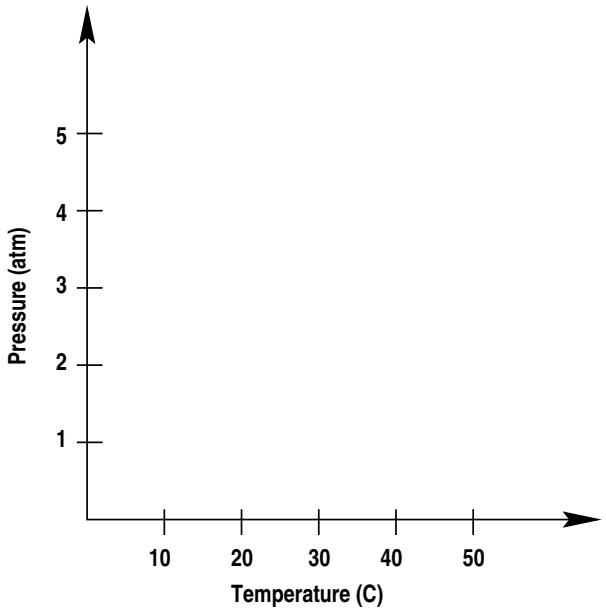
12 (5 pts) Describe the crater size distribution on the planet GROVER.

13 (5 pts) Describe the crater size distribution on the planet OSCAR.

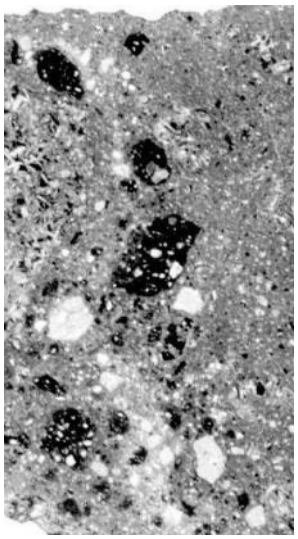
14 (6 pts) The surface of planet ERNIE has the same crater density as the mare surface of the Earth's Moon. Based on the crater density alone, why may it be wrong to conclude that the age is the same as the Lunar Mare?

15 (8 pts) You send a lander to planet GROVER. The lander discovers a substance on the surface. The lander collected the data (shown in the table below) about its phase at different temperatures and pressures. In the blank graph below **plot your data** and construct a phase diagram that is consistent with the data.

Temperature (° C)	Pressure (atm)	Phase
10	2	Solid
10	5	Liquid
20	1	Solid
20	3	Solid
30	4	Liquid
40	1	Gas
50	3	Gas
50	5	Gas



16 (6 pts) The lander collects some of the substance in an open container. Assume that the temperature on the surface is 20° C. Describe the change in substance as the lander lifts off the planet back into space [be quantitative - describe the temperature and pressure change going from the surface into space].



17 (3 pts) Your lander returns a sample from the surface of GROVER. On the left is an image on a thin section you made of the rock. 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

18 (4 pts) Describe how the rock this sample came from formed.

19 (6 pts) Explain why this type of rock is relatively rare on the surface of the Earth.

20 (6 pts) You discover in your returned sample from planet GROVER that one of the rocks has that same composition as most of the rocks from the planet OSCAR. If this rock is a piece of planet OSCAR, explain how it got to planet GROVER.