ASTRONOMY 150 – FINAL Name: _____

June 8, 2005 – Spring 2005 TA's Name & Section: _____

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

The star *51 Peg* has an extra-solar planet 0.47 times the mass of Jupiter (or a little more massive than Saturn) orbiting at a distance of only 0.052 AU. *Assume that the 51 Peg planet is made of the same type and abundance of elements as Jupiter.*

1 (5 pts) Explain why the 51 Peg planet would be difficult to detect if it was at the same distance as Jupiter.

2 (8 pts) Describe how the visible appearance of its clouds and the diameter of the 51 Peg planet would compare to Jupiter.

3 (4 pts) The Roche limit for Saturn lies about 2.5 planetary radii away. This distance is:

(a) at the orbit of Titan
(b) at the largest gap in Saturn's rings
(c) near the outer edge of the rings
(d) near the inner edge of the rings
(e) just beyond the orbit of the outermost satellite

A friend hands you a piece of **basalt** he claims he saw fall from the sky. Since you have taken Astronomy 150, he knows you will be able to confirm that is it a meteorite.

4 (5 pts) If this sample **is** a meteorite, to what class of meteorites does it belong?

You take this sample to your lab and determine its age to be about 1 billion years old.

5 (5 pts) Explain why this sample probably did **not** originate in the asteroid belt or the Moon.

You measure that all of the **iron minerals** are strongly aligned (they all point in the same direction) in this sample.

6 (5 pts) Explain why this sample probably did **not** originate on Mars or Venus.

7 (5 pts) Explain the most likely origin of this sample.

A lot of the facts that we have learned in this class come from analyzing extraterrestrial materials. On the right is a table of 3 extraterrestrial samples we have discussed in class.

For each of the following facts, name the which sample was used to determine the fact (2 pts) and how the sample allowed us to determine the fact (5pts).

Sample	**Collection Point**
Moon Rock - Impact Breccia	Imbrium Basin, Apollo 15
Meteorite - Iron	Odessa, Texas
Meteorite - Carbonaceous Chondrite	Antarctica

8 (7 pts) *Fact #1*: The Earth was heavily bombarded 3.8 billion years ago.

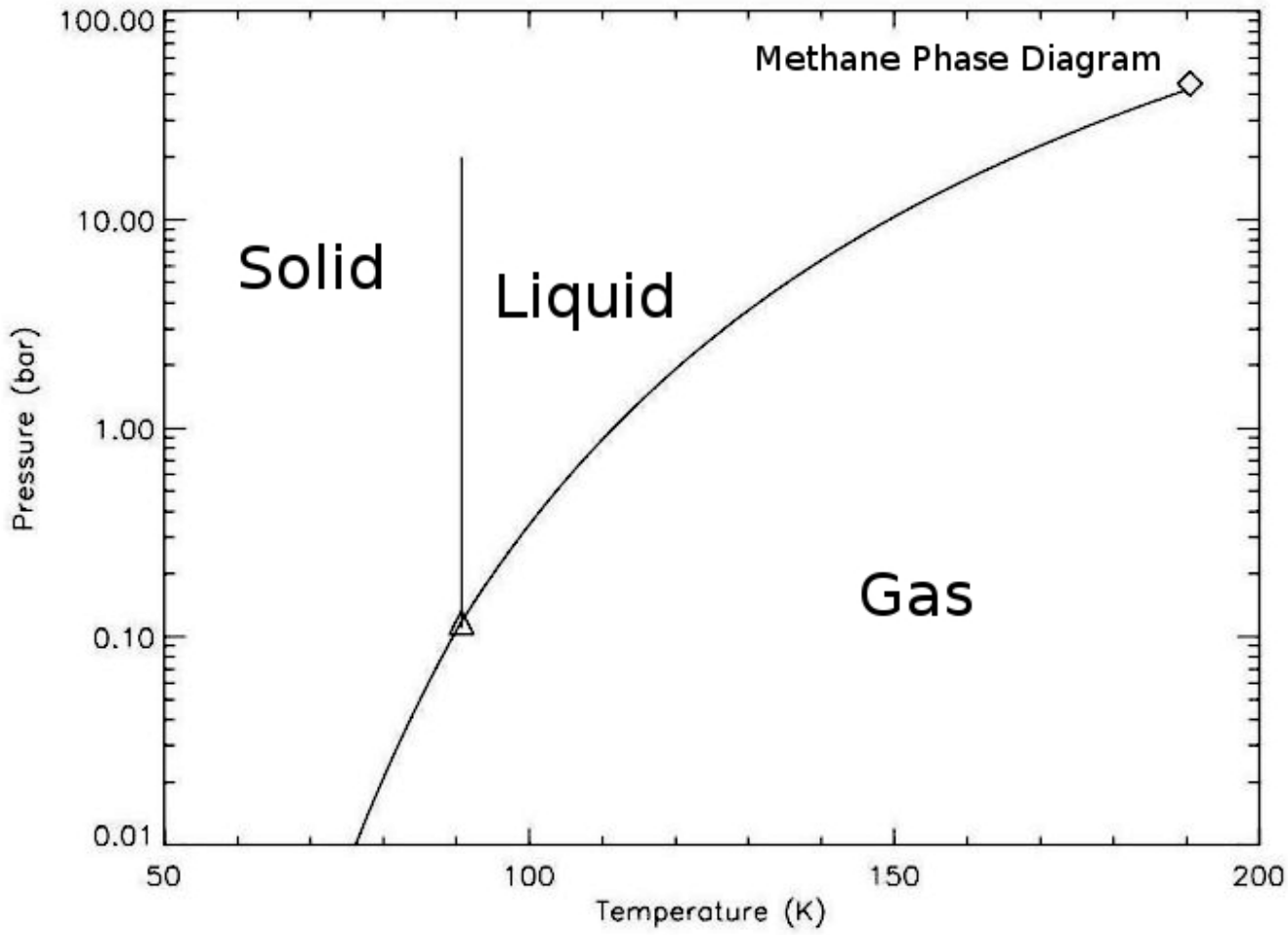
Sample used:

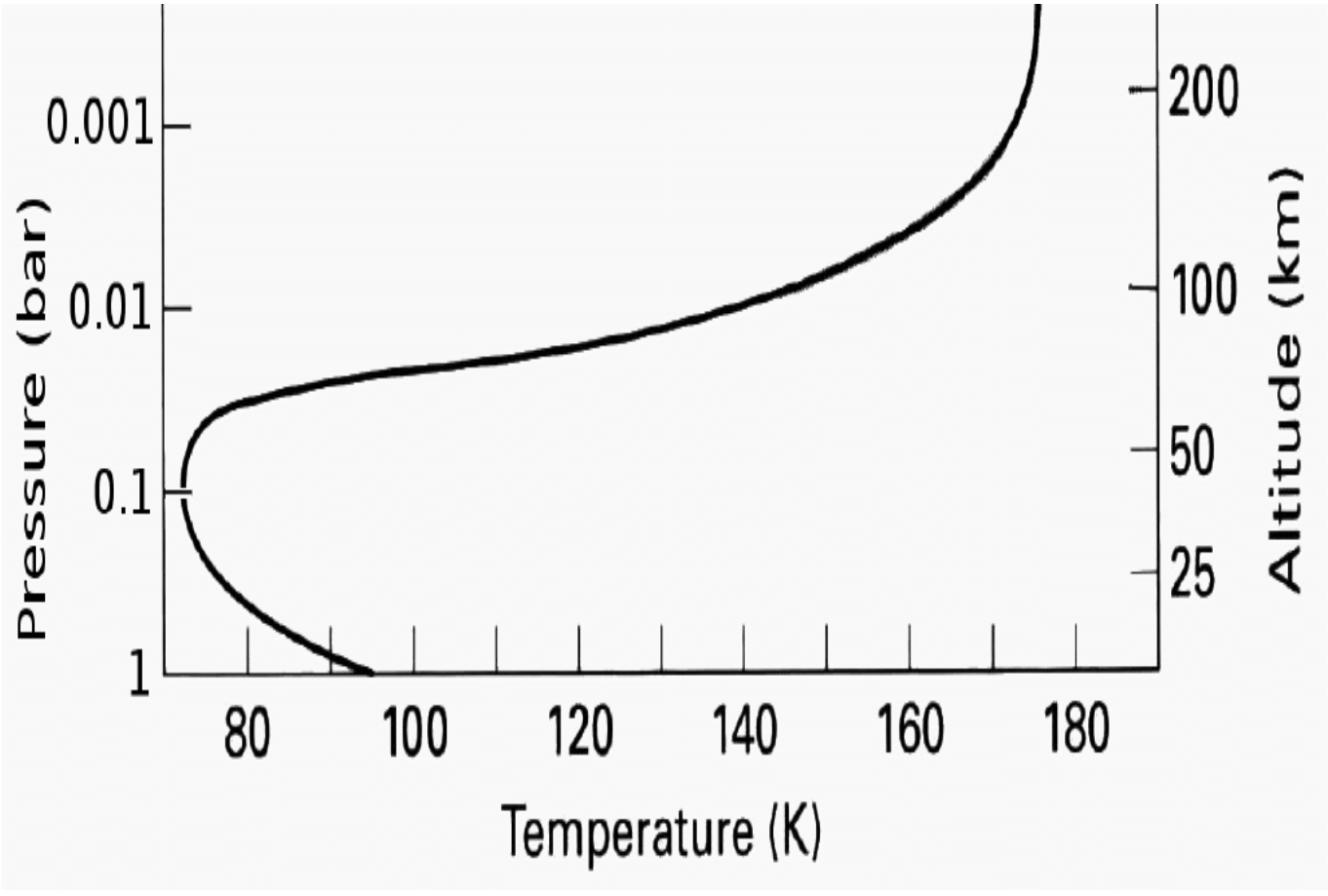
9 (7 pts) *Fact #2*: The Solar system formed 4.5 billion years ago.

Sample used:

10 (7 pts) *Fact #3*: Some asteroids are very differentiated.

Sample used:


Methane Phase Diagram
Solid
Liquid
Gas
Pressure (bar)
Temperature (K)
100.00
10.00
1.00
0.10
0.01
50
100
150
200


Pressure (bar)
Altitude (km)
Temperature (K)
0.001
0.01
0.1
1
200
100
50
25
80
100
120
140
160
180

On the facing page is the plot of the phase diagram of Methane (Top) and the temperature profile of Titan's atmosphere (Bottom). Use these plots to answer the following questions.

11 (3 pts) What is the temperature on the surface of Titan? _____ K

12 (2 pts) What is the phase of Methane on the surface of Titan? ◯ Solid ◯ Liquid ◯ Gas

13 (2 pts) At what altitude is the atmosphere of Titan the coldest? _____ km

14 (2 pts) What is the phase of Methane at this coldest point? ◯ Solid ◯ Liquid ◯ Gas

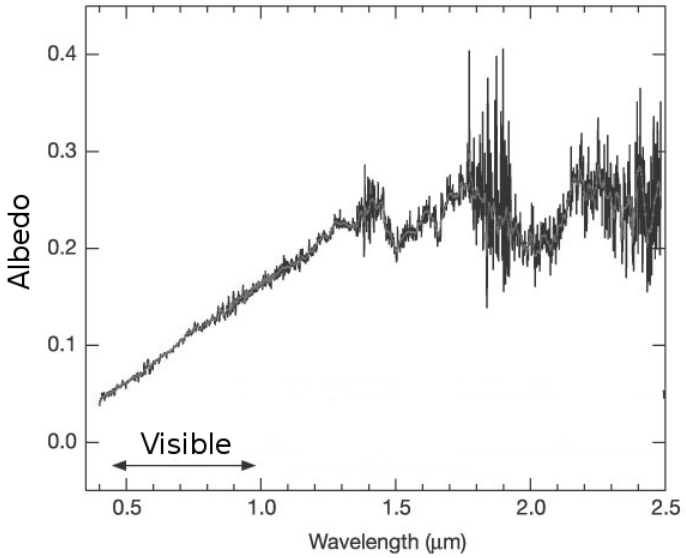
15 (2 pts) What is the phase of Methane 100 km above the surface of Titan? ◯ Solid ◯ Liquid ◯ Gas

16 (3 pts) At what altitude above Titan does Methane change from a liquid to a solid? _____ km

17 (6 pts) Explain why **liquid** water can not exist on the surface of Titan, but may be abundant under the surface.

18 (3 pts) Saturn's moon Titan is about the same size as the Earth's Moon. Why can Titan retain a thick atmosphere while the Moon can not?

(a) The Moon is more volcanically active than the Titan.
(b) The Moon moves faster through space than Titan.
(c) Titan is being tidal heated
(d) The Moon is too cold to have an atmosphere
(e) Titan is further from the Sun than the Moon



19 (4 pts) On the left is the reflectance spectra of the Kuiper Belt Object Quaoar. Describe the visible appearance of this object.

20 (4 pts) On the same plot above, sketch and label the reflectance spectra of a piece of basalt.

21 (4 pts) Quaoar has an estimated diameter of 1300 km (about the typical size of a giant planet satellite). Explain why Quaoar's shape would be different from that of a *typical* asteroid.

22 (4 pts) Which of the following worlds would you expect to have the **most** volatile materials?

(a) The Moon
(b) Mars
(c) Io
(d) Callisto
(e) Quaoar

23 (3 pts) And finally, list the top 100 objects in the solar system.