Answer TRUE or FALSE (not T or F) (2 pts each)

1. Ozone (O$_3$) contributes to the greenhouse effect whereas, “normal” oxygen (O$_2$) does not.
2. We seek to decrease the ozone at ground level, but retain it 50 km up in our atmosphere.
3. It’s a chicken-and-the-egg sort of problem: to have life on Earth you want an ozone layer, but the way you make an ozone layer is by having life make oxygen.
4. The heavily cratered lunar maria represent the oldest surface on the Moon.
5. The far side of the Moon looks quite different from the near side: it is mostly highlands.
6. Moonquakes show that the Moon’s lithosphere is thicker than the Earth’s.
7. Some sunlight must make it through the clouds of Venus or else we’d see a “nuclear winter” there: a zero lapse rate near the surface.
8. Most planets with atmospheres have strong equatorial winds, but the Earth is an exception.
9. Venus has concentrated sulfuric acid clouds, but acid rain does not fall on its surface.
10. On the surface of Mars, an open container of liquid water would boil until it froze.
11. Methane (CH$_4$) and ammonia (NH$_3$) are the most common gases in the atmosphere of Saturn.
12. Among the gas giants, Uranus is odd both in terms of its nearly absent internal heat source and in its spin-axis direction.
13. All the jovian planets have magnetic fields, but the convecting, conducting fluid responsible for the field is different for Jupiter, Neptune, and Earth.
14. Earlier in its history we think Saturn had more helium in its atmosphere, but instead of escaping, it sank.
15. Neither gas giant nor terrestrial planet, Pluto is most like a moon of Neptune.
16. All gas giant planets have densities less than that of Pluto; all terrestrial planets have densities greater than that of Pluto.
17. The densities of the Galilean moons echo the densities of the planets: moving outward from the central object, the densities decline.
18. The Kuiper belt lies inside the Oort cloud.
19. Volatile elements are the first to vaporize as the temperature rises.
20. Comets are “short” lived objects: they evaporate after a few thousand approaches to the Sun.
Give a short explanation (5 pts each)

21. Three factors that control whether a particular molecule is retained or lost from a planet’s atmosphere are the planet’s __________, the atmosphere’s __________ and the molecule’s __________. Report these factors, and state how each factor would need to change to make it more likely that the particular molecule is retained.

22. The majority of terrestrial-planet atmospheres are rich in CO₂, but Earth is an exception. What evidence suggests the Earth once had a CO₂-rich atmosphere and what happened to all that CO₂?

23. Starting from ground level, report the four layers of the Earth’s atmosphere. The majority of planet atmospheres have just two layers. Why the difference?

24. What evidence suggests that Mercury’s internal structure differs from the Mars’s internal structure?

25. Describe astronomers best guess as to how the Moon formed.

26. What evidence could be given to indicate that Mars once had a much more massive atmosphere? Clearly explain how your evidence “measures” the size-of-atmosphere.

27. Compared to the Earth, Venus seems to be missing water. What happened to Venus’s water? (Note: evaporation doesn’t remove water, just changes it to gas.) What evidence supports this hypothesis?

28. A new “spot” is discovered in the clouds of the northern hemisphere of Jupiter. Telescopic images show that the clouds in the spot rotate clockwise. Is the pressure in the clouds at the center of the spot relatively high or low. Why?

29. For the terrestrial planets we argued that differences in density suggested differences in composition. However Saturn and Jupiter are thought to have similar compositions, yet Saturn’s density is nearly half of Jupiter’s. SO, when does density provide evidence for composition?

30. On 1997 October 15, NASA launched the “Cassini-Huygens Mission to Saturn and Titan”; it should arrive on 2004 July 1. Out of all of the moons in the Solar System, why is Titan so particularly interesting that a probe is devoted to it? Why didn’t previous missions past Saturn map Titan as was done with the Galilean moons?

31. What is the difference between moons orbiting within the Roche limit and those orbiting outside the Roche limit, i.e., what is the Roche limit?

32. Report three types of asteroids. How do we determine the type of asteroid from Earth?

33. Rank order from “dead” to “quite active” the current tectonic (“geologic”) activity of Venus, Moon, Mars, Io, Triton.

34. Rank order from large to small the size (i.e., radius) of Earth, Uranus, Moon, Pluto, Jupiter.

35. Rank order from large to small the bulk density of Mercury, Saturn, Io, Pluto, Neptune.
36. The below left shows a three dimensional slice of the Earth’s atmosphere near ground level in the southern hemisphere with surfaces with constant air pressure (“isobars”) displayed. North is to the left; south is to the right; up the page is vertically up through the Earth’s atmosphere; into the page is east. Two vertical columns starting at ground level are displayed: the leftmost has altitudes labeled \(A\) and \(B\), the rightmost has altitudes labeled \(A'\) and \(B'\). The labels \(A\) and \(A'\) represent exactly the same altitude; similarly for \(B\) and \(B'\). Answer the following data using this sketch and your knowledge of the atmospheres.

(a) Consider the pressure at the four locations \((A, B, A', B')\). Sort the locations by pressure, i.e., list the location with the highest pressure first, second highest second, . . . .

(b) Consider the density of the air: (I) below \(A\) and (II) below \(A'\). Which air is the more dense? Why?

(c) Applying the geostrophic approximation, report which way the wind in the region between \(B'\) & \(B\) is blowing and why.

37. Greenhouse analogy described in class:

Water flows at a steady rate into a bucket with a small leak. The water level in the bucket rises until as much water leaves the bucket through the leak as flows in.

(a) For the bucket: if we enlarge the leak, the water level will fall. What would be the analogous statement for our atmosphere?

(b) For the bucket: if we allow greater inflow, the water level will rise. What would be the analogous statement for our atmosphere?

(c) For the bucket: the deeper the water level the faster the outflow, but the inflow is uneffected. What would be the analogous statement for our atmosphere?
38. Earth seems to be unique in that it shows signs of continental drift.

(a) What are the differences between the Earth and Venus that are believed to explain the absence of continental drift on Venus?

(b) What are the differences between the Earth and Mars that are believed to explain the absence of continental drift on Mars?

(c) What are the differences between the Earth and its Moon that are believed to explain the absence of continental drift on the Moon?

39. Sketch the orbit of a comet around the Sun and on that same sketch draw the orbit of the Earth. Label with A a point on the comet’s orbit where the comet would show a tail. Label with B a point where it would not show a tail. At the point A on your orbit, sketch the comet and label: coma and tail. Why is it difficult for astronomers to see the comet when it is located at B?

40. Below is that part of the sky called the winter hexagon. Label any constellation you should know. Circle and name the “important” stars.