

Except for questions 22 and 40 marks/answers on these sheets are not graded.

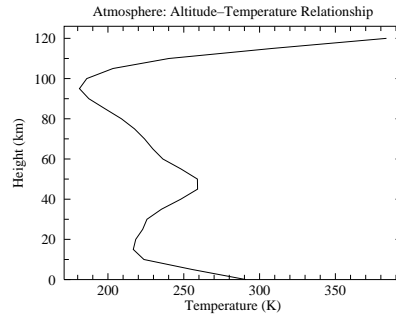
**Answer TRUE or FALSE (not T or F) (2 pts each)**

1. The Earth's surface is heated more by the troposphere than by direct sunlight.
2. *Geostrophic balance*: the Coriolis force on moving air (i.e., a wind) is balanced by a pressure force.
3. *Lapse rate*: the change in temperature as you move up in an atmosphere.
4. The Earth used to have an atmosphere rich in CO<sub>2</sub>, but that gas has ended up in carbonate rocks like limestone.
5. The lava that comes out of Earth's volcanoes, wells up from the liquid core.
6. Generally, felsic rocks are found in the core and ultra mafic rocks rocks are found in the mantle.
7. We expect that smaller "planets" are less geologically active, but Io is an exception.
8. The heavily cratered lunar maria represent the oldest surface on the Moon.
9. The far side of the Moon looks quite different from the near side: it is mostly highlands.
10. The surfaces of Moon and Mercury look similar; furthermore the evidence suggests the interiors are also much the same.
11. Venus has concentrated sulfuric acid clouds, but acid rain does not fall on its surface.
12. A strong Coriolis force combined with a hot dense atmosphere results in huge thunderstorms on Venus.
13. Seismometers left on the surface of the Mars suggest that the Martian lithosphere is thicker than the Earth's.
14. Olympus Mons is the largest known volcano in the Solar System.
15. The fact that Jupiter's density is greater than Saturn's tells us that Jupiter includes a greater proportion of heavy materials like iron.
16. At the level of the cloud tops, the Great Red spot is a high pressure system in the southern hemisphere, and hence has winds blowing counter-clockwise.
17. Uranus's atmosphere is unusual: as you move up in the atmosphere the air pressure at first declines, but then increases.
18. Triton, a moon of Neptune, is believed to be similar to Pluto.
19. Uranus and Neptune have super-rotating jetstreams around their equator.
20. All the Jovian planets have rings.

**Give a short explanation (5 pts each)**

21. Define and give an example of two of the following three rock types: sedimentary, metamorphic, igneous.

22. The graph displays the relationship between altitude and temperature in the Earth's atmosphere. According to this graph, what is the temperature 50 km up? Locate, name, and label (directly on this graph) the layers in the Earth's atmosphere.



23. Describe astronomers' best guess as to how the Moon formed.

24. Name and describe two surface features of the Moon.

25. What evidence points to a liquid iron/nickel core inside Mercury?

26. In old books Venus is often called "Earth's Twin", but it turns out to be quite different from Earth. Pick *one* of the below aspects and explain why the Earth and Venus differ.

(a) Venus has a carbon dioxide atmosphere.

(b) Venus has much less water.

27. 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.

28. Jupiter's atmosphere displays features called *zones* and *belts*. Describe the appearance of zones and belts. Describe the physical difference between zones and belts.

29. The Galilean moons of Jupiter form an interesting set of large moons. Name and describe two of them, pointing out the unique features of both.

30. Describe the environment on the surface of Saturn's moon Titan.

31. Describe the internal structure of the four Jovian planets. What *evidence* points to a difference in structure between the inner and outer Jovian planets?

32. Report (in order) the two primary constituents of the atmosphere of:

(a) Earth

(b) Mars

(c) Neptune

33. Define and give an example of *resonance* in the Solar System.

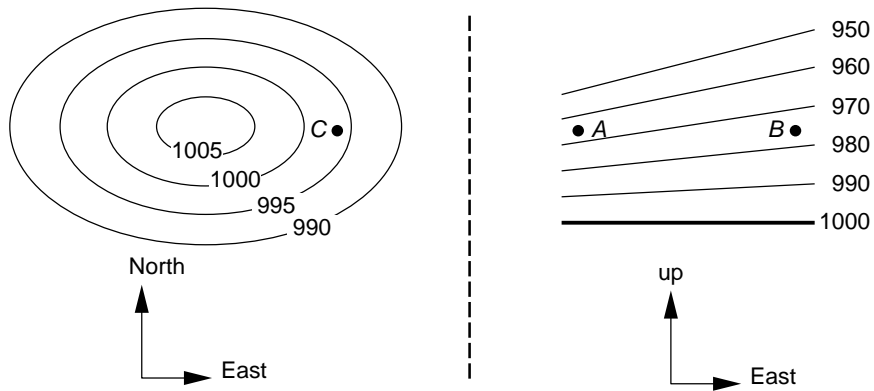
34. Rank the densities of the following objects from highest to lowest: Neptune, Saturn, Mars, Earth, Moon.

35. Rank order from "dead" to "quite active" the current tectonic ("geologic") activity of Venus, Moon, Earth, Mars, Io.

**Write out a complete answer (10 pts each)**

36. Consider the below left “bull’s eye” diagram which shows a set of surface isobars in the Earth’s northern hemisphere. What is the pressure at the point *C*? Which way would the wind end up blowing at *C*?

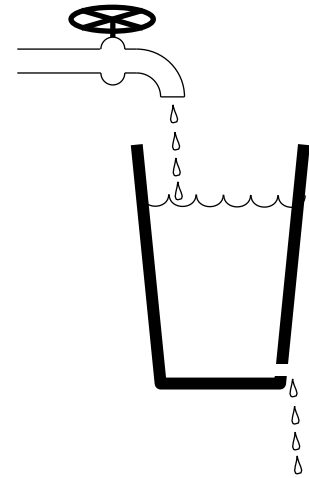
Consider the below right diagram which shows a vertical cut through the Earth’s atmosphere. Points *A* and *B* are at exactly the same altitude above the ground (the ground here is at the 1000-level isobar). Of the two points (*A* and *B*), which is at the higher *pressure*? Which is at the higher *temperature*? Which way will the wind end up blowing in the region between *A* and *B*?



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.

- The inflow is analogous to \_\_\_\_\_; the outflow is analogous to \_\_\_\_\_; the water depth is analogous to \_\_\_\_\_. (As usual report your answers on your answer sheet!)
- For the bucket: if we reduce the size of the hole, the water level will rise. What change in the atmosphere would be analogous to a reduced hole size?
- For the bucket: if we reduced the inflow, the water level will fall. What change would be analogous to a decrease in inflow?
- If the albedo of the atmosphere increased, what would be the analogous change for the bucket?
- If the amount of CO<sub>2</sub> in the atmosphere were decreased, what would be the analogous change for the bucket?



38. Make a sketch of the cross section of the upper layers of rock on the Earth. The sketch should accurately show how pieces of the Earth's crust are created and destroyed. Label: mid-ocean rift zone, oceanic crust, continental crust, lithosphere, asthenosphere, mantle, convection cell, subduction, area of mountain building, and which way the plates are moving.
39. We classify the Jovian planets together because of their similarities, but of course there are differences between the various Jovian planets also. For *five* (5) of the below, describe briefly how the four Jovian planets differ.
- |                          |                                  |
|--------------------------|----------------------------------|
| (a) magnetic field       | (e) jetstreams in the atmosphere |
| (b) internal heat source | (f) appearance                   |
| (c) chemical composition | (g) rings                        |
| (d) spin                 | (h) moons                        |
40. Below is that part of the sky called the winter hexagon. Label the six constellation you should know. Circle and name the eight "important" stars. (Answer on this sheet.)

