Answer *TRUE* or *FALSE* (<u>not</u> *T* or *F*) (2 pts each)

1. It seems natural that planets rich in refractory materials are found near the Sun, whereas planets with lots of volatiles are found far from the Sun. However, exoplanets seem to defy this trend.
2. Our planetary system (together with the Sun) formed about $4\frac{1}{2}$ billion years ago from a small part of a giant nebula.
3. The surfaces of Moon and Mercury look similar; furthermore the evidence suggests the interiors are also much the same.
4. The heavily cratered lunar highlands represent the oldest surface on the Moon.
5. The far side of the Moon looks quite different from the near side: it has fewer maria.
6. Pictures of Venus from Earth using visible light show only a featureless disk; no cloud or surface features can be seen using visible light.
7. If the clouds of Venus were more opaque a runaway "greenhouse effect" might become a "nuclear winter".
8. Because the Martian atmosphere lacks carbon dioxide, UV light can sterilize the Martian surface.
9. Valles Marineris is the largest known canyon in the Solar System.
10. All the gas giant planets except Uranus have magnetic fields and rings.
11. Earlier in its history we think Saturn had more helium in its atmosphere, but instead of escaping, it sank.
12. Uranus's atmosphere is unusual: unlike the other gas giants, its heated more from above rather than below.
13. Most planets with atmospheres have super-rotating jetstreams around their equator, but Earth and Neptune are exceptions.
14. On Titan, a strong Coriolis force combined with a dense atmosphere results in mid-latitude high and low pressure systems much like Earth.
15. Asteroids are the broken remains of a giant planet that once orbited between Mars and Jupiter.
16. Comet nuclei, which partially evaporate when near the Sun, spend most of their time in the "deep freezer": the Kuiper belt or the Oort cloud.
17. *Nuclear fission*: breaking big nuclei apart; *Nuclear fusion*: putting small nuclei together.
18. The "surface" of the Sun, although not solid, is crushed to a density greater than that of lead.
19. The Sun's magnetic field reverses much more frequently than does Jupiter's.
20. *Isostatic balance*: mountains float high above an asthenosphere because of deep roots.

Give a short explanation (5 pts each)

21. *Describe* (provide more than just a name, e.g., what does it look like and how did it form) three surface features of the Moon

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

23. The Moon and Mercury look much the same, but differences exist. *Describe* (provide more than just a name, e.g., what does its presence imply) one feature they both have. Describe one feature only one has.

24. 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) magnetic field

    (b) plate tectonics (continental drift).

25. 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.

26. Both Jupiter's Great Red Spot and Neptune's Great Dark Spot are (were) high pressure systems in the southern hemisphere of a planet that rotates much like Earth. As seen from space, explain which way the winds blow about such spots (clockwise or counter-clockwise)? Note: your answer will be graded based on the quality of your explanation—using words like Coriolis and pressure. An answer consisting of a single word like "clockwise" or "counter-clockwise" will receive zero credit.

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

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

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. Draw a picture showing comet's orbit around the Sun. On your drawing sketch what the comet would look like when it is near the Sun. Sketch again showing what it would look like when it is far from the Sun. Why the difference?

31. Report the two primary constituents of the atmosphere of:

    (a) Venus

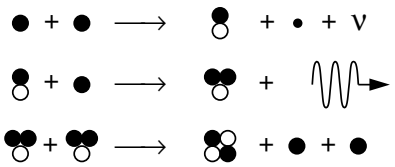
    (b) Jupiter

    (c) Titan

32. Rank order from largest to smallest surface atmospheric pressure: Venus, Titan, Earth, Mars.

33. How do we learn about the interior of the Sun?

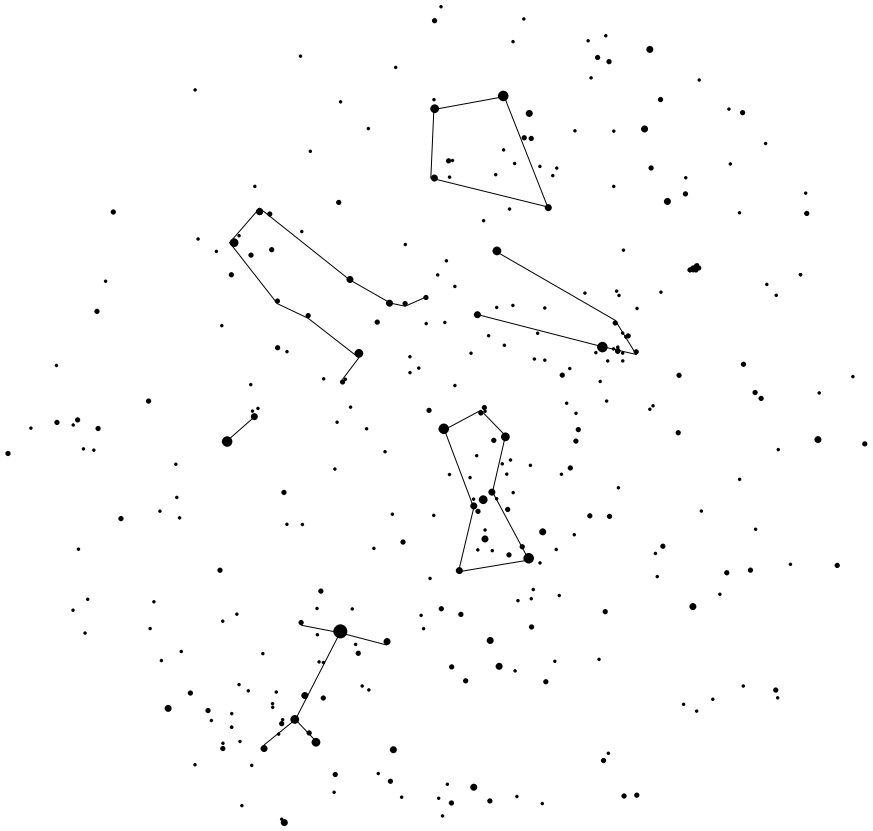
34. The cartoon to the right is a representation of the reactions that power the Sun. On this sheet label/name at least five (5) distinct participants.



35. Sketch a picture of the Sun and show where the following are located: chromosphere, convection zone, corona, photosphere, radiation zone, solar wind.

Write out a complete answer (10 pts each)

36. Below is that part of the sky called the winter hexagon. Circle and name the "important" stars. (Answer on this sheet.)



37. We classify the terrestrial planets together because of their similarities, but of course there are differences too. Explain *three* (3) of the similarities/differences listed below.

    (a) What are the similarities between the Earth and Mercury that result in a heavily cratered Mercury, but few craters on Earth?

    (b) What are the differences between the Earth and Venus that result in the difference in surface temperature?

    (c) What are the differences between the Earth and its Moon that result in the different atmospheres?

    (d) What are the differences between the Earth and Mars that explain the larger volcanoes on Mars?

38. We classify the giant planets together because of their similarities, but of course there are differences between the various giant planets too. For *five* (5) of the below, describe briefly how the four giant planets differ.

(a) magnetic field
(b) internal heat source
(c) internal structure
(d) spin
(e) jetstreams in the atmosphere
(f) appearance
(g) rings
(h) moons

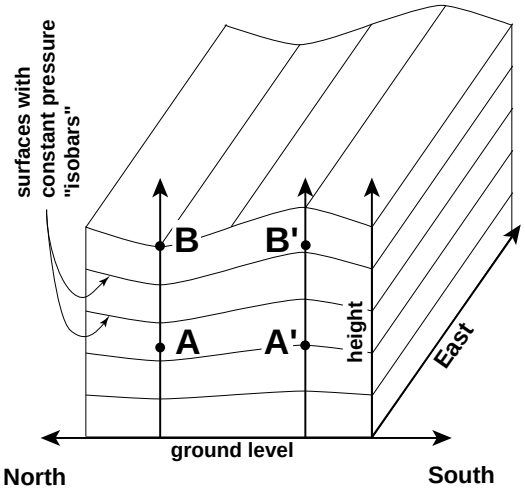
39. The below shows a three dimensional slice of a gas giant's "zone and belt" atmosphere in the *northern* hemisphere with surfaces with constant air pressure ("isobars") displayed. North is to the left; south is to the right; up the page is vertically up through the planet's atmosphere; into the page is east. Two vertical columns starting at "ground" level are displayed: the leftmost has altitudes labeled **A** and **B**, the rightmost has altitudes labeled $\mathbf{A}'$ and $\mathbf{B}'$. The labels **A** and $\mathbf{A}'$ represent exactly the same altitude; similarly for **B** and $\mathbf{B}'$. Answer the following data using this sketch and your knowledge of the atmospheres.

(a) Consider the pressure at the four locations $(\mathbf{A}, \mathbf{B}, \mathbf{A}', \mathbf{B}')$. 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 $\mathbf{A}'$. Which air is the more dense? *Why?*

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

(d) Which column **AB** or $\mathbf{A}'\mathbf{B}'$ would be a zone?



40. Describe the positive feedback cycle that explains why things usually explode. State the hypothesis and conclusion of the Virial Theorem. Describe how the Virial Theorem breaks the positive feedback cycle and keeps the Sun from exploding.