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 molecular cloud.
3. *Isostatic balance*: On Earth mountains stand high because they are floating and have deep roots sunk into the asthenosphere.
4. The Earth's surface is heated more by the troposphere than by direct sunlight.
5. The surfaces of Moon and Mercury look similar; furthermore the evidence suggests the interiors are also much the same.
6. The heavily cratered lunar highlands represent the oldest surface on the Moon.
7. The far side of the Moon looks quite different from the near side: it has fewer maria.
8. Pictures of Venus from Earth using visible light show only a featureless cloud deck; no surface features can be seen using visible light.
9. Venus has concentrated sulfuric acid clouds, but acid rain does not fall on its surface.
10. Because the Martian atmosphere lacks carbon dioxide, UV light can sterilize the Martian surface.
11. Valles Marineris is the largest known canyon in the Solar System.
12. Among the gas giants, Neptune is odd both in terms of its nearly absent internal heat source and in its spin-axis direction.
13. The only planets lacking a magnetic field are slow-spinning terrestrial planets.
14. Earlier in its history we think Saturn had more helium in its atmosphere, but instead of escaping, it sank.
15. From space Uranus and Neptune appear as nearly featureless blue balls as a result of CH_4 clouds it their atmosphere.
16. Most planets with atmospheres have super-rotating jetstreams around their equator, but Venus and Neptune are exceptions.
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. Sunspot: magnetically sequestered from the convection zone, it cools but remains hotter than the filament of an incandescent light bulb.

Give a short explanation (5 pts each)

21. Define and give an example of two of the following three methods of heat transfer: conduction, convection, radiation.

22. Describe how a blanket keeps the person under it warmer then they would be without the blanket. Avoid using the word "trapped"!

23. Describe how 'nuclear winter' destroys the greenhouse effect. Describe how nuclear winter is like putting a blanket over a dead body.

24. There are two methods we have used to date geological features on the Moon. Describe both.

25. *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

26. 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.

27. 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).

28. 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.

29. 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?

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

    (a) Venus

    (b) Jupiter

    (c) Earth

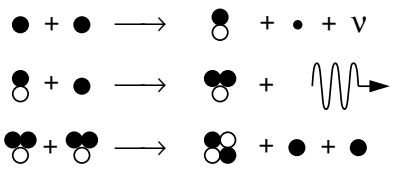
31. Rank order the densities of the following objects from highest to lowest: Mars, Mercury, Moon, Saturn, Uranus.

32. Rank order the escape velocity of the following objects from highest to lowest: Jupiter, Mars, Moon, Neptune, Saturn.

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

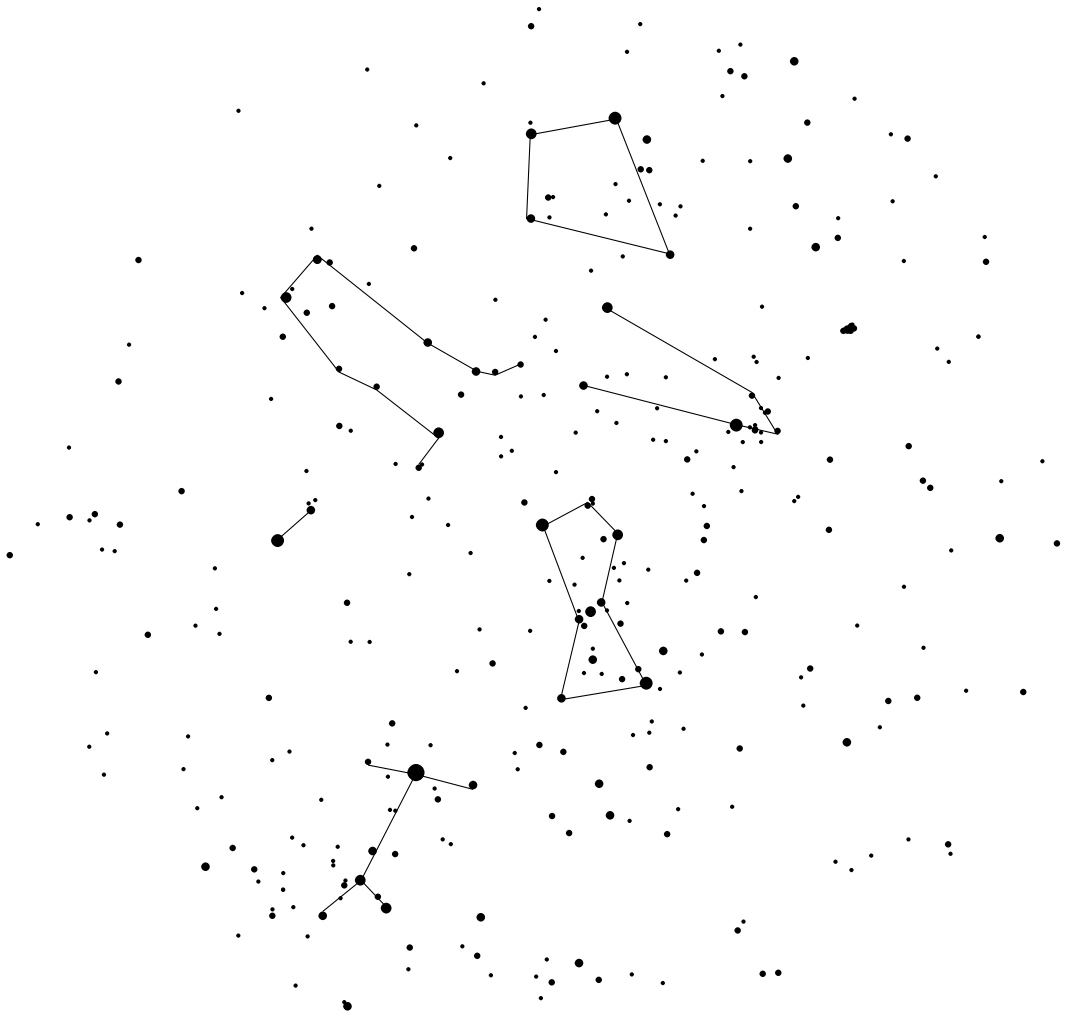
34. Sketch a picture of the Sun and show where the following are located: chromosphere, convection zone, corona, photosphere, radiation zone, solar wind.

35. 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.



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.)

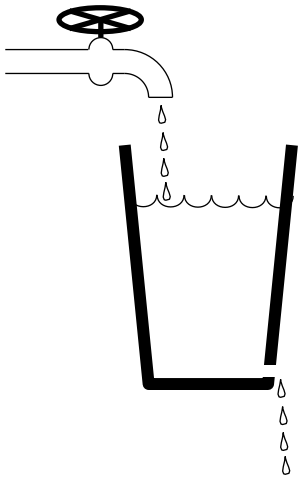


37. Describe the positive feedback cycle that explains why things usually explode. Nevertheless, explosion seem rare on Earth. Why? State the hypothesis and conclusion of the Virial Theorem. Describe how the Virial Theorem breaks the positive feedback cycle and keeps the Sun from exploding.

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. 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) 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!)

(b) For the bucket: if we allow greater inflow, the water level will rise. What change would be analogous to an increase in inflow?

(c) 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 smaller hole size?

40. 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?