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

1. Analogy: *isotope* is to neutron, as *ion* is to electron.
2. Every isotope of carbon has the same number of protons in its nucleus.
3. High temperatures break apart composites.
4. A hot ionized gas could be called a *plasma*.
5. When the TV meteorologist says a high pressure system has moved into Minnesota, it simply means that the mass of air directly over our heads has increased.
6. Generally speaking, the bigger the musical instrument the bigger the frequency it produces.
7. For light: the smaller the wavelength the bigger the frequency.
8. In comparing two photons of light, the photon with the smaller wavelength will have the smaller energy.
9. The Sun produces an emission spectra.
10. Every object is incandescent, but the light emitted may not be visible to people.
11. A green object moving at a high velocity away from you (at say a few percent of the speed of light), might look yellow.
12. At prime focus, your head would block some of the light you're trying to see.
13. The main reason for building bigger telescopes is to achieve greater magnification.
14. Lens A (with diameter 2 cm and focal length 4 cm) produces brighter images than Lens B (which has diameter 3 cm and focal length 9 cm).
15. A resolution of 2 arcsec is better than one of 1 arcsec.
16. The lava that comes out of volcanoes, wells up from the liquid core.
17. We "see" inside the Earth using sound (both P and S).
18. If the *optical depth* (τ) is large a photon is likely to bounce around a bit before escaping.
19. O_3 is a greenhouse gas that also is harmful to human lungs— Al Gore would like to have it removed from Earth's atmosphere.
20. The following three diatomic gases do *not* contribute to a greenhouse effect: N_2, O_2, NO.

Give a short explanation (5 pts each)

21. Sketch a picture of an atom. Label nucleus, protons, neutrons, and electrons. Where are the quarks located?

22. Order the following list of types of light from shortest to longest wavelength: X-rays, microwaves, blue, red, AM radio, and infrared.

23. Sketch a Newtonian focus telescope. Label: objective, aperture, and the direction to the stars.

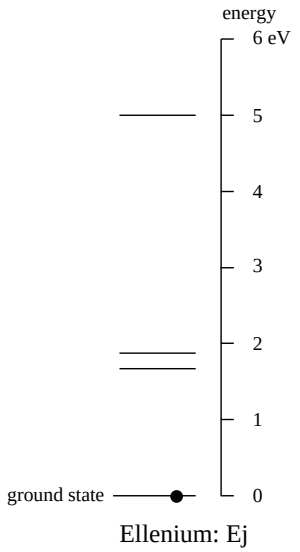
24. What is *seeing* (applied to telescope viewing)?

25. Describe how you could measure the focal length of a lens.

26. The two most famous telescopes currently in active use are the Hubble Space Telescope (HST) and the Keck telescope. HST is a f/13, 2.4 meter telescope which is deployed in low-Earth orbit (about 600 km above the Earth). The f/1.75, 10 meter Keck telescope is on the summit of Hawaii's dormant Mauna Kea volcano, 4 km above sea level. Which telescope should you use to photograph dim objects? Which telescope shows the finest details? Which telescope produces the most "magnified" images?

27. The mythical element Ej has the energy levels shown. As usual the electron is in the ground state. It is found that Ej will absorb a particular color of orange light and a particular color of red light. Recopy the energy level diagram onto your paper, and show: (A) how the electron moves when it absorbs orange light and (B) how it moves when it absorbs red light.

    When Ej is excited via electron collisions it is seen to *produce* a particular color of violet light and a particular color of blue light (colors it does not normally absorb) in addition to the orange and red light (which it will normally absorb). Show on your energy level diagram (C) how the electron moves when the violet light is produced.



Ellenium: Ej

28. Looking through a spectroscope (as you did in class), describe exactly what you would see: (A) looking at a fluorescent light and (B) looking at an incandescent light.

29. In class we derived a formula for "the" temperature of a planet:

$$T = T_{\odot}\sqrt{\frac{R_{\odot}}{2a}}\left[\frac{1-A}{\epsilon}\right]^{1/4}$$

    Name/describe three of the factors in this formula. For each factor report how *decreasing* the factor would change the planet's temperature.

30. What is the difference between *mafic* and *felsic* rock? Where in the interior of the Earth would you expect to find mafic and felsic rock? Why?

31. The Earth is an active planet (i.e., volcanoe erupt, continenets move, etc.). List two sources of energy that powers all of this activity.

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

33. 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*.

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

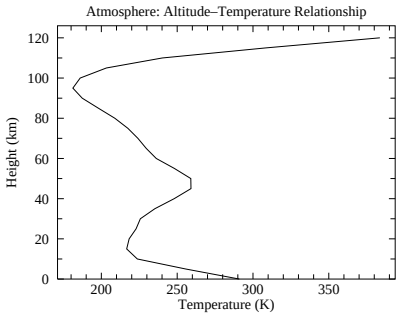
35. Nuclear Winter and Snowball Earth are two scenarios that involve much reduced surface temperatures on Earth. Describe one of these processes.

Write out a complete answer (10 pts each)

36. Sketch and label three spectra: (A) the spectra of the light produced by a very hot object (say, 30,000 K), (B) the spectra of the light produced by hot object (say, 3000 K) and (C) the spectra of the light produced by a room temperature object (say, 300 K). Assume that the objects are identical in every way except temperature. In order to make the relationships between these spectra clear, draw all three on one set of axes. Which object produces the most infrared radiation? Which produces the most visible radiation? For each object: describe the color you see produced by the object. Be sure to include x and y labels on your spectra!

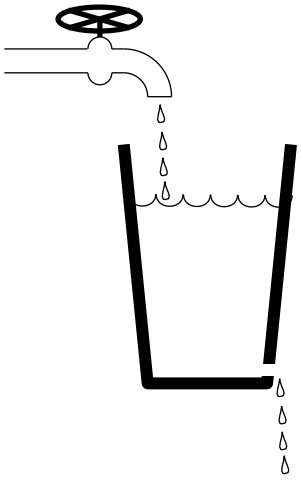
37. Make a sketch of the cross section of the upper layers of rock on the Earth. The sketch should accurately show how pieces of the Earth's crust are created and destroyed. Label: mid-ocean rift zone, oceanic crust, continental crust, lithosphere, asthenosphere, mantle, convection cell, subduction, area of mountain building, and which way the plates are moving.

38. 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. According to this graph ground level and heights of 45 km and above 120 km are hotter than nearby layers. In each case the cause of the odd temperature reversals in the graph?



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 shrink the size of the hole, the water level will rise. What change in the atmosphere would be analogous to a shrinkage in hole size?

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

40. Name each of the below constellations.