Except for questions 29, 39 and 40 marks/answers on these sheets are not graded.

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

1. Energy may be produced in a nuclear power plant, converted to electrical energy, and transmitted to our homes where it is used up in various electrical appliances.
2. Since an ice skater spins faster and faster as she draws her arms in close to her body, her angular momentum is increasing.
3. Parcels of air don't fall for the same reason airplanes don't fall: the air pressure force pushing up on the bottom of the parcel/plane is equal to the air pressure force pushing down on the top of the parcel/plane plus the weight.
4. 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.
5. Absent twisting forces, a gyroscope points in a fixed direction; with twisting forces a gyroscope *precesses*.
6. Longer wavelength means bigger frequency.
7. Every isotope of carbon has the same number of protons in its nucleus.
8. *Temperature* is a measure of the kinetic energy of the constituent particles (e.g., atoms).
9. High temperatures break apart composites.
10. A hot ionized gas could be called a *plasma*.
11. *Refraction* has to do with lenses; *rarefaction* has to do with sound waves.
12. In comparing two photons of light, the photon with the smaller wavelength will have the smaller energy.
13. The Sun produces an emission spectra.
14. Visible light moves faster than radio light, for the same reason we see the flash of lightening before we hear the rumble.
15. Red hot is hotter than white hot.
16. Every object is incandescent, but the light emitted may not be visible to people.
17. At prime focus, your head would block some of the light you're trying to see.
18. The main reason for building bigger telescopes is to achieve greater magnification.
19. A resolution of 2 arcsec is better than one of 1 arcsec.
20. Few telescopes use an equatorial mount since the equator is a poor place to put a telescope.

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 *atmospheric seeing* (applied to telescope viewing)?

25. Describe how you measured the focal length of a lens in class.

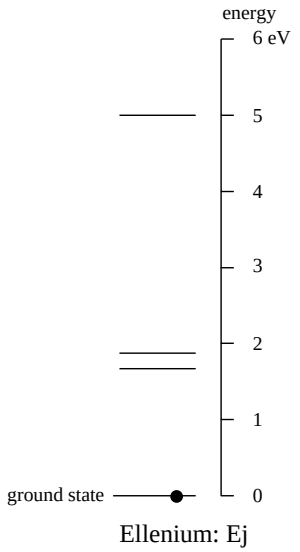
26. Consider two lenses: Lens **A** is 2" in diameter and has a focal length of 2"; Lens **B** is 3" in diameter and has a focal length of 6". Which lens will work faster for burning holes in paper using the image of the Sun? (Hint: f-number) Which lens will burn larger holes in paper using the image of the Sun? (Hint: image size)

27. 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?

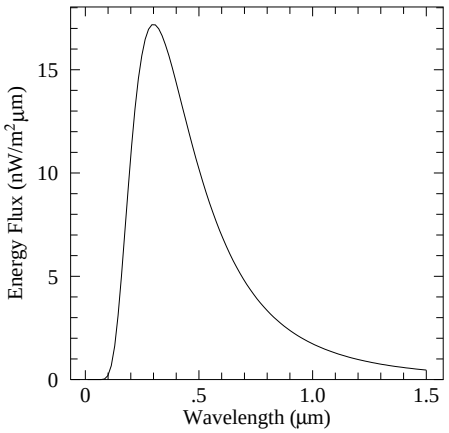
28. Generally speaking, long-wavelength light is less dangerous than short-wavelength light. Describe how short-wavelength light causes damage and why long-wavelength photons cannot cause this sort of damage.

29. 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. Directly on energy level diagram right, show/label: (A) how (include arrow) 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/label (C) how the electron moves when the violet light is produced.



30. If blue light has a wavelength of 400 nm and red light has a wavelength of 700 nm, use the plot right to determine: (A) the amount of blue light emitted (B) the amount of red light emitted and (C) the ratio of the amount of red light over the amount of blue light. (If you don't have a calculator, feel free to make a single digit estimate of this ratio.)



31. If the object in the previous problem reduced its temperature to 50% of what it had in the plot (but otherwise remained the same), how would that effect (A) the amount of blue light emitted (B) the amount of red light emitted and (C) the ratio of the amount of red light over the amount of blue light.

32. Looking through a spectroscope (as you did in class), describe (to a ten-year-old child) exactly what you would see: (A) looking at a fluorescent light and (B) looking at an incandescent light.

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. In 1835 the French philosopher Auguste Comte wrote that science could never learn the physical properties (chemical makeup, temperature, etc.) of stars and planets because we could never bring bits of planets and stars home to a laboratory. Just 50 years later American astronomer Samuel Pierpont Langley was reporting measurements of exactly those same physical properties. How was this possible?

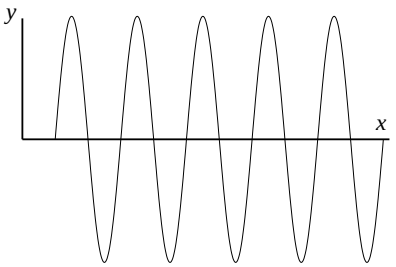
Write out a complete answer (10 pts each)

36. 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 *increasing* the factor would change the planet's temperature. What is this "the" temperature of? How/why could the "surface" temperature differ from this formula temperature?

37. When discussing waves, typically a picture as shown below is displayed. (A) If this is a picture related to a sound wave, what are the x and y axes? (B) If this is a picture related to a light wave, what are the x and y axes? (C) Using a similar diagram and/or words define wavelength, frequency, and amplitude. (D) For a sound wave, what human experiences corresponds to frequency and amplitude. (Please give relationships, e.g., more frequency corresponds to more of what human experience.) (E) For a light wave, what human experiences corresponds to frequency and amplitude. (Again give relationships.)



38. List the terrestrial planets. List the Jovian planets. Select an extensive planetary property and report (a) how we measure it for planets in the Solar System and (b) how this quantity differs between/among the jovian and terrestrial planets. Select an intensive planetary property and report (c) how we measure it for planets in the Solar System and (d) how this quantity differs between/among the jovian and terrestrial planets.

39. Answer this question by directly drawing/labeling on the graph below.

    (a) Label/locate: **G** where the green light is, **IR** where the infrared light is and **UV** where the ultraviolet light is.

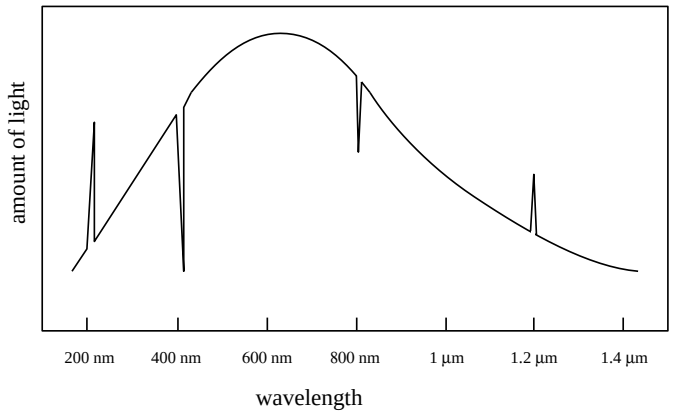
    (b) Label: an absorption line **A**, an emission line **E**.

    (c) What is the numerical value of the peak wavelength?

    (d) Sketch how the graph would change if the object producing the light were cooler.

    (e) Sketch how the graph would change if electrons made the quantum leaps corresponding to your labeled emission line *less* frequently.

    (f) Sketch how the graph would change if the object producing the light were moving at high speed (say 10% of the speed of light) away from Earth.



40. Name each of the below constellations.