Except for questions 38 and 39 marks/answers on these sheets are not graded.

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

1. Since an ice skater spins faster and faster as she draws her arms in close to her body, her angular momentum is increasing.
2. Generally speaking, larger sized musical instruments produce larger (bigger number) frequencies.
3. If the Earth's atmosphere had a uniform air pressure (i.e., the same at all altitudes), the atmosphere would fall like a rock.
4. For sound or light: the smaller the wavelength the bigger the frequency.
5. Doppler effect: Stopped in the station the train's whistle sounds an A (440 Hz), but when it approaching me at a railroad crossing it sounds an A$^\flat$ (415 Hz).
6. Standard incandescent (Edison) light bulbs produce an emission spectra.
7. At high temperatures nature favors increased energy; at low temperatures it favors increased entropy.
8. High temperatures break apart composites.
9. The ions in a plasma are atoms that have lost electrons.
10. Every isotope of carbon has the same number of protons in its nucleus.
11. Deuterium is like normal hydrogen, except it has exactly one neutron.
12. While both are electrically neutral, the neutrino and the neutron are as different as the electron and the proton, i.e., not closely related.
13. A microwave photon carries more energy than a ultraviolet photon.
14. In comparing two photons of light, the photon with the smaller wavelength will have the smaller energy.
15. Radio waves move slower through space than X-rays.
16. The main reason for building large Earth-based telescopes is to magnify the tiny images of stars.
17. Smaller resolution is the aim of a radio interferometer.
18. A telescope able to resolve two arc seconds is better than one able to resolve one arc second.
19. When taking pictures in dim light one usually uses a larger aperture, which means a larger f number: say f/11 instead of f/2.
20. In astronomy, poor *seeing* means it's cloudy outside.

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

21. The binoculars used at the observatory were labeled $7 \times 50$. What do the 7 and 50 mean?

22. What is a *conservation law*? In class I described three conservation laws of Newtonian mechanics. Name two conservation laws and give an example where each law applies.

23. Define *wavelength*, *frequency*, and *amplitude*.

24. What is it that is 'waving' in the case of sound? In the case of light?

25. Rank order the following types of light from from longest to shortest wavelength: infrared, AM radio, microwave, blue, gamma ray.

26. What is the difference between hot gas and cool gas, i.e., on the atomic scale what changes as temperature increases?

27. Draw a picture of an atom. Label: electron, nucleus, proton, neutron. Where could quarks be found?

28. Define: atomic energy level, ground state, excited state.

29. How does a fluorescent lamp product light? Why/how does the light produced by different gases differ?

30. How would you measure the focal length of a lens?

31. Sketch a Cassegrain reflecting telescope. Show and label: the direction to the stars, the objective, aperture, eyepiece, and focal length of the objective.

32. Define *resolution* of a telescope. What determines the resolution of the telescopes we use in lab?

33. Why does a single-dish radio telescope produce images much more blurred than big single-mirror visible-light telescopes? How can we get detailed images using radio light?

34. Why are some telescopes put in space?

35. Albereo is the double star (i.e., two stars orbiting around each other) at the foot of the northern cross. When viewed through the telescope, Albereo looks like a yellowish star (magnitude 3) next to a blue star (magnitude 5). Compare the two stars by reporting which is brighter, which has the higher surface temperature, and which must have the larger radius.

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

36. Describe why the Sun doesn't explode. Your explanation should include a full statement of the Virial theorem, an explanation of why things "usually" explode, and an explanation of why you haven't seen anything explode recently.

37. Consider two famous old telescopes: the "great refractor" at Yerkes Observatory in Williams Bay WI and the Hale telescope on top of Mt. Palomar (5600 feet up and 50 miles northeast of San Diego, CA). The great refractor is a f/19, 40 inch telescope on the shores of Lake Geneva. The Hale has a 200 inch mirror and may be configured as a f/3.3 Newtonian. Which telescope should you use to photograph dim objects? Which telescope shows the finest details? Which telescope produces the most "magnified" images?

    Sketch each telescope; show/label the objective lens/mirror, eyepiece and direction to the stars.

38. (20 points) Answer this question by directly drawing/labeling on the graph below.

    (a) What are the $x$ and $y$ axes? What is the name of this plot?

    (b) Label/locate: **B** where the blue light is, **R** where the red light is and **UV** where the ultraviolet light is.

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

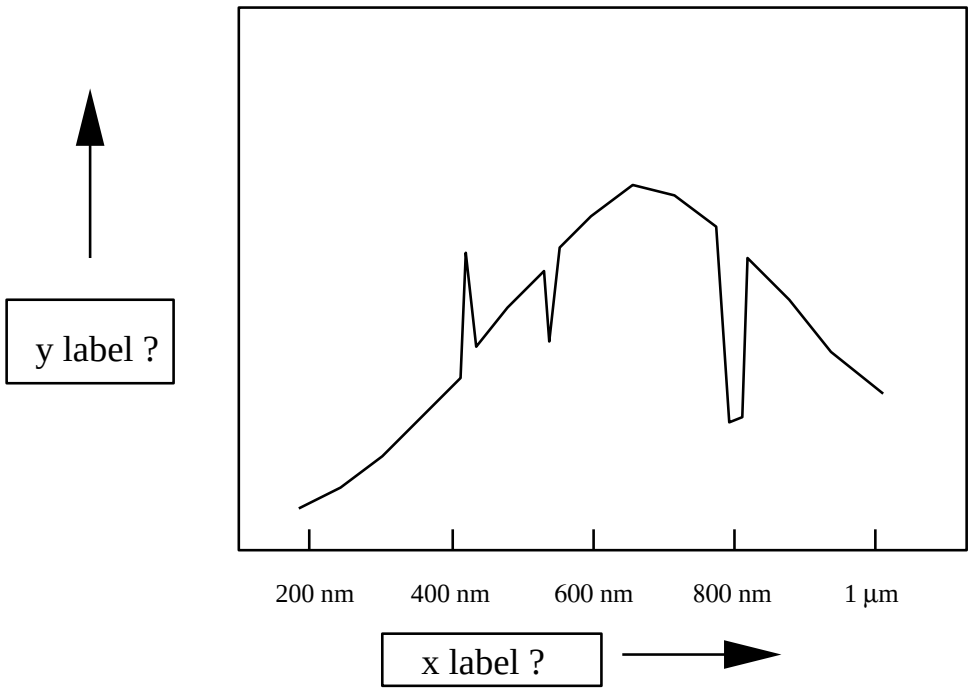
    (d) Draw a set of energy levels and electron jumps that would produce the absorption line and emission line you labeled above. Include arrows and label: **A** for the absorption line and **E** for the emission line.

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

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

    (g) Sketch how the graph would change if in the quantum leap producing your labeled emission line the initial energy level were slightly higher.

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



39. Identify the below three constellations.