Name: _____

Homework 1 – Ast 281 – Spring 2009
Due Thursday 1/22/09 – 12:00pm, Watanabe 420

The homeworks are not intended to be difficult – if you think about the answers. Please keep the answers brief - but always justify your answer (*i.e.* if the question asks you to choose something, state why you chose it, but fill in the blank questions do not need justifications). Feel free to work with others and use class materials. The point values for each question are shown in the [] following each question. [**100 points**].

1. Which of the following regimes carries the most energy: (*a*) x-rays, (*b*) radio (*c*) γ-rays (*d*) infra-red? [2] _____

2. Which of the above regimes of electromagnetic radiation have the shortest wavelength? [2] _____

3. Convert the following units to meters.[6]

2μm	_____	10 AU	_____
10^3m	_____	50 Å	_____
3 mm	_____	4 nm	_____

4. For continuous spectra, how might you estimate the temperature of an object? [8]

5. Beside each of the cases below, list the type of spectrum you would expect to see: (*a*) a black-body spectrum *only*, (*b*) an emission spectrum *only*, an (*c*) absorbtion spectrum *only*, or (*d*) a combination. [10]

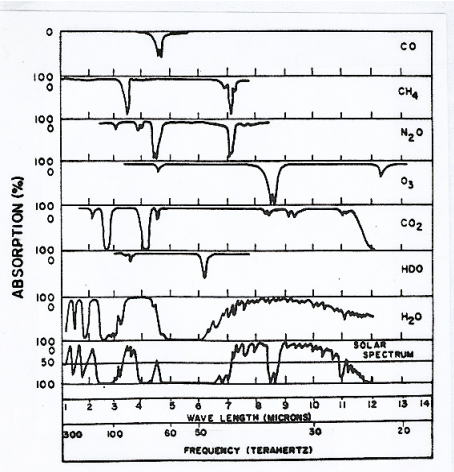
   _____ A warm, opaque dust cloud in space which you suspect to be the site of star formation
   _____ Low density gas excited to incandescence by electrical discharge
   _____ Looking at the sun through the Earth's atmosphere.
   _____ Spectrum of a star
   _____ Spectrum of your cat in the infra-red

6. We can see that very little radiation from space actually makes it to the surface of the Earth. In which 2 wavelength regions is the Earth's atmosphere mostly transparent? [4]

   _____

7. Which object is a more likely source of x-rays: Jupiter, comets, asteroids, the sun, and why? [5]

8. The following figure shows the absorption spectra of several common gases as well as that of the sun. Which gasses seem to be mostly responsible for the appearnce of the solar spectrum after passing through the Earth's atmosphere? [5]

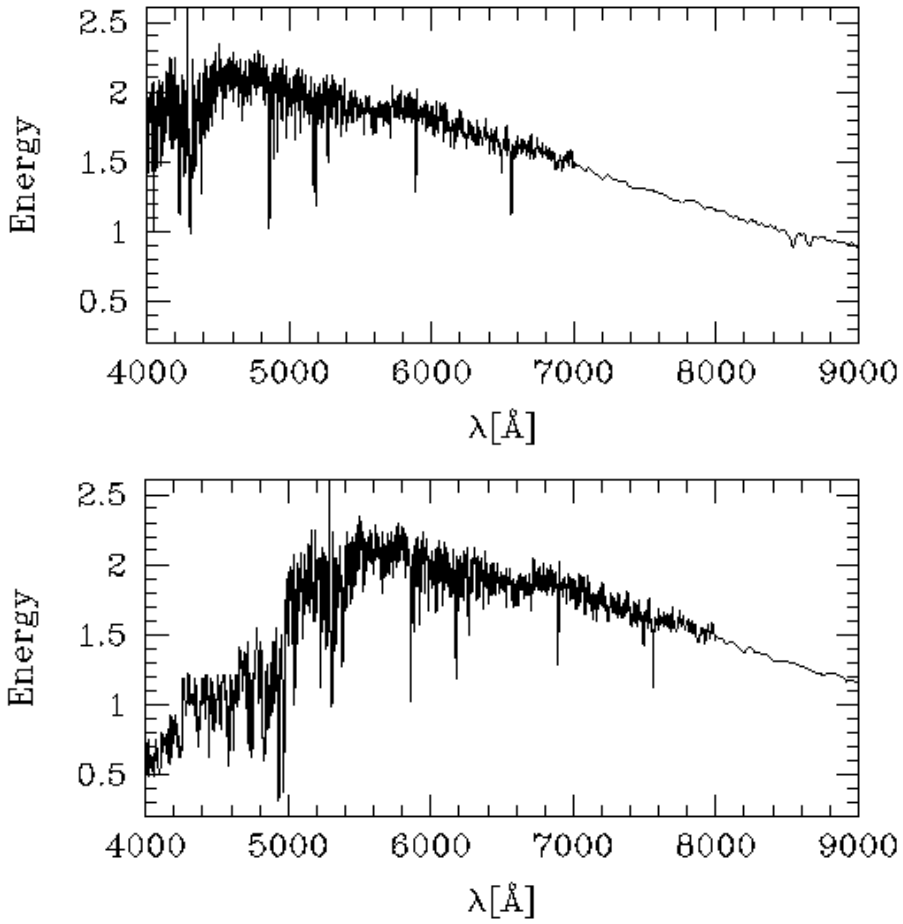


9. Take the diffraction grating you have been given, and try to look at several objects around town and report what you see (discussing the type of emission and any difficulties you may have had with the observation): [8]

   - A street light –
   - The Moon –
   - A lightbulb –
   - The burner on your stove – turn it on high and watch as the burner gets red-hot –

10. The Doppler Effect is a useful tool in astronomy to measure velocities and indirectly tell us how far away things are. In fact, everyone has experienced this phenomena, perhaps without knowing the name. Both from theory, and from laboratory measurements we know the wavelength (λ) or frequency (f) at which we expect the spectral lines of an atom or molecule to fall, therefore the doppler shift is a simple measurement of the change in wavelength or frequency from that which is expected. When something is moving away from us, the radiation is shifted toward the red, and when something is moving towards us, the radiation is shifted toward the blue. Below are examples of 2 spectra. The first one is from an object fixed relative to us and the second one is the "mystery" object. Is the mystery spectrum moving towards or away from us? [5] _____

    - What type of object do you think this spectrum is from? [5]



- Suppose that you are standing at the exact center of a park surrounded by a circular road. Suppose an ambulance drives completely around this circular road. How will the pitch of the ambulance's siren change as the ambulance circles around you? [5]

11. The intensity of the radiation from the sun will fall off as the inverse of the square of the distance from the object – this is because the energy is spreading out over the surface of a sphere (*i.e.* in all directions) – and since the surface area of a sphere is $4\pi r^2$, as r increases, the amount of light per unit area will decrease as $1/r^2$. Neptune is in an orbit near 30 AU. How much energy from the sun does it receive as a fraction of the amount that the Earth receives in its orbit at 1 AU? [5]

12. In radar astronomy, we send a signal from Earth to be reflected off the surface of an asteroid or planet and we collect this reflected signal on Earth. Why do you suppose radar astronomers can only look at the Moon, Venus, Mercury and a few nearby asteroids? [5]

13. Do you think a comet with a coma and tail would be colder or warmer than an asteroid at exactly the same distance from the sun and why? Assume that the bodies are the same size and have the same albedo. [Hint: think about their energy budget – what causes them to be warm and what happens to this energy]. [10]

14. Suppose you visit an unknown world and you make the observation that during the day the color of the sky is black. What can you tell about a possible atmosphere on this planet? [5]

15. How might you expect the Earth's climate to change if our atmosphere was suddenly replaced by a gas mixture with the following optical properties shown in the figure? [10]