Review for ASTR/ATOC 3720 Quiz #1

The Quiz:

- Will cover all material covered in class, readings, and homeworks
- Will consist of calculations, short answers and maybe some T/F
- No notes or books will be allowed
- I will give you constants and equations, but you'll have to figure out which ones to use, which ones are which, and what to plug into them!
- Calculators are allowed, but if I see that you've got notes stored in a handheld, I'll take it away and make you use my RPN calculator
- Bring a pen or pencil, paper, and your brain

Topics Covered So Far:

- General characteristics of the planets
- "Story" of the formation of the solar system
- Calculating "equilibrium" or "effective" temperature
- Ideal gas law: temperature, pressure, number density
- Hydrostatic equilibrium
- Barometric equation
- Scale height
- Adiabatic lapse rate: specific heats and gravity
- Atmospheric structure
    - By composition: homosphere, heterosphere, diffusive separation
    - By temperature: troposphere, stratosphere, mesosphere, thermosphere
    - By ionization: ionosphere
- Light interacting with matter
    - Scattering, absorption, ionization, dissociation, …
    - Lambert-Beer Law: optical depth, cross sections
    - The solar spectrum
    - Chapman profile
    - Kirchoff's Laws of Radiation:
        - High pressure gas (or liquid or solid) when heated
            - Wien's Law, Stefan-Boltzmann Law
        - Low pressure gas at high temperatures
            - Emission spectrum
        - Low pressure gas at low temperatures
            - Absorption spectrum
    - Spectroscopy as diagnostic of composition, concentration, temperature, relative motion
- Energy Budget of Earth:
    - Roles of the atmosphere in energy balance
    - Greenhouse effect
    - Enhanced greenhouse effect
    - Ozone and ozone changes
- Radiative transfer and the "Slab" or "Two-stream" model
    - Te and Tg

    - Optical depth
    - Column density
- Global Circulation in atmospheres
    - Hadley cells
    - Coriolis effect
    - Easterlies, westerlies, highs and lows
    - Pressure forces and highs and lows
        - On small scales
        - On large scales (coriolis effect)
    - Geostrophic wind
    - Planetary scale waves

Reading done so far:

- Goody & Walker: Chapters 1-4
- The New Solar System: Chapters 1 & 2

Equations:

- Stefan-Boltzmann Law: $Power = Area \cdot \sigma \cdot T^4$
- Equilibrium or Effective Temperature: $T_e = \left[\frac{S_0 \cdot (1 - \alpha)}{D^2 \cdot 4 \cdot \varepsilon} \right]^{1/4}$
- Ideal Gas Law: $p = nkT$
- Hydrostatic Equilibrium: $dp = -g \cdot n \cdot \overline{m} \cdot dz$
- Barometric Equation: $p = p_{ref} \cdot e^{-\frac{(z - z_{ref})}{H}}$, or $n = n_{ref} \cdot e^{-\frac{(z - z_{ref})}{H}}$
- Scale Height: $H = \frac{k \cdot T}{\overline{m} \cdot g}$
- Adiabatic Lapse Rate: $\frac{dT}{dz} = -\frac{g}{c_p}$
- Lambert-Beer Law: $I = I_0 \cdot e^{-\tau}$
- Optical Depth: $\tau = \int_s \sigma \cdot n \cdot ds$
- Wien's Law: $\lambda_{\max} = \frac{2.9 \cdot 10^6 nm \cdot K}{T}$
- Slab or Two-Stream Approximation: $T_g^4 = (1 + \tau) \cdot T_e^4$
- Column Density: $N = \int_s n \cdot ds$