

- Study Tips:**
- Compare your notes to text in the book
 - Much of the covered material is only in the class notes
 - Work over review questions in the book and on the web
 - Work over previous exams on the web
 - Work over theory parts in the lab manual (1-7)

About the Midterm Exam:

- Bring your **calculator, eraser, pencil, pen**
- There are **four sections**: multiple choice, true/false, fill the blanks, problems
- **Multiple choice** and **true/false**: answers only on the **NCS forms** with **pencils provided**
- For **problem** questions: all **formulae** and **constants** are **given**. A graph of the **Clausius-Clapeyron curve** will also be given.

0. Introduction - General

(class notes only)

- Weather vs. Climate

1. Atmosphere

(A&B: p 1-20, 175-182, 387-396)

- air is a *fluid* (liquids and gases are fluids)
- Composition of the atmosphere: 3 most abundant permanent gases, 3 most abundant variable gases
- *Phase changes* of water: transitions between solid (ice), liquid (water) and gas (vapor) involve transfer of energy → *latent heat*
- Greenhouse effect, and *greenhouse gases*, pollutants
- Ozone, *ozone layer*, ozone hole
- *Pressure*, definition, vertical structure
- *Gas laws* (be able to use them, if formula given)
- *Temperature structure* of the atmosphere, main layers of the atmosphere

2. Earth-Sun Geometry

(A&B: 39-50, CD 1)

- Principal motions of Earth: orbital rotation, revolution
- Orbital characteristics: ecliptic inclination, eccentricity, perihelion change
- Sun's altitude, noon sun angle and latitude, circle of illumination and day length, seasons
- How does the solar altitude determine the amount of energy received on Earth?

3. Energy Transfer

(A&B: 29-32, CD 2)

- Energy, definition, conservation principle
- System approach: Input - Output = Storage Change
- Energy transfer modes (characteristics of each)
- In which part of the Earth/Atmosphere system is each mode most important?

4. Radiation

(A&B: 32-73, CD 2)

- Spectrum, wavelengths, spectral ranges (UV, visible, IR, shortwave, longwave, solar, terrestrial)
- Black bodies, gray bodies, emissivity
- Radiation laws: Stefan-Boltzmann law, Wien's law, Kirchhoff's law (be able to use them if given)
- absorption, reflection, transmission
- Scatter and absorption, atmospheric windows, blue sky – white clouds
- Main absorber gases for longwave radiation, and for shortwave radiation

- Solar constant
- Radiation balance, basic equation, balance at surface
- Where does longwave radiation come from? What causes it?
- Where does shortwave radiation come from? How is it affected?
- What is net radiation?
- Role of cloud cover in radiation balance, green house effect: back- or re-radiation
- Global distribution of radiation balance (latitudes, seasons)
- How do the surplus and deficit regions of net radiation get compensated?

5. Energy and Water Balance (A&B: p.60-73, CD 2)

- Role of transport by atmosphere and oceans in energy balance
- Surface energy balance equation (all 3 energy transfer modes), *concept equation: need to know it - accounts for inputs, outputs and storage change*
- Conduction - ground heat flux
- Convection - sensible heat flux
- Convection latent heat flux - evaporation flux
- latent heat and sensible heat, phase changes of water
- Water balance → link to energy balance

6. Temperature (A&B: p.66-81)

- relationship energy – heat – temperature
- temperature gradients and heat flow
- controls on air temperature (solar radiation, clouds, wind, land/ocean)

7. Atmospheric moisture (A&B: p.90-115, CD 3, 4)

- Forms of water in the atmosphere (vapor, droplets, ice)
- Partial pressure of vapor = vapor pressure
- concept of saturation and equilibrium
- The Clausius-Clapeyron curve: need to be able to work with it
- measures of humidity (vapor pressure, relative humidity, specific humidity, dew point temperature)
- Conservative measures of humidity
- variations of humidity (daily, global, annual, with temperature)