MET 101 Exam 1 Study Outline

Chapter 1: INTRODUCTION TO THE ATMOSPHERE

Learning Objectives

1. Distinguish between weather and climate.
2. List the basic elements of weather and climate.
3. List and briefly describe the four major “spheres” that make up the natural environment.
4. Describe Earth as a system.
5. Discuss the importance of the following atmospheric components: carbon dioxide, water vapor, ozone, and aerosols, and describe the principal gases of dry air.
6. Summarize the cause and possible effects of stratospheric ozone depletion, and discuss international efforts to reduce it.
7. List at least four different methods of exploring the atmosphere, that is, four different means of gathering atmospheric data.
8. Sketch, label, and explain a graph showing the thermal structure of the atmosphere.
9. Describe the vertical changes in air pressure and atmospheric composition from Earth’s surface to a height of several hundred kilometers.
10. Define the homosphere and the heterosphere and know where they occur.
11. Describe the nature and extent of the ionosphere and the electrical phenomena that take place there.
12. Outline the stages in the evolution of the atmosphere.
13. Describe how a scientific theory is developed.
14. Compare the weather and climate on Mars with that on Earth.
15. Define the terms listed in the vocabulary review

Chapter Outline

I. Introduction/Overview
II. Meteorology Weather and Climate
   A. Basic Elements of Weather and Climate
      1. Temperature
      2. Humidity
      3. Clouds
      4. Precipitation
      5. Pressure
      6. Wind
   B. Atmospheric Hazards: Assault by the Elements
   C. The Nature of Scientific Inquiry
      1. Hypothesis
      2. Theory
      3. Scientific methods
   D. Observing the Atmosphere
      1. Radiosondes
III. Earth’s Spheres
   A. Earth’s Four Spheres
      1. Geosphere
      2. Atmosphere
      3. Hydrosphere
      4. Biosphere
   B. Earth as a System
      1. What is a system?
      2. Feedback mechanisms
      3. The Earth system
IV. Composition of the Atmosphere  
   A. Major Components  
   B. Carbon Dioxide  
   C. Variable Components  
      1. Water vapor  
      2. Aerosols  
      3. Ozone  
   D. Ozone Depletion: A Global Issue  
      1. The ozone hole  
      2. Effects of ozone depletion  
      3. Montreal protocol  

V. Extent of the Atmosphere  

VI. Thermal Structure  
   A. Troposphere  
      1. Environmental lapse rate  
   B. Stratosphere  
   C. Mesosphere  
   D. Thermosphere  
   E. Vertical Variations in Composition  
      1. Homosphere  
      2. Heterosphere  
   F. Ionosphere  
      1. Auroras  

Chapter 2: HEATING EARTH’S SURFACE AND ATMOSPHERE  

Learning Objectives:  
1. Describe the basic motions of Earth (rotation and revolution).  
2. Discuss the causes for seasons.  
3. List the basic characteristics of the solstices and equinoxes, and the dates on which each occurs.  
4. Define energy, and contrast kinetic and potential energy.  
5. Contrast the concepts of heat and temperature.  
6. Distinguish among the three basic mechanisms of energy transfer and give an example of each.  
7. Discuss general properties of radiation, and also state the basic laws governing radiation.  
8. Distinguish among scattering, reflection, and absorption of solar energy, and discuss where each of these occurs in the Earth–Atmosphere system.  
9. Explain how Earth’s atmosphere is “heated from the ground up” and why this happens, including an understanding of the greenhouse effect.  
10. Define heat budget and discuss the importance of radiation balance in this matter.  
11. Discuss the concept of heat budget on a global scale, and the role of global winds and ocean currents in this matter.  
12. Discuss heat budget on a local scale.  
13. Define the terms listed in the vocabulary review.  

Chapter Outline  
I. Earth–Sun Relationships  
   A. Earth’s Motions  
      1. Rotation  
      2. Revolution  
         a. Perihelion  
         b. Aphelion
B. The Seasons
C. Earth’s Orientation
   1. Plane of the ecliptic
   2. Inclination of the axis
D. Solstices and Equinoxes
   1. Summer solstice; Tropic of Cancer
   2. Winter solstice; Tropic of Capricorn
   3. Autumnal equinox
   4. Spring equinox
II. Energy, Heat, and Temperature
   A. Forms of Energy
      1. Kinetic energy
      2. Potential energy
   B. Temperature
   C. Heat
III. Mechanisms of Energy Transfer
   A. Conduction
   B. Convection
   C. Radiation
      1. Electromagnetic radiation
      2. Laws of radiation
IV. What Happens to Incoming Solar Radiation?
   A. Reflection and Scattering
      1. Reflection and Earth’s albedo
      2. Diffused light
   B. Absorption by Earth’s Surface and Atmosphere
V. Radiation Emitted by Earth
   A. Heating the Atmosphere
      1. Atmospheric window
   B. The “Greenhouse Effect”
   C. Role of Clouds in Heating Earth
VI. Heat Budget
VII. Latitudinal Heat Balance

Chapter 3 TEMPERATURE

Learning Objectives

1. Know that temperature is one of the basic elements of weather and climate and describe how the daily mean, daily range, monthly mean, annual mean, and annual range are determined.
2. List and discuss major controls of temperature.
3. Define isotherms and explain their distribution on a global scale.
4. Discuss how Earth’s rotation controls the daily cycle of air temperatures. In addition, know other factors that influence the magnitude of the diurnal temperature range.
5. Recognize that the months of highest and lowest temperatures do not coincide with the periods of maximum and minimum incoming solar radiation as a consequence of the mechanism by which Earth’s atmosphere is heated.
6. Describe the two ways in which thermometers measure temperature.
7. Contrast Fahrenheit, Celsius, and Kelvin temperature scales.
8. Understand how to calculate heating, cooling, and growing degree-days.
10. Define the terms listed in the vocabulary review.

**Chapter Outline**

I. For the Record: Air Temperature Data
   A. Daily Mean Temperature
   B. Daily Temperature Range
   C. Monthly Mean Temperature
   D. Annual Mean Temperature
   E. Annual Temperature Range

II. Controls of Temperature
   A. Land and Water
      1. Specific heat
   B. Ocean Currents
   C. Altitude
   D. Geographic Position
   E. Cloud Cover and Albedo

III. World Distribution of Temperatures

IV. Cycles of Air Temperature
   A. Daily Variations
   B. Annual Variations

V. Temperature Measurement
   A. Thermometers
      1. Mechanical
         a. Liquid-in-glass
         b. Maximum
         c. Minimum
         d. Bimetal strip
      1. Thermograph
   2. Electrical Thermometers
      a. Thermistor
   B. Instrument Shelters

VI. Temperature Scales
   A. Fahrenheit
      1. Ice point
      2. Steam point
   B. Celsius Scale
   C. Kelvin/Absolute Scale
      1. Absolute zero

VII. Applications of Temperature Data
   A. Heating Degree-days
   B. Cooling Degree-days
   C. Growing Degree-days
   D. Temperature and Comfort
      1. Heat index
      2. Windchill

**Test format (on next page)**
Test format:

Part 1 will be multiple choice questions. Part 2 questions are constructed response. Be prepared to discuss the following items.

1. The change in the Sun's path through the year.
2. Seasons
3. The thermal structure of the atmosphere
4. Earth's Heat Budget - Explaining the time lag between maximum insolation and maximum temperature; time lag between minimum insolation and minimum temperature.
5. How the lower atmosphere heats from the bottom up.
6. Feedback mechanisms in Earth systems.
7. How Earth formed from the solar nebula