

Mid-Term Review Questions:

Composition of the Atmosphere:

1. What are the three most abundant permanent gases?
2. What is the most important variable gas?
3. Discuss the importance of other variable gases.

Vertical Structure of the Atmosphere:

1. Define pressure and density. How are they related?
2. How are pressure and density distributed in the vertical?
3. Define sea level pressure. What is the standard value?
4. Describe how temperature varies with height in the troposphere and stratosphere.
5. What is an inversion layer?
6. In which atmospheric layer does weather occur?
7. Where is the ozone layer located and what is its significance?

Weather & Climate:

1. What are weather and climate? How do they differ?
2. What characteristics are used to describe the weather?

Temperature & Heat Transfer:

1. What is kinetic energy?
2. What is specific heat capacity?
3. What is latent heat?
4. What are the three transfer mechanisms? Describe the role of these processes with respect to the atmosphere.
5. What characteristics distinguish waves?
6. What is a blackbody?
7. What information do the Stefan-Boltzman Law and Wien's Law provide?
8. Describe the primary differences in the radiation curves between the sun and the earth.
9. What is meant by radiative equilibrium?
10. What is the approximate radiative equilibrium temperature of the earth?
11. Why would the radiative equilibrium temperature of the earth be below 0°C for an "atmosphere-free" earth?
12. Define albedo.
13. Describe the different methods by which the atmosphere interacts with solar and terrestrial radiation.
14. What are the common "greenhouse" gases?
15. What is selective absorption? How does the atmosphere qualify as a selective absorber?

Atmospheric Optics:

1. Why is it difficult to see the road while driving on a foggy night with your high beams lights on?
2. What would be the colour of the sky if air molecules scattered the longest wavelengths of visible light and passed the shorter wavelengths straight through?
3. If there were no atmosphere surrounding the earth, what colour would the sky be at sunset?
4. Again, assuming there were no atmosphere surrounding the earth, what colour would the sun be at noon? At sunrise? At sunset?

The Seasons & Energy Balance:

1. What feature is responsible for the seasons?
2. What is the shape of the Earth's orbit around the sun?
3. When is the earth closest to the sun and farthest away from the sun?
4. What factors determine the amount of solar radiation reaching the surface?
5. How does the atmosphere attenuate incoming radiation?
6. Why do the seasonal temperature maxima and minima not coincide with the solstices?
7. What acts to redistribute heat within the atmosphere?
8. Outline a typical diurnal temperature cycle. Relate the variation to the surface radiation budget. What factors can influence the shape of the cycle?

Air Temperature:

1. What factors affect the surface temperature?
2. How is a nocturnal radiation inversion formed?
3. Describe the circumstances that promote the development of a deep inversion layer.
4. Outline the factors that influence the diurnal and annual temperature range.

Atmospheric Moisture & Clouds:

1. Discuss the phase changes and associated energy changes in water.
2. Outline the various methods to describe the amount of water vapour in the atmosphere.
3. What are the controls of relative humidity?
4. What is fog? List the different types of fog and describe their formation methods.
5. What are the main categories for classifying clouds?
6. Describe the relationship between saturation vapour pressure and temperature.
7. Why is absolute humidity not a useful variable for indication the amount of moisture in the air?
8. What is meant by the word saturation in terms of water vapour?
9. How can air become saturated?
10. Outline the diurnal variation of relative humidity.
11. Why does air expand as it rises?
12. What is responsible for the decrease in temperature as a parcel rises?
13. Outline the principles on which the determination of relative humidity by the sling psychrometer is based.
14. What are condensation nuclei and ice (freezing) nuclei?
15. Why can you see your breath on cold mornings?

Atmospheric Stability:

1. What is meant by stable and unstable equilibrium? How are these concepts related to the atmosphere?
2. Why does rising/sinking air cool/warm?
3. What is an adiabatic process?
4. What do the dry and moist adiabatic lapse rates represent?
5. Why do the moist and dry adiabatic lapse rates differ?
6. What does the environmental lapse rate represent?
7. What are the three categories of atmospheric stability?
8. With respect to the atmospheric profile of temperature, where would you expect to see an absolutely unstable profile most commonly?
9. Discuss how stable and unstable layers are formed in the atmosphere.
10. What general type of clouds would you expect to see in unstable and stable environments?
11. What does the “level of free convection” represent?
12. Outline the common lifting mechanisms associated with cloud formation.

Precipitation:

1. Discuss the relative sizes of CCN, cloud droplets and raindrops. Outline how CCN and cloud droplets are associated with the formation of raindrops.
2. Describe the droplet growth mechanisms in warm clouds.
3. Upon what is a particle's terminal velocity based?
4. What factors affect a particle's fall speed (ground relative velocity)?
5. Describe the ice crystal growth processes.
6. Why will ice particles grow more readily than super-cooled drops in the mixed phase of a cloud?
7. Describe the processes that form the various types of precipitation (rain, snow, sleet, hail, graupel, freezing rain) and relate to the temperature profile.
8. What are the common ice-crystal habits?