This exam covers Ahrens Chapters 1 and 2, plus related lecture notes
Write the letter of the choice that best completes the statement or answers the question.

__b__ 1. The Earth’s atmosphere is currently composed of mostly:
   a. A mixture of Oxygen, water vapor, and Carbon Dioxide
   b. A mixture of Nitrogen and Oxygen
   c. Methane and Ozone
   d. Hydrogen and Helium

__a__ 2. Earth’s earliest atmosphere was probably composed of
   a. Hydrogen and Helium that reflect the main elements in the Universe
   b. Carbon dioxide and water vapor released by volcanic action
   c. Methane and Ammonia like that of other planets
   d. Mostly Oxygen and Nitrogen

__c__ 3. Bombardment of the Earth by high-energy collisions with other bodies probably caused:
   a. The formation of Earth’s ocean basins
   b. The formation of the ozone layer
   c. The loss of the earliest atmosphere
   d. The destruction of Pangea
   e. The extinction of sulfur-based bacteria

__b__ 4. The primary source of oxygen for the earth's atmosphere has been:
   a. volcanic eruptions
   b. photosynthesis
   c. photodissociation
   d. exhalations of animal life
   e. transpiration

__c__ 5. The most abundant greenhouse gas in the earth's atmosphere:
   a. carbon dioxide (CO$_2$)
   b. nitrous oxide (N$_2$O)
   c. water vapor (H$_2$O)
   d. methane (CH$_4$)
   e. chlorofluorocarbons (CFCs)

__b__ 6. This holds a planet's atmosphere close to its surface:
   a. radiation
   b. gravity
   c. cloud cover
   d. moisture
   e. pressure

__b__ 7. Without the atmospheric greenhouse effect, the average surface temperature would be:
   a. higher than at present
   b. lower than at present
   c. the same as it is now
   d. much more variable than it is now

__c__ 8. Ozone is formed in the stratosphere by
   a. Aircraft exhaust
   b. A reaction between Nitrous Oxide and Methane
   c. Photochemical dissociation of Oxygen
   d. Trace bacteria
   e. Volcanic emissions
9. The processes of condensation and freezing:
   a. both release sensible heat into the environment
   b. both absorb sensible heat from the environment
   c. do not affect the temperature of their surroundings
   d. do not involve energy changes

10. The amount of force exerted over an area of surface is called:
    a. density
    b. weight
    c. temperature
    d. pressure

11. The temperature scale where 0°F represents freezing and 100°F boiling:
    a. Fahrenheit
    b. Celsius
    c. Kelvin
    d. absolute

12. The change of state of ice into water vapor is known as:
    a. deposition
    b. sublimation
    c. melting
    d. condensation
    e. crystallization

13. Stratospheric ozone:
    a. Is a pollutant that causes crop losses
    b. Has decreased by over 50% since the 1950’s
    c. Shields the Earth’s surface from harmful ultraviolet radiation
    d. Is increasing due to combustion of fossil fuels

14. The primary source of energy for the earth's atmosphere is:
    a. energy from within the earth
    b. the sun
    c. erupting volcanoes
    d. lightning discharges associated with thunderstorms
    e. latent heat released during the formation of hurricanes

15. The atmosphere near the earth's surface is "heated from below."
    Which of the following is least responsible for the heating?
    a. conduction of heat upward from a hot surface
    b. convection from a hot surface
    c. absorption of infrared energy that has been radiated from the surface
    d. heat energy from the earth's interior

16. Energy of motion is also known as:
    a. dynamic energy
    b. kinetic energy
    c. sensible heat energy
    d. static energy
    e. latent heat energy

17. The blueness of the sky is mainly due to:
    a. the scattering of sunlight by air molecules
    b. the presence of water vapor
    c. absorption of blue light by the air
    d. emission of blue light by the atmosphere
__c__ 18. Air that rises always
   a. contracts and warms
   b. contracts and cools
   c. expands and cools
   d. expands and warms

__b__ 19. How do red and blue light differ?
   a. blue light has a higher speed of propagation
   b. the wavelength of red light is longer
   c. red light has a higher intensity
   d. red and blue light have different directions of polarization

__b__ 20. The sun emits a maximum amount of radiation at wavelengths near __________, while the earth emits maximum radiation near wavelengths of __________.
   a. 0.5 micrometers, 30 micrometers
   b. 0.5 micrometers, 10 micrometers
   c. 10 micrometers, 30 micrometers
   d. 1 micrometer, 10 micrometers

__d__ 21. During Earth’s Ice Ages, atmospheric Carbon Dioxide
   a. Caused the extinction of the Wooly Mammoth
   b. Was released from the ocean
   c. Was slightly toxic to dinosaurs
   d. Decreased dramatically

__e__ 22. Atmospheric CO2 has:
   a. Been much higher in the distant geologic past than it is today
   b. Oscillated up and down in time with the Ice Ages
   c. Been drawn down over billions of years by photosynthesis and burial of organic matter
   d. Been increasing rapidly since about 1800
   e. all of the above

__c__ 23. Density is:
   a. Force per unit area
   b. Energy per unit height
   c. Mass per unit volume
   d. Kinetic energy per unit molecule

__b__ 24. Atmospheric pressure:
   a. Has been increasing since the industrial revolution
   b. Is caused by the weight of the overlying air
   c. Increases with altitude
   d. All of the above

__b__ 25. A change of one degree on the Celsius scale is ____ a change of one degree on the Fahrenheit scale.
   a. equal to
   b. larger than
   c. smaller than
   d. is in the opposite direction of

__d__ 26. Hydrostatic balance refers to:
   a. The balance of forces between pressure and temperature
   b. The motion of water molecules stopping when ice freezes
   c. The balance between the Coriolis force and solar radiation
   d. The balance of forces between pressure gradients and gravity
27. Temperature is a measure of:
   a. The pressure of the average molecule of air
   b. The average density per unit volume
   c. The average kinetic energy of air molecules
   d. All of the above

28. A temperature scale based on the absolute kinetic energy of moving molecules is
   a. Fahrenheit
   b. Celsius
   c. Kelvin
   d. Boltzman

29. Atmospheric temperatures decrease with height in:
   a. The Stratosphere
   b. The Mesosphere
   c. The Troposphere
   d. all of the above
   e. only (b) and (c) are correct

30. The “Ideal Gas Law” governs the relationships among
   a. Pressure, humidity, and radiation
   b. Temperature, Pressure, and Density
   c. Density, Kinetic Energy, and Gravity
   d. CO2 and water vapor
   e. none of the above

31. Winds and temperatures throughout the troposphere and stratosphere are routinely measured by
   a. mercury barometer
   b. stethoscope
   c. ceilometer
   d. radiosonde

32. The gas that shows the most variation from place to place and from time to time in the atmosphere:
   a. ozone (O₃)
   b. carbon dioxide (CO₂)
   c. water vapor (H₂O)
   d. methane (CH₄)
   e. argon (Ar)

33. If pressure remains constant, then increasing temperature will lead to
   a. Decreasing kinetic energy
   b. Increasing density
   c. Decreasing longwave radiation
   d. Decreasing density

34. The albedo of the earth’s surface is only about 4%, yet the combined albedo of the earth and
   the atmosphere is about 30%. Which set of conditions below best explains why this is so?
   a. high albedo of clouds, low albedo of water
   b. high albedo of clouds, high albedo of water
   c. low albedo of clouds, low albedo of water
   d. low albedo of clouds, high albedo of water
35. Energy can be transported in the atmosphere by:
   a. Convection or Advection
   b. The Stefan-Boltzman process
   c. Conduction near the Earth’s surface
   d. Electromagnetic radiation
   e. a, c, and d

36. Radiant energy is transported in the atmosphere by:
   a. Condensation
   b. Convection and advection
   c. Oscillations of electric and magnetic fields
   d. All of the above

37. How much radiant energy will an object emit if its temperature is at zero degrees Kelvin?
   a. the maximum theoretical amount
   b. none
   c. the same as it would at any other temperature
   d. depends on the chemical composition of the object

38. Radiation carries more energy when it has:
   a. Longer waves
   b. Lower frequencies
   c. Shorter waves
   d. Higher speeds

39. Which of the following determine the wavelength and amount of radiation that an object emits?
   a. Temperature
   b. thermal conductivity
   c. Density
   d. latent heat

40. Doubling the absolute temperature of a blackbody causes it to:
   a. Glow with red light
   b. Emit twice as much radiation
   c. Evaporate
   d. Emit sixteen times as much radiation

41. Hotter objects emit:
   a. More longwave radiation than cold objects
   b. More shortwave radiation than cold objects
   c. Radiation almost proportional to the fourth power of their temperature
   d. All of the above

42. The wavelength at which objects emit the most radiation is:
   a. proportional to the square of the temperature
   b. proportional to the fourth power of temperature
   c. inversely related to temperature
   d. uniquely determined by the chemical composition of the object
   e. directly related to the pressure

43. Sunsets appear red because:
   a. The human eye is more sensitive to red than yellow light
   b. The moon’s gravity interferes with other colors in the evening
   c. The atmosphere scatters shorter wavelengths more efficiently than longer wavelengths
   d. The true color of the sun is red and is revealed when the sun nears the horizon
44. The “Greenhouse Effect” is caused by:
   a. Scattering of sunlight by highly transparent glass and metal
   b. Absorption and emission of longwave radiation by molecular transitions
   c. The ozone hole
   d. Oxygen and Nitrogen
45. The Earth’s surface is warmed:
   a. More by sunlight than by atmospheric radiation
   b. Mostly by conduction and convection
   c. More by downward emission from the atmosphere than from the sun
   d. By the loss of stratospheric ozone
46. Atmospheric water vapor and Carbon Dioxide are: BOGUS QUESTION! (Sorry!)
   a. More efficient at absorbing shortwave radiation than ozone
   b. Less efficient at absorbing ozone than chlorofluorocarbons
   c. along the Pacific coast of North America
   d. high in the mountains in the middle of a continent
   e. on a small island near the equator
47. The atmospheric greenhouse effect is produced mainly by the:
   a. absorption and re-emission of visible light by the atmosphere
   b. absorption and re-emission of ultraviolet radiation by the atmosphere
   c. absorption and re-emission of infrared radiation by the atmosphere
   d. absorption and re-emission of visible light by clouds
   e. absorption and re-emission of visible light by the ground