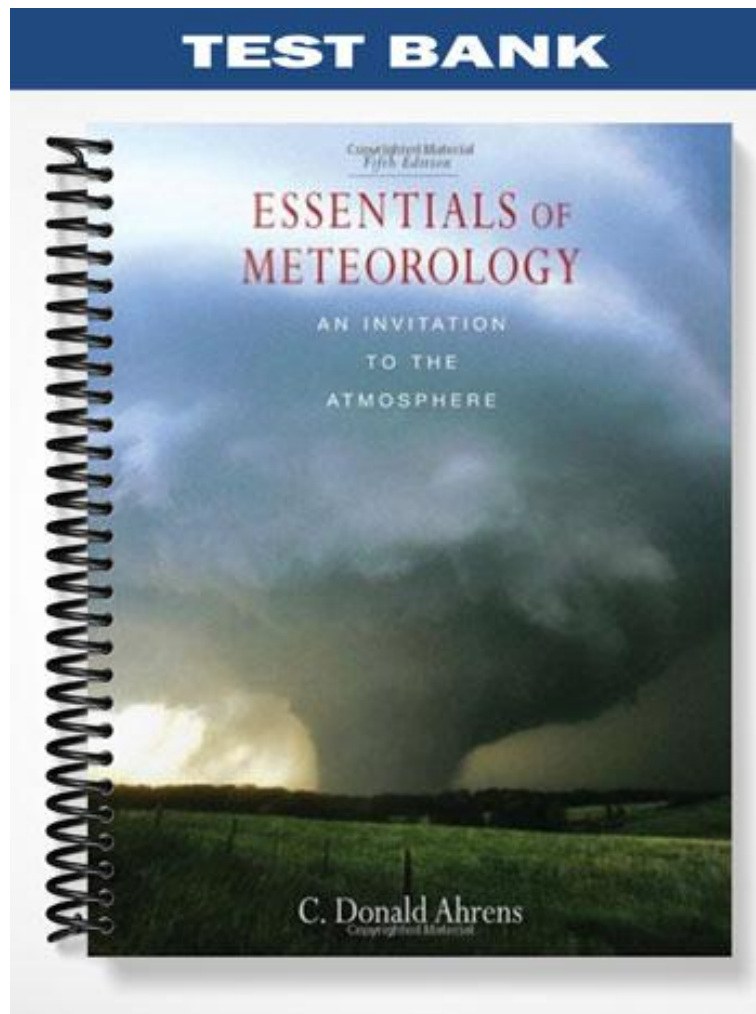


TEST BANK



Chapter 2--Warming the Earth and the Atmosphere

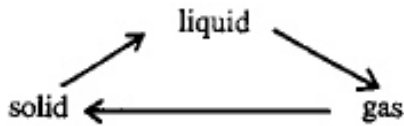
Student: _____

1. Which of the following provides a measure of the average speed of air molecules?
 - A. pressure
 - B. temperature
 - C. density
 - D. heat
2. 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
3. Which of the following is not considered a temperature scale?
 - A. Fahrenheit
 - B. Kelvin
 - C. Calorie
 - D. Celsius
4. The temperature scale where 0° represents the freezing point and 100° the boiling point of water.
 - A. Fahrenheit
 - B. Celsius
 - C. Kelvin
 - D. absolute
5. If the temperature of the air is said to be at absolute zero, one might conclude that
 - A. the motion of the molecules is at a maximum.
 - B. the molecules are occupying a large volume.
 - C. the molecules contain a minimum amount of energy.
 - D. the temperature is 0° F.
 - E. the air temperature is 0° C.
6. The temperature scale that sets freezing of pure water at 32° .
 - A. Kelvin
 - B. Fahrenheit
 - C. Celsius
 - D. British
7. Room temperature is about 300 degrees on the ____ temperature scale.
 - A. Fahrenheit
 - B. British
 - C. Celsius
 - D. Kelvin

8. Energy of motion is also known as
- A. dynamic energy.
 - B. kinetic energy.
 - C. sensible heat energy.
 - D. static energy.
 - E. latent heat energy.
9. The transfer of heat by molecule-to-molecule contact is
- A. conduction.
 - B. convection.
 - C. radiation.
 - D. ultrasonic.
10. Which of the following is the poorest conductor of heat?
- A. still air
 - B. water
 - C. ice
 - D. snow
 - E. soil
11. Heat is energy in the process of being transferred from
- A. hot objects to cold objects.
 - B. low pressure to high pressure.
 - C. cold objects to hot objects.
 - D. high pressure to low pressure.
 - E. regions of low density toward regions of high density.
12. The horizontal transport of any atmospheric property by the wind is called
- A. advection.
 - B. radiation.
 - C. conduction.
 - D. latent heat.
 - E. reflection.
13. Heat transferred upward from the surface of the *moon* can take place by
- A. convection.
 - B. conduction.
 - C. latent heat.
 - D. radiation.
14. Which of the following is *not* a heat-transport process in the atmosphere?
- A. conduction
 - B. radiation
 - C. convergence
 - D. convection
15. A heat transfer process in the atmosphere that depends upon the movement of air is
- A. conduction.
 - B. reflection.
 - C. convection.
 - D. radiation.

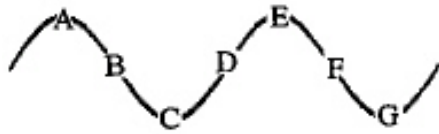
16. Snow will usually *melt* on the roof of a home that is a
- A. good radiator of heat.
 - B. good conductor of heat.
 - C. poor radiator of heat.
 - D. poor conductor of heat.
17. The heat energy released when water vapor changes to a liquid is called
- A. latent heat of evaporation.
 - B. latent heat of fusion.
 - C. latent heat of fission.
 - D. latent heat of condensation.
18. When water changes from a liquid to a vapor, we call this process
- A. freezing.
 - B. condensation.
 - C. sublimation.
 - D. deposition.
 - E. evaporation.
19. This is released as sensible heat during the formation of clouds.
- A. potential energy
 - B. longwave radiation
 - C. latent heat
 - D. kinetic energy
20. 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 transport.
21. This process causes rising air to cool.
- A. expansion
 - B. evaporation
 - C. compression
 - D. condensation
22. The cold feeling that you experience after leaving a swimming pool on a hot, dry, summer day is
- A. heat transport by conduction.
 - B. heat transport by convection.
 - C. heat transport by radiation.
 - D. heat transport by latent heat.

23. ____ of the phase changes shown below release(s) energy to the surroundings.



- A. none
 - B. one
 - C. two
 - D. all
24. The temperature of a rising air parcel
- A. always cools due to expansion.
 - B. always warms due to expansion.
 - C. always cools due to compression.
 - D. always warms due to compression.
 - E. remains constant.
25. Sinking air warms by this process.
- A. compression
 - B. expansion
 - C. condensation
 - D. friction
26. Energy transferred by electromagnetic waves is called
- A. magnetism.
 - B. convection.
 - C. conduction.
 - D. radiation.
27. Micrometers (mm) are units of
- A. intensity.
 - B. distance.
 - C. frequency.
 - D. speed.
28. The proper order from shortest to longest wavelength is
- A. visible, infrared, ultraviolet.
 - B. infrared, visible, ultraviolet.
 - C. ultraviolet, visible, infrared.
 - D. visible, ultraviolet, infrared.
 - E. ultraviolet, infrared, visible.
29. Which of the following has a wavelength shorter than that of violet light?
- A. green light
 - B. blue light
 - C. infrared radiation
 - D. red light
 - E. ultraviolet radiation

30. Points A and C are ____ wavelength apart.



- A. 1
 - B. 1/2
 - C. 1/3
 - D. 1/4
31. One micrometer is a unit of length equal to
- A. one million meters.
 - B. one millionth of a meter.
 - C. one tenth of a millimeter.
 - D. one thousandth of a meter.
32. Electromagnetic radiation with wavelengths between 0.4 and 0.7 micrometers is called
- A. ultraviolet light.
 - B. visible light.
 - C. infrared light.
 - D. microwaves.
33. Solar radiation reaches the earth's surface as
- A. visible radiation only.
 - B. ultraviolet radiation only.
 - C. infrared radiation only.
 - D. visible and infrared radiation only.
 - E. ultraviolet, visible, and infrared radiation.
34. Which of the following is *not* found in the infrared (IR) portion of the electromagnetic spectrum?
- A. 0.4 to 0.7 mm interval
 - B. the atmospheric window
 - C. selective absorption by water vapor (H₂O) and carbon dioxide (CO₂)
 - D. peak emission from the earth
35. The earth's radiation is often referred to as ____ radiation, while the sun's radiation is often referred to as ____ radiation.
- A. shortwave, longwave
 - B. shortwave, shortwave
 - C. longwave, shortwave
 - D. longwave, longwave
36. 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
 - E. 0.3 micrometers, 50 micrometers

37. The earth emits radiation with greatest intensity at
- infrared wavelengths.
 - radio wavelengths.
 - visible wavelengths.
 - ultraviolet wavelengths.
38. When we see the moon at night, we are seeing
- visible light emitted by the moon.
 - infrared light emitted by the moon.
 - visible light reflected by the moon.
 - infrared light reflected by the moon.
39. Most of the radiation emitted by a human body is in the form of
- ultraviolet radiation and is invisible.
 - visible radiation but is too weak to be visible.
 - infrared radiation and is invisible.
 - humans do not emit electromagnetic radiation.
40. The sun emits its greatest intensity of radiation in
- the visible portion of the spectrum.
 - the infrared portion of the spectrum.
 - the ultraviolet portion of the spectrum.
 - the x-ray portion of the spectrum.
41. Which of the following has the highest energy and is potentially the most dangerous kind of radiation?
- UVA radiation
 - UVB radiation
 - UVC radiation
 - IR radiation
42. About 90% of all skin cancers are linked to exposure to
- UVA radiation.
 - UVB radiation.
 - UVC radiation.
 - IR radiation.
43. If a careful series of measurements reveals that the wavelength of peak emission from the sun (λ_{max}) is slowly increasing (shifting to longer wavelength), you might conclude that the sun is getting
- hotter.
 - bigger.
 - colder.
 - closer.
44. If the average temperature of the sun increased, the wavelength of peak solar emission would
- shift to a shorter wavelength.
 - shift to a longer wavelength.
 - remain the same.
 - impossible to tell from given information

45. Which of the following determine the kind (wavelength) and amount of radiation that an object emits?
- A. temperature
 - B. thermal conductivity
 - C. density
 - D. latent heat
46. At which temperature would the earth be radiating energy at the greatest rate or intensity?
- A. -5° F
 - B. -40° F
 - C. 60° F
 - D. 32° F
 - E. 105° F
47. This question number was omitted in the printed copy of the test bank. To maintain the integrity of the numbering system between the printed copy and ExamView, this question has been marked "do not use on test" in ExamView's question information dialog.
- A. not available
 - B. not available
 - C. not available
 - D. not available
 - E. all of these
48. The rate at which radiant energy is emitted by a body
- A. increases with increasing temperature.
 - B. increases with decreasing temperature.
 - C. does not depend on the temperature.
 - D. depends on the chemical composition of the body.
49. This property of electromagnetic radiation is inversely proportional to temperature; if temperature increases ____ will decrease.
- A. propagation speed
 - B. intensity
 - C. rate of emission
 - D. wavelength of peak emission
50. The earth's atmospheric window is in the
- A. ultraviolet region.
 - B. visible region.
 - C. infrared region.
 - D. polar regions.
51. Which of the following is known primarily as a selective absorber of *ultraviolet* radiation?
- A. carbon dioxide
 - B. ozone
 - C. water vapor
 - D. clouds

52. Which of the following statements is *not* correct?
- A. calm, cloudy nights are usually warmer than calm, clear nights
 - B. each year the earth's surface radiates away more energy than it receives from the sun
 - C. the horizontal transport of heat by the wind is called advection
 - D. good absorbers of radiation are usually poor emitters of radiation
53. The atmospheric greenhouse effect is due primarily to the fact that
- A. oxygen and ozone absorb ultraviolet radiation.
 - B. nitrogen and oxygen transmit visible radiation.
 - C. cloud formation releases latent heat energy.
 - D. carbon dioxide and water vapor absorb infrared radiation.
54. 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.
55. 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.
56. Imagine going outside at night with an instrument that can detect infrared (IR) radiation. Which of the following would you expect to observe?
- A. IR radiation traveling upward from the ground only
 - B. IR radiation propagating downward from the sky only
 - C. IR radiation coming from both the ground and the sky
 - D. no IR radiation would be detected at night
57. Which of the following gases are mainly responsible for the atmospheric greenhouse effect in the earth's atmosphere?
- A. oxygen and nitrogen
 - B. nitrogen and carbon dioxide
 - C. ozone and oxygen
 - D. water vapor and carbon dioxide
58. Clouds ____ infrared radiation and ____ visible radiation.
- A. absorb, absorb
 - B. absorb, reflect
 - C. reflect, reflect
 - D. reflect, absorb
59. At night, low clouds
- A. enhance the atmospheric greenhouse effect.
 - B. weaken the atmospheric greenhouse effect.
 - C. are often caused by the atmospheric greenhouse effect.
 - D. have no effect on the atmospheric greenhouse effect.

60. Suppose last night was clear and calm. Tonight low clouds will be present. From this you would conclude that tonight's minimum temperature will be
- A. higher than last night's minimum temperature.
 - B. lower than last night's minimum temperature.
 - C. the same as last night's minimum temperature.
 - D. above freezing.
61. Of the gases listed below, which is *not* believed to be responsible for enhancing the earth's greenhouse effect?
- A. chlorofluorocarbons (CFCs)
 - B. molecular oxygen (O_2)
 - C. nitrous oxide (N_2O)
 - D. carbon dioxide (CO_2)
 - E. methane (CH_4)
62. Low clouds retard surface cooling at night better than clear skies because
- A. the clouds absorb and radiate infrared energy back to earth.
 - B. the water droplets in the clouds reflect infrared energy back to earth.
 - C. the clouds start convection currents between them.
 - D. the clouds are better conductors of heat than is the clear night air.
 - E. the formation of the clouds releases latent heat energy.
63. If the present concentration of CO_2 doubles by the end of the 21st century, climate models predict that for the earth's average temperature to rise $2.5^\circ C$, what gas *must* also increase in concentration?
- A. nitrogen
 - B. oxygen
 - C. methane
 - D. water vapor
64. The combined albedo of the earth and the atmosphere is approximately
- A. 4 percent.
 - B. 10 percent.
 - C. 30 percent.
 - D. 50 percent.
 - E. 90 percent.
65. 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
66. The albedo of the moon is 7%. This means that
- A. 7% of the sunlight striking the moon is reflected.
 - B. 7% of the sunlight striking the moon is absorbed.
 - C. the moon emits only 7% as much energy as it absorbs from the sun.
 - D. 93% of the sunlight striking the moon is reflected.

67. Which of the following is an *incorrect* identification?
- A. albedo - percent of radiation reflected from a surface
 - B. kinetic energy - energy of motion
 - C. black body - selective absorber
 - D. long-wave radiation - earth radiation
68. Which of the following has the highest albedo?
- A. snow
 - B. sand
 - C. forests
 - D. water
 - E. grass
69. An increase in albedo would be accompanied by _____ in radiative equilibrium temperature.
- A. an increase
 - B. a decrease
 - C. no change
 - D. unstable oscillations
70. On the average, about what percentage of the solar energy that strikes the outer atmosphere eventually reaches the earth's surface?
- A. 5%
 - B. 15%
 - C. 30%
 - D. 50%
 - E. 70%
71. About 50% of the sunlight reaching the top of the atmosphere is
- A. absorbed by ozone in the stratosphere.
 - B. reflected or scattered by air molecules and clouds.
 - C. absorbed at the ground.
 - D. absorbed by greenhouse gases.
72. The major process that warms the lower *atmosphere* is
- A. the release of latent heat during condensation.
 - B. conduction of heat upward from the surface.
 - C. convection.
 - D. absorption of infrared radiation.
 - E. direct absorption of sunlight by the atmosphere.
73. If the sun suddenly began emitting more energy, the earth's radiative equilibrium temperature would
- A. increase.
 - B. decrease.
 - C. remain the same.
 - D. begin to oscillate.

74. If the amount of energy lost by the earth to space each year were not approximately equal to that received,
- A. the atmosphere's average temperature would change.
 - B. the length of the year would change.
 - C. the sun's output would change.
 - D. the mass of the atmosphere would change.
75. Sunlight that bounces off a surface is said to be ____ from the surface.
- A. radiated
 - B. absorbed
 - C. emitted
 - D. reflected
76. The earth's surface
- A. radiates more energy than it receives from the sun.
 - B. radiates less energy than it receives from the sun.
 - C. radiates the same amount of energy that it receives from the sun.
 - D. does not radiate any energy.
77. The atmosphere near the earth's surface is "heated from below." Which of the following contributes the smallest amount of energy?
- 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
78. An object is absorbing 3 units of visible light, has a temperature of 300 K, and is in radiative equilibrium. Which of the following is true?
- A. the object is not emitting any radiation
 - B. the object is emitting 3 units of visible radiation
 - C. the object is emitting 3 units of infrared radiation
 - D. the object is reflecting 3 units of visible radiation
79. 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.
80. Which of the following processes transports, on average, the most energy from the ground to the atmosphere?
- A. convection
 - B. conduction
 - C. radiation
 - D. latent heat
81. Which of the following is true when the earth is in radiative equilibrium?
- A. the earth absorbs 100% of the sunlight reaching it
 - B. the earth does not emit any radiant energy into space
 - C. the earth does not reflect any of the radiation reaching it
 - D. the earth gains and loses energy at equal rates

82. The earth's radiative equilibrium temperature is
- A. the temperature at which the earth is absorbing solar radiation and emitting infrared radiation at equal rates.
 - B. the temperature at which the earth is radiating energy at maximum intensity.
 - C. the average temperature the earth must maintain to prevent the oceans from freezing solid.
 - D. the temperature at which rates of evaporation and condensation on the earth are in balance.
83. In the earth's upper atmosphere, visible light given off by excited atoms and molecules produces
- A. flares.
 - B. the solar wind.
 - C. the aurora.
 - D. prominences.
84. Charged particles from the sun that travel through space at high speeds are called
- A. radiation.
 - B. the aurora.
 - C. solar wind.
 - D. solar flares.
85. Incoming solar radiation in middle latitudes is less in winter than in summer because
- A. the sun's rays slant more and spread their energy over a larger area.
 - B. there is a decrease in carbon dioxide levels in the atmosphere.
 - C. the cold dense air lowers the intensity of the sun's rays.
 - D. the earth is furthest from the sun.
86. The earth is closest to the sun in
- A. January
 - B. March
 - C. July
 - D. September
87. During an equinox
- A. the days and nights are of equal length except at the poles.
 - B. at noon the sun is overhead at the equator.
 - C. the earth is not tilted toward nor away from the sun.
 - D. all of these.
88. On a clear day, the sun's rays are most intense at
- A. 10 am
 - B. 12 pm (noon)
 - C. 2 pm
 - D. 4 pm
89. The main reason for warm summers in middle latitudes is that
- A. the earth is closer to the sun in summer.
 - B. the sun is higher in the sky and we receive more direct solar radiation.
 - C. oceans currents transport heat from the tropics to middle latitudes.
 - D. growing plants enhance the greenhouse effect.

90. Which of the following is one of the main causes of the seasons?
- A. the changing distance between the earth and the sun
 - B. a periodic reversal in global scale air circulation patterns
 - C. the length of the daylight hours
 - D. land/ocean temperature contrasts
91. In the Northern Hemisphere, this day has the fewest hours of daylight.
- A. summer solstice
 - B. winter solstice
 - C. vernal equinox
 - D. autumnal equinox
92. Indian Summer would most likely occur during the month of
- A. October.
 - B. December.
 - C. June.
 - D. August.
93. Which of the following is correct at the time of the summer solstice in June?
- A. it marks the beginning of astronomical summer in the Northern Hemisphere
 - B. it occurs around June 22
 - C. the noon sun is overhead at the Tropic of Cancer
 - D. all of these
94. Where are the days and nights of equal length all year long?
- A. at 66.5° latitude
 - B. nowhere
 - C. at 23.5° latitude
 - D. at the Equator
95. Which of the following best describes the weather conditions necessary to bring Indian Summer weather to the eastern half of the United States?
- A. a cold front moving off the New Jersey coast
 - B. a strong slow-moving low pressure area just east of Virginia
 - C. a strong slow-moving high pressure area off the southeast coast
 - D. a strong fast-moving low pressure area over Georgia
 - E. a cold front that stretches from South Carolina to Texas
96. During the summer in the Northern Hemisphere, the "land of the midnight sun" would be found
- A. at high latitudes.
 - B. at middle latitudes.
 - C. near the equator.
 - D. in the Southern Hemisphere.
97. During the course of a year the sun will disappear from view at the *North Pole* on or about what date?
- A. June 21
 - B. September 23
 - C. December 23
 - D. January 1
 - E. March 21

98. The first day of spring occurs on or about March 21; March 21 is called the
- A. vernal solstice
 - B. equinox
 - C. aphelion
 - D. perihelion
99. At the time of the winter solstice in the Northern Hemisphere
- A. astronomical winter begins in the Northern Hemisphere.
 - B. the noon sun is over latitude 23.5° S.
 - C. at middle latitudes in the Northern Hemisphere, this marks the longest night of the year.
 - D. all of these.
100. Which of the following helps to explain why even though northern latitudes experience 24 hours of sunlight on June 22, they are not warmer than latitudes further south?
- A. solar energy is spread over a larger area in northern latitudes
 - B. some of the sun's energy is reflected by snow and ice in the northern latitudes
 - C. increased cloud cover reflects solar energy in the northern latitudes
 - D. solar energy is used to melt frozen soil in the northern latitudes
 - E. all of these
101. The sun is directly overhead at Mexico City (latitude 19° N)
- A. once a year.
 - B. twice a year.
 - C. four times a year.
 - D. never.
102. Which of the latitudes below would experience the fewest hours of daylight on December 22?
- A. 60° S
 - B. 20° S
 - C. Equator
 - D. 20° N
 - E. 60° N
103. On what day would you expect the sun to be overhead at Lima, Peru (latitude 12° S)?
- A. August 15
 - B. February 4
 - C. March 10
 - D. April 21
104. In the middle latitudes of the Northern Hemisphere on June 22, the sun
- A. rises in the east and sets in the west.
 - B. rises in the southeast and sets in the southwest.
 - C. rises in the northeast and sets in the northwest.
 - D. rises in the north east and sets in the southwest.
 - E. rises in the southeast and sets in the northwest.

105. The astronomical beginning of spring occurs around this date in the Northern Hemisphere.
- A. March 1
 - B. April 1
 - C. March 21
 - D. March 15
 - E. April 15
106. Between Christmas and New Year's, at middle latitudes in the Northern Hemisphere, the length of the day
- A. increases.
 - B. decreases.
 - C. does not change.
 - D. is 12 hours long.
107. On which date would the sun's rays be closest to being perpendicular to the earth's surface in the middle latitudes of the Northern Hemisphere?
- A. March 21
 - B. June 21
 - C. July 1
 - D. July 21
 - E. August 1
108. The sun will pass directly overhead at noon in Miami, Florida (latitude 26° N)
- A. once a year.
 - B. twice a year.
 - C. four times a year.
 - D. never.
109. When it is January and winter in the Northern Hemisphere, it is ____ and ____ in the Southern Hemisphere.
- A. January and summer
 - B. January and winter
 - C. July and winter
 - D. July and summer
110. At middle latitudes in the Northern Hemisphere, we can expect the day with the longest number of daylight hours to occur on or about
- A. June 22.
 - B. December 22.
 - C. September 23.
 - D. July 4.
 - E. August 1.
111. At middle latitudes in the Northern Hemisphere, we can expect the day with the shortest number of daylight hours to occur around
- A. June 22.
 - B. December 22.
 - C. September 23.
 - D. January 1.
 - E. February 15.

112. At the North Pole the sun will rise above the horizon on ____ and set below the horizon on ____.
- A. June 22, September 23
 - B. September 23, December 22
 - C. March 21, September 23
 - D. June 22, December 22
 - E. March 21, December 22
113. In July, at middle latitudes in the Northern Hemisphere, the day is ____ long and is ____ with each passing day.
- A. less than 12 hours, getting longer
 - B. less than 12 hours, getting shorter
 - C. more than 12 hours, getting longer
 - D. more than 12 hours, getting shorter
114. At noon on June 22, the sun will be directly overhead at
- A. the Arctic circle.
 - B. the Equator.
 - C. the Tropic of Cancer.
 - D. the North Pole.
115. The sun will be directly overhead at noon at the equator
- A. never
 - B. on March 21
 - C. on June 21
 - D. always
116. For maximum winter warmth, in the Northern Hemisphere, large windows in a house should face
- A. north.
 - B. south.
 - C. east.
 - D. west.
117. Although the polar regions radiate away more heat energy than they receive by insolation in the course of a year, they are prevented from becoming progressively colder each year by the
- A. conduction of heat through the interior of the earth.
 - B. concentration of earth's magnetic field lines at the poles.
 - C. circulation of heat by the atmosphere and oceans.
 - D. the insulating properties of snow.
 - E. release of latent heat to the atmosphere when polar ice melts.
118. The most important reason why summers in the Southern Hemisphere are not warmer than summers in the Northern Hemisphere is that
- A. the earth is closer to the sun in January.
 - B. the earth is farther from the sun in July.
 - C. over 80% of the Southern Hemisphere is covered with water.
 - D. the sun's energy is less intense in the Southern Hemisphere.

119. The north-facing side of a hill in a mountainous region tends to
- A. receive less sunlight during a year than the south-facing side.
 - B. grow a variety of trees that are typically observed at higher elevation.
 - C. be a better location for a ski run than the south-facing side.
 - D. have snow on the ground for a longer period of time in winter compared to the south-facing side.
 - E. all of these.
120. In meteorology, the word insolation refers to
- A. a well-constructed, energy-efficient home.
 - B. the solar constant.
 - C. incoming solar radiation.
 - D. an increase in solar output.
121. Suppose you drive to and from work on a street that runs east to west. On what day would you most likely have the sun shining directly in your eyes while driving to and from work?
- A. summer solstice
 - B. winter solstice
 - C. autumnal equinox
 - D. any day at noon
122. In most of the world, temperature readings are taken in Kelvins (degrees Kelvin).
- True False
123. The Celsius temperature scale contains only positive values.
- True False
124. As you heat air you would expect its density to decrease.
- True False
125. The formation of frost (deposition) releases heat and warms the surroundings.
- True False
126. Microwave radiation has a longer wavelength and is a more energetic form of radiation than visible light.
- True False
127. Virtually all the UV-C radiation, which is more harmful than UV-A or UV-B, is absorbed by ozone in the stratosphere.
- True False
128. The atmosphere is essentially completely transparent to electromagnetic radiation.
- True False
129. If our eyes responded to infrared radiation instead of visible light, clouds would appear black because they are good absorbers of IR.
- True False

130. Because air molecules are so small, compared to the wavelength of light, air does not scatter or absorb incoming sunlight.

True False

131. Satellite data from the *Earth Radiation Budget Experiment (ERBE)* indicate that the overall effect of clouds is to cool the earth's climate.

True False

132. The earth's surface receives nearly twice as much longwave IR energy from the atmosphere as it does shortwave radiation from the sun.

True False

133. The Southern Hemisphere has warmer summers and colder winters than the Northern Hemisphere.

True False

134. On a hot day, you are likely to stay cooler if you wear a white shirt.

True False

135. **INSTRUCTIONS:** Choose one answer from each pair or group of selections.

If you could somehow see the random motions of the atoms and molecules in air, would they all be moving at the SAME or at DIFFERENT speeds?

136. **INSTRUCTIONS:** Choose one answer from each pair or group of selections.

50° C is WARMER than, COLDER than, EQUAL to 100° F.

137.**INSTRUCTIONS:** Choose one answer from each pair or group of selections.

Is the energy transport in the figure below UPWARD, DOWNWARD, or ZERO?

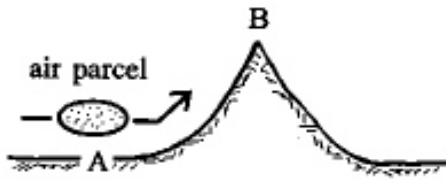


138.**INSTRUCTIONS:** Choose one answer from each pair or group of selections.

About 44% of the energy emitted by the sun is visible light. Most of the remaining radiation falls in the INFRARED ULTRAVIOLET portion of the spectrum.

139.**INSTRUCTIONS:** Choose one answer from each pair or group of selections.

As the air in the picture below moves from A to B will its volume INCREASE, DECREASE, or remain the SAME? Will its temperature INCREASE, DECREASE, or remain the SAME?



140.**INSTRUCTIONS:** Choose one answer from each pair or group of selections.

If the earth's average surface temperature were to increase, the amount of radiation emitted from the earth's surface would INCREASE DECREASE and the wavelength of peak emission would shift toward LONGER SHORTER wavelengths.

141.**INSTRUCTIONS:** Choose one answer from each pair or group of selections.

A "window" is a wavelength region where the atmosphere TRANSMITS ABSORBS EMITS radiant energy.

142.**INSTRUCTIONS:** Choose one answer from each pair or group of selections.

Overcast skies usually result in **WARMER COOLER** daytime temperatures because clouds are good **REFLECTORS ABSORBERS** of **VISIBLE INFRARED** light.

143.**INSTRUCTIONS:** Choose one answer from each pair or group of selections.

Generally speaking, to see the aurora you must be located at high **ALTITUDE LATITUDE**.

144.**INSTRUCTIONS:** Choose one answer from each pair or group of selections.

Compared to Phoenix (30° N latitude), Minneapolis (45° N) will have **LONGER SHORTER** days in the winter and **LONGER SHORTER** days in the summer.

145.**INSTRUCTIONS:** Choose one answer from each pair or group of selections.

In a positive water vapor-temperature feedback process, warming will result in **INCREASED** **DECREASED** atmospheric water vapor concentrations which will **STRENGTHEN** **WEAKEN** the greenhouse effect.

146.**INSTRUCTIONS:** Choose one answer from each pair or group of selections.

High latitudes lose **MORE**, **LESS**, the **SAME** amount of energy to space as(**than**) they receive from the sun.

147.**INSTRUCTIONS:** Choose one answer from each pair or group of selections.

The earth **ALWAYS** **SOMETIMES** receives solar radiation and **ALWAYS** **SOMETIMES** emits infrared radiation

148. _____ provides a measure of the average speed or kinetic energy of the atoms or molecules in air.

149. Fill in the blanks below using one of the choices at right. (choices at right may be used more than once or not at all).

- a. boiling point of water (sea level) _____
- b. hottest temperature _____
- c. coldest temperature _____
- d. melting point of ice _____

0° F 0° C
100° F 100° C

150. Warm rising air has formed a cloud in the figure below. This illustrates which two energy transport processes?



151. Ocean currents transport energy in the form of warm ocean water from the tropical oceans to higher latitudes. This is an example of which energy transport process?

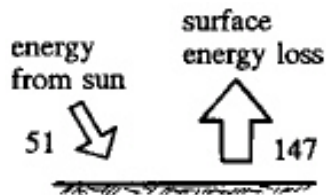
152. One _____ of energy is needed to raise the temperature of 1 gram of water 1° C.

153. _____ originates from rapidly vibrating electrons which exist in every object.

154. In some situations light behaves as if it were composed of particles rather than having a wavelike nature. What is the name given to light "particles"?

155. What important ability or property does electromagnetic radiation have that other energy transport processes, such as conduction and convection, do not?

156. How can the energy budget at the earth's surface be in balance when the ground loses more energy than it receives from the sun? (refer to the figure below)



157. Which of the processes listed below transports the most conduction energy from the earth to the atmosphere? Which process convection transports the least amount of energy? What important radiation process is missing from the list?

conduction
convection
radiation

158. What is the name given to the stream of charged particles that travels outward from the sun?

159. A faint glow known as the _____ can be seen at high latitudes when charged particles from the sun collide with atmospheric gases causing them to emit visible light.

160. The line drawn at 23.5° S latitude on maps and globes is called the _____.

161. The fur of a polar bear is a(n) _____ absorber of visible light.

162. In the discussion of the earth's annual energy balance we saw that the earth absorbed approximately 51 units of solar energy but emitted 117 units of infrared energy. What prevents the earth from getting colder and colder?
163. Will a rising parcel of air always expand? Why? Does this expansion cause the air temperature to increase or decrease? Why?
164. Describe and give examples of the various ways that heat can be transported in the atmosphere.
165. Explain how energy in the form of sunlight absorbed at the ground could be transferred upward in the atmosphere in the form of latent heat. How or when is the latent heat energy released in the air above the ground?

166. What is meant by the term "positive feedback"? What role could positive feedback play in the atmospheric greenhouse effect? Would this enhance or reduce global warming? Can you think of any "negative feedback" mechanisms?
167. The moon is located at about the same distance from the sun as the earth. How would you expect surface temperatures on the moon to compare with the earth? (you can assume that the moon has the same average albedo as the earth)
168. Describe the atmospheric greenhouse effect. Is there any difference between the way the atmospheric greenhouse effect works on a clear night and on a cloudy night?
169. Several of the planets in our solar system are further from the sun and cooler than the earth. Do they emit electromagnetic radiation? Why are we able to see the planets in the sky at night?

170. How could increased cloud cover cause an increase in the average surface temperature? How could increased cloudiness cause a decrease in average surface temperatures?
171. When you remove a cold beverage from a refrigerator in a humid room, water vapor will condense on the sides of the container. Would this act to warm or cool the beverage, or would the condensation have no effect on the beverage's temperature?
172. Imagine that the temperature of the sun were to change. Describe or discuss some of the effects that this might have on the earth's energy budget and the earth's climate. How might it affect the weather where you live?
173. Describe the seasons that you would experience at two widely different points on the earth. How do you think seasonal changes can influence a region's culture and traditions?

174. Many automobile engines are cooled by water which flows in a closed circuit through the engine block and the car's radiator. How many different heat transport processes do you find in operation here?

175. Many people will blow on a bowl of hot soup to try to cool it. In your view, what are the two most important heat transport processes cooling the soup?

176. What are the other factors, besides increasing CO₂ concentrations, that affect global warming?

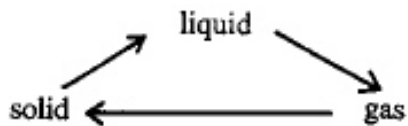
Chapter 2--Warming the Earth and the Atmosphere **Key**

- Which of the following provides a measure of the average speed of air molecules?
A. pressure
B. temperature
C. density
D. heat
- 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
- Which of the following is not considered a temperature scale?
A. Fahrenheit
B. Kelvin
C. Calorie
D. Celsius
- The temperature scale where 0° represents the freezing point and 100° the boiling point of water.
A. Fahrenheit
B. Celsius
C. Kelvin
D. absolute
- If the temperature of the air is said to be at absolute zero, one might conclude that
A. the motion of the molecules is at a maximum.
B. the molecules are occupying a large volume.
C. the molecules contain a minimum amount of energy.
D. the temperature is 0° F.
E. the air temperature is 0° C.
- The temperature scale that sets freezing of pure water at 32° .
A. Kelvin
B. Fahrenheit
C. Celsius
D. British
- Room temperature is about 300 degrees on the ____ temperature scale.
A. Fahrenheit
B. British
C. Celsius
D. Kelvin

8. Energy of motion is also known as
- A. dynamic energy.
 - B.** kinetic energy.
 - C. sensible heat energy.
 - D. static energy.
 - E. latent heat energy.
9. The transfer of heat by molecule-to-molecule contact is
- A.** conduction.
 - B. convection.
 - C. radiation.
 - D. ultrasonic.
10. Which of the following is the poorest conductor of heat?
- A.** still air
 - B. water
 - C. ice
 - D. snow
 - E. soil
11. Heat is energy in the process of being transferred from
- A.** hot objects to cold objects.
 - B. low pressure to high pressure.
 - C. cold objects to hot objects.
 - D. high pressure to low pressure.
 - E. regions of low density toward regions of high density.
12. The horizontal transport of any atmospheric property by the wind is called
- A.** advection.
 - B. radiation.
 - C. conduction.
 - D. latent heat.
 - E. reflection.
13. Heat transferred upward from the surface of the *moon* can take place by
- A. convection.
 - B. conduction.
 - C. latent heat.
 - D.** radiation.
14. Which of the following is *not* a heat-transport process in the atmosphere?
- A. conduction
 - B. radiation
 - C.** convergence
 - D. convection
15. A heat transfer process in the atmosphere that depends upon the movement of air is
- A. conduction.
 - B. reflection.
 - C.** convection.
 - D. radiation.

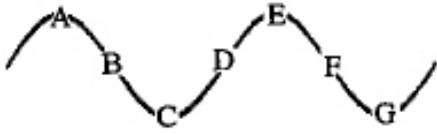
16. Snow will usually *melt* on the roof of a home that is a
- A. good radiator of heat.
 - B.** good conductor of heat.
 - C. poor radiator of heat.
 - D. poor conductor of heat.
17. The heat energy released when water vapor changes to a liquid is called
- A. latent heat of evaporation.
 - B. latent heat of fusion.
 - C. latent heat of fission.
 - D.** latent heat of condensation.
18. When water changes from a liquid to a vapor, we call this process
- A. freezing.
 - B. condensation.
 - C. sublimation.
 - D. deposition.
 - E.** evaporation.
19. This is released as sensible heat during the formation of clouds.
- A. potential energy
 - B. longwave radiation
 - C.** latent heat
 - D. kinetic energy
20. 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 transport.
21. This process causes rising air to cool.
- A.** expansion
 - B. evaporation
 - C. compression
 - D. condensation
22. The cold feeling that you experience after leaving a swimming pool on a hot, dry, summer day is
- A. heat transport by conduction.
 - B. heat transport by convection.
 - C. heat transport by radiation.
 - D.** heat transport by latent heat.

23. ____ of the phase changes shown below release(s) energy to the surroundings.



- A. none
 - B.** one
 - C. two
 - D. all
24. The temperature of a rising air parcel
- A.** always cools due to expansion.
 - B. always warms due to expansion.
 - C. always cools due to compression.
 - D. always warms due to compression.
 - E. remains constant.
25. Sinking air warms by this process.
- A.** compression
 - B. expansion
 - C. condensation
 - D. friction
26. Energy transferred by electromagnetic waves is called
- A. magnetism.
 - B. convection.
 - C. conduction.
 - D.** radiation.
27. Micrometers (mm) are units of
- A. intensity.
 - B.** distance.
 - C. frequency.
 - D. speed.
28. The proper order from shortest to longest wavelength is
- A. visible, infrared, ultraviolet.
 - B. infrared, visible, ultraviolet.
 - C.** ultraviolet, visible, infrared.
 - D. visible, ultraviolet, infrared.
 - E. ultraviolet, infrared, visible.
29. Which of the following has a wavelength shorter than that of violet light?
- A. green light
 - B. blue light
 - C. infrared radiation
 - D. red light
 - E.** ultraviolet radiation

30. Points A and C are ____ wavelength apart.



- A. 1
B. 1/2
C. 1/3
D. 1/4
31. One micrometer is a unit of length equal to
- A. one million meters.
B. one millionth of a meter.
C. one tenth of a millimeter.
D. one thousandth of a meter.
32. Electromagnetic radiation with wavelengths between 0.4 and 0.7 micrometers is called
- A. ultraviolet light.
B. visible light.
C. infrared light.
D. microwaves.
33. Solar radiation reaches the earth's surface as
- A. visible radiation only.
B. ultraviolet radiation only.
C. infrared radiation only.
D. visible and infrared radiation only.
E. ultraviolet, visible, and infrared radiation.
34. Which of the following is *not* found in the infrared (IR) portion of the electromagnetic spectrum?
- A.** 0.4 to 0.7 mm interval
B. the atmospheric window
C. selective absorption by water vapor (H₂O) and carbon dioxide (CO₂)
D. peak emission from the earth
35. The earth's radiation is often referred to as ____ radiation, while the sun's radiation is often referred to as ____ radiation.
- A. shortwave, longwave
B. shortwave, shortwave
C. longwave, shortwave
D. longwave, longwave
36. 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
E. 0.3 micrometers, 50 micrometers

37. The earth emits radiation with greatest intensity at
A. infrared wavelengths.
B. radio wavelengths.
C. visible wavelengths.
D. ultraviolet wavelengths.
38. When we see the moon at night, we are seeing
A. visible light emitted by the moon.
B. infrared light emitted by the moon.
C. visible light reflected by the moon.
D. infrared light reflected by the moon.
39. Most of the radiation emitted by a human body is in the form of
A. ultraviolet radiation and is invisible.
B. visible radiation but is too weak to be visible.
C. infrared radiation and is invisible.
D. humans do not emit electromagnetic radiation.
40. The sun emits its greatest intensity of radiation in
A. the visible portion of the spectrum.
B. the infrared portion of the spectrum.
C. the ultraviolet portion of the spectrum.
D. the x-ray portion of the spectrum.
41. Which of the following has the highest energy and is potentially the most dangerous kind of radiation?
A. UVA radiation
B. UVB radiation
C. UVC radiation
D. IR radiation
42. About 90% of all skin cancers are linked to exposure to
A. UVA radiation.
B. UVB radiation.
C. UVC radiation.
D. IR radiation.
43. If a careful series of measurements reveals that the wavelength of peak emission from the sun (λ_{max}) is slowly increasing (shifting to longer wavelength), you might conclude that the sun is getting
A. hotter.
B. bigger.
C. colder.
D. closer.
44. If the average temperature of the sun increased, the wavelength of peak solar emission would
A. shift to a shorter wavelength.
B. shift to a longer wavelength.
C. remain the same.
D. impossible to tell from given information

45. Which of the following determine the kind (wavelength) and amount of radiation that an object emits?
- A. temperature
 - B. thermal conductivity
 - C. density
 - D. latent heat
46. At which temperature would the earth be radiating energy at the greatest rate or intensity?
- A. -5° F
 - B. -40° F
 - C. 60° F
 - D. 32° F
 - E. 105° F
47. This question number was omitted in the printed copy of the test bank. To maintain the integrity of the numbering system between the printed copy and ExamView, this question has been marked "do not use on test" in ExamView's question information dialog.
- A. not available
 - B. not available
 - C. not available
 - D. not available
 - E. all of these
48. The rate at which radiant energy is emitted by a body
- A. increases with increasing temperature.
 - B. increases with decreasing temperature.
 - C. does not depend on the temperature.
 - D. depends on the chemical composition of the body.
49. This property of electromagnetic radiation is inversely proportional to temperature; if temperature increases ____ will decrease.
- A. propagation speed
 - B. intensity
 - C. rate of emission
 - D. wavelength of peak emission
50. The earth's atmospheric window is in the
- A. ultraviolet region.
 - B. visible region.
 - C. infrared region.
 - D. polar regions.
51. Which of the following is known primarily as a selective absorber of *ultraviolet* radiation?
- A. carbon dioxide
 - B. ozone
 - C. water vapor
 - D. clouds

52. Which of the following statements is *not* correct?
- A. calm, cloudy nights are usually warmer than calm, clear nights
 - B. each year the earth's surface radiates away more energy than it receives from the sun
 - C. the horizontal transport of heat by the wind is called advection
 - D.** good absorbers of radiation are usually poor emitters of radiation
53. The atmospheric greenhouse effect is due primarily to the fact that
- A. oxygen and ozone absorb ultraviolet radiation.
 - B. nitrogen and oxygen transmit visible radiation.
 - C. cloud formation releases latent heat energy.
 - D.** carbon dioxide and water vapor absorb infrared radiation.
54. 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.
55. 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.
56. Imagine going outside at night with an instrument that can detect infrared (IR) radiation. Which of the following would you expect to observe?
- A. IR radiation traveling upward from the ground only
 - B. IR radiation propagating downward from the sky only
 - C.** IR radiation coming from both the ground and the sky
 - D. no IR radiation would be detected at night
57. Which of the following gases are mainly responsible for the atmospheric greenhouse effect in the earth's atmosphere?
- A. oxygen and nitrogen
 - B. nitrogen and carbon dioxide
 - C. ozone and oxygen
 - D.** water vapor and carbon dioxide
58. Clouds ____ infrared radiation and ____ visible radiation.
- A. absorb, absorb
 - B.** absorb, reflect
 - C. reflect, reflect
 - D. reflect, absorb
59. At night, low clouds
- A.** enhance the atmospheric greenhouse effect.
 - B. weaken the atmospheric greenhouse effect.
 - C. are often caused by the atmospheric greenhouse effect.
 - D. have no effect on the atmospheric greenhouse effect.

60. Suppose last night was clear and calm. Tonight low clouds will be present. From this you would conclude that tonight's minimum temperature will be
- A. higher than last night's minimum temperature.
 - B. lower than last night's minimum temperature.
 - C. the same as last night's minimum temperature.
 - D. above freezing.
61. Of the gases listed below, which is *not* believed to be responsible for enhancing the earth's greenhouse effect?
- A. chlorofluorocarbons (CFCs)
 - B. molecular oxygen (O_2)
 - C. nitrous oxide (N_2O)
 - D. carbon dioxide (CO_2)
 - E. methane (CH_4)
62. Low clouds retard surface cooling at night better than clear skies because
- A. the clouds absorb and radiate infrared energy back to earth.
 - B. the water droplets in the clouds reflect infrared energy back to earth.
 - C. the clouds start convection currents between them.
 - D. the clouds are better conductors of heat than is the clear night air.
 - E. the formation of the clouds releases latent heat energy.
63. If the present concentration of CO_2 doubles by the end of the 21st century, climate models predict that for the earth's average temperature to rise $2.5^\circ C$, what gas *must* also increase in concentration?
- A. nitrogen
 - B. oxygen
 - C. methane
 - D. water vapor
64. The combined albedo of the earth and the atmosphere is approximately
- A. 4 percent.
 - B. 10 percent.
 - C. 30 percent.
 - D. 50 percent.
 - E. 90 percent.
65. 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
66. The albedo of the moon is 7%. This means that
- A. 7% of the sunlight striking the moon is reflected.
 - B. 7% of the sunlight striking the moon is absorbed.
 - C. the moon emits only 7% as much energy as it absorbs from the sun.
 - D. 93% of the sunlight striking the moon is reflected.

67. Which of the following is an *incorrect* identification?
- A. albedo - percent of radiation reflected from a surface
 - B. kinetic energy - energy of motion
 - C.** black body - selective absorber
 - D. long-wave radiation - earth radiation
68. Which of the following has the highest albedo?
- A.** snow
 - B. sand
 - C. forests
 - D. water
 - E. grass
69. An increase in albedo would be accompanied by ____ in radiative equilibrium temperature.
- A. an increase
 - B.** a decrease
 - C. no change
 - D. unstable oscillations
70. On the average, about what percentage of the solar energy that strikes the outer atmosphere eventually reaches the earth's surface?
- A. 5%
 - B. 15%
 - C. 30%
 - D.** 50%
 - E. 70%
71. About 50% of the sunlight reaching the top of the atmosphere is
- A. absorbed by ozone in the stratosphere.
 - B. reflected or scattered by air molecules and clouds.
 - C.** absorbed at the ground.
 - D. absorbed by greenhouse gases.
72. The major process that warms the lower *atmosphere* is
- A. the release of latent heat during condensation.
 - B. conduction of heat upward from the surface.
 - C. convection.
 - D.** absorption of infrared radiation.
 - E. direct absorption of sunlight by the atmosphere.
73. If the sun suddenly began emitting more energy, the earth's radiative equilibrium temperature would
- A.** increase.
 - B. decrease.
 - C. remain the same.
 - D. begin to oscillate.

74. If the amount of energy lost by the earth to space each year were not approximately equal to that received,
- A. the atmosphere's average temperature would change.
 - B. the length of the year would change.
 - C. the sun's output would change.
 - D. the mass of the atmosphere would change.
75. Sunlight that bounces off a surface is said to be ____ from the surface.
- A. radiated
 - B. absorbed
 - C. emitted
 - D. reflected
76. The earth's surface
- A. radiates more energy than it receives from the sun.
 - B. radiates less energy than it receives from the sun.
 - C. radiates the same amount of energy that it receives from the sun.
 - D. does not radiate any energy.
77. The atmosphere near the earth's surface is "heated from below." Which of the following contributes the smallest amount of energy?
- 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
78. An object is absorbing 3 units of visible light, has a temperature of 300 K, and is in radiative equilibrium. Which of the following is true?
- A. the object is not emitting any radiation
 - B. the object is emitting 3 units of visible radiation
 - C. the object is emitting 3 units of infrared radiation
 - D. the object is reflecting 3 units of visible radiation
79. 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.
80. Which of the following processes transports, on average, the most energy from the ground to the atmosphere?
- A. convection
 - B. conduction
 - C. radiation
 - D. latent heat
81. Which of the following is true when the earth is in radiative equilibrium?
- A. the earth absorbs 100% of the sunlight reaching it
 - B. the earth does not emit any radiant energy into space
 - C. the earth does not reflect any of the radiation reaching it
 - D. the earth gains and loses energy at equal rates

82. The earth's radiative equilibrium temperature is
- A. the temperature at which the earth is absorbing solar radiation and emitting infrared radiation at equal rates.
 - B. the temperature at which the earth is radiating energy at maximum intensity.
 - C. the average temperature the earth must maintain to prevent the oceans from freezing solid.
 - D. the temperature at which rates of evaporation and condensation on the earth are in balance.
83. In the earth's upper atmosphere, visible light given off by excited atoms and molecules produces
- A. flares.
 - B. the solar wind.
 - C. the aurora.
 - D. prominences.
84. Charged particles from the sun that travel through space at high speeds are called
- A. radiation.
 - B. the aurora.
 - C. solar wind.
 - D. solar flares.
85. Incoming solar radiation in middle latitudes is less in winter than in summer because
- A. the sun's rays slant more and spread their energy over a larger area.
 - B. there is a decrease in carbon dioxide levels in the atmosphere.
 - C. the cold dense air lowers the intensity of the sun's rays.
 - D. the earth is furthest from the sun.
86. The earth is closest to the sun in
- A. January
 - B. March
 - C. July
 - D. September
87. During an equinox
- A. the days and nights are of equal length except at the poles.
 - B. at noon the sun is overhead at the equator.
 - C. the earth is not tilted toward nor away from the sun.
 - D. all of these.
88. On a clear day, the sun's rays are most intense at
- A. 10 am
 - B. 12 pm (noon)
 - C. 2 pm
 - D. 4 pm
89. The main reason for warm summers in middle latitudes is that
- A. the earth is closer to the sun in summer.
 - B. the sun is higher in the sky and we receive more direct solar radiation.
 - C. oceans currents transport heat from the tropics to middle latitudes.
 - D. growing plants enhance the greenhouse effect.

90. Which of the following is one of the main causes of the seasons?
- A. the changing distance between the earth and the sun
 - B. a periodic reversal in global scale air circulation patterns
 - C.** the length of the daylight hours
 - D. land/ocean temperature contrasts
91. In the Northern Hemisphere, this day has the fewest hours of daylight.
- A. summer solstice
 - B.** winter solstice
 - C. vernal equinox
 - D. autumnal equinox
92. Indian Summer would most likely occur during the month of
- A.** October.
 - B. December.
 - C. June.
 - D. August.
93. Which of the following is correct at the time of the summer solstice in June?
- A. it marks the beginning of astronomical summer in the Northern Hemisphere
 - B. it occurs around June 22
 - C. the noon sun is overhead at the Tropic of Cancer
 - D.** all of these
94. Where are the days and nights of equal length all year long?
- A. at 66.5° latitude
 - B. nowhere
 - C. at 23.5° latitude
 - D.** at the Equator
95. Which of the following best describes the weather conditions necessary to bring Indian Summer weather to the eastern half of the United States?
- A. a cold front moving off the New Jersey coast
 - B. a strong slow-moving low pressure area just east of Virginia
 - C.** a strong slow-moving high pressure area off the southeast coast
 - D. a strong fast-moving low pressure area over Georgia
 - E. a cold front that stretches from South Carolina to Texas
96. During the summer in the Northern Hemisphere, the "land of the midnight sun" would be found
- A.** at high latitudes.
 - B. at middle latitudes.
 - C. near the equator.
 - D. in the Southern Hemisphere.
97. During the course of a year the sun will disappear from view at the *North Pole* on or about what date?
- A. June 21
 - B.** September 23
 - C. December 23
 - D. January 1
 - E. March 21

98. The first day of spring occurs on or about March 21; March 21 is called the
- A. vernal solstice
 - B.** equinox
 - C. aphelion
 - D. perihelion
99. At the time of the winter solstice in the Northern Hemisphere
- A. astronomical winter begins in the Northern Hemisphere.
 - B. the noon sun is over latitude 23.5° S.
 - C. at middle latitudes in the Northern Hemisphere, this marks the longest night of the year.
 - D.** all of these.
100. Which of the following helps to explain why even though northern latitudes experience 24 hours of sunlight on June 22, they are not warmer than latitudes further south?
- A. solar energy is spread over a larger area in northern latitudes
 - B. some of the sun's energy is reflected by snow and ice in the northern latitudes
 - C. increased cloud cover reflects solar energy in the northern latitudes
 - D. solar energy is used to melt frozen soil in the northern latitudes
 - E.** all of these
101. The sun is directly overhead at Mexico City (latitude 19° N)
- A. once a year.
 - B.** twice a year.
 - C. four times a year.
 - D. never.
102. Which of the latitudes below would experience the fewest hours of daylight on December 22?
- A. 60° S
 - B. 20° S
 - C. Equator
 - D. 20° N
 - E.** 60° N
103. On what day would you expect the sun to be overhead at Lima, Peru (latitude 12° S)?
- A. August 15
 - B.** February 4
 - C. March 10
 - D. April 21
104. In the middle latitudes of the Northern Hemisphere on June 22, the sun
- A. rises in the east and sets in the west.
 - B. rises in the southeast and sets in the southwest.
 - C.** rises in the northeast and sets in the northwest.
 - D. rises in the north east and sets in the southwest.
 - E. rises in the southeast and sets in the northwest.

105. The astronomical beginning of spring occurs around this date in the Northern Hemisphere.
- A. March 1
 - B. April 1
 - C. March 21**
 - D. March 15
 - E. April 15
106. Between Christmas and New Year's, at middle latitudes in the Northern Hemisphere, the length of the day
- A. increases.**
 - B. decreases.
 - C. does not change.
 - D. is 12 hours long.
107. On which date would the sun's rays be closest to being perpendicular to the earth's surface in the middle latitudes of the Northern Hemisphere?
- A. March 21
 - B. June 21**
 - C. July 1
 - D. July 21
 - E. August 1
108. The sun will pass directly overhead at noon in Miami, Florida (latitude 26° N)
- A. once a year.
 - B. twice a year.
 - C. four times a year.
 - D. never.**
109. When it is January and winter in the Northern Hemisphere, it is ____ and ____ in the Southern Hemisphere.
- A. January and summer**
 - B. January and winter
 - C. July and winter
 - D. July and summer
110. At middle latitudes in the Northern Hemisphere, we can expect the day with the longest number of daylight hours to occur on or about
- A. June 22.**
 - B. December 22.
 - C. September 23.
 - D. July 4.
 - E. August 1.
111. At middle latitudes in the Northern Hemisphere, we can expect the day with the shortest number of daylight hours to occur around
- A. June 22.
 - B. December 22.**
 - C. September 23.
 - D. January 1.
 - E. February 15.

112. At the North Pole the sun will rise above the horizon on ____ and set below the horizon on ____.
- A. June 22, September 23
 - B. September 23, December 22
 - C.** March 21, September 23
 - D. June 22, December 22
 - E. March 21, December 22
113. In July, at middle latitudes in the Northern Hemisphere, the day is ____ long and is ____ with each passing day.
- A. less than 12 hours, getting longer
 - B. less than 12 hours, getting shorter
 - C. more than 12 hours, getting longer
 - D.** more than 12 hours, getting shorter
114. At noon on June 22, the sun will be directly overhead at
- A. the Arctic circle.
 - B. the Equator.
 - C.** the Tropic of Cancer.
 - D. the North Pole.
115. The sun will be directly overhead at noon at the equator
- A. never
 - B.** on March 21
 - C. on June 21
 - D. always
116. For maximum winter warmth, in the Northern Hemisphere, large windows in a house should face
- A. north.
 - B.** south.
 - C. east.
 - D. west.
117. Although the polar regions radiate away more heat energy than they receive by insolation in the course of a year, they are prevented from becoming progressively colder each year by the
- A. conduction of heat through the interior of the earth.
 - B. concentration of earth's magnetic field lines at the poles.
 - C.** circulation of heat by the atmosphere and oceans.
 - D. the insulating properties of snow.
 - E. release of latent heat to the atmosphere when polar ice melts.
118. The most important reason why summers in the Southern Hemisphere are not warmer than summers in the Northern Hemisphere is that
- A. the earth is closer to the sun in January.
 - B. the earth is farther from the sun in July.
 - C.** over 80% of the Southern Hemisphere is covered with water.
 - D. the sun's energy is less intense in the Southern Hemisphere.

119. The north-facing side of a hill in a mountainous region tends to
- A. receive less sunlight during a year than the south-facing side.
 - B. grow a variety of trees that are typically observed at higher elevation.
 - C. be a better location for a ski run than the south-facing side.
 - D. have snow on the ground for a longer period of time in winter compared to the south-facing side.
 - E.** all of these.
120. In meteorology, the word insolation refers to
- A. a well-constructed, energy-efficient home.
 - B. the solar constant.
 - C.** incoming solar radiation.
 - D. an increase in solar output.
121. Suppose you drive to and from work on a street that runs east to west. On what day would you most likely have the sun shining directly in your eyes while driving to and from work?
- A. summer solstice
 - B. winter solstice
 - C.** autumnal equinox
 - D. any day at noon
122. In most of the world, temperature readings are taken in Kelvins (degrees Kelvin).
- FALSE**
123. The Celsius temperature scale contains only positive values.
- FALSE**
124. As you heat air you would expect its density to decrease.
- TRUE**
125. The formation of frost (deposition) releases heat and warms the surroundings.
- TRUE**
126. Microwave radiation has a longer wavelength and is a more energetic form of radiation than visible light.
- FALSE**
127. Virtually all the UV-C radiation, which is more harmful than UV-A or UV-B, is absorbed by ozone in the stratosphere.
- TRUE**
128. The atmosphere is essentially completely transparent to electromagnetic radiation.
- FALSE**
129. If our eyes responded to infrared radiation instead of visible light, clouds would appear black because they are good absorbers of IR.
- TRUE**

130. Because air molecules are so small, compared to the wavelength of light, air does not scatter or absorb incoming sunlight.

FALSE

131. Satellite data from the *Earth Radiation Budget Experiment (ERBE)* indicate that the overall effect of clouds is to cool the earth's climate.

TRUE

132. The earth's surface receives nearly twice as much longwave IR energy from the atmosphere as it does shortwave radiation from the sun.

TRUE

133. The Southern Hemisphere has warmer summers and colder winters than the Northern Hemisphere.

FALSE

134. On a hot day, you are likely to stay cooler if you wear a white shirt.

TRUE

135. **INSTRUCTIONS:** Choose one answer from each pair or group of selections.

If you could somehow see the random motions of the atoms and molecules in air, would they all be moving at the SAME or at DIFFERENT speeds?

DIFFERENT

136. **INSTRUCTIONS:** Choose one answer from each pair or group of selections.

50° C is WARMER than, COLDER than, EQUAL to 100° F.

WARMER

137. **INSTRUCTIONS:** Choose one answer from each pair or group of selections.

Is the energy transport in the figure below UPWARD, DOWNWARD, or ZERO?



UPWARD

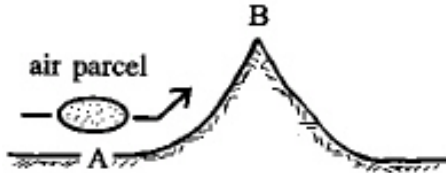
138. **INSTRUCTIONS:** Choose one answer from each pair or group of selections.

About 44% of the energy emitted by the sun is visible light. Most of the remaining radiation falls in the INFRARED ULTRAVIOLET portion of the spectrum.

INFRARED

139. **INSTRUCTIONS:** Choose one answer from each pair or group of selections.

As the air in the picture below moves from A to B will its volume INCREASE, DECREASE, or remain the SAME? Will its temperature INCREASE, DECREASE, or remain the SAME?



INCREASE, DECREASE

140. **INSTRUCTIONS:** Choose one answer from each pair or group of selections.

If the earth's average surface temperature were to increase, the amount of radiation emitted from the earth's surface would INCREASE DECREASE and the wavelength of peak emission would shift toward LONGER SHORTER wavelengths.

INCREASE, SHORTER

141. **INSTRUCTIONS:** Choose one answer from each pair or group of selections.

A "window" is a wavelength region where the atmosphere TRANSMITS ABSORBS EMITS radiant energy.

TRANSMITS

142. **INSTRUCTIONS:** Choose one answer from each pair or group of selections.

Overcast skies usually result in WARMER COOLER daytime temperatures because clouds are good REFLECTORS ABSORBERS of VISIBLE INFRARED light.

COOLER, REFLECTORS, VISIBLE

143. **INSTRUCTIONS:** Choose one answer from each pair or group of selections.

Generally speaking, to see the aurora you must be located at high ALTITUDE LATITUDE.

LATITUDE

144. **INSTRUCTIONS:** Choose one answer from each pair or group of selections.

Compared to Phoenix (30° N latitude), Minneapolis (45° N) will have LONGER SHORTER days in the winter and LONGER SHORTER days in the summer.

SHORTER, LONGER

145. **INSTRUCTIONS:** Choose one answer from each pair or group of selections.

In a positive water vapor-temperature feedback process, warming will result in INCREASED DECREASED atmospheric water vapor concentrations which will STRENGTHEN WEAKEN the greenhouse effect.

INCREASED, STRENGTHEN

146. **INSTRUCTIONS:** Choose one answer from each pair or group of selections.

High latitudes lose MORE, LESS, the SAME amount of energy to space as(than) they receive from the sun.

MORE

147. **INSTRUCTIONS:** Choose one answer from each pair or group of selections.

The earth ALWAYS SOMETIMES receives solar radiation and ALWAYS SOMETIMES emits infrared radiation

SOMETIMES, ALWAYS

148. _____ provides a measure of the average speed or kinetic energy of the atoms or molecules in air.

TEMPERATURE

149. Fill in the blanks below using one of the choices at right. (choices at right may be used more than once or not at all).

- a. boiling point of water (sea level) _____
- b. hottest temperature _____
- c. coldest temperature _____
- d. melting point of ice _____

0° F 0° C
100° F 100° C

a. 100°C, b. 100°C, c. 0°F, d. 0°C

150. Warm rising air has formed a cloud in the figure below. This illustrates which two energy transport processes?



CONVECTION and LATENT HEAT ENERGY TRANSPORT

151. Ocean currents transport energy in the form of warm ocean water from the tropical oceans to higher latitudes. This is an example of which energy transport process?

CONVECTION or ADVECTION

152. One _____ of energy is needed to raise the temperature of 1 gram of water 1° C.

CALORIE

153. _____ originates from rapidly vibrating electrons which exist in every object.

ELECTROMAGNETIC RADIATION

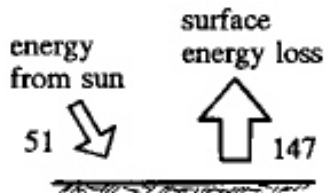
154. In some situations light behaves as if it were composed of particles rather than having a wavelike nature. What is the name given to light "particles"?

PHOTONS

155. What important ability or property does electromagnetic radiation have that other energy transport processes, such as conduction and convection, do not?

Radiation can propagate through empty space.

156. How can the energy budget at the earth's surface be in balance when the ground loses more energy than it receives from the sun? (refer to the figure below)



Some of the radiation emitted by the earth is absorbed by the atmosphere. The atmosphere then radiates a portion of this energy back to the ground.

157. Which of the processes listed below transports the most conduction energy from the earth to the atmosphere? Which process convection transports the least amount of energy? What important radiation process is missing from the list?

conduction
convection
radiation

most - RADIATION, least - CONDUCTION, missing - LATENT HEAT

158. What is the name given to the stream of charged particles that travels outward from the sun?

SOLAR WIND

159. A faint glow known as the _____ can be seen at high latitudes when charged particles from the sun collide with atmospheric gases causing them to emit visible light.

AURORA

160. The line drawn at 23.5° S latitude on maps and globes is called the _____.

TROPIC OF CAPRICORN

161. The fur of a polar bear is a(n) _____ absorber of visible light.

POOR

162. In the discussion of the earth's annual energy balance we saw that the earth absorbed approximately 51 units of solar energy but emitted 117 units of infrared energy. What prevents the earth from getting colder and colder?

Answer not provided.

163. Will a rising parcel of air always expand? Why? Does this expansion cause the air temperature to increase or decrease? Why?

Answer not provided.

164. Describe and give examples of the various ways that heat can be transported in the atmosphere.

Answer not provided.

165. Explain how energy in the form of sunlight absorbed at the ground could be transferred upward in the atmosphere in the form of latent heat. How or when is the latent heat energy released in the air above the ground?

Answer not provided.

166. What is meant by the term "positive feedback"? What role could positive feedback play in the atmospheric greenhouse effect? Would this enhance or reduce global warming? Can you think of any "negative feedback" mechanisms?

Answer not provided.

167. The moon is located at about the same distance from the sun as the earth. How would you expect surface temperatures on the moon to compare with the earth? (you can assume that the moon has the same average albedo as the earth)

Answer not provided.

168. Describe the atmospheric greenhouse effect. Is there any difference between the way the atmospheric greenhouse effect works on a clear night and on a cloudy night?

Answer not provided.

169. Several of the planets in our solar system are further from the sun and cooler than the earth. Do they emit electromagnetic radiation? Why are we able to see the planets in the sky at night?

Answer not provided.

170. How could increased cloud cover cause an increase in the average surface temperature? How could increased cloudiness cause a decrease in average surface temperatures?

Answer not provided.

171. When you remove a cold beverage from a refrigerator in a humid room, water vapor will condense on the sides of the container. Would this act to warm or cool the beverage, or would the condensation have no effect on the beverage's temperature?

Answer not provided.

172. Imagine that the temperature of the sun were to change. Describe or discuss some of the effects that this might have on the earth's energy budget and the earth's climate. How might it affect the weather where you live?

Answer not provided.

173. Describe the seasons that you would experience at two widely different points on the earth. How do you think seasonal changes can influence a region's culture and traditions?

Answer not provided.

174. Many automobile engines are cooled by water which flows in a closed circuit through the engine block and the car's radiator. How many different heat transport processes do you find in operation here?

Answer not provided.

175. Many people will blow on a bowl of hot soup to try to cool it. In your view, what are the two most important heat transport processes cooling the soup?

Answer not provided.

176. What are the other factors, besides increasing CO₂ concentrations, that affect global warming?

Answer not provided.