

# Multiple Choice Exam Questions

## Chapter 1

1. 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

ANSWER: b

2. The most abundant gases in the earth's atmosphere by volume are:

- a. carbon dioxide and nitrogen
- b. oxygen and water vapor
- c. nitrogen and oxygen
- d. oxygen and helium
- e. oxygen and ozone

ANSWER: c

4. Water vapor is:

- a. a gas
- b. a cloud droplet
- c. a rain drop
- d. a snowflake

ANSWER: a

7. Which of the following is considered a variable gas in the earth's atmosphere?

- a. water vapor
- b. nitrogen
- c. oxygen
- d. argon

ANSWER: a

8. The gas that shows the most variation from place to place and from time to time in the lower atmosphere:

- a. ozone ( $O_3$ )
- b. carbon dioxide ( $CO_2$ )
- c. water vapor ( $H_2O$ )
- d. methane ( $CH_4$ )
- e. argon (Ar)

ANSWER: c

12. In the atmosphere, tiny solid or liquid suspended particles of various composition are called:

- a. aerosols
- b. carcinogens
- c. greenhouse gases
- d. microbes

ANSWER: a

13. The most abundant greenhouse gas in the earth's atmosphere:

- a. carbon dioxide (CO<sub>2</sub>)
- b. nitrous oxide (N<sub>2</sub>O)
- c. water vapor (H<sub>2</sub>O)
- d. methane (CH<sub>4</sub>)
- e. chlorofluorocarbons (CFCs)

ANSWER: c

17. Which of the following processes acts to remove carbon dioxide from the atmosphere?

- a. lightning
- b. deforestation
- c. photosynthesis
- d. burning fossil fuels

ANSWER: c

19. The earth's first atmosphere was composed primarily of:

- a. carbon dioxide and water vapor
- b. hydrogen and helium
- c. oxygen and water vapor
- d. argon and nitrogen

ANSWER: b

21. The most abundant gas emitted from volcanoes is:

- a. nitrogen
- b. sulfur dioxide
- c. helium
- d. carbon dioxide
- e. water vapor

ANSWER: e

23. This holds a planet's atmosphere close to its surface:

- a. radiation
- b. gravity
- c. cloud cover
- d. moisture
- e. pressure

ANSWER: b

24. The amount of force exerted over an area of surface is called:

- a. density
- b. weight
- c. temperature
- d. pressure

ANSWER: d

25. Much of Tibet lies at altitudes over 18,000 feet where the pressure is about 500 mb. At such altitudes, the Tibetans are above roughly:

- a. 10% of the air molecules in the atmosphere
- b. 25% of the air molecules in the atmosphere
- c. 50% of the air molecules in the atmosphere
- d. 75% of the air molecules in the atmosphere

ANSWER: c

28. Which of the following weather elements always decreases as we climb upward in the atmosphere?

- a. wind
- b. temperature
- c. pressure
- d. moisture
- e. all of the above

ANSWER: c

32. The gas responsible for the greenhouse effect on Venus:

- a. carbon dioxide (CO<sub>2</sub>)
- b. oxygen (O<sub>2</sub>)
- c. ozone (O<sub>3</sub>)
- d. nitrogen (N<sub>2</sub>)
- e. water vapor (H<sub>2</sub>O)

ANSWER: a

33. The planet with a strong greenhouse effect, whose surface temperature averages 480 °C (900 °F):

- a. Earth
- b. Venus
- c. Mars
- d. Pluto

ANSWER: b

35. The earth's atmosphere is divided into layers based on the vertical profile of:

- a. air pressure
- b. air temperature
- c. air density
- d. wind speed

ANSWER: b

37. Almost all of the earth's weather occurs in the:

- a. exosphere
- b. stratosphere
- c. mesosphere
- d. thermosphere
- e. troposphere

ANSWER: e

39. The hottest atmospheric layer is the:

- a. stratosphere
- b. mesosphere
- c. thermosphere
- d. troposphere

ANSWER: c

41. The atmospheric layer in which we live is called the:

- a. troposphere
- b. stratosphere
- c. thermosphere
- d. ionosphere
- e. exosphere

ANSWER: a

43. The instrument that measures temperature, pressure, and humidity at various altitudes in the atmosphere:

- a. barograph
- b. radiosonde
- c. aneroid barometer
- d. altimeter

ANSWER: b

44. Warming in the stratosphere is mainly caused by:

- a. absorption of ultraviolet radiation by ozone
- b. release of latent heat energy during condensation
- c. chemical reactions between ozone and chlorofluorocarbons
- d. frictional heating caused by meteorites

ANSWER: a

45. In a temperature inversion:

- a. air temperature increases with increasing height
- b. air temperature decreases with increasing height
- c. air temperature remains constant with increasing height
- d. it is warmer at night than during the day

ANSWER: a

46. The rate at which temperature decreases with increasing altitude is known as the:

- a. temperature slope
- b. lapse rate
- c. sounding
- d. thermocline

ANSWER: b

49. The electrified region of the upper atmosphere is called the:

- a. thermosphere
- b. mesosphere
- c. stratosphere
- d. ionosphere
- e. troposphere

ANSWER: d

52. The gas that absorbs most of the harmful ultraviolet radiation in the stratosphere:

- a. water vapor
- b. nitrous oxide
- c. carbon dioxide
- d. ozone
- e. chlorofluorocarbons

ANSWER: d

55. Which latitude belt best describes the middle latitudes?

- a. 20° to 80°
- b. 10° to 35°
- c. 20° to 35°
- d. 40° to 70°
- e. 30° to 50°

ANSWER: e

58. The wind direction is:

- a. the direction from which the wind is blowing
- b. the direction to which the wind is blowing
- c. always directly from high toward low pressure
- d. always directly from low toward high pressure

ANSWER: a

77. In an average year, more people die from this than from any other natural disaster.

- a. lightning
- b. earthquakes
- c. tornadoes
- d. flash floods and flooding
- e. droughts

ANSWER: d

## Chapter 2

1. Which of the following provides a measure of the average speed of air molecules?

- a. pressure
- b. temperature
- c. density
- d. heat

ANSWER: b

3. Which of the following is not considered a temperature scale?

- a. Fahrenheit
- b. Kelvin
- c. Calorie
- d. Celsius

ANSWER: c

4. The temperature scale where 0° represents freezing and 100° boiling:

- a. Fahrenheit
- b. Celsius
- c. Kelvin
- d. absolute

ANSWER: b

5. The temperature scale that sets freezing of pure water at 32° F:

- a. Kelvin
- b. Fahrenheit
- c. Celsius
- d. British

ANSWER: b

9. 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

ANSWER: a

10. 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

ANSWER: d

11. The change of state of ice into water vapor is known as:

- a. deposition
- b. sublimation
- c. melting
- d. condensation
- e. crystallization

ANSWER: b

12. When water changes from a liquid to a vapor, we call this process:

- a. freezing
- b. condensation
- c. sublimation
- d. deposition
- e. evaporation

ANSWER: e

14. The cold feeling that you experience after leaving a swimming pool on a hot, dry, summer day represents heat transfer by:

- a. conduction
- b. convection
- c. radiation
- d. latent heat

ANSWER: d

16. 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

ANSWER: a

17. The transfer of heat by molecule-to-molecule contact:

- a. conduction
- b. convection
- c. radiation
- d. ultrasonic

ANSWER: a

18. Which of the following is the poorest conductor of heat?

- a. still air
- b. water
- c. ice
- d. snow
- e. soil

ANSWER: a

19. The horizontal transport of any atmospheric property by the wind is called:

- a. advection
- b. radiation
- c. conduction
- d. latent heat
- e. reflection

ANSWER: a

20. A heat transfer process in the atmosphere that depends upon the movement of air is:

- a. conduction
- b. absorption
- c. reflection
- d. convection
- e. radiation

ANSWER: d

23. Rising air cools by this process:

- a. expansion
- b. evaporation
- c. compression
- d. condensation

ANSWER: a

25. 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

ANSWER: c

26. Sinking air warms by this process:

- a. compression
- b. expansion

- c. condensation
- d. friction

ANSWER: a

27. Heat transferred outward from the surface of the moon can take place by:

- a. convection
- b. conduction
- c. latent heat
- d. radiation

ANSWER: d

29. 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

ANSWER: a

30. 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

ANSWER: e

31. Electromagnetic radiation with wavelengths between 0.4 and 0.7 micrometers is called:

- a. ultraviolet light
- b. visible light
- c. infrared light
- d. microwaves

ANSWER: b

33. 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

ANSWER: a

34. 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

ANSWER: a



35. Often before sunrise on a clear, calm, cold morning, ice (frost) can be seen on the tops of parked cars, even when the air temperature is above freezing. This condition happens because the tops of the cars are cooling by:

- a. conduction
- b. convection
- c. latent heat
- d. radiation

ANSWER: d

37. Evaporation is a \_\_\_\_\_ process.

- a. cooling
- b. heating
- c. can't tell - it depends on the temperature
- d. both a and c

ANSWER: a

38. If you want to keep an object cool while exposed to direct sunlight,

- a. put it inside a brown paper bag
- b. wrap it in black paper
- c. wrap it in aluminum foil with the shiny side facing inward
- d. wrap it in aluminum foil with the shiny side facing outward

ANSWER: d

39. 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

ANSWER: e

40. If the absolute temperature of an object doubles, the maximum energy emitted goes up by a factor of:

- a. 2
- b. 4
- c. 8
- d. 16
- e. 32

ANSWER: d

42. How much radiant energy will an object emit if its temperature is at absolute zero?

- 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

ANSWER: b

43. 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

ANSWER: c

45. 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

ANSWER: a

47. 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

ANSWER: c

50. The earth emits radiation with greatest intensity at:

- a. infrared wavelengths
- b. radio wavelengths
- c. visible wavelengths
- d. ultraviolet wavelengths

ANSWER: a

51. "A good absorber of a given wavelength of radiation is also a good emitter of that wavelength." This is a statement of:

- a. Stefan-Boltzmann's law
- b. Wien's Law
- c. Kirchoff's Law
- d. the First Law of Thermodynamics
- e. the Law of Relativity

ANSWER: c

54. 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

ANSWER: b

55. The earth's atmospheric window is in the:

- a. ultraviolet region
- b. visible region
- c. infrared region
- d. polar regions

ANSWER: c

56. 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

ANSWER: c

57. 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

ANSWER: a

59. 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

ANSWER: a

60. 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

ANSWER: a

61. 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

ANSWER: d

63. The combined albedo of the earth and the atmosphere is approximately:

- a. 4%
- b. 10%
- c. 30%
- d. 50%
- e. 90%

ANSWER: c

64. According to the Stefan-Boltzmann law, the radiative energy emitted by one square meter of an object is equal to a constant multiplied by its temperature raised to the \_\_\_\_\_ power.

- a. negative third
- b. zeroeth
- c. fourth
- d. tenth

ANSWER: c

67. 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

ANSWER: a

68. According to Wein's displacement law, the wavelength at which maximum radiation occurs

- a. is inversely proportional to the temperature
- b. is proportional to the temperature
- c. is inversely proportional to the pressure
- d. is proportional to the pressure

ANSWER: a

71. 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%

ANSWER: d

72. 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

ANSWER: a

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

ANSWER: a

74. Sunlight that bounces off a surface is said to be \_\_\_\_\_ from the surface.

- a. radiated
- b. absorbed
- c. emitted
- d. reflected

ANSWER: d

77. The atmosphere near the earth's surface is "heated from below." Which of the following does not significantly contribute to this 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

ANSWER: d

78. 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

ANSWER: a

93. Sunlight passes through a thicker portion of the atmosphere at

- a. sunrise
- b. noon
- c. sunset
- d. night
- e. both a and c

ANSWER: e

95. A red shirt

- a. selectively absorbs red wavelengths of visible light and scatters the rest
- b. selectively scatters red wavelengths of visible light and absorbs the rest

ANSWER: b

96. Perspiration cools the body by

- a. advective heat transfer
- b. radiative heat transfer
- c. conductive heat transfer
- d. latent heat transfer

ANSWER: d

### Chapter 3

1. During the winter 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 desert southwest
- e. on the West Coast

ANSWER: a

3. In the Northern Hemisphere, this day has the fewest hours of daylight:

- a. summer solstice
- b. winter solstice
- c. vernal equinox
- d. autumnal equinox

ANSWER: b

4. 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 the above

ANSWER: d

7. During the winter solstice in the Northern Hemisphere:
- a. astronomical winter begins in the Northern Hemisphere
  - b. the noon sun is overhead at 23.5° S latitude
  - c. at middle latitudes in the Northern Hemisphere, this marks the longest night of the year
  - d. all of the above

ANSWER: d

10. Where are the days and nights of equal length all year long?
- a. at 66.5°
  - b. nowhere
  - c. at 23.5°
  - d. at the Equator

ANSWER: d

12. 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 the above

ANSWER: e

15. The north-facing side of a hill in a mountainous region in the US 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 the above

ANSWER: e

17. The maximum in daytime surface temperature typically occurs \_\_\_\_\_ the earth receives its most intense solar radiation.
- a. before
  - b. after
  - c. exactly when

ANSWER: b

19. The strongest radiation inversions occur when
- a. skies are overcast
  - b. skies are partly cloudy

- c. skies are clear
- d. precipitation is falling

ANSWER: c

20. 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

ANSWER: a

21. 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

ANSWER: c

23. Thermal belts are usually found

- a. on valley floors
- b. on hillsides
- c. on mountain tops

ANSWER: b

25. During a radiation inversion, wind machines

- a. bring warm air down toward the surface
- b. lift cool, surface air to higher altitudes
- c. mix the air near the ground
- d. all of the above

ANSWER: d

26. The main reason(s) for warm summers in northern 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. the days are longer
- d. all of the above
- e. only (b) and (c) are correct

ANSWER: e

27. Our seasons are caused by:

- a. the changing distance between the earth and the sun
- b. the angle at which sunlight reaches the earth
- c. the length of the daylight hours
- d. all of the above
- e. only (b) and (c) are correct

ANSWER: e

31. The earth is tilted at an angle of 23.5° with respect to the plane of its orbit around the sun. If the amount of tilt were increased to 40°, we would expect in middle latitudes:

- a. hotter summers and colder winters than at present
- b. cooler summers and milder winters than at present
- c. hotter summers and milder winters than at present
- d. cooler summers and colder winters than at present
- e. no appreciable change from present conditions

ANSWER: a

33. 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

ANSWER: c

37. 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

ANSWER: c

38. During the afternoon the greatest temperature difference between the surface air and the air several meters above occurs on a:

- a. clear, calm afternoon
- b. clear, windy afternoon
- c. cloudy, calm afternoon
- d. cloudy, windy afternoon

ANSWER: a

39. The greatest variation in daily temperature usually occurs:

- a. at the ground
- b. about 5 feet above the ground
- c. at the top of a high-rise apartment complex
- d. at the level where thermals stop rising

ANSWER: a

40. In most areas the warmest time of the day about 5 feet above the ground occurs:

- a. around noon
- b. in the afternoon between 2 and 5 pm
- c. in the early evening after 6 pm
- d. just before the sun sets

ANSWER: b

42. The lowest temperature is usually observed:

- a. at the time of sunset
- b. near midnight
- c. several hours before sunrise



- d. around sunrise
- e. several hours after sunrise

ANSWER: d

44. Suppose yesterday morning you noticed ice crystals (frost) on the grass, yet the minimum temperature reported in the newspaper was only 35° F. The most likely reason for this apparent discrepancy is that:

- a. temperature readings are taken in instrument shelters more than 5 feet above the ground
- b. the thermometer was in error
- c. the newspaper reported the wrong temperature
- d. the thermometer was read before the minimum temperature was reached for that day
- e. the thermometer was read incorrectly

ANSWER: a

46. At what time during a 24-hour day would a radiation temperature inversion best be developed?

- a. at sunset
- b. near sunrise
- c. toward the end of the morning
- d. between 2 and 5 pm when the air temperature reaches a maximum

ANSWER: b

47. The lag in daily temperature refers to the time lag between the:

- a. time of maximum solar radiation and the time of maximum temperature
- b. time of minimum temperature and the time of maximum solar radiation
- c. minimum and maximum temperature for a day
- d. minimum and maximum solar energy received at the surface for a given day
- e. sunrise and sunset

ANSWER: a

48. Ideal conditions for a strong radiation inversion:

- a. clear, calm, dry, winter night
- b. clear, calm, moist, summer night
- c. cloudy, calm, moist, winter night
- d. cloudy, windy, moist, summer night
- e. clear, windy, dry, summer night

ANSWER: a

49. Thermal belts are:

- a. pockets of warm air resting on a valley during the afternoon
- b. pockets of cold air resting on a valley floor at night
- c. warmer hillsides that are less likely to experience freezing conditions
- d. cold, below-freezing air found at the top of a mountain

ANSWER: c

50. The primary cause of a radiation inversion is:

- a. infrared radiation emitted by the earth's surface
- b. infrared radiation absorbed by the earth's surface
- c. solar radiation absorbed by the earth's surface

- d. solar radiation reflected by the earth's surface
- e. infrared radiation absorbed by the atmosphere and clouds

ANSWER: a

51. The deepest radiation inversion would be observed:

- a. at the equator any day of the year
- b. in polar regions in winter
- c. at the top of a high mountain in winter
- d. on a desert in winter
- e. in a deep valley during the summer

ANSWER: b

53. On a clear, calm, night, the ground and air above cool mainly by this process:

- a. evaporation
- b. reflection
- c. convection
- d. conduction
- e. radiation

ANSWER: e

54. Which of the following can be used as a method of protecting an orchard from damaging low temperatures during a radiation inversion?

- a. orchard heaters
- b. wind machines
- c. irrigation (cover the area with water)
- d. all of the above

ANSWER: d

57. Lines connecting points of equal temperature are called:

- a. isobars
- b. isotherms
- c. thermals
- d. thermographs

ANSWER: b

58. In summer, humid regions typically have \_\_\_\_\_ daily temperature ranges and \_\_\_\_\_ maximum temperatures than drier regions.

- a. smaller, lower
- b. smaller, higher
- c. larger, lower
- d. larger, higher

ANSWER: a

62. An important reason for the large daily temperature range over deserts is:

- a. there is little water vapor in the air to absorb and re-radiate infrared radiation
- b. the light-colored sand radiates heat very rapidly at night
- c. dry air is a very poor heat conductor
- d. free convection cells are unable to form above the hot desert ground
- e. the ozone content of desert air is very low

ANSWER: a

64. Two objects A and B have the same mass but the specific heat of A is larger than B. If both objects absorb equal amounts of energy:

- a. A will become warmer than B
- b. B will become warmer than A
- c. both A and B will warm at the same rate
- d. A will get warmer, but B will get colder

ANSWER: b

65. The largest annual ranges of temperatures are found:

- a. at polar latitudes over land
- b. at polar latitudes over water
- c. at middle latitudes near large bodies of water
- d. at the Equator
- e. in the Northern Central Plains of the United States

ANSWER: a

67. This is used as a guide to planting and for determining the approximate date for harvesting crops:

- a. growing degree-days
- b. heating degree-days
- c. cooling degree-days
- d. mean annual temperature

ANSWER: a

68. This is used as an index for fuel consumption:

- a. growing degree-days
- b. consumer price index
- c. heating degree-days
- d. mean annual temperature

ANSWER: c

69. Which of the following is not a reason why water warms and cools much more slowly than land?

- a. solar energy penetrates more deeply into water
- b. heat energy is mixed in a deeper layer of water
- c. water has a higher heat capacity
- d. a portion of the solar energy that strikes water is used to evaporate it
- e. it takes more heat to raise the temperature of a given amount of soil 1°C than it does to raise the temperature of water 1°C.

ANSWER: e

74. In calm air the air temperature is -10°C, if the wind speed should increase to 30 knots (with no change in air temperature) the thermometer would indicate:

- a. a much higher temperature than -10°C
- b. a much lower temperature than -10°C
- c. a temperature of -10°C
- d. a temperature of -30°C

ANSWER: c

75. The air temperature is 45°F, the wind is blowing at 30 MPH, and the wind chill temperature is 15°F. These conditions would be equivalent to:

- a. a 15°F air temperature and 0 MPH winds
- b. a 30°F air temperature and 45 MPH winds
- c. a 30°F air temperature and 15 MPH winds
- d. a 15°F air temperature and 30 MPH winds

ANSWER: a

76. Hypothermia is most common in:

- a. hot, humid weather
- b. cold, wet weather
- c. hot, dry weather
- d. cold, dry weather

ANSWER: b

78. The wind-chill factor:

- a. relates body heat loss with wind to an equivalent temperature with no wind
- b. indicates the temperature at which water freezes on exposed skin
- c. takes into account humidity and air temperature in expressing the current air temperature
- d. tells farmers when to protect crops from a freeze
- e. determines how low the air temperature will be on any given day

ANSWER: a

95. In the northern hemisphere, the number of hours of daylight begin to shorten after the

- a. spring equinox
- b. summer solstice
- c. autumn equinox
- d. winter solstice

ANSWER: b

96. At any given time, \_\_\_\_\_ of the earth is illuminated by the sun.

- a. one-fourth
- b. one-third
- c. one-half
- d. two-thirds

ANSWER: c

103. Water heats up \_\_\_\_\_ and cools off \_\_\_\_\_ than land.

- a. more quickly, more quickly
- b. more quickly, more slowly
- c. more slowly, more quickly
- d. more slowly, more slowly

ANSWER: d

## Chapter 4

1. If a glass of water were surrounded by saturated air:

- a. the level of the water in the glass would slowly decrease
- b. the water's temperature would slowly increase

- c. the level of the water in the glass would not change
- d. the water's temperature would slowly decrease

ANSWER: c

3. As the air temperature increases, the air's capacity for water vapor:

- a. increases
- b. decreases
- c. remains constant
- d. is unrelated to air temperature and can either increase or decrease

ANSWER: a

4. If all the water vapor in the atmosphere were to condense and fall to the ground, the globe would be covered with about of water.

- a. 1 millimeter
- b. 1 inch
- c. 1 foot
- d. 1 meter

ANSWER: b

5. The total mass of water vapor stored in the atmosphere at any moment is about \_\_\_\_\_ of the world's supply of precipitation.

- a. 1 day
- b. 1 week
- c. 1 month
- d. 1 year

ANSWER: b

7. The density of water vapor in a given parcel of air is expressed by the:

- a. absolute humidity
- b. relative humidity
- c. mixing ratio
- d. specific humidity
- e. saturation vapor pressure

ANSWER: a

8. Which of the following will increase in a rising parcel of air?

- a. saturation vapor pressure
- b. relative humidity
- c. mixing ratio
- d. air temperature
- e. none of the above

ANSWER: b

9. Which of the following will decrease in a rising parcel of air?

- a. relative humidity
- b. absolute humidity
- c. specific humidity
- d. all of the above

ANSWER: b

10. The ratio of the mass of water vapor in a given volume (parcel) of air to the mass of the remaining dry air describes the:

- a. absolute humidity
- b. mixing ratio
- c. relative humidity
- d. dew point

ANSWER: b

11. When the air temperature increases, the saturation vapor pressure will:

- a. increase
- b. decrease
- c. remain the same
- d. vary over an increasingly broad range of values

ANSWER: a

12. The maximum pressure that water vapor molecules would exert if the air were saturated is called the:

- a. absolute humidity
- b. boiling point
- c. mixing ratio
- d. none of the above

ANSWER: d

13. If water vapor comprises 3.5% of an air parcel whose total pressure is 1000 mb, the water vapor pressure would be:

- a. 1035 mb
- b. 35 mb
- c. 350 mb
- d. 965 mb

ANSWER: b

15. If the air temperature increased, with no addition or removal of water vapor, the actual vapor pressure would:

- a. increase
- b. decrease
- c. stay the same
- d. become greater than the saturation vapor pressure

ANSWER: c

16. When the air temperature is below freezing, the saturation vapor pressure over water is .

- a. equal to zero
- b. less than the saturation vapor pressure over ice
- c. greater than the saturation vapor pressure over ice
- d. equal to the saturation vapor pressure over ice

ANSWER: c

19. The Gulf Coast states are more humid in summer than the coastal areas of Southern California mainly because of the:

- a. higher air temperature in the Gulf States
- b. lower air temperature in Southern California
- c. higher water temperature in the Gulf of Mexico

d. low relative humidity of the air over the Pacific Ocean

ANSWER: c

20. If very cold air is brought indoors and warmed with no change in its moisture content, the saturation vapor pressure of this air will \_\_\_\_\_ and the relative humidity of this air will \_\_\_\_\_ .

- a. increase, increase
- b. decrease, decrease
- c. increase, decrease
- d. decrease, increase

ANSWER: c

27. The main reason why vegetables take longer to cook in boiling water at high altitudes is because:

- a. water boils at a higher temperature with higher altitude
- b. the temperature of the boiling water decreases with increasing altitude
- c. there is less oxygen in the air at high altitude
- d. saturation vapor pressure decreases with increasing altitude

ANSWER: b

28. The temperature at which water boils depends mainly on:

- a. air temperature
- b. relative humidity
- c. air pressure
- d. air density
- e. the specific heat of air

ANSWER: c

29. The percentage of water vapor present in the air compared to that required for saturation is the:

- a. mixing ratio
- b. absolute humidity
- c. dew point
- d. relative humidity
- e. specific humidity

ANSWER: d

31. At what time of day is the relative humidity normally at a minimum?

- a. when the air temperature is highest
- b. just before sunrise
- c. about midnight
- d. when the air temperature is lowest

ANSWER: a

32. The time of day when the relative humidity reaches a maximum value is usually:

- a. at the time when the air temperature is highest
- b. in the middle of the afternoon
- c. at the time when the air temperature is lowest
- d. just before sunrise
- e. about midnight

ANSWER: c

33. The dew point temperature is a measure of the total amount of water vapor in the air.

- a. true
- b. false

ANSWER: a

34. As the air temperature increases, with no addition of water vapor to the air, the relative humidity will:

- a. remain the same
- b. increase
- c. decrease
- d. increase until it becomes equal to the dew point temperature

ANSWER: c

40. Suppose saturated polar air has an air temperature and dew point of  $-10^{\circ}\text{C}$ , and unsaturated desert air has an air temperature of  $35^{\circ}\text{C}$  and a dew point of  $10^{\circ}\text{C}$ . The desert air contains \_\_\_\_\_ water vapor and has a \_\_\_\_\_ relative humidity than the polar air.

- a. more, lower
- b. more, higher
- c. less, lower
- d. less, higher

ANSWER: a

42. As the difference between the air temperature and the dew point increases, the relative humidity:

- a. increases
- b. decreases
- c. remains constant at a value less than 100%
- d. remains constant and equal to 100%

ANSWER: b

43. The temperature to which air must be cooled in order to become saturated is the:

- a. minimum temperature
- b. dew point temperature
- c. wet-bulb temperature
- d. freezing point

ANSWER: b

44. As the air temperature increases, with no addition of water vapor to the air, the dew point will:

- a. remain the same
- b. increase
- c. decrease
- d. increase and become equal to the air temperature

ANSWER: a

52. Nighttime temperatures rarely drop below the dew point temperature because

- a. the dew will absorb all the heat
- b. saturation vapor pressures always increase at night
- c. at saturation, latent heat of condensation is released into the air
- d. both (b) and (c)

ANSWER: c