Chapter 1 Earth as a Rotating Planet

Multiple Choice Questions

1. The shape of the Earth is best described as a(n) _______________.
   a. perfect sphere
   b. ellipsoid
   c. oblate ellipsoid
   d. spherical ellipsoid

2. The direction of the Earth’s rotation is _______________ when viewed from above the north pole, or from _______________ if viewed from directly above the equator with the north pole on top.
   a. clockwise, west to east
   b. clockwise, east to west
   c. counterclockwise, east to west
   d. counterclockwise, west to east

3. The Earth _______________ about its axis and _______________ around the Sun.
   a. revolves, rotates
   b. spins, rotates
   c. rotates, revolves
   d. revolves, orbits

4. The _______________ is a phenomenon, related to the Earth’s rotation that causes air and ocean currents to deflect to the right of their direction of motion in the northern hemisphere and to the left of their direction of motion in the southern hemisphere.
   a. Van Allen effect
   b. Coriolis effect
   c. Bayer-Hoffman effect
   d. centripetal force effect

5. The Earth is nearest to the Sun at _______________, which occurs on or about _______________.
   a. aphelion, July 4
   b. perihelion, July 4
   c. perihelion, January 3
   d. aphelion, January 3

6. On the Earth’s surface, the geographic grid consisting of intersecting parallels and meridians are identified by _______________, respectively.
   a. latitudes and longitudes
   b. longitudes and latitudes
   c. time and space
   d. azimuth and space
7. All meridians converge at points located at the _____________.
   a. equator
   b. tropic of cancer
   c. arctic and Antarctic circles
   d. poles

8. The single major problem all maps have in common is _________________.
   a. that they are flat
   b. distortion
   c. shape distortion
   d. area distortion

9. The ___________ projection is centered on the north or south pole and contains
    meridians that are represented as ______________ lines.
   a. Mercator, curved
   b. Goode, straight
   c. polar, straight
   d. Lambert’s conic conformal, curved

10. The ___________________ projection is a rectangular grid of meridians and
    parallels depicted as straight vertical and horizontal lines, respectively.
    a. polar
    b. Goode
    c. Mercator
    d. conic

11. While the _______________  projection portrays the relative areas of landmasses on
    the Earth’s surface correctly, their shapes however become distorted near the poles.
    a. Mercator
    b. Goode
    c. conic
    d. polar

12. ____________ time is based on twenty-four, __________ degree wide time zones.
    a. Polar, 7 1/2
    b. World, 15
    c. Standard, 7 1/2
    d. Standard, 15

13. At 6:00 P.M. in New York (EST and 75W meridian), it is correspondingly
    ____________ in Lake Tahoe, California (PST and 120W meridian).
    a. 9:00 P.M.
    b. 6:00 P.M.
    c. 3:00 A.M.
    d. 3:00 P.M.
14. At noon on Tuesday in Lake Tahoe, California, (120W meridian), the corresponding
time and day on the east coast of Australia (150E meridian) is ________________.
   a. 6:00 A.M. on Monday
   b. 6:00 P.M. on Wednesday
   c. 6:00 A.M. on Wednesday
   d. 6:00 P.M. on Monday

15. The purpose of daylight savings time is to make the daylight period of the day
   ________________.
   a. correspond more closely with the modern pace of society and is accomplished
      by moving the clock back one hour
   b. longer by moving all clocks ahead by one hour
   c. correspond more closely with the modern pace of society, and is accomplished by
      moving the clock ahead one hour
   d. longer and results in a slight savings in electricity

16. The Earth completes a(n) _______________ revolution around the sun in _________
days.
   a. circular, 366
   b. elliptical, 365
   c. elliptical, 365 1/4
   d. circular, 365

17. The tilt of the Earth’s axis is ________________.
   a. 23 1/2 degrees from the plane of the ecliptic
   b. 66 1/2 degrees from a perpendicular to the plane of the ecliptic
   c. 23 1/2 degrees from the sun
   d. 23 1/2 degrees from a perpendicular to the plane of the ecliptic

18. The ______________________ divides the Earth into a sunlit side and a night side.
   a. International Date Line
   b. Prime Meridian
   c. circle of illumination
   d. Arctic circle

19. During an equinox, the circle of illumination passes through the ________________.
   a. north and south poles
   b. Antarctic circle
   c. Arctic circle
   d. Equator

20. At the __________ solstice, the north pole is tilted toward the Sun, while at the
    __________ solstice, it is tilted away from the Sun.
   a. December, June
   b. June, December
Multiple Choice Questions

1. In the case of electromagnetic energy, _______________ objects radiate more energy at shorter wavelengths than _______________ objects.
   a. hotter; cooler
   b. rotating, stationary
   c. cooler, hotter
   d. larger, smaller

2. The highest energy, shortest wavelength form of electromagnetic radiation emitted by the sun is:
   a. shortwave infrared
   b. visible light
   c. thermal infrared radiation
   d. ultraviolet radiation

3. The Earth, maintaining a significantly cooler surface temperature than the Sun, emits _______________.
   a. ultraviolet radiation
   b. shortwave infrared radiation
   c. longwave radiation
   d. visible light

4. The solar constant, which represents the average rate of incoming solar energy received on a small, fixed area of the top of Earth’s atmosphere, has an approximate value of _______________.
   a. 1300 Wm$^2$
   b. 1000 Wm$^2$
   c. 1500 Wm$^2$
   d. 1400 Wm$^2$

5. The amount of incoming solar radiation or insolation, received by the surface of the Earth, is most dependent upon the _______________.
   a. angle at which the insolation is received by the Earth’s surface
   b. total solar radiation output of the sun
   c. amount of glacial coverage in a particular area
   d. amount of ocean surface in a particular region

6. The _______________ region(s) of the Earth receives the greatest amount of insolation.
a. polar
b. equatorial
c. midlatitude
d. subtropical

7. On an annual basis, the Earth’s polar regions receive about ______________ of the insolation received at the equator.
   a. fifty percent
   b. forty percent
   c. sixty percent
   d. thirty percent

8. The Earth’s ______________ regions have the greatest insolation variation.
   a. polar
   b. equatorial
   c. midlatitude
   d. tropical

9. Of the following gases, ______________ is not found in the atmosphere in measurable quantities.
   a. nitrogen
   b. helium
   c. argon
   d. carbon dioxide

10. Of the following gases, ______________ is the major atmospheric greenhouse gas.
    a. nitrogen
    b. argon
    c. carbon dioxide
    d. oxygen

11. The chemical formula __________ represents that of ozone.
    a. $O_2$
    b. $O^3$
    c. $O_3$
    d. $CO_2$

12. Of the following gases, ______________ result(s) in the most prolific destruction of ozone.
    a. nitrogen
    b. carbon dioxide
    c. chlorofluorocarbons (CFCs)
    d. argon

13. ______________ is a natural ozone layer destroying product.
    a. Carbon dioxide
b. Volcanic dust
c. Argon
d. Salt spray from the oceans

14. Sensible heat transfer refers to the flow of heat between the Earth’s surface and the atmosphere ________________.
   a. that can be measured with a thermometer
   b. by advection
   c. occurring between the various states of water
   d. by conduction and/or convection.

15. Scattered radiation moving in all directions through that atmosphere is known as ________________.
   a. diffuse radiation
   b. diffuse reflection
   c. direct radiation
   d. refracted radiation

16. The percentage of shortwave radiant energy scattered upward by a surface is termed its ____________.
   a. outflow
   b. output
   c. albedo
   d. reflection

17. While the Earth’s surface can only radiate longwave radiation __________, the atmosphere tends to radiate longwave radiation ________________.
   a. upwards, downwards
   b. upwards, in all directions
   c. downwards, upwards
   d. upwards, at right angles to the upwards flow

18. _______________ from the atmosphere helps to warm the Earth’s surface through a process known as the _______________.
   a. Outbound longwave radiation, ozone effect
   b. Insolation, greenhouse effect
   c. Counterradiation, greenhouse effect
   d. Counterradiation, ozone effect

19. ___________ is the difference between all incoming and outgoing radiations.
   a. Net radiation
   b. Counterradiation
   c. The greenhouse effect
   d. Albedo
20. _______________, driven by the imbalance in net radiation between low and high latitudes, is the power source for ocean currents and broad-scale atmospheric circulation patterns.
   a. Midlatitude heat transfer
   b. Poleward heat transfer
   c. Surface net radiation
   d. Energy balance

Chapter 3: Air Temperature and Air Temperature Cycles

Multiple Choice Questions

1. Temperature is _______________.
   a. a measure of the level of sensible heat of matter
   b. only measured with a thermistor
   c. a measure of the level of latent heat of matter
   d. measured only through advection

2. Heat in the atmosphere is distributed through a vertical mixing process called _______________.
   a. advection
   b. particle acceleration
   c. convection
   d. conduction

3. Positive net radiation values usually commence _______________.
   a. at noon
   b. shortly after sunrise
   c. in the afternoon
   d. at night

4. Minimum daily temperatures usually occur _______________.
   a. just before sunrise
   b. at midnight
   c. one hour before sunrise
   d. about one-half hour after sunrise

5. Urban surface temperatures tend to be warmer than rural temperatures during the day because:
   a. drier surfaces are cooler than wet soils
   b. drier surfaces have less water to evaporate than do moist soils
   c. paved surfaces reflect so much heat away into the air
   d. paved surfaces absorb little solar insolation
6. ________________ is the process whereby plants loose a portion of their acquired water to the air through evaporation.
   a. Radiation  
   b. Sublimation  
   c. Respiration  
   d. Transpiration

7. The urban heat island effect is not a desert environment phenomenon because _______________.
   a. more transpiration is occurring in the city than in the surrounding countryside  
   b. the surrounding desert is hot too  
   c. deserts cool the cities which they surround  
   d. atmospheric mixing in the deserts is greater than in other environments

8. The defining characteristic of the troposphere is its _________________.
   a. poorly mixed atmospheric gases  
   b. paucity of weather  
   c. environmental temperature lapse rate  
   d. precipitation lapse rate

9. The average rate of temperature decrease with height in the troposphere is termed the environmental temperature lapse rate which averages _________________.
   a. 3.0°C/1000 m (6.5°F/1000 ft.)  
   b. 6.0°C/1000 m (3.5°F/1000 ft.)  
   c. 5.0°C/1000 m (3.0°F/1000 ft.)  
   d. 3.0°C/1000 m (5.0°F/1000 ft.)

10. The ___________ is noted for the fact that air warms as altitude increases to a height of about thirty miles (50 kilometers).
    a. troposphere  
    b. mesosphere  
    c. heterosphere  
    d. stratosphere

11. Gasses are well mixed in the ________________ region of the atmosphere.
    a. homosphere  
    b. heterosphere  
    c. mesosphere  
    d. thermosphere

12. A temperature inversion occurs when _________________.
    a. cold air lies atop warm air near the stratosphere  
    b. warm air lies atop cold air near the stratosphere  
    c. warm air lies atop cooler air next to the ground  
    d. cold air lies atop warm air next to the ground
13. Continental locations generally experience ___________ seasonal temperature variations than ocean adjacent locations.
   a. weaker
   b. stronger
   c. more stable
   d. unstable

14. Since large bodies of water heat and cool more ____________ compared to land surfaces, monthly temperature maximums and minimums tend to be delayed at coastal stations.
   a. slowly
   b. rapidly
   c. constantly
   d. randomly

15. _______________ are lines of equal temperature drawn on a weather map.
   a. Isohyets
   b. Isobars
   c. Isopachs
   d. Isotherms

16. Relative to adjacent ocean surfaces, isotherms over a large continental land masses tend to shift _______________ in latitude during the winter and _______________ in latitude during the summer.
   a. north; south
   b. south; north
   c. west; east
   d. east; west

17. _______________ is not a greenhouse gas.
   a. Carbon dioxide
   b. Methane
   c. Argon
   d. Nitrous oxide

18. While greenhouse gases such as CO₂, CH₄ and N₂O act primarily to enhance global warming ____________, cloud changes and land cover alterations caused by human activity act to retard global warming.
   a. aerosols
   b. chlorofluorocarbons
   c. tropospheric ozone
   d. water vapour

19. At present, carbon dioxide levels are increasing in the atmosphere at an annual rate of ____________.
a. one percent  
b. two percent  
c. three percent  
d. four percent

20. _______________ does not remove carbon dioxide from the atmosphere.  
a. A terrestrial photosynthesizing plant  
b. A marine photosynthesizing organism  
c. A decaying plant  
d. none of the above

<Chapter 4: Atmospheric Moisture and Precipitation>

Multiple Choice Questions

1. The transition from water vapor to solid ice and solid ice to water vapor is called _______________.  
a. deposition  
b. vaporization  
c. sublimation  
d. fusion

2. The movement of water among the great global reservoirs constitutes the _______________.  
a. water-factor cycle  
b. hydraulic cycle  
c. hydrologic cycle  
d. evaporation-precipitation cycle

3. _______________ energy is released or absorbed as water changes from one state to another.  
a. latent heat  
b. sensible heat  
c. conductive heat  
d. convective heat

4. Relative humidity _______________.  
a. is the total amount of water vapor present in the air  
b. is responsible for life on Earth  
c. depends upon the volume of water present in the air unrelated to temperature  
d. is the amount of water vapor in the air compared to the amount it could hold

5. Relative humidity is usually lowest during the _______________.  
a. early morning
b. early afternoon  
c. evening  
d. night

6. The _______________ of the air represents the actual quantity of water vapor held by the air.  
a. relative humidity  
b. saturation level  
c. specific humidity  
d. absolute saturation level

7. _______________ temperature changes occur in parcels of air solely as a result of air expansion or compression.  
a. Adiabatic  
b. Compressive  
c. Latent  
d. Specific

8. Since rising air cools less rapidly when condensation is occurring as a result of the release of latent heat, the _______________ has a lesser value than the _______________.  
a. dry adiabatic lapse rate; wet adiabatic lapse rate  
b. dry adiabatic lapse rate; environmental adiabatic lapse rate  
c. environmental adiabatic lapse rate; wet adiabatic lapse rate  
d. wet adiabatic lapse rate; dry adiabatic lapse rate

9. Clouds are grouped into two major classes on the basis of form: ___________ and ___________.  
a. nimboform, luceriform  
b. nimboform, stratiform  
c. stratiform, cumuliform  
d. cumiliform, luceriform

10. _______________ fog forms when warm, moist air moves over a colder surface.  
a. Radiation  
b. Advection  
c. Sublimation  
d. Compression

11. _______________ is the type of precipitation that forms as rain freezes during its decent through the atmosphere.  
a. Freezing rain  
b. Snow  
c. Hail  
d. Sleet
12. ______________ precipitation is a result of air being lifted over a highland area.
   a. Convective
   b. Orographic
   c. Convergence
   d. Frontal

13. ______________ lifting of air is due to heating.
   a. Convective
   b. Orographic
   c. Frontal
   d. Adiabatic

14. The two conditions that promote thunderstorm development are ______________.
   a. warm, moist air and a decreasing lapse rate
   b. cool, dry air in collision with a colder air mass
   c. warm, moist air and an environmental lapse rate greater than the wet and dry rates
   d. cold, wet air, and an environmental lapse rate greater than the wet and dry rates

15. The ______________ lapse rate is in effect when a parcel of air rises above the condensation level.
   a. environmental
   b. adiabatic
   c. dry adiabatic
   d. wet adiabatic

16. A very intense downdraft of air produced by a thunderstorm is called ______________.
    a. a tornado
    b. a hurricane
    c. a microburst
    d. sleet storm

17. Smog has three toxic ingredients of which ______________ are (is) not a member.
    a. nitrogen oxides
    b. hydrocarbons
    c. polycarbonates
    d. ozone

18. Heat inversions are directly related to ______________ and its dire effects, because pollutants are unable to rise far above the surface.
    a. smog
    b. acid rain
    c. acid precipitation
    d. acid pollution

19. A smog layer can cut visibility and illumination by up to ________ percent in winter.
a. five  
b. ten  
c. fifteen  
d. twenty

20. Acid deposition is produced by the release of sulfur dioxide and __________ into the air.  
a. carbon dioxide  
b. ozone  
c. nitric oxide  
d. sulfur perchlorate

<Chapter 5: Winds and Global Circulation>

Multiple Choice Questions

1. A barometer is an instrument used to measure ___________.  
a. air pressure  
b. hydraulic pressure  
c. tectonic pressure at earthquake fault zones  
d. glacial compression under ice sheets

2. The standard sea-level atmospheric pressure in millibars (mb) is __________.  
a. 1000.0  
b. 1013.2  
c. 1013.0  
d. 1000.2

3. As an individual moves higher in elevation, the _______________.  
a. easier it is to breathe because the air is cleaner  
b. easier it is to breathe because the air is thinner and therefore cleaner  
c. harder it is to breathe because the air molecules are closer together  
d. harder it is to breathe because the air is thinner

4. The boiling point of water lowers as one goes higher in elevation because __________.  
a. water is less dense at the higher elevation  
b. air is denser at the higher elevation  
c. air pressure is less at the higher elevation  
d. upwards water pressure is much greater

5. On weather maps ______________ connect lines of equal atmospheric pressure.  
a. isobars  
b. isotherms  
c. pressure contours
6. Wind speed is measured using an instrument called a(n) _______________.
   a. barometer
   b. wind vane
   c. speedometer
   d. anemometer

7. A land breeze generally occurs _______________.
   a. at nightfall, when the land cools below the surface temperature of the sea
   b. when strong winds blow in from the sea over the land
   c. only during certain restricted seasons
   d. during the day when the land heats above the surface temperature of the sea

8. A parcel of air is subjected to three forces and the balance among the _______________, Coriolis, and frictional forces determines the direction of motion of the parcel of air.
   a. gravitational
   b. pressure gradient
   c. centrifugal
   d. divergent

9. The Coriolis effect is _______________.
   a. a result of the Earth’s rotation from east to west
   b. a result of the Earth’s rotation from the west to the east and causes objects to curve to the right in the Northern Hemisphere
   c. a result of the Earth’s rotation from the west to the east and causes objects to curve to the left in the Northern Hemisphere
   d. unrelated to other physical phenomena on the Earth

10. A northern hemisphere anticyclone _______________.
    a. is a high-pressure system that rotates counterclockwise
    b. is a low-pressure system that rotates clockwise
    c. is a high-pressure system that rotates clockwise
    d. is a low-pressure system that rotates counterclockwise

11. Cloudy and rainy weather is often associated with the inward and upward convergence of air within _______________.
    a. anticyclones
    b. cold fronts
    c. warm fronts
    d. cyclones

12. Strong wind convergence in association with the ITCZ generally occurs at __________ degrees latitude.
    a. zero
b. thirty
   c. forty-five
   d. sixty

13. In the Hadley cell convection loop, air rises at the ITCZ and descends in the _________.
   a. polar high-pressure cells
   b. subpolar low-pressure cells
   c. subtropical high-pressure cells
   d. polar low-pressure cells

14. The movement of the ITCZ and the change in the pressure pattern with the seasons create a reversing wind pattern in Asia known as the _______________ where cool-dry air flow from the northeast dominates during the low-Sun season and warm-moist airflow from the southwest dominates during the high-Sun season.
   a. northeast trades
   b. southeast trades
   c. monsoon
   d. westerlies

15. At upper levels in the atmosphere, as a parcel of air moves in response to a pressure gradient, it is turned progressively sideward until the gradient and Coriolis forces balance to produce the _______________.
   a. geostrophic wind
   b. tropospheric wind
   c. upper-air westerlies
   d. equatorial easterlies

16. Jet streams are _______________.
   a. narrow zones at a high altitude in which wind streams reach great speeds over the speed of sound
   b. narrow zones at a high altitude in which wind streams reach great speeds of over 200 miles per hour
   c. rivers of wind that only exist along the equator and travel at fairly high velocities
   d. well known for shredding aircraft when they inadvertently enter them

17. _______________, which form in the westerlies of the northern hemisphere, mark the boundary between cold polar air and warm tropical air.
   a. Hadley waves
   b. Jet stream waves
   c. Rossby waves
   d. Polar front waves

18. El Niño is the name given to the warm phase of an effect associated with the reversal of _______________.
   a. ocean currents in the northern hemisphere
b. ocean currents in the southern ocean  
c. wind flow patterns along the ITCZ  
d. ocean currents in the southern Pacific Ocean

19. In the ocean, the boundary between warmer surface water and colder subsurface water is marked by the _______________.
   a. thermohaline  
   b. thermocline  
   c. thermogyre  
   d. chemocline

20. Global surface ocean currents are dominated by huge, wind-driven circular ________________ centered near the subtropical high-pressure cells.
   a. gyres  
   b. currents  
   c. circulations  
   d. gyrocurrents

<Chapter 6: Weather Systems>

Multiple Choice Questions

1. A(n) ________________ is a large body of air with fairly uniform temperature and moisture characteristics.
   a. air source  
   b. air resource  
   c. climate zone  
   d. air mass

2. ________________ air masses generally posses the lowest moisture content.
   a. Maritime tropical  
   b. Continental polar  
   c. Maritime tropical  
   d. Continental tropical

3. The __________ air mass generally does not influence North America.
   a. mE  
   b. mP  
   c. mT  
   d. cP

4. A ________________ forms when a cold air mass penetrates a warm air mass.
   a. warm front  
   b. occluded front
c. cold front
d. stationary front

5. In _____________, convergence and uplift typically cause condensation and precipitation, while subsidence in _____________ causes the air to warm producing clear conditions.
   a. cyclones; warm fronts
   b. anticyclones; cyclones
   c. anticyclones; warm fronts
   d. cyclones; anticyclones

6. A ________________ forms between two high-pressure cells.
   a. ridge
   b. siphon of low pressure
   c. low-pressure trough
   d. high-pressure ridge

7. In middle and high latitudes, the dominant form of weather system is the ________________, a large inspiral of air that repeatedly forms, intensifies, and dissolves along the polar front.
   a. warm front
   b. wave anticylone
   c. wave cyclone
   d. cold front

8. An occluded front occurs within a wave cyclone ________________.
   a. on every occasion of warm front formation
   b. on every occasion of cold front formation
   c. whenever a cP air mass meets a mE air mass
   d. when a cold front has overtaken a warm front

9. A ________________ is a small but intense cyclonic vortex with very high wind speeds.
   a. hurricane
   b. tornado
   c. typhoon
   d. cyclone

10. Tropical weather tends to be ________________.
    a. based on westerly waves
    b. based on divergence of air masses
    c. convectional in nature
    d. based on the horse latitude divergence

11. Easterly waves dominantly occur within the ________________ latitudinal zone(s).
    a. 0°to 20° N and S
b. 10° to 40° N and S  
c. 5° to 30° N and S  
d. 25° N to 25° S  

12. The leading edge of a polar outbreak is ______________.
   a. a warm front which develops into an occluded front
   b. clear weather
   c. clear weather followed by warm and occluded fronts
   d. a cold front with squalls

13. Hurricanes and typhoons generally develop within the ______________ latitudinal zones.
   a. fifteen to thirty degrees North and South
   b. ten to twenty degrees North and South
   c. eight to fifteen degrees North and South
   d. thirty to forty-five degrees North and South

14. The ______________ continent is rarely if ever threatened by hurricanes or typhoons.
   a. North American
   b. South American
   c. African
   d. Eurasian

15. A(n) ______________ is a sudden rise of water level caused by a hurricane.
   a. storm surge
   b. flood
   c. tsunami
   d. tidal flood

16. Poleward transport of heat and moisture is accomplished by ______________.
   a. Hadley cell convection and Rossby waves
   b. Hadley cell convection and frontal system weather
   c. frontal system weather and Rossby waves
   d. storm surges and Hadley cell convection

17. Ocean heat circulation acts to move warm water on the ______________ and colder water _______ of an ocean.
   a. bottom, on the surface
   b. surface, on the bottom
   c. surface, along the thermocline
   d. bottom, along the thermocline

18. Water vapor in the atmosphere ______________.
   a. leads to cooler days and warmer evenings, on average
   b. releases large amounts of heat to the stratosphere
c. transports heat toward the equator
d. acts as a greenhouse gas and emits longwave radiation

19. Increased cloud cover, resulting from the greenhouse effect increase in water vapor in the atmosphere, presently results in _______________.
   a. warmer troposphere temperatures
   b. cooler troposphere temperatures
   c. a decrease in tropospheric temperatures
   d. a net cooling of the planet

20. A(n) ______________ is a center of high pressure and is generally responsible for fair weather.
   a. anticyclone
   b. cyclone
   c. trade wind
   d. midlatitude storm front