

**Elemental Geosystems, 5e (Christopherson)**  
**Chapter 4 Atmospheric and Oceanic Circulation**

- 1) The eruption of Mount Pinatubo in June 1991
- A) lofted several million tons of ash, dust, and SO<sub>2</sub> into the atmosphere.
  - B) was tracked by AVHRR instruments aboard Earth-orbiting satellites.
  - C) eventually affected almost half the planet after only a few weeks of circulation.
  - D) produced spectacular sunrises and sunsets for almost two years.
  - E) All of these are correct.

Answer: E

- 2) The sulfate particles produced by the eruption of Mount Pinatubo \_\_\_\_\_ the albedo of the atmosphere, and this \_\_\_\_\_ the earth.
- A) increased; warmed
  - B) increased; cooled
  - C) decreased; warmed
  - D) decreased; cooled

Answer: B

- 3) Which of the following refers to primary circulation?
- A) migratory high and low pressure systems
  - B) the monsoons
  - C) general circulation of the atmosphere
  - D) land-sea breezes

Answer: C

- 4) Which of the following refers to secondary circulation?
- A) migratory high and low pressure systems
  - B) weather patterns
  - C) general circulation of the atmosphere
  - D) mountain-valley breezes

Answer: A

- 5) Which of the following refers to tertiary circulation?
- A) migratory high and low pressure systems
  - B) subtropical high pressure systems
  - C) general circulation of the atmosphere
  - D) land-sea breezes

Answer: D

- 6) Air flow is initiated by the
- A) Coriolis force.
  - B) pressure gradient force.
  - C) friction force.
  - D) centrifugal force.

Answer: B

- 7) The horizontal motion of air relative to Earth's surface is
- A) barometric pressure.
  - B) wind.
  - C) convection flow.
  - D) a result of equalized pressure across the surface.

Answer: B

- 8) Which of the following is not true of the wind?
- A) It is initiated by the pressure gradient force.
  - B) It blows from regions of high pressure to regions of low pressure.
  - C) The direction of flow can be affected by the rotation of the earth.
  - D) Air blows from regions of hotter air to regions of colder air.
  - E) Winds are named based on the direction from which they blow.

Answer: D

- 9) Normal sea level pressure has a value of
- A) 1013.2 millibars or 29.92 inches of mercury in a barometer.
  - B) 28.50 inches of lead.
  - C) 32.01 millibars of mercury.
  - D) 500 mb.

Answer: A

- 10) Which of the following is not a correct expression for standard atmospheric pressure at sea level?
- A) 1 kg/cm<sup>2</sup>
  - B) 30.00 millibars
  - C) 29.92 inches of Hg
  - D) 760 mm of Hg (mercury)
  - E) 1013.2 mb

Answer: B

- 11) The average height of a column of mercury (Hg) in a barometer at sea level is
- A) 760 mm (76 cm).
  - B) 1013 inches.
  - C) something that can not be determined without knowing air temperature.
  - D) 29.00 millibars.

Answer: A

- 12) An instrument used to measure air pressure is
- A) a thermometer.
  - B) an aneroid barometer.
  - C) a mercury thermometer.
  - D) a bowl of mercury.
  - E) an anemometer.

Answer: B

- 13) An increase in air pressure will cause the mercury in a barometer to \_\_\_\_\_.
- A) rise
  - B) fall
  - C) freeze
  - D) None of the above barometers do not measure air pressure.

Answer: A

- 14) \_\_\_\_\_ is used in a barometer because \_\_\_\_\_.
- A) Water; it is liquid at normal air temperature
  - B) Water; it weighs more than mercury
  - C) Mercury; it will rise more than water will under the same air pressure
  - D) Mercury; it weighs more than water

Answer: D

- 15) The normal range for air pressure at sea level is
- A) 500 to 1000 mb.
  - B) 100 to 650 mb.
  - C) 980 to 1050 mb.
  - D) 1060 to 210 mb.

Answer: C

- 16) The highest surface air pressure ever recorded occurred when the air was
- A) very cold.
  - B) very warm.
  - C) very wet.
  - D) very high above the surface of the earth.

Answer: A

- 17) As air temperature increases, the speed of the molecules in a mass of air \_\_\_\_\_ and the air pressure \_\_\_\_\_.
- A) increases; increases
  - B) increases; decreases
  - C) decreases; increases
  - D) decreases; decreases

Answer: A

- 18) Which of the following describes the pressure gradient force?
- A) It drives air from areas of higher to lower barometric pressure.
  - B) It decreases with height above the surface.
  - C) It causes apparent deflection of winds from a straight path.
  - D) It is the only force acting on atmospheric flows in the upper troposphere.

Answer: A

- 19) An isoline of equal pressure plotted on a weather map is known as
- A) an isotherm.
  - B) an equilibrium line.
  - C) an isobar.
  - D) the thermal equator.

Answer: C

- 20) Air flows \_\_\_\_\_ a surface high pressure area because the density of the air in the high pressure zone is \_\_\_\_\_ than that of the surrounding air.
- A) into; more dense
  - B) into; less dense
  - C) out of; more dense
  - D) out of; less dense

Answer: C



- 21) If the earth did not rotate, air would flow
- A) perpendicular to the isobars, i.e., straight across the isobars.
  - B) to the right of its direction of motion in the Northern Hemisphere.
  - C) to the left of its direction of motion in the Northern Hemisphere.
  - D) parallel to the isobars.

Answer: A

- 22) Which of the following is true of high pressure areas?
- A) Air converges and ascends within high pressure systems.
  - B) Air descends and diverges within high pressure systems.
  - C) They generally involve atmospheric pressures lower than 1000 mb.
  - D) They are characteristic for areas along the equator.

Answer: B

- 23) On a weather map of air pressure, what can you infer from a closer spacing of isobars?
- A) little without knowing temperature patterns
  - B) a steep pressure gradient creating a slower flow of air
  - C) a steep pressure gradient creating a faster flow of air
  - D) higher pressures
  - E) a weak pressure gradient creating a slower flow of air

Answer: C

- 24) Which of the following describes the Coriolis force?
- A) It drives air from areas of higher to lower barometric pressure.
  - B) It decreases with height above the surface.
  - C) It causes the apparent deflection of winds from a straight path.
  - D) It is the only force acting on flows of air in the upper troposphere.

Answer: C

- 25) Which of the following is true of objects and wind moving over distance and time on Earth's surface?
- A) They are always deflected from a straight path to the west in the Southern Hemisphere.
  - B) They are affected only by the pressure gradient and friction force.
  - C) They are always deflected to the right by the friction force.
  - D) They are apparently deflected from a straight path to the right in the Northern Hemisphere.

Answer: D

- 26) The deflection produced by the Coriolis force is caused by
- A) the fact that Earth's rotation decreases in speed toward the poles.
  - B) differing pressure gradients.
  - C) forces that affect winds but not ocean currents.
  - D) air temperature.
  - E) the fact that the earth revolves.

Answer: A

- 27) Which of the following is true regarding the effects of the Coriolis force?
- A) The amount of Coriolis deflection is uniform from equator to poles.
  - B) Coriolis deflection occurs only along parallels, not meridians.
  - C) The Coriolis force is zero at the poles, increasing to maximum along the equator.
  - D) The Coriolis force is zero along the equator, increasing to one-half of maximum at 30° latitude and maximum at the poles.

Answer: D

- 28) The effect of the Coriolis force is \_\_\_\_\_ in the upper atmosphere because \_\_\_\_\_.
- A) enhanced; the pressure gradient is weaker
  - B) enhanced; there is less friction
  - C) enhanced; there is more friction
  - D) diminished; the pressure gradient is weaker
  - E) diminished; there is less friction

Answer: B

- 29) If the earth's direction of rotation were reversed, the SE trades would become
- A) SW trades.
  - B) NE trades.
  - C) NW trades.
  - D) easterlies.

Answer: A

- 30) In the absence of friction, the combined effect of the Coriolis force and the pressure gradient force produces
- A) geostrophic winds at high altitudes above the ground.
  - B) surface winds.
  - C) air flow from low to high pressure centers.
  - D) air flow in a north-south direction.
  - E) air flow perpendicular to the isobars.

Answer: A

- 31) Which of the following matches is incorrect relative to air circulation?
- A) anticyclone = high pressure center
  - B) cyclone = low pressure center
  - C) anticyclone = clockwise circulation in the Southern Hemisphere
  - D) cyclone = counterclockwise in the Northern Hemisphere

Answer: C

- 32) Which of the following matches is correct relative to air circulation?
- A) anticyclone = low pressure center
  - B) cyclone = high pressure center
  - C) cyclone = clockwise circulation in the Southern Hemisphere
  - D) anticyclone = counterclockwise circulation in the Northern Hemisphere

Answer: C

- 33) Which of the following primary pressure areas are produced by thermal factors, rather than dynamic factors?
- A) subtropical high and subpolar low
  - B) equatorial low and polar high
  - C) equatorial low and Bermuda high
  - D) Aleutian low and Icelandic low

Answer: B

- 34) The intertropical convergence zone is characterized by
- A) convergence and uplift of warm surface air.
  - B) convergence and subsidence of cold surface air.
  - C) divergence and uplift of warm surface air.
  - D) divergence and subsidence of cold surface air.

Answer: A

- 35) The wind belts used by mariners to travel from Europe to North America during the days of sailing ships were the
- A) polar easterlies.
  - B) westerlies.
  - C) SE trades.
  - D) NE trades.

Answer: D

- 36) Between 20° to 35° north latitude and 20° to 35° south latitude are
- A) the largest zone of water surpluses in the world.
  - B) warm and wet conditions, and the world's great tropical forests.
  - C) the world's arid and semi-arid desert regions.
  - D) cyclonic systems of low pressure.

Answer: C

- 37) Light and variable winds which caused difficulties for mariners in the days of sailing ships occur under the
- A) subpolar low and equatorial low.
  - B) subpolar low and subtropical high.
  - C) equatorial low and subtropical high.
  - D) equatorial low and subpolar low.

Answer: C

- 38) Winds that blow predominantly from the northeast and the southeast are the
- A) westerlies.
  - B) polar easterlies.
  - C) horse latitudes.
  - D) trade winds.

Answer: D

- 39) The dominant surface winds from the subtropics to high latitudes are the
- A) westerlies.
  - B) trade winds.
  - C) polar easterlies.
  - D) geostrophic winds.

Answer: A

- 40) If you were between 40° and 50° north latitude and you wanted to stand with the average winds blowing in your face, you would stand facing
- A) north.
  - B) south.
  - C) east.
  - D) west.

Answer: D

- 41) Which of the following are correctly matched?
- A) high pressure ascending, converging air movements
  - B) cyclones low pressure cells
  - C) high pressure cells cyclonic circulation
  - D) anticyclones subpolar pressure cells

Answer: B

- 42) Air flow in a Northern Hemisphere high pressure zone is
- A) downward, outward and clockwise.
  - B) downward, outward and counterclockwise.
  - C) inward, upward and clockwise.
  - D) inward, upward and counterclockwise.
  - E) downward, inward and clockwise.

Answer: A

- 43) The intertropical convergence zone (ITCZ) is associated with
- A) the horse latitudes.
  - B) the principal midlatitude circulations.
  - C) the equatorial low-pressure trough.
  - D) subtropical high-pressure development.

Answer: C

- 44) Which of the following is true of Hadley cells?
- A) They dominate the polar circulation.
  - B) They appear most vertically symmetrical on either side of the equator at the equinoxes.
  - C) They are associated with the subpolar low pressure systems.
  - D) They occur at great depth in the oceans.

Answer: B

- 45) The Pacific high and Bermuda high are
- A) strongest during the summer months because the ocean temperatures are warmer than land temperatures at the same latitude.
  - B) strongest during the summer months because the ocean temperatures are cooler than land temperatures at the same latitude.
  - C) weakest during the winter months because the ocean temperatures are cooler than land temperatures at the same latitude.

Answer: B

- 46) The Aleutian low and Icelandic low are
- A) strongest during the winter months because the ocean temperatures are warmer than land temperatures at the same latitude.
  - B) strongest during the winter months because the ocean temperatures are cooler than land temperatures at the same latitude.
  - C) weakest during the summer months because the ocean temperatures are warmer than land temperatures at the same latitude.

Answer: A

- 47) During the winter, the Bermuda high migrates to the \_\_\_\_\_ and becomes the \_\_\_\_\_.
- A) east; Aleutian low
  - B) west; Pacific high
  - C) west; Aleutian low
  - D) west; Azores high
  - E) east; Azores high

Answer: E



- 48) The Polar high above the North Pole is a \_\_\_\_\_ pressure system that produces variable winds that flow in a/an \_\_\_\_\_ pattern.
- A) strong; cyclonic
  - B) strong; anticyclonic
  - C) weak; cyclonic
  - D) weak; anticyclonic

Answer: D

- 49) The western side of subtropical high pressure cells tend to be
- A) cool and moist.
  - B) warm, moist, and unstable.
  - C) dry, stable, and warm, with cooler ocean currents.
  - D) generally in the same position all year, i.e., they do not migrate with the high Sun.

Answer: B

- 50) Which of the following is incorrect regarding the subpolar low-pressure cells?
- A) They are known as the Aleutian and Icelandic lows.
  - B) They develop more strongly over the ocean than over land.
  - C) In the Northern Hemisphere, they are generally stronger in summer than in winter.
  - D) They are associated with the polar front.

Answer: C

- 51) Which of the following is true of the polar front zone?
- A) The polar jet stream is usually located above it.
  - B) It is a zone in which warm and cold air mix.
  - C) It is a zone of frequently strong winds.
  - D) All of the above are true.
  - E) A and B only

Answer: D

- 52) The polar high pressure cells
- A) are the strongest of the four primary pressure areas.
  - B) are cyclonic in nature.
  - C) produce the weak, variable polar easterlies.
  - D) are more pronounced at the North Pole than at the South Pole.

Answer: C

- 53) Upper atmospheric winds refer to
- A) winds in the thermosphere.
  - B) winds that are unrelated to surface weather patterns.
  - C) middle and upper tropospheric circulation.
  - D) winds that flow principally from the east.
  - E) mesospheric wind flow.

Answer: C

- 54) Within the upper-air westerly wind flow are great waving undulations
- A) that were first described by Hadley, an 18th century English scientist.
  - B) known as Rossby waves that involve contact between cooler and warmer air masses.
  - C) that are unrelated to the jet stream.
  - D) that are called Hadley cells.

Answer: B

55) Which of the following is true?

- A) The polar and the subtropical jet streams both occur near the tropopause boundary.
- B) Jet stream flows undulate, producing a wavy pattern when viewed from above.
- C) The polar jet stream can migrate as far south as Texas.
- D) All of these are true.

Answer: D

56) The polar jet tends to flow above the

- A) ITCZ.
- B) subtropical high.
- C) subpolar low.
- D) polar high.

Answer: C

57) The jet streams help control

- A) the movement of high and low pressure systems.
- B) the movement of storms.
- C) the boundary between cold polar air to the north and warm air to the south.
- D) all of the above
- E) None of these jet streams do not affect surface weather phenomena.

Answer: D

58) Which of the following is true regarding multiyear oscillations?

- A) Although it is most famous, the El Niño - La Niña system is not a multiyear oscillation.
- B) The Arctic Oscillation alternates with the Antarctic Oscillation.
- C) The Pacific Decadal Oscillation has a 20-30 year cycle.
- D) The North Atlantic Oscillation is unrelated to the Arctic Oscillation.

Answer: C

59) Land-sea breezes are caused by

- A) the fact that water heats and cools faster than land surfaces.
- B) cooler air flowing offshore (toward the ocean) in the afternoon.
- C) onshore (toward the land) air flows that develop in the afternoon as the land heats faster than neighboring water surfaces.
- D) the fact that warmer air is denser and settles to the surface of the land.

Answer: C

60) During the day along the coast, the wind tends to blow toward the \_\_\_\_\_ because \_\_\_\_\_.

- A) land; land heats more rapidly than water
- B) land; land heats more slowly than water
- C) water; water heats more slowly than land
- D) water; water heats more rapidly than land

Answer: A

61) Mountain-valley breezes are caused by

- A) warmer air descending mountain slopes during the day.
- B) valley air ascending the mountain slopes at night.
- C) warm air rising upslope during the day and cooler air descending the slopes at night.
- D) gravity-drainage.

Answer: C



62) The winds that blow off the ice sheets of Antarctica and Greenland are

- A) similar to land-sea breezes.
- B) mountain-valley breezes.
- C) unrelated to pressure differences.
- D) called katabatic winds.

Answer: D

63) Monsoonal winds are

- A) katabatic in nature.
- B) regional wind systems that seasonally vary.
- C) limited to the Indian subcontinent.
- D) a form of mountain-valley wind.

Answer: B

64) A monsoon climate is characterized by \_\_\_\_\_ summers and \_\_\_\_\_ winters.

- A) dry; dry
- B) dry; wet
- C) wet; dry
- D) wet; wet

Answer: C

65) The winter monsoon occurs because

- A) the Asian landmass is warmer than the ocean during winter.
- B) the Asian landmass is colder than the ocean during winter.
- C) high pressures develop over the Asian landmass during winter.
- D) both A and C
- E) both B and C

Answer: E

66) Which of the following is true of India's weather patterns?

- A) Monsoonal rains are heaviest in winter from December to February.
- B) The shifting of the intertropical convergence zone and upper air circulation brings heavy precipitation in summer from June to September.
- C) Dry winds desiccate the land during each summer.
- D) They are characterized by an even distribution of precipitation throughout the year.

Answer: B

67) Which of the following is true of the monsoons in the Indian subcontinent?

- A) Dry winds blow offshore from March through May.
- B) A wet period occurs in the summer between June and September.
- C) Cool dry winds blow out from Asia during winter months.
- D) Spring is characterized by dust and heat, and the summer by heavy rains.
- E) All of these are correct.

Answer: E

68) Ocean currents are produced by

- A) the frictional drag of winds.
- B) the Coriolis force and water density differences.
- C) land-sea breezes.
- D) Both A and B are correct.

Answer: D

- 69) Forceful northward flowing warm currents in the Northern Hemisphere are the
- A) equatorial countercurrents.
  - B) California and Peru currents.
  - C) upwelling and downwelling currents.
  - D) Gulf Stream current and Kuroshio.

Answer: D

- 70) The equatorial currents are driven by
- A) the upper-level easterlies.
  - B) the trade winds.
  - C) salinity differences in the ocean.
  - D) monsoon winds.

Answer: B

- 71) Which of the following is true of upwelling zones?
- A) They are nutrient-rich.
  - B) They occur along the west coasts of continents.
  - C) They are most common above deep ocean basins.
  - D) All of the above are true.
  - E) A and B only

Answer: D

- 72) Which of the following is false regarding thermohaline circulation?
- A) Its speed is increasing as fresh water enters the ocean from melting glaciers.
  - B) It has slowed down by 30%.
  - C) A complete cycle can take 1000 years to complete.
  - D) Surface polar waters are becoming less saline, while surface tropical waters are becoming more saline.

Answer: A

- 73) Which of the following is false regarding wind power in the United States?
- A) Farmers in Wyoming could earn \$100,000 per acre "farming" wind power.
  - B) Wind power is cheaper and less risky than nuclear power.
  - C) Seasonal production and demand are well matched.
  - D) Texas, North Dakota, and South Dakota could provide enough electricity from wind to power the entire country.
  - E) None of these is false, they are all true.

Answer: E

- 74) Relative to the costs (cost per kilowatt hour) for wind turbines,
- A) coal power is much cheaper and safer.
  - B) nuclear power is much cheaper and safer.
  - C) electricity generated from natural gas is much cheaper.
  - D) coal, nuclear power, and natural gas are all much cheaper.
  - E) coal, nuclear power, and natural gas are all more expensive.

Answer: E

- 75) Which of the following is a benefit of wind power as opposed to other, more traditional power sources?
- A) It does not produce radioactive wastes.
  - B) It is renewable.
  - C) It does not produce air pollution and acid rain.
  - D) It does not require mining.
  - E) All of the above are benefits.

Answer: E

- 76) Of the following countries, this one has done the least to promote the use of wind energy
- A) United States.
  - B) Germany.
  - C) Denmark.
  - D) Spain.

Answer: A

- 77) This country has the highest installed wind-generating capacity
- A) Spain.
  - B) India.
  - C) China.
  - D) Germany.

Answer: D

- 78) Which of the following is false regarding wind power?
- A) Globally, the supply of wind power is five times greater than current energy use.
  - B) 70 percent of wind power installations are in the United States.
  - C) Wind power in the United States could reduce coal emissions of CO<sub>2</sub> by 59 percent.
  - D) By 2010, wind power could supply 10 percent of worldwide energy and create 1.7 million new jobs.

Answer: B

- 79) An understanding of atmospheric air circulation was an impetus for the development of a nuclear test ban treaty for above-ground explosions.

Answer:  True  False

- 80) E. Torricelli invented a device used for the measurement of air pressure.

Answer:  True  False

- 81) Normal sea level pressure has a standard value of 1013.2 mb (29.92 in) of Hg.

Answer:  True  False

- 82) Wind speed is measured with a barometer.

Answer:  True  False

- 83) Winds are named for the direction in which they are blowing, not from where they originate.

Answer:  True  False

- 84) The pressure gradient force drives air from areas of higher pressure to areas of lower pressure.

Answer:  True  False

- 85) The Coriolis force is responsible for the direction water rotates when flowing into a drain.

Answer:  True  False

- 86) Friction creates a deflection in wind movements that is always to the right in the Northern Hemisphere.  
Answer: True  False
- 87) The forces that control the wind include the pressure gradient force, Coriolis force, and friction force.  
Answer:  True False
- 88) A line connecting points of equal pressure on a weather map is called an isobar.  
Answer:  True False
- 89) The pressure gradient force and the friction force together produce geostrophic winds along Earth's surface.  
Answer: True  False
- 90) The effect of surface friction extends to a height of about 500 m (1640 ft) although it may vary with wind speed, season, time of day, and pressure patterns.  
Answer:  True False
- 91) A primary low-pressure area occurs from 20 degrees to 35 degrees north latitude and south latitude.  
Answer: True  False
- 92) The dynamic secondary pressure areas located around 60 degrees north latitude are the subpolar low-pressure centers.  
Answer:  True False
- 93) The intertropical convergence zone (ITCZ) shifts as far north as the Persian Gulf region in July even though it is associated with equatorial circulation.  
Answer:  True False
- 94) Subtropical high-pressure systems generate both the trade winds and the westerlies.  
Answer:  True False
- 95) The doldrums are associated with the subtropical pressure belt, and the horse latitudes are associated with the equatorial belt.  
Answer: True  False
- 96) In India, monsoon rains come in the winter season.  
Answer: True  False
- 97) Ocean currents play a relatively small role in regulating climate.  
Answer: True  False
- 98) Areas in which gravity drainage of air occurs would make potentially good sites for wind turbines.  
Answer:  True False
- 99) In Wyoming, the amount of electricity generated by wind turbines in a single year can actually exceed the price of a hectare of land by many times.  
Answer:  True False
- 100) The U.S. has less than 5 percent of the world's population and consumes nearly 30 percent of the crude oil extracted worldwide.  
Answer:  True False

- 101) The global potential for wind energy is enough to meet a little less than half the planet's energy needs.  
Answer: True  False
- 102) Currently, the European Union has plans to develop more wind energy than United States plans for.  
Answer:  True  False
- 103) The keystone of Vice-President Cheney's energy policy was reliance on cheaper, environmentally friendly, renewable energy sources such as wind and solar.  
Answer: True  False
- 104) The horizontal motion of air across Earth's surface is called \_\_\_\_\_. Wind speed is measured with an \_\_\_\_\_ and wind direction with a \_\_\_\_\_. A descriptive scale useful in visually estimating winds is the traditional \_\_\_\_\_.  
Answer: wind; anemometer; wind vane; Beaufort wind scale
- 105) The four forces that shape the speed and direction of winds are \_\_\_\_\_; \_\_\_\_\_; \_\_\_\_\_; \_\_\_\_\_.  
Answer: gravity; pressure gradient force; Coriolis force; friction