

1. What is the average amount of solar energy retained by Earth?
 - A) 238 W/m^2
 - B) 340 W/m^2
 - C) 1362 W/m^2
 - D) 2700 W/m^2
 - E) None of the answers is correct.

2. What percentage of the gases that form Earth's atmosphere are contained in the troposphere and stratosphere?
 - A) 19.9%
 - B) 30%
 - C) 80%
 - D) 99.9%
 - E) None of the answers is correct.

3. Which of the following has the highest average albedo range?
 - A) desert sand
 - B) forest
 - C) fresh snow or ice
 - D) water
 - E) All of the above are similar in albedo range.

4. Where on Earth experiences the largest seasonal temperature range?
 - A) Africa
 - B) Asia
 - C) Australia
 - D) Indian Ocean
 - E) South America

5. Water heated to 100°C will stop increasing in temperature for a time even as additional energy is applied. Why?
 - A) A significant amount of energy is required to affect the state change of water from liquid to vapor.
 - B) Boiling water dampens the source of heat.
 - C) Energy sources are always cyclical in nature.
 - D) Excess energy warms the air rather than the water.
 - E) All of the answers are correct.

6. How much of the net transport of heat from the equator toward Earth's poles occurs in the lower atmosphere?
- A) one-eighth
 - B) two-thirds
 - C) three-quarters
 - D) four-fifths
 - E) None of the answers is correct.
7. In which of the following cases would the atmosphere tend to be destabilized?
- A) Air at low levels is cold with little water vapor.
 - B) Air near the surface is very dense.
 - C) Little solar energy is being absorbed by the ground surface.
 - D) The lower atmosphere is warm with a high water vapor content.
 - E) All of the answers are correct.
8. What is the driving force for the Hadley cell circulation pattern?
- A) glacial movement
 - B) ocean gyres
 - C) tectonic convection
 - D) tropical heating
 - E) None of the answers is correct.
9. Which of the following statements about monsoonal circulations is correct?
- A) High pressure over continental surfaces leads to heavy precipitation on land.
 - B) Monsoons are caused by tropical storms embedded in the Hadley cells.
 - C) Summer monsoons tend to produce precipitation on continental surfaces.
 - D) The strongest monsoon circulations occur where there are little seasonal differences in the surface heating of the land and ocean.
 - E) None of the answers is correct.
10. What effect do mountain ranges have on the distribution of precipitation?
- A) Air is warmed as it rises up the side of a mountain, reducing precipitation rates.
 - B) A rain shadow is produced on the side facing ocean winds.
 - C) Precipitation is enhanced on the windward side and reduced on the leeward side.
 - D) Water vapor is added to the atmosphere as it descends the leeward side, leading to wetter conditions.
 - E) All of the answers are correct.

11. Which of the following statements about subtropical ocean gyres is not true?
- A) Sea level in the middle of a gyre is 2 meters lower than the surrounding ocean.
 - B) Gyre circulation is influenced by atmospheric winds, the Coriolis effect, and continental boundaries.
 - C) Gyres circulate in a clockwise fashion in the Northern Hemisphere.
 - D) The volume of water circulating in gyres is far greater than the combined flow of all of Earth's rivers.
 - E) None of the answers is true.
12. Why does no deep water form today in the high latitudes of the Pacific Ocean?
- A) The ocean depth is too shallow.
 - B) There is excess salt rejection.
 - C) The salinity of the surface water is too low.
 - D) The surface water is too cold.
 - E) All of the answers are correct.
13. In which of the following areas would you expect upwelling of ocean water to occur?
- A) where sea ice forms
 - B) where surface waters cool
 - C) where surface winds blow parallel to coastlines
 - D) where high evaporation rates increase surface salinity
 - E) None of the answers is correct.
14. What effect does sea ice have on atmospheric temperature?
- A) Latent heat is given off to the atmosphere as sea ice melts, providing additional warming.
 - B) Sea ice prevents the release of heat from the ocean beneath, allowing air temperatures to get much colder in winter.
 - C) Solar energy is reflected off of sea ice and back through the atmosphere, providing additional warming in summer.
 - D) Thermal energy is conducted rapidly through sea ice from the ocean to the atmosphere above.
 - E) None of the answers is correct.
15. What percentage of the Earth's land surface is covered by the two existing ice sheets on Antarctica and Greenland?
- A) 0.11%
 - B) 0.3%
 - C) 1.3%
 - D) 3%
 - E) 11%

16. In which of the following cases would glacier mass balance be positive?
- A) Ablation exceeds accumulation.
 - B) The glacier is shrinking.
 - C) The mean annual temperature at the highest elevation of the ice sheet is -5°C .
 - D) The overall snowfall rate is greater than ice loss through melting and calving.
 - E) All of the cases would be positive.
17. Which of the following statements about Earth's carbon cycle is correct?
- A) Carbon contained in sediments and rocks is permanently removed from the carbon cycle.
 - B) Carbon does not readily move between the atmosphere and surface ocean.
 - C) The largest carbon reservoirs exchange carbon at the fastest rates.
 - D) Photosynthesis constitutes the most rapid annual carbon exchange.
 - E) All of the answers are correct.
18. What is the main factor that influences regional biomass?
- A) the amount of rainfall received
 - B) the amount of sunlight striking the surface
 - C) the concentration of atmospheric carbon dioxide
 - D) the type and depth of soil
 - E) None of the answers is correct.
19. Why are the rates of photosynthesis in sunlit surface ocean waters limited?
- A) Sunlight cannot penetrate below the top 1 m of water.
 - B) Surface waters are depleted of nutrients when phytoplankton die and sink to deeper waters.
 - C) There is no photosynthesizing plant life in the surface oceans.
 - D) There is very little CO_2 in surface ocean waters.
 - E) All of the answers are correct.
20. What causes the observed annual rise and fall of carbon dioxide?
- A) annual patterns of deforestation and forest regrowth in the tropics
 - B) seasonal changes in atmospheric circulation patterns
 - C) seasonal changes in the rate of fossil fuel burning
 - D) seasonal changes in the rates of photosynthesis and oxidation in the Northern Hemisphere
 - E) None of the answers is correct.

21. The radiant energy important to Earth's climate system falls within a narrow band of the electromagnetic spectrum from infrared to ultraviolet.
A) True
B) False
22. The greenhouse effect of Earth's atmosphere is responsible for raising the temperature of Earth's surface by about 5°C above what it would be in the absence of an atmosphere.
A) True
B) False
23. Latitudes near the equator experience much larger seasonal changes in solar radiation than mid- and high-latitudes.
A) True
B) False
24. Deep ocean waters tend to be colder and saltier than waters at the surface.
A) True
B) False
25. Ocean productivity is greatest near the centers of the subtropical gyres.
A) True
B) False
26. Summarize Earth's radiation budget, describing the pathways taken by incoming shortwave and outgoing longwave radiation.
27. Why is the annual temperature range over northwestern Asia so much greater than the annual temperature range over the Indian Ocean?
28. Describe the circulation of the atmosphere within the tropics and subtropics, including the important pressure, wind, and precipitation belts. How do monsoons play a role in tropical and subtropical circulation?
29. What drives the circulation of the deep ocean? Describe the important sources of subsurface water filling the North Atlantic basin.

30. Outline the Earth's carbon cycle. Include the important carbon reservoirs and the processes involved in exchanging carbon between them.

Answer Key

1. A
2. D
3. C
4. B
5. A
6. B
7. D
8. D
9. C
10. C
11. A
12. C
13. C
14. B
15. E
16. D
17. D
18. A
19. B
20. D
21. A
22. B
23. B
24. A
25. B
- 26.
- 27.
- 28.
- 29.
- 30.