Team #: _____ Team Name: _____

1. Which of the following best compares and contrasts weather and climate?
    a. Both describe the atmosphere, but characterize different variables
    b. Both describe the atmosphere, but over different timescales
    c. Both describe the earth system, but describe different physical features
    d. Both describe the earth system, but describe different locations within it

2. Climate "normals" span
    a. 10 years
    b. 20 years
    c. 30 years
    d. 40 years
    e. 50 years

3. Which of the following is the *best* weather forecast for the high temperature in Grand Rapids one year from now on February 22, 2026?
    a. The high temperature will be 27°F since the forecasted high temperature for 2-22-2025 was 27°F
    b. The high temperature will be 26°F since the actual high temperature for 2-22-2025 was 26°F
    c. The high temperature will be 36°F since the average high temperature from 1991-2020 was 36°F
    d. The high temperature will be 67°F because the record high temperature was 67°F

4. Predicting weather is a(n) "_____ value problem" whereas predicting climate is a(n) "_____ value problem".
    a. initial; boundary
    b. boundary; initial
    c. quantitative; qualitative
    d. qualitative; quantitative

5. All of the following are greenhouse gases *except*
    a. Argon (Ar)
    b. Carbon dioxide (CO_2)
    c. Nitrous oxide (N_2O)
    d. Water vapor (H_2O)

6. Which of the following greenhouse gases does *not* have any naturally occurring sources?
    a. Sulfur hexafluoride (SF_6)
    b. Methane (CH_4)
    c. Carbon tetrachloride (CCl_4)
    d. Ozone (O_3)

Team #: _____ Team Name: _____

7. As compared to carbon dioxide (CO_2), Methane (CH_4)
    a. Is found at much higher concentrations in the atmosphere
    b. Absorbs and re-radiates more energy per molecule
    c. Is increasing in concentration in the atmosphere at a faster rate
    d. Contributes more overall to human-caused warming of the climate

8. The global warming potential (GWP) value of a greenhouse gas depends on which of the following properties of the gas? (*Select two*)
    a. Lifetime within the atmosphere
    b. Concentration in the atmosphere
    c. Density at standard temperature and pressure
    d. Effectiveness absorbing and re-radiating IR radiation

9. What is the global warming potential of carbon dioxide over 50 years?
    a. 1
    b. 7.1
    c. 50
    d. 100
    e. 2,500

10. All of the following are sources of nitrous oxide driven by human activity *except*
    a. Burning of fossil fuels
    b. Agriculture and wastewater
    c. Refrigerant gases
    d. Biomass burning

11. The largest source of man-made methane is
    a. Landfill waste
    b. Agriculture
    c. Permafrost melting
    d. Fossil fuel burning

12. Earth receives energy from the sun as _____ and loses energy to space as _____.
    a. longwave radiation; shortwave radiation
    b. shortwave radiation; longwave radiation
    c. longwave radiation; longwave radiation
    d. shortwave radiation; shortwave radiation

Team #: _____ Team Name: _____

13. Total solar irradiance at the top of the atmosphere is closest to
    a. 740 W/m^2
    b. 980 W/m^2
    c. 1120 W/m^2
    d. 1360 W/m^2

14. Albedo is the fraction of incoming solar radiation
    a. Absorbed by the atmosphere and surface
    b. Reflected by the atmosphere
    c. Absorbed by the surface
    d. Reflected by the atmosphere and surface

15. On average, the albedo of Earth's surface is closest to
    a. 10%
    b. 20%
    c. 30%
    d. 40%

16. Which of the following land surfaces has the *lowest* albedo?
    a. Fresh snow
    b. Grassy field
    c. Worn concrete
    d. New asphalt

17. Which type of clouds are mostly comprised of ice crystals?
    a. Low clouds
    b. High clouds

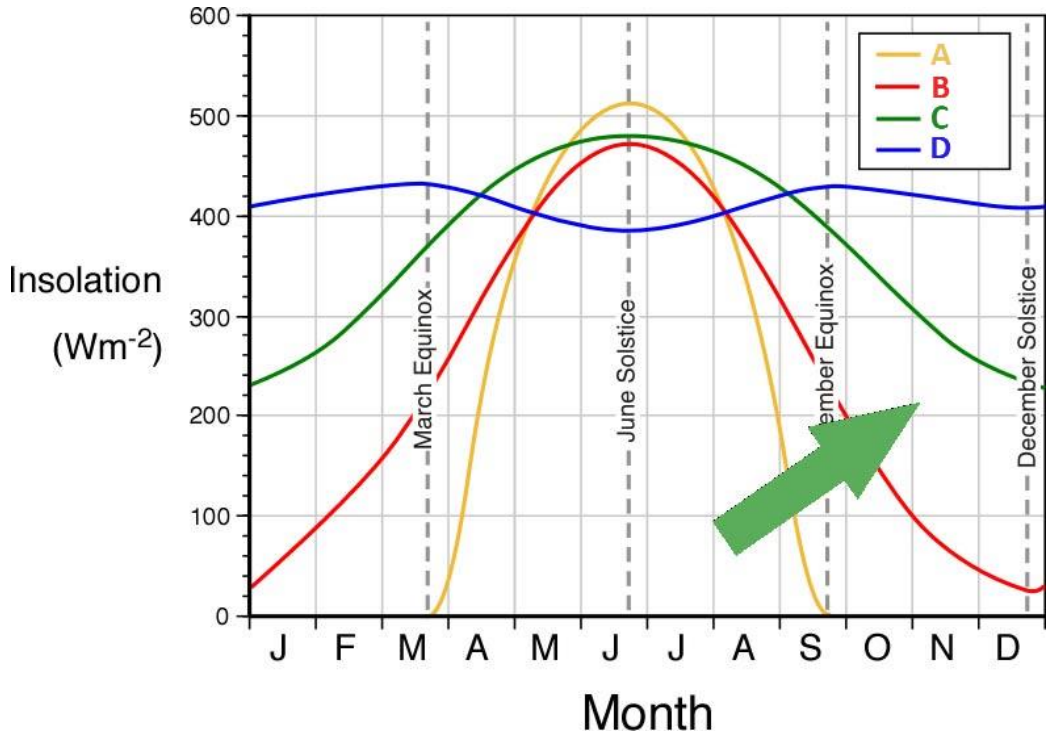
18. Which type of clouds generally have the highest albedo?
    a. Low clouds
    b. High clouds

19. Which type of clouds generally have a cooling effect on temperatures?
    a. Low clouds
    b. High clouds

20. Higher latitudes generally have lower temperatures because
    a. Higher latitudes tend to have weaker urban heat island effects
    b. There is more extensive cloud cover at higher latitudes
    c. Sunlight is spread over larger areas at high latitudes
    d. The Earth is an oblate spheroid, and thus the surface at higher latitudes is different in elevation than lower latitudes

Team #: _____ Team Name: _____

Use the four colored lines in the graph below to answer questions 21-26:



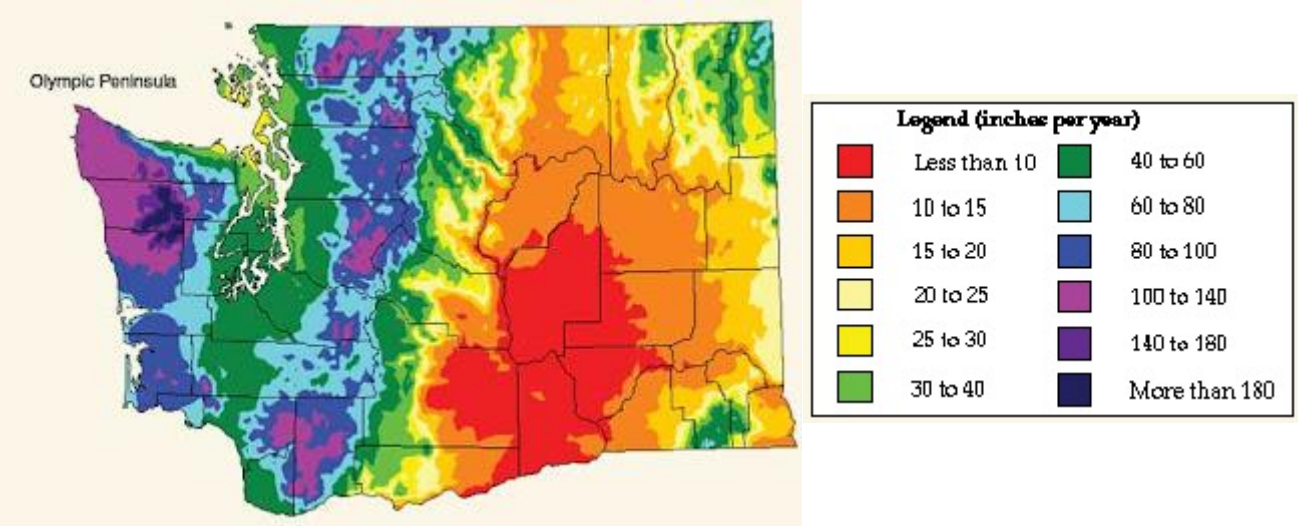
21. Which line in the graph (A, B, C, or D) represents 0° latitude?
22. Which line in the graph (A, B, C, or D) represents 30° latitude?
23. Which line in the graph (A, B, C, or D) represents 60° latitude?
24. Which line in the graph (A, B, C, or D) represents 90° latitude?

25. Which hemisphere do the lines representing 30°, 60°, and 90° represent?
    a. Eastern Hemisphere
    b. Western Hemisphere
    c. Northern Hemisphere
    d. Southern Hemisphere

26. Why does the latitude represented by the blue line receive slightly more insolation at the December Solstice than the June Solstice?
    a. The blue line represents a location in the Southern Hemisphere
    b. The Earth is tilted on its axis
    c. The Earth's orbit is slightly elliptical
    d. The Earth's rotates counterclockwise on its axis rather than clockwise

Team #: _____ Team Name: _____

Use the image below to answer questions 27-32:



27. What type of variable is average annual precipitation?
    a. Discrete
    b. Continuous
    c. Nominal
    d. Ordinal
28. What type of variable is used to display average annual precipitation on the map?
    a. Discrete
    b. Continuous
    c. Nominal
    d. Ordinal
29. What is the prevailing wind direction at latitudes that the state of Washington is found in?
    a. North to South
    b. South to North
    c. East to West
    d. West to East
30. The Olympic Peninsula on the west side of the state contains the Olympic Mountains. On which side of this mountain range does the most precipitation occur?
    a. Western side
    b. Eastern side
    c. Southern side
    d. Northern side
31. The topography of mainland Washington is dominated by the Cascade Mountains. Which direction does this mountain range extend?
    a. East-West
    b. North-South
    c. Any direction is equally likely from the data

Team #: _____ Team Name: _____

32. What term is used to describe the phenomenon by which places in much of eastern Washington, such as Yakima, receive relatively little annual precipitation?
    a. Orogenic aridification effect
    b. Elevation-Transpiration coefficient
    c. Altitude-Condensation coefficient
    d. Rain shadow effect

33. Areas near large bodies of water tend to have a _____ range of monthly average temperatures throughout the year as compared to landlocked areas far from large bodies of water.
    a. Larger
    b. Smaller
    c. Similar
    d. Larger or smaller, depending on if the body of water is saltwater or freshwater

34. Areas on the western side of continents tend to be drier and more arid than areas at the same latitude on the eastern side of continents because
    a. Western sides of continents have different land use patterns, such as more slash-and-burn agriculture
    b. Western sides of continents are located adjacent to cool ocean currents as opposed to warm ocean currents
    c. Western sides of continents receive more incoming solar radiation throughout the year
    d. Prevailing winds always carry air east to west, preventing maritime air from moving onshore on the western side of continents

35. Deep ocean currents are driven by which two properties of water? (*Select two*)
    a. Temperature
    b. Pressure
    c. Salinity (saltiness)
    d. Humidity

36. Which of the following is true about the pressure belt known as the intertropical convergence zone (ITCZ)?
    a. It is found at the equator year-round
    b. It is responsible for a noticeable decrease in albedo in areas where it occurs
    c. It is associated with frequent thunderstorm activity
    d. It is a band of relatively high atmospheric pressure

Team #: _____ Team Name: _____

37. During the winter, the North Pacific weather tends to be driven by a semi-permanent area of pressure known as the
    a. Aleutian Low
    b. Siberian High
    c. Pacific High
    d. Canadian High

38. Plants can affect a location's climate by releasing water vapor into the atmosphere during photosynthesis, a process known as
    a. Transpiration
    b. Arboreal vaporization
    c. Hydrosynthesis
    d. None of the above

39. The process described in the previous question can rapidly cool air temperatures nearby due to
    a. Latent heat
    b. Reduced greenhouse effect
    c. Specific heat
    d. Increased greenhouse effect

40. The NOAA evaluates El Niño and La Niña based on
    a. Ocean current speed over the eastern equatorial Pacific
    b. Sea surface temperatures over the eastern equatorial Pacific
    c. Ocean current speed over coastal waters off Peru
    d. Sea surface temperatures over coastal waters off Peru

41. Currently (as of February 2024), the status of the El Niño-Southern Oscillation is
    a. Strong El Niño
    b. Weak El Niño
    c. Neutral
    d. Weak La Niña
    e. Strong La Niña

42. Over the past few decades, new records for "hottest year on record" have typically been set during
    a. El Niño years
    b. ENSO-neutral years
    c. La Niña years
    d. ENSO-undetermined years

Team #: _____ Team Name: _____

43. Which condition tends to be associated with drier than average conditions along the Gulf Coast region of the United States?
    a. El Niño
    b. La Niña

44. A heat wave is most typically defined as
    a. A brief period of intense heat in an area lasting several hours or more
    b. A stretch of three or more days when the high and low temperature of an area exceeds 90°F
    c. A period of relatively intense heat and potentially humid weather persisting for multiple days
    d. A stretch of multiple days when daytime high temperatures exceed nighttime low temperatures by 40°F or more

45. According to the IPCC, if current temperature trends persist, heat waves will increase in
    a. Duration
    b. Frequency
    c. Intensity
    d. All of the above
    e. None of the above

46. Heat waves typically have negative impacts on all of the following *except*
    a. Health, particularly among senior citizens
    b. Ozone depletion
    c. Labor productivity
    d. Agricultural yields

47. The vast majority (>90%) of excess energy that has accumulated in Earth's climate system due to global warming is stored in
    a. The atmosphere as temperature increases
    b. The lithosphere as geothermal heat
    c. The atmosphere as stronger winds
    d. The oceans as temperature increases

48. Which of the following will have the *least* significant impact on sea level rise?
    a. Melting of Arctic sea ice
    b. Melting of the Greenland Ice Sheet
    c. Melting of the West Antarctic Ice Sheet
    d. Melting of the East Antarctic Ice Sheet

Team #: _____ Team Name: _____

49. Sea level rise is expected to accelerate due to
    a. Breakup of sea ice in the Northwest Passage
    b. Climate feedback mechanisms
    c. Disruption of the thermohaline circulation
    d. Thermal expansion of deep-ocean water
    e. All of the above

50. Abnormally high rainfall events in fire-prone areas do all of the following *except*
    a. Increase wildfire risk in future years
    b. Decrease short-term wildfire risk
    c. Reduce risk of thunderstorms in future years
    d. Alleviate potential drought conditions

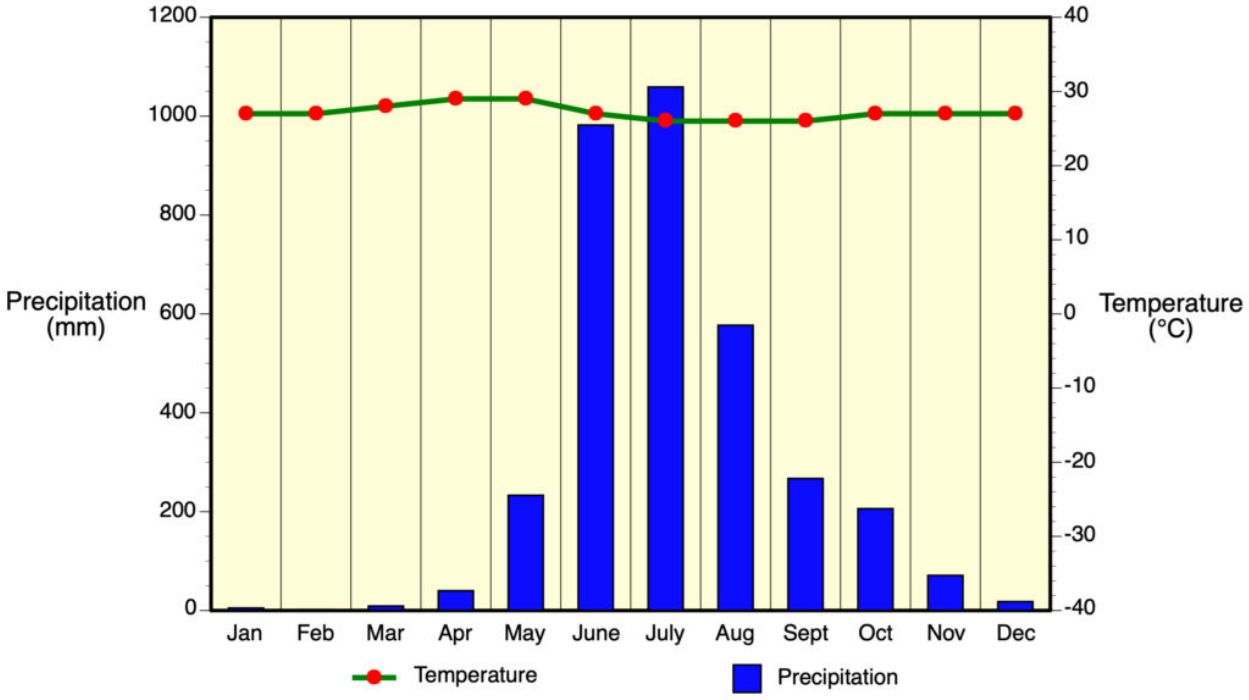
51. All of the following are true regarding wildfires in the United States since the 1980s *except*
    a. The amount of area burned has increased
    b. The intensity/severity of damage from fires has increased
    c. The total number of wildfires annually has increased
    d. The peak of wildfire season is generally occurring earlier in the year

52. Over the past 50 years, river flooding intensity and frequency in the US has
    a. Increased nearly everywhere
    b. Increased in some areas and decreased in other areas
    c. Decreased nearly everywhere
    d. Remained mostly constant
    e. None of the above

53. Changes in river flooding in the US over the past 50 years correlate best with changes in
    a. Frequency of heavy precipitation events
    b. Sea level rise
    c. Evapo-transpiration rates
    d. River flooding has remained constant

Team #: _____ Team Name: _____

Use the climatograph of Mangalore, India below to answer questions 54-56:



54. Roughly what percent of Mangalore's precipitation falls in the months of June, July, and August?
    a. 15%
    b. 25%
    c. 40%
    d. 60%
    e. 80%

55. The seasonal circulation that results in the extreme variation in monthly precipitation in Mangalore throughout the year is known as a
    a. Chinook wind
    b. Walker cell
    c. Northeast trade wind
    d. Monsoon

56. Which of the following major classes does Mangalore belong to using the Köppen climate classification system?
    a. A (tropical)
    b. B (arid)
    c. C (temperate)
    d. D (continental)
    e. E (polar)

Team #: _____ Team Name: _____

57. Which of the following correctly contrasts positive and negative feedback systems?
    a. Positive feedback loops are known as “reinforcing” feedback, whereas negative feedback loops are known as “balancing” feedback
    b. Positive feedback loops increase the temperature of the planet, whereas negative feedback loops decrease the temperature of the planet
    c. Positive feedback loops involve an initial increase in temperature, whereas negative feedback loops involve an initial decrease in temperature
    d. Positive feedback loops are confined to the atmosphere only, whereas negative feedback loops may involve the hydrosphere, cryosphere, biosphere, and lithosphere

58. If atmospheric temperatures were to decrease, which of the following feedback systems would result in a subsequent increase in temperatures
    a. Ice-albedo feedback
    b. Water vapor feedback
    c. Blackbody radiation feedback
    d. Forest fire feedback

59. If atmospheric and oceanic temperatures increase, the solubility of carbon dioxide in the ocean would _____, eventually resulting in a(n) _____ in temperatures.
    a. increase; increase
    b. increase; decrease
    c. decrease; increase
    d. decrease; decrease

60. Paleoclimates can be studied using speleothems (such as stalactites and stalagmites) using analysis of all of the following *except*
    a. Growth-ring thickness
    b. Brachiopod fossils
    c. Uranium-Thorium radioactive dating
    d. Oxygen isotope ratio

61. Which of the following sources of paleoclimate data would be the most likely to be able to provide direct samples of the prehistoric atmosphere?
    a. Tree rings
    b. Speleothems
    c. Sediment cores
    d. Ice cores

Team #: _____ Team Name: _____

62. Which of the following sources of paleoclimate data generally has the most limited range (i.e. can't go as far back in time as the others)?
    a. Tree rings
    b. Speleothems
    c. Sediment Cores
    d. Ice cores

63. Factors that contributed to the most recent ice age (Pleistocene) include
    a. Decreases in atmospheric carbon dioxide
    b. Movements of tectonic plates
    c. Changes in Earth's orbit and rotation
    d. All of the above
    e. None of the above

64. Which of the following best describes how temperatures were impacted during the period known as the Younger Dryas?
    a. Many locations in the Northern Hemisphere experienced cooling, while many locations in the Southern Hemisphere experienced warming
    b. Many locations in the Northern Hemisphere experienced warming, while many locations in the Southern Hemisphere experienced cooling
    c. Most locations in both hemispheres experienced cooling of roughly 1°F
    d. Most locations in both hemispheres experienced warming of roughly 1°F

65. The leading theory of why the Younger Dryas period occurred is that it was due to
    a. A sudden decrease in carbon dioxide levels due to vegetation growth in recently de-glaciated areas
    b. A large meteor impact over North America
    c. Disruption of thermohaline ocean currents due to freshwater from melting glaciers
    d. Reductions in stratospheric ozone concentrations

66. Large, explosive volcanic eruptions such as those of Krakatoa in 1883 and Mount Pinatubo in 1991 can have a *warming* effect on climate by
    a. Releasing large amounts of geothermal heat into the ocean
    b. Reducing the amounts of atmospheric oxygen-18
    c. Releasing greenhouse gases like carbon dioxide and water vapor into the atmosphere
    d. Reducing land albedo as a result of the formation of igneous rocks such as obsidian

Team #: _____ Team Name: _____

67. Large, explosive volcanic eruptions such as those of Krakatoa in 1883 and Mount Pinatubo in 1991 can have a *cooling* effect on climate by
    a. Releasing sulfur compounds into the stratosphere which form aerosols that increase albedo
    b. Interrupting surface ocean currents near the eruption
    c. Removing carbon dioxide from the atmosphere through the formation of carbonate rocks
    d. Creating long-lived pyrocumulus clouds near the volcano that block most incoming solar radiation

68. Altogether, what effect do eruptions like those mentioned in questions 66 and 67 have on global temperatures?
    a. Warming effect
    b. Cooling effect
    c. Neither cooling nor warming

69. The representative concentration pathways (RCPs) describe the projected change in radiative forcing for the year _____ as compared to the year 1750.
    a. 2035
    b. 2050
    c. 2100
    d. None of the above

70. Plot the Berkley Earth global temperature anomaly data in the table below on the blank graph provided with your answer sheet. Be sure to label the axes.

Year	Temperature anomaly relative to 1951-1980 normals (°C)
1970	+0.015
1980	+0.309
1990	+0.464
2000	+0.445
2010	+0.777
2020	+1.049
2024	+1.311