Science Olympiad Division B
Test SSSS 2020

Meteorology

Team Name:_____

Team #:_____

Student #1:_____

Student #2:_____

Do not open this packet until instructed to open it.

This is a 50-minute test. The test may be taken apart but all answers must be recorded on the answer sheet provided. When taking this test remember that you can choose more than one answer for multiple choice questions but have to choose all correct answers to get any credit.

Part 1:

For questions 1-4 use the diagram below.
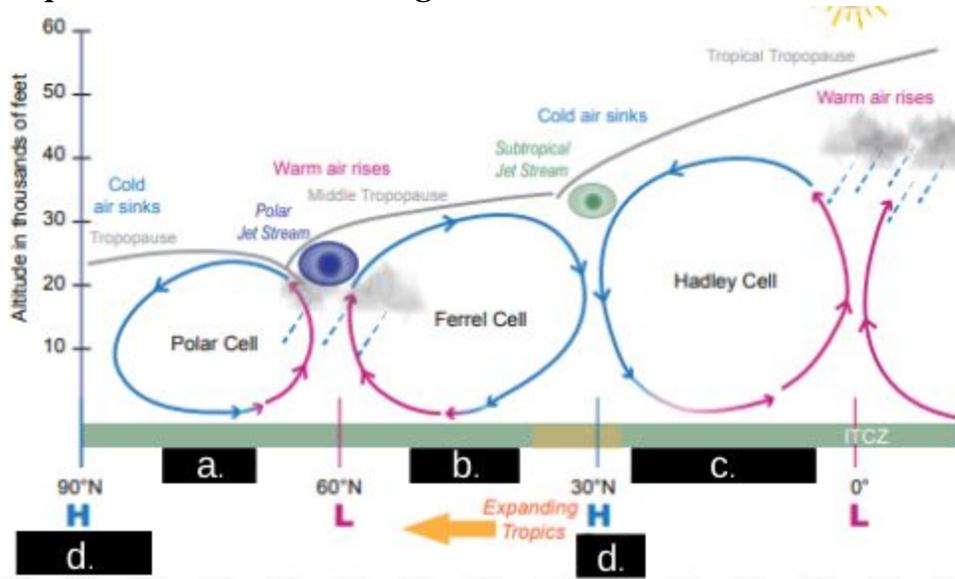
1. What phrase goes in the box labeled a?

a._____

2. What phrase goes in the box labeled b?

b._____

3. What phrase goes in the box labeled c?

c._____

4. What phrase goes in the box labeled d?

d._____

5. _____ warming is related to how frequent and intense severe storms are in the US. What choice(s) fits in the blank?

a) Artic
b) Pacific
c) Sudden stratospheric
d) Global

6. What would a poleward shift, of the Hadley, Ferrel, and Polar cells, affect?

a) Agriculture

b) Urban and suburban areas
c) Industry
d) Synthetic habitats

7. What pollutant has a significant effect on jet streams and their behaviors?
a) Tropospheric ozone
b) Sulfur Dioxide
c) PFAS
d) Aerosols

Questions 8-9 are in true or false format.
8. Only one cell remains dominant, throughout the whole duration of the storm, during a multicell thunderstorm.
a) True
b) False

9. Out of the three types of supercell storms, classic supercells are the most likely to produce tornadoes.
a) True
b) False

10. During a thunderstorm what cloud type does the cumulonimbus storm cloud turn into?
a) Nimbostratus
b) Stratus
c) Cirrus
d) Cumulus

For question 11 reference the image below.

11. Is the following statement true or false? The picture of the clouds was taken after or during the dissipating phase of a thunderstorm.
a) True
b) False

For question 12 reference the image below.

12. Is the following statement true or false? The clouds pictured lead to fair weather.
a) True
b) False

For question 13 reference the image below.

13. What cloud is pictured in the image?
a) Cirrus clouds
b) Orographic clouds
c) Stratus clouds
d) Wave clouds

14. What is the distance of the dissipating phase of a thunderstorm?
a) 5-8 km
b) 8-11 km
c) 8-16 km
d) 11-16 km

For questions 15-16 reference the image below.

15. What is pictured in the image above?
a) Nimbostratus clouds
b) Cirrus clouds
c) Vigra
d) Fallstreaks

16. How did the event in the image above occur?
a) Dry air causing water vapor to transform into ice crystals and form a cloud
b) Snowflakes that fall through dry air that causes the water to evaporate
c) Altostratus clouds deepen and thicken
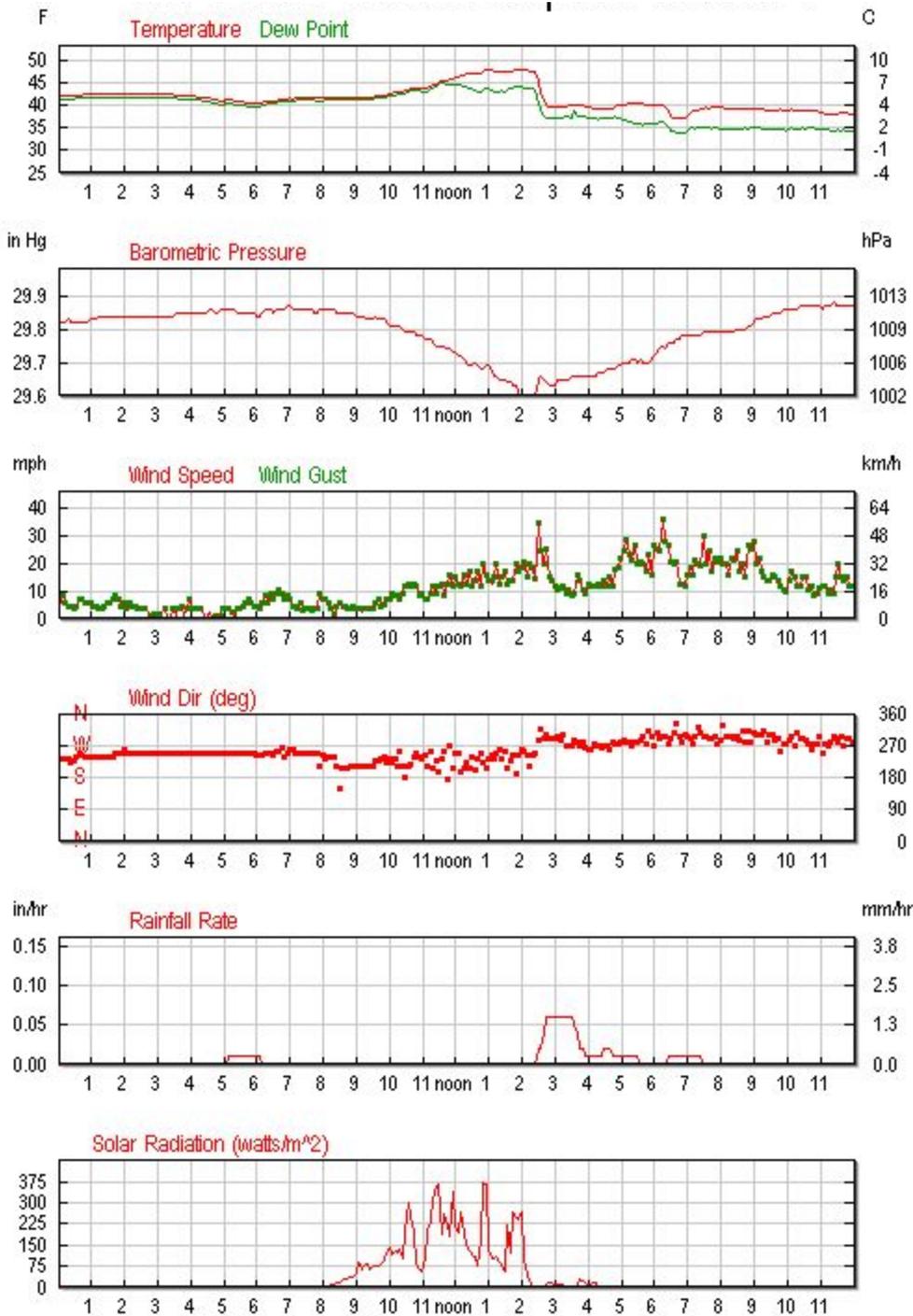d) Rain that evaporates while it is falling

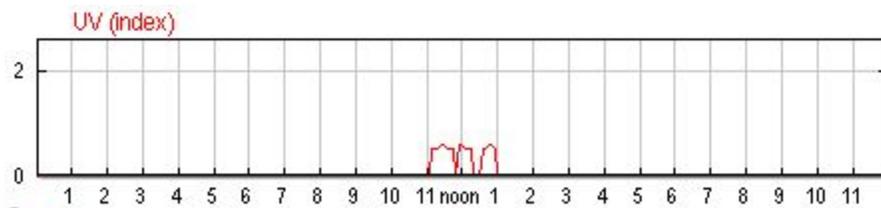**17. By what percent did heavy precipitation change, from 1958-2012, in Hawaii and did it increase or decrease?**
a) 5%, increase
b) 11%, increase
c) 12%, decrease
d) 16%, decrease

18. Increased global warming leads to changes in the levels of
a) Droughts
b) Floods
c) Heavy precipitation
d) Wind strength

For questions 19-20 use the image below.

19. The data above was gathered on 1/25/2014 during a squall line thunderstorm. What kind of general assumption can be drawn from the data provided?

_____
_____

20. Around what time does it appear that the storm was the most severe?
a) 1-2 P.M
b) 2-3 P.M
c) 11 A.M-12 P.M
d) 5-6 P.M

21. A study was conducted that measured the frequency of squall lines in Oklahoma from 1994 to 2003. The study discovered that _____. What goes in the blank? Use your knowledge of squall lines and recent environmental changes to answer this question.
a) Squall lines were more as the years progressed, numbers peaking in the hundreds per year
b) Squall lines were less as the years progressed, numbers peaking in the hundreds per year during the 1995's and decrease since
c) Squall lines were more frequent during warm months, peaking in May
d) Squall lines were more frequent during warm months, peaking in June

22. From the years 1978-1999 what was the minimum and maximum amount of Mesoscale Convective Complexes (MCC) recorded in the US?
a) Minimum: 15; Maximum: 47
b) Minimum: 15; Maximum: 58
c) Minimum: 19; Maximum: 47
d) Minimum: 19; Maximum: 58

23. What percent of the width, at least, must be the equal to the length of the MCC?
a) 30%
b) 50%
c) 70%
d) 90%

24. During a straight-line wind storm what does evaporative cooling enhance?
a) Negative buoyancy of a parcel
b) Severity of the storm
c) Strength and speed of the winds
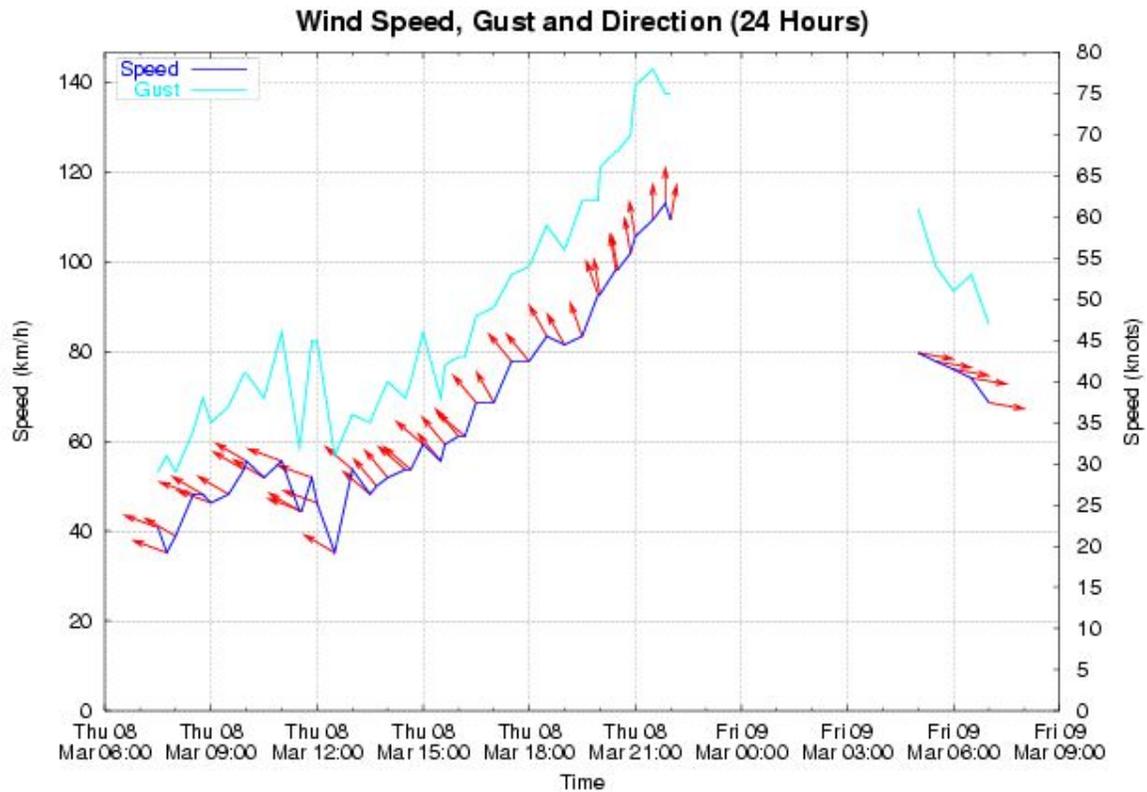d) Temperature of the air

For question 25 reference the image below.

25. Using your knowledge of meteorology which of the options provided likely caused the damage in the image?
a) A derecho
b) A downburst
c) A straight-line wind
d) A microburst

For question 26 reference the graph below.

Wind Speed, Gust and Direction (24 Hours)

26. Using your knowledge of meteorology and data collections, why could there be a gap in the data on this graph?
a) No data was being sent to or received by the weather station
b) The weather station wasn't sending data out
c) Technical problems occured
d) The weather station was reporting irregularly and the data couldn't be used

For questions 27-29 reference the graph below.
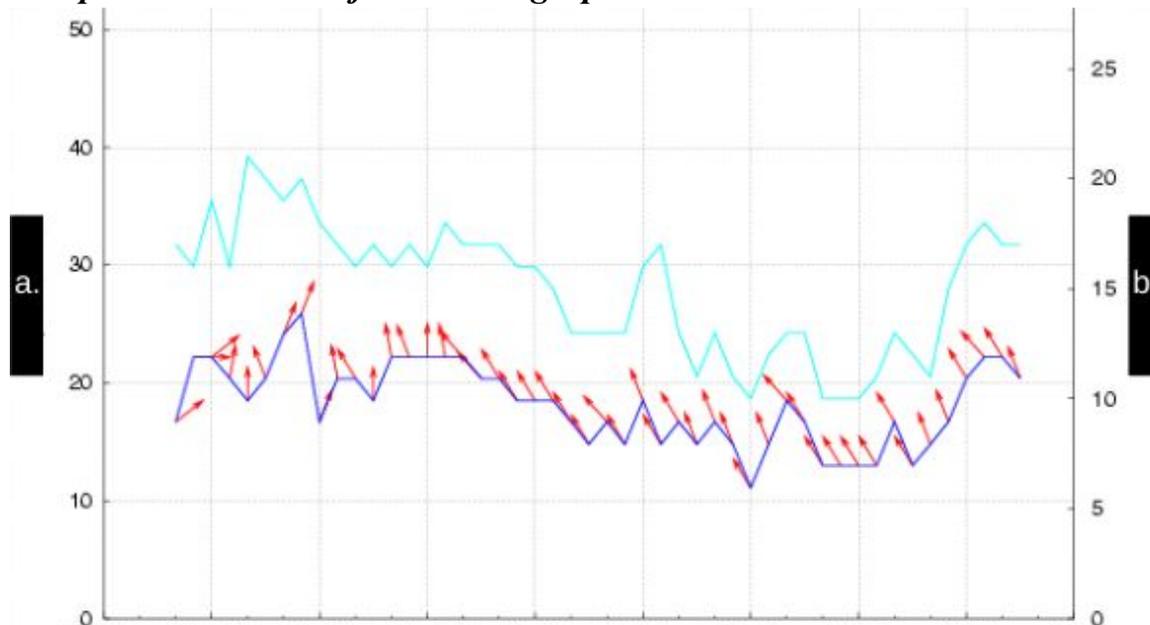
27. What does the graph measure and represent?
a) Wind speed
b) Wind gusts
c) Wind direction
d) Wind altitude

28. What goes in the box labeled a?
a) Altitude (km)
b) Speed (km/h)
c) Speed (knots)
d) Time (hr)

29. What goes in the box labeled b?
a) Altitude (km)
b) Speed (km/h)
c) Speed (knots)
d) Time (hr)

30. Wind graphs show data from the previous _____ hours. What goes in the blank?
a) 12 hours
b) 24 hours

c) 36 hours
d) 72 hours

31. Of the options below which winds are katabatic winds?
a) Foehn winds
b) Mountain breeze
c) Fall winds
d) Planetary winds

32. Where and what causes the peak of the katabatic winds?
a) The pressure-gradient; above the surface of the slope
b) The high-density cold air; on the surface of the slope
c) The surface friction; above the surface of the slope
d) The enormous gravitational energy; on the surface of the slope

For questions 33-34 reference the image below.

33. What meteorological event is portrayed in the image above?
a) Valley fog
b) Freezing fog
c) Frost pocket
d) Frost hollow

34. What caused the meteorological event portrayed in the image above?
a) Strong katabatic winds that flow over mountains into valleys
b) Gentle katabatic winds that flow over hills
c) Cold air moved up over warm water
d) Supercooled water droplets that remain liquid

35. What phenomenon occurs on the Polar Plateau in Antarctica?
a) Density stratification of the air
b) Temperature inversion

c) Mechanical turbulence

d) Atmospheric refraction

For questions 36-39 use the graph below and your information of data collection and organization along with meteorology to answer the questions.

TORNADO DISTRIBUTION
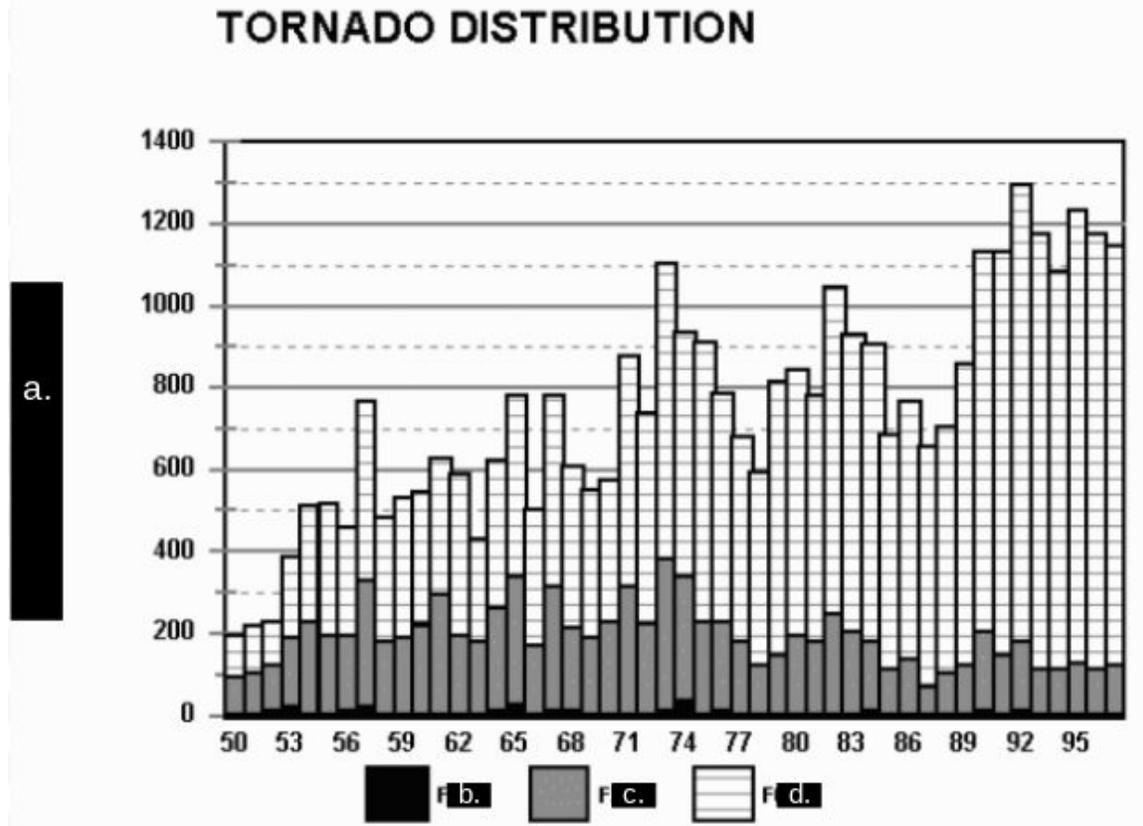
36. What goes in box a?

_____

_____

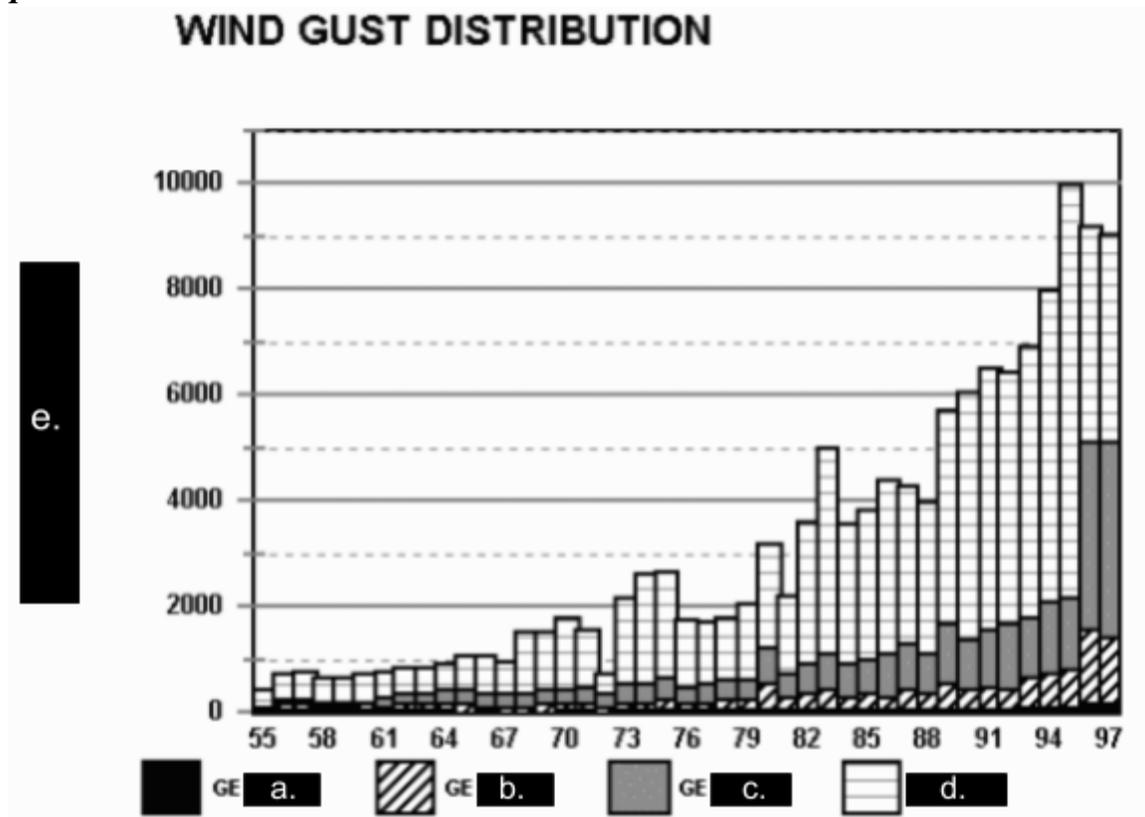**37. What goes in box b?**

a) 0&1

b) 2&3

c) 4&5

38. What goes in box c?

a) 0&1

b) 2&3

c) 4&5

39. What goes in box d?
a) 0&1
b) 2&3
c) 4&5

40. What conclusion can be drawn from the data above?

_____

_____

For questions 41-46 use the graph below and your information of data collection and organization along with meteorology to answer the questions.

WIND GUST DISTRIBUTION

41. What conclusion can be drawn from the data above?

_____

_____

42. What goes in box a?
a) 75 kts
b) 60 kts
c) 50 kts
d) Damage

43. What goes in box b?

a) 75 kts

b) 60 kts

c) 50 kts

d) Damage

44. What goes in box c?

a) 75 kts

b) 60 kts

c) 50 kts

d) Damage

45. What goes in box d?

a) 75 kts

b) 60 kts

c) 50 kts

d) Damage

46. What goes in box e?

_____

_____

For questions 47-50 use the data provided below and your knowledge of meteorology to answer them. This data was provided to the NOAA and was taken from all states in the US and shows the number of droughts during different years.

a).

Number of County/Zone areas affected:	242
Number of Days with Event:	23
Number of Days with Event and Death:	0
Number of Days with Event and Death or Injury:	0
Number of Days with Event and Property Damage:	0
Number of Days with Event and Crop Damage:	2
Number of Event Types reported:	1

b).

Number of County/Zone areas affected:	218
Number of Days with Event:	7
Number of Days with Event and Death:	0
Number of Days with Event and Death or Injury:	0
Number of Days with Event and Property Damage:	0
Number of Days with Event and Crop Damage:	0
Number of Event Types reported:	1

c).

Number of County/Zone areas affected:	297
Number of Days with Event:	6
Number of Days with Event and Death:	0
Number of Days with Event and Death or Injury:	0
Number of Days with Event and Property Damage:	0
Number of Days with Event and Crop Damage:	2
Number of Event Types reported:	1

d).

Number of County/Zone areas affected:	185
Number of Days with Event:	12
Number of Days with Event and Death:	0
Number of Days with Event and Death or Injury:	0
Number of Days with Event and Property Damage:	2
Number of Days with Event and Crop Damage:	3
Number of Event Types reported:	1

47. During what time period was the data in section a taken?
a) 2019-2020
b) 2019-2018
c) 2016-2017
d) 2012-2013

48. During what time period was the data in section b taken?
a) 2019-2020
b) 2019-2018
c) 2016-2017
d) 2012-2013

49. During what time period was the data in section c taken?
a) 2019-2020
b) 2019-2018
c) 2016-2017
d) 2012-2013

50. During what time period was the data in section d taken?
a) 2019-2020
b) 2019-2018
c) 2016-2017
d) 2012-2013

51. What are NEXRAD Level III products?
a) Hail Index Overlay (HI)
b) Mesocyclone Overlay (M)
c) Storm Structure (SS)
d) Tornadic Vortex Signature Overlay (TVS)

For questions 52-55 use this excerpt from NOAA "The U.S. has sustained __ weather-related disasters over the past __ years in which overall damages and costs reached or exceeded $1 billion. ____ of these disasters occurred during the 19___-19___ period with total damages/costs exceeding $170 billion." Use your prior knowledge and reasoning to fill in the blanks.

52. What goes in the first blank?
a) 20
b) 30
c) 40
d) 50

53. What goes in the second blank?
a) 20
b) 30
c) 40
d) 50

54. What goes in the third blank?
a) 16

b) 28
c) 34
d) 46

55. What goes in blanks four and five?
a) 79-88
b) 80-88
c) 88-96
d) 88-99

56. How many stages are there in a gust fronts life span and which one is the last one?
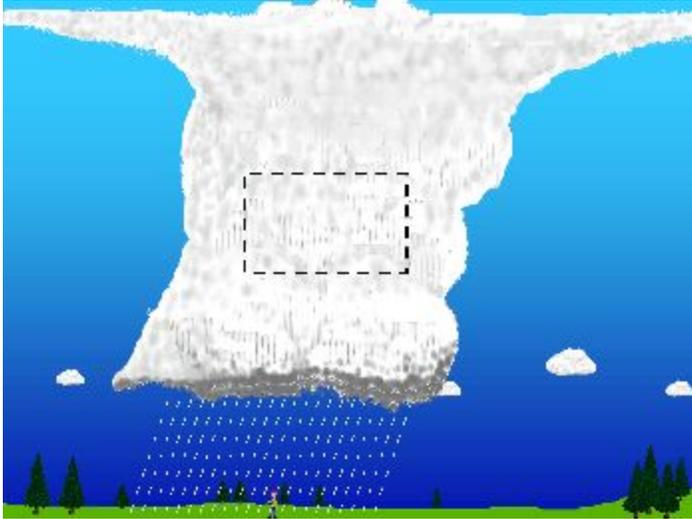a) 3 stages; Late mature stage
b) 3 stages; Dissipating stage
c) 4 stages; Late mature stage
d) 4 stages; Dissipating state

57. What kind of changes do winds associated with gust fronts (coming from thunderstorms) show?
_____
_____

58. What conditions are needed for a storm to form along a gust front?
_____
_____

59. What area is represented in the image below?

_____
_____

60. What is the basic dipole charge system of a thunderstorm?

_____
_____