School Name: _____ Team Number: _____

2016 Purdue Science Olympiad Regional

Meteorology

Division B

You will have 50 minutes to complete this exam. There are 61 questions for a total of 131 points. Points are allotted as noted. Many questions have partial credit, so be sure to show all relevant work.

You may use reference materials in a 3-ring-binder and a calculator that does not connect to the internet. ****Allowing an entire binder was a rule change for the state of Indiana****

You may not consult other teams or use your phones at any time. You may split the test up, but be sure to write your school name on every page. Do not begin until instructed to do so. Good luck!

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1. List the layers of the atmosphere, from closest to the surface to furthest into space. (2 pts)

2. Briefly describe a main reason why the atmosphere is thicker at the equator than the poles. (2 pts)

3. What are the 2 main components of the atmosphere, and what percent of the volume does each account for? (2 pts)

4. Which one of the following items is not considered a pollutant? Circle the correct answer. (2 pts)
    a. Nitrogen Oxides
    b. Ozone
    c. Carbon Monoxide
    d. Argon
5. Which region of the atmosphere contains the ozone layer? (2 pts)

6. In which layer of the atmosphere to most weather patterns occur? (2 pts)

7. Is the temperature hotter at the bottom or the top of the mesosphere? (2 pts)

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8. About what percent of incoming solar radiation is reflected directly back to space by the atmosphere? (2 pts)

9. Briefly define conduction, convection, and radiation. Give one example of each. (6 pts)

10. What are beam spreading and beam depletion, and how does each contribute to the effects of seasons? (3 pts)

11. Which of the following gasses is a greenhouse gas? (2 pts)
    a. Water vapor
    b. Nitrogen
    c. Argon
    d. Hydrogen

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12. How does the tilt of the earth lead to seasons? (2 pts)

13. What causes coastal regions to have more temperate climates than nearby inland regions? (3 pts)

14. Define sensible and latent heat. (2 pts)

15. Why does hot air rise and cold air fall? (2 pts)

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16. What is an air mass? (2 pts)

17. How would you describe an air mass that contained warm, moist air? (1 pt)

18. What is atmospheric stability? (1 pt)

19. What is advection? (2 pts)

20. What is the difference between specific humidity and relative humidity? Which one is measured in percents? (3 pts)

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21. What does the dew point mean? (2 pts)

22. How do most clouds form? (2 pts)

23. Describe the process in which sleet forms. (3 pts)

24. What is the difference between freezing fog and ice fog? (2 pts)

25. In the atmosphere, are vertical or horizontal changes in pressure usually larger? (1 pt)

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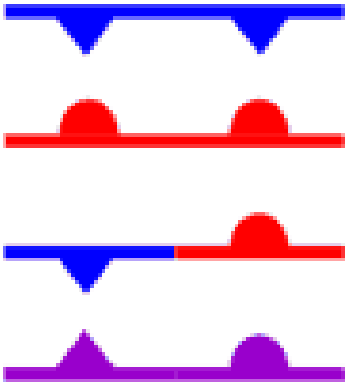
26. Label the fronts in the picture below. (4 pts)



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_____

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27. Is rising air associated with the center of a low pressure system or a high pressure system? (1 pts)

28. Are cloudy and rainy conditions associated with high or low pressure systems? (1 pt)

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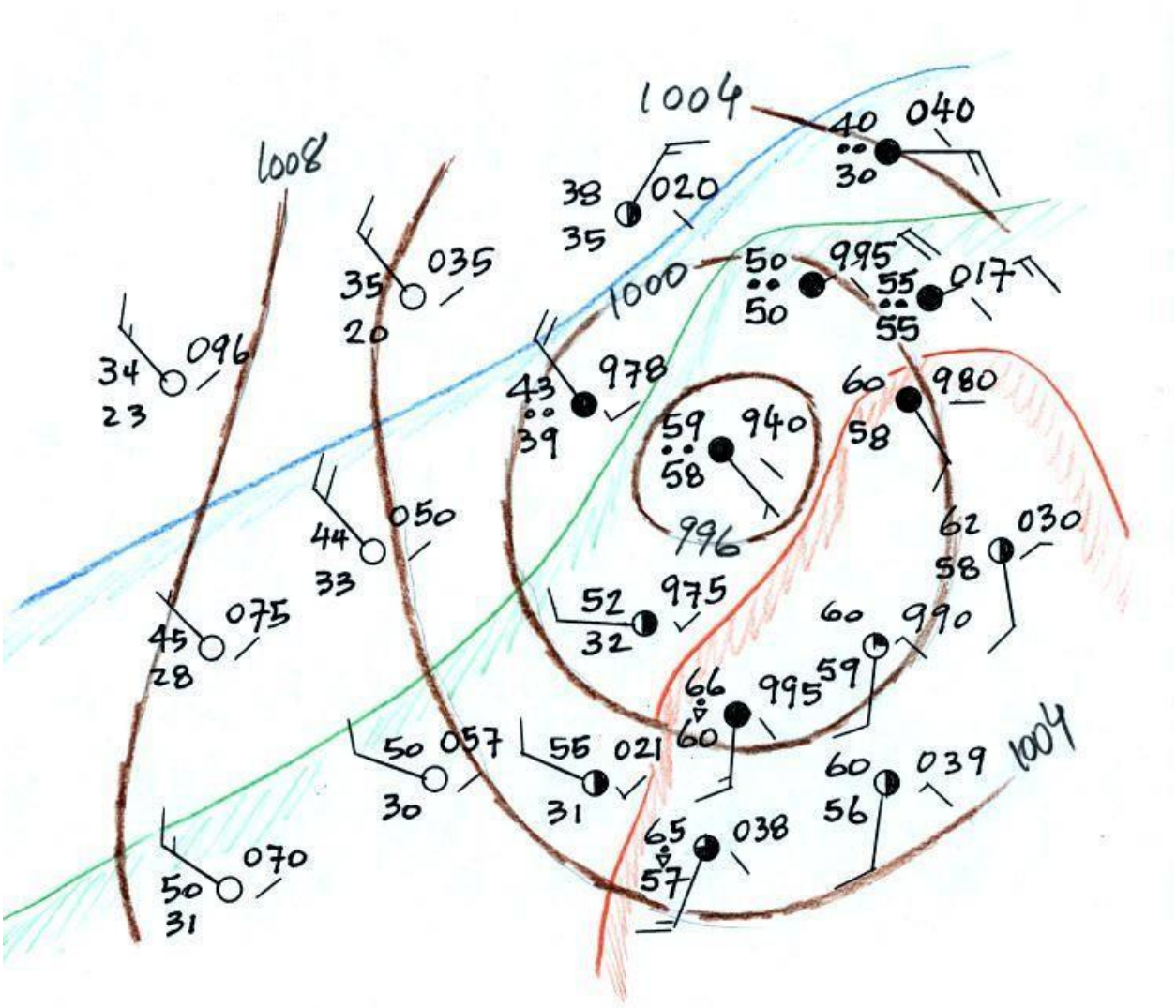
29. Is this system a high or low pressure system? How can you tell? (2 pts)



30. Is the feature in the question above found in the northern or southern hemisphere? How can you tell? (3 pts)

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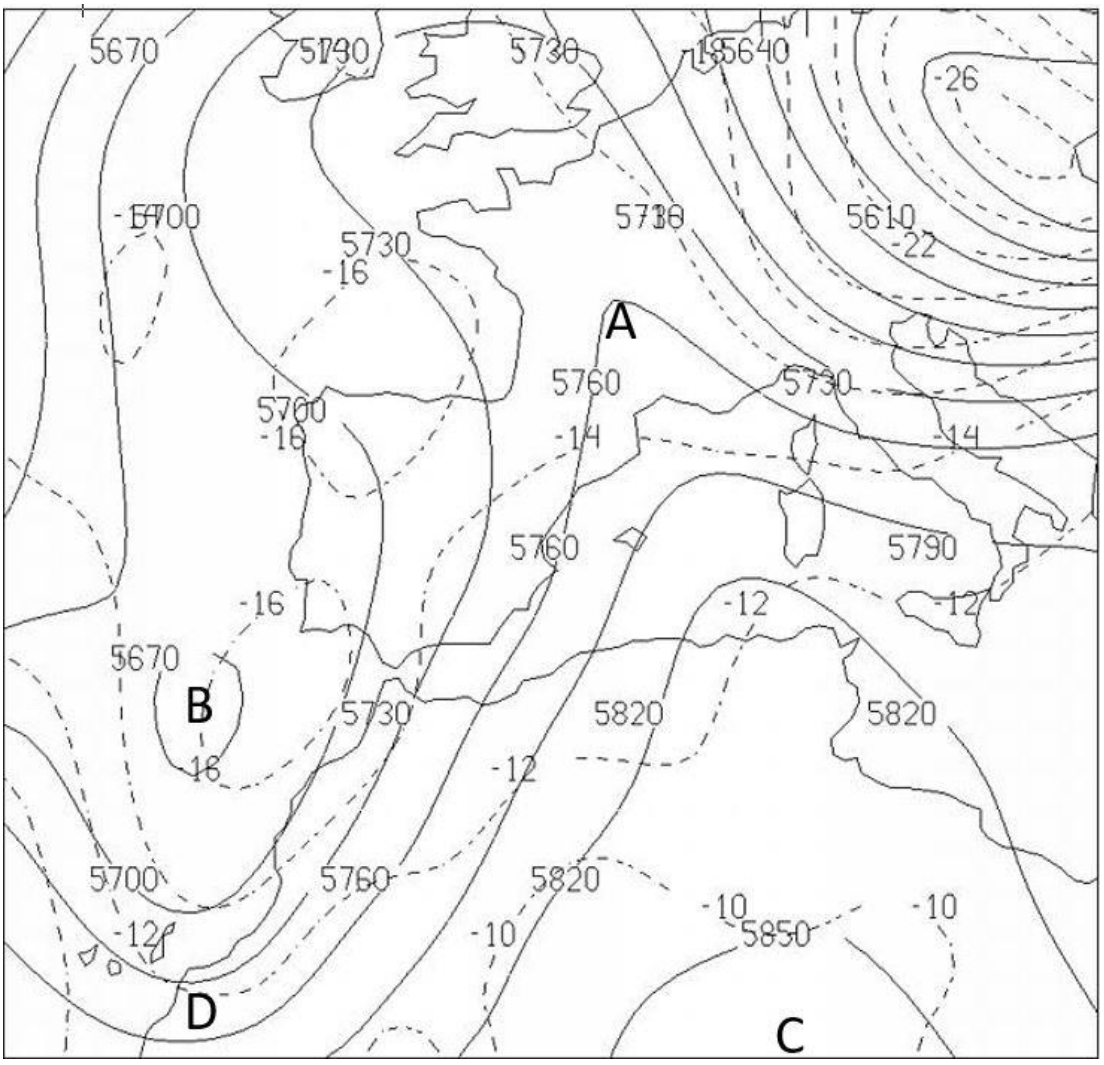
31. Match the features listed below with their locations on the following map with isobars. Use terms from this list: Polar cell, high, low, warm front, cold front, trough, ridge, jet stream. For each letter, pick the feature it best describes. The isobars are the solid lines. (4 pts)

A: _____

B: _____

C: _____

D: _____



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32. What atmospheric circulation pattern carries air upward near the equator and back downward about 30 degrees latitude North and South of the equator? (1 pt)

33. What is the Coriolis Effect and why does it occur? (3 pts)

34. Why does the wind near the ground move slower than wind in the upper atmosphere? (1 pt)

35. What is the name for wind that is blowing parallel to isobars? (1 pt)

36. Which jet stream is stronger: polar jets or subtropical jets? (1 pt)

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37. Match the following terms with their descriptions. Write the name of the event below the description (8 pts).

    Terms:
    Santa Ana winds Chinook winds Foehn winds Sea breezes Nor'easter
    Mountain breeze Alberta Clippers Panhandle hook

a. A low pressure area that travels just off the coast of New England bringing the region heavy precipitation and strong wind.

b. A low pressure system that moves out of southwest Canada and brings cold weather, strong winds, and light snow to the Midwest and Great Lakes region.

c. A wind pattern that occurs at night where cool air moves to replace warmer air.

d. A wind pattern that occurs during the day where cooler air moves to replace warmer air.

e. A wind pattern caused by air being pushed from higher ground inland to lower ground towards the coast. As the wind sinks it becomes dry and hot, accelerates as it squeezes through mountains, and reaches the coast as strong winds of hot, dry air.

f. A low pressure system that forms in winter as Pacific air dips down after crossing the Rocky Mountains. The low pressure systems attract moisture from the gulf, then hook northward, bringing large quantities of snow to the upper Midwest and Great Lakes.

g. Air from the Pacific travels over the Rocky Mountains and dries out, then warms a lot as it descends just east of the Rockies. Regions just east of the Rockies see temperatures rise substantially.

h. Generic term for winds that bring warm and dry air to the leeward side of a mountain range.

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38. What does an anemometer measure? (1 pt)

39. What is a radiosonde and how is it different from a rawinsonde? (2 pts)

40. How is Doppler radar different from regular radar? (2 pts)

41. What are Rayleigh scattering and Mie scattering, and which type is responsible for the blue appearance of the sky? (3 pts)

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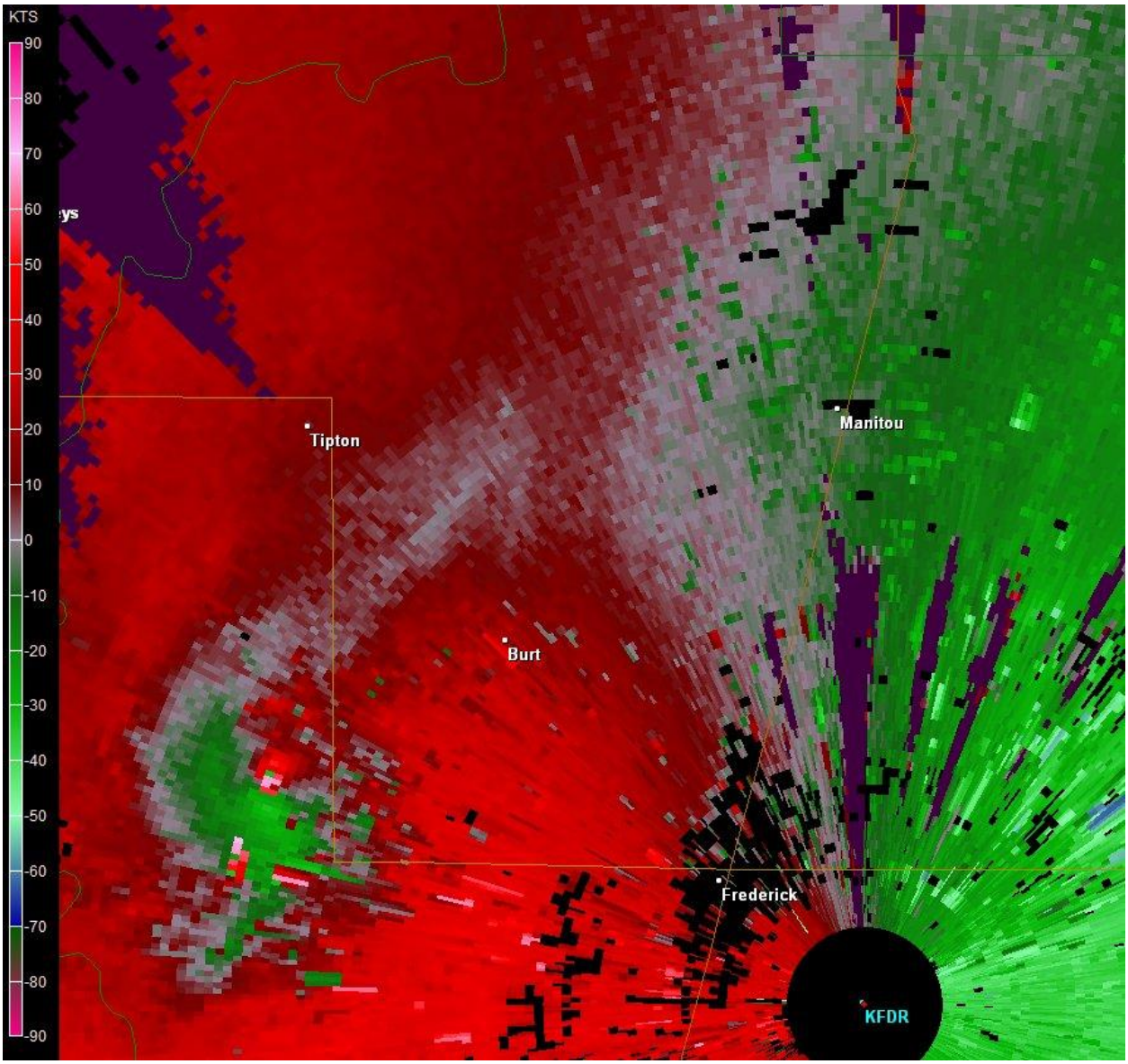
42. In the following Doppler image of radial velocity, conditions for what weather event are present in the lower left corner of the image, and how can you tell? (2 pts)



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43. What layer of the atmosphere do aurora occur in? (2 pt)

44. What is the name for precipitation that does not reach the ground due to evaporation or sublimation? (1 pt)

45. What is the phenomenon in the picture below and what is the cause of this phenomenon? (2 pts)

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46. What is the phenomenon in the figure below, and what conditions cause it? (2 pts)

47. What does a wind chill temperature mean? (2 pts)

48. What does a heat index temperature mean? (2 pts)

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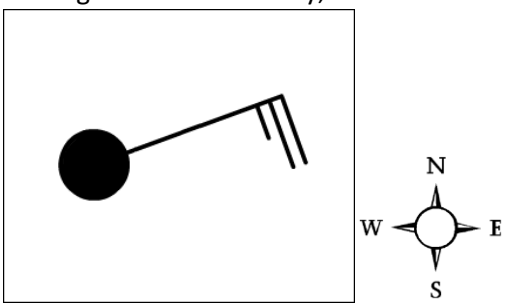
49. How many heating degree days are in the following week? Assume the desired temperature of a building is 70 degrees Fahrenheit. Show work. (3 pts)

    Average Outside Temperature (Fahrenheit):
    Monday: 53
    Tuesday: 46
    Wednesday: 35
    Thursday: 37
    Friday: 41
    Saturday: 49
    Sunday: 43

50. Based on the following station model, how strong is the wind in knots, and which direction is it coming from? Additionally, is the weather sunny or cloudy? (3 pts)



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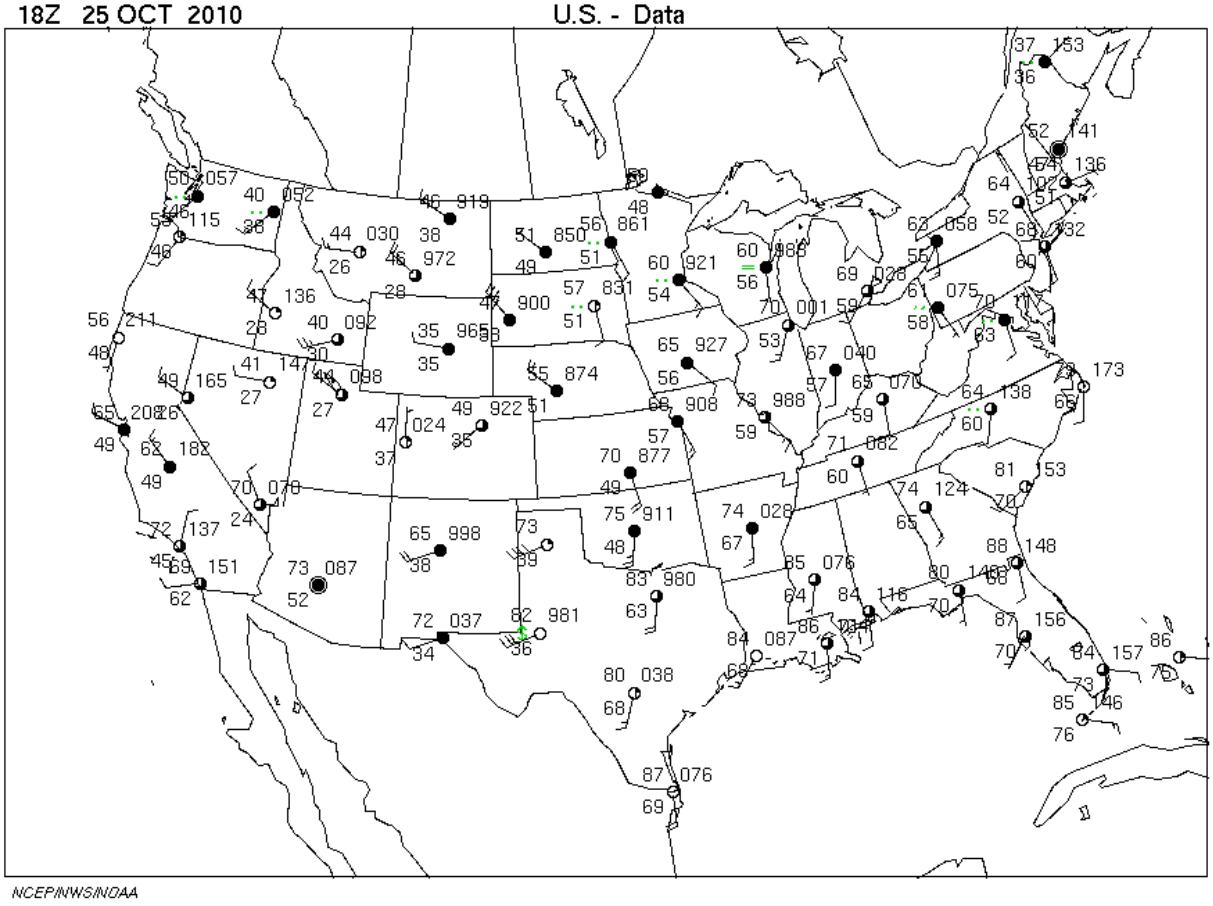
51. Based on the following surface map, what is the temperature, cloud cover, wind direction, and wind speed in Indianapolis? (4 pts)



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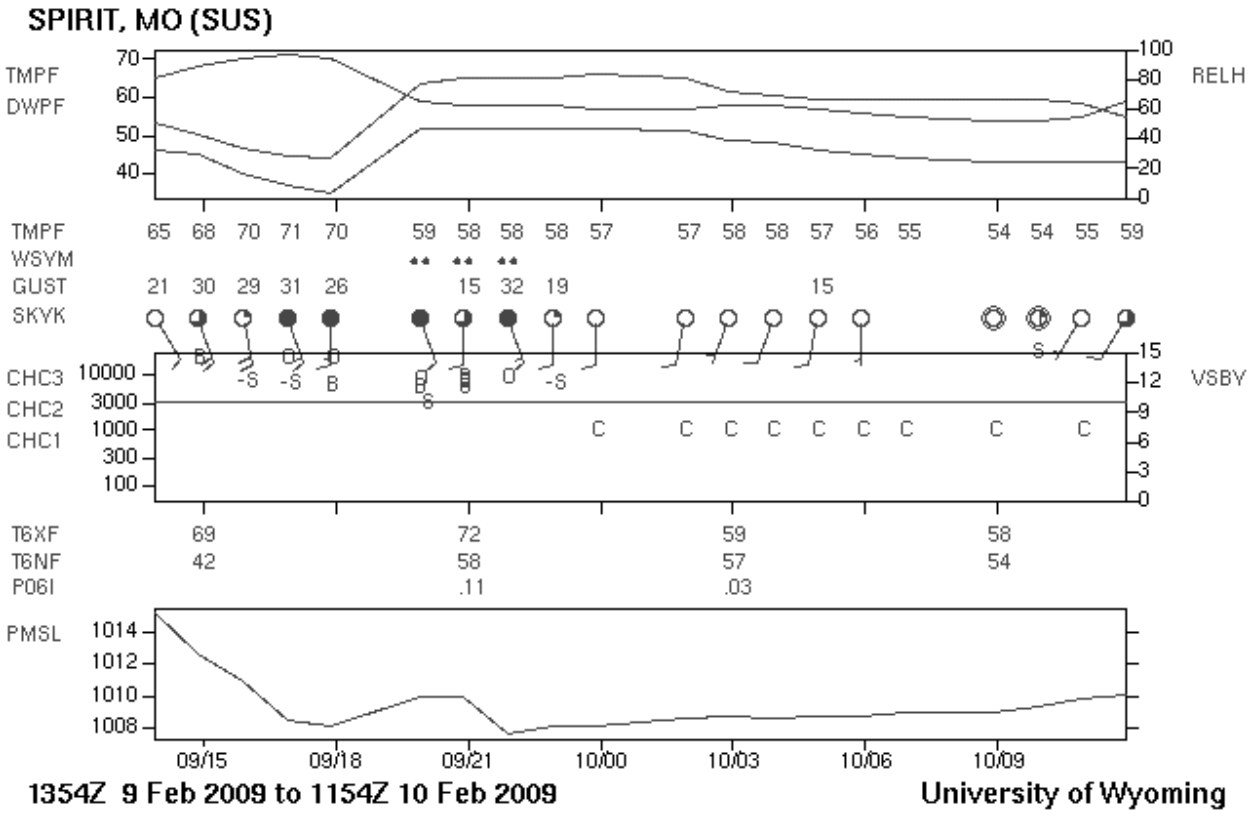
Based on the following meteogram, answer the following four questions. Assume Spirit, MO is on Central Daylight Time (UTC -0500).



52. At the time when there was no wind, what was the temperature? (1 pt)

53. During the second hour in which the temperature was 70 degrees, what types of cloud cover were present, and at what heights? (2 pts)

54. What is the local time when the light rain occurred? (1 pt)

55. How much precipitation fell during the rainstorm? (1 pt)

56. What is an isopleth? (1 pt)

57. Draw a vertical profile of the atmosphere showing how temperatures vary across the following layers: stratosphere, mesosphere, troposphere, and thermosphere. Exact values are not needed, just trends. (2 pts)

58. Draw a vertical profile of the atmosphere showing how the pressure varies. Exact values are not needed, just trends. (2 pts)

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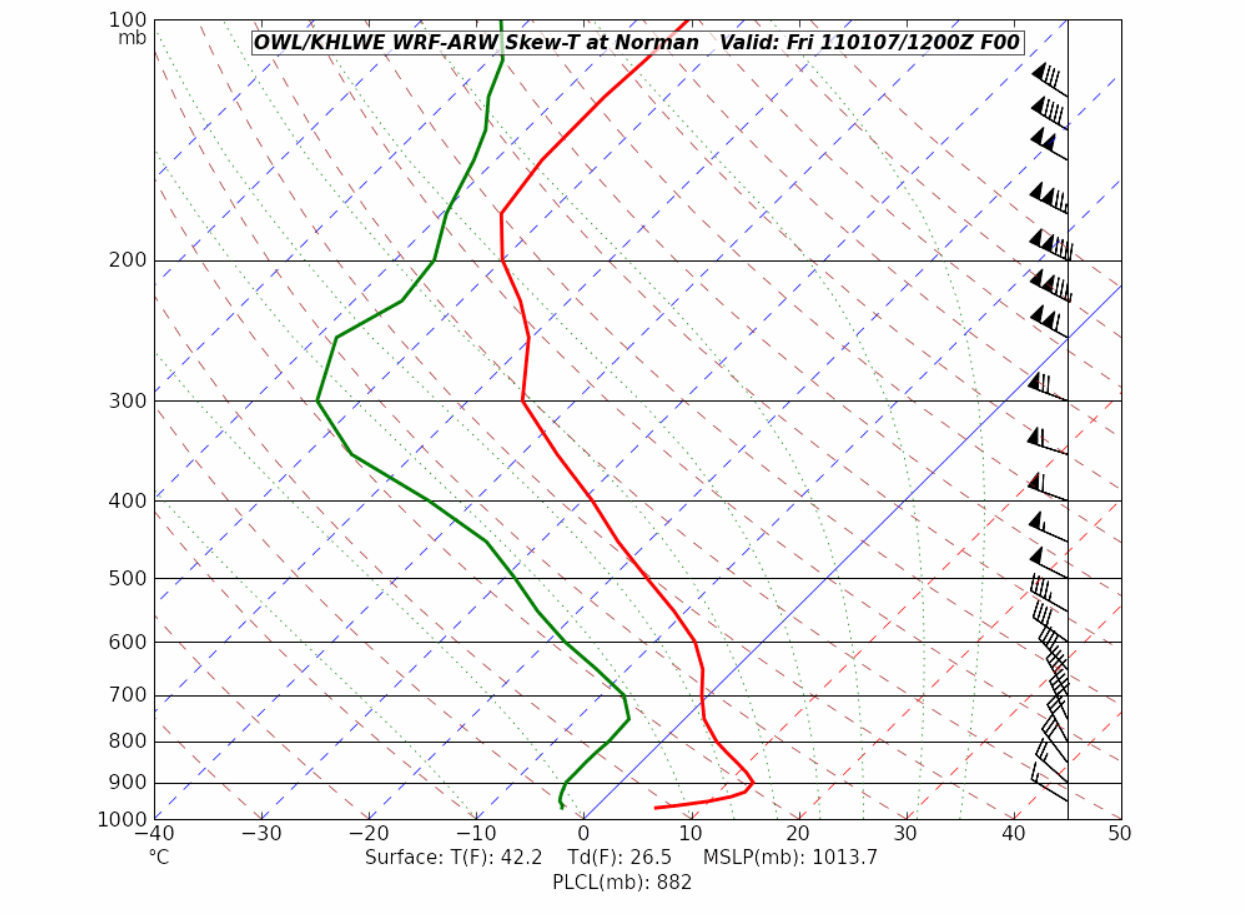
Use the following Skew-T diagram to answer the next 3 questions.



59. Circle the temperature inversion on the diagram (1 pt).

60. Identify an absolutely stable region and a conditionally stable region. (2 pts)

61. What is the stability of the region from 400-600mb, and how can you tell? (2 pts)