## RR\#4 - Free Response

Base your answers to questions $\mathbf{1}$ through $\mathbf{3}$ on the table below, on the map, and on your knowledge of Earth science. The table lists the latitude, longitude, and barometric pressure, in millibars ( mb ), of the center of a low-pressure system (L) as it moved across North America from March 14 to March 17. The map in your answer booklet shows the center of this low-pressure system (l) and associated fronts on March 14. The location of the low-pressure system 24 hours later on March 15 is also indicated.

The Center of the Low - Pressure System (L)

| March Date | Latitude | Longtitude | Barometric Pressure (mb) |
| :---: | :---: | :---: | :---: |
| 14 | $50^{\circ} \mathrm{N}$ | $112^{\circ} \mathrm{W}$ | 999.7 |
| 15 | $52^{\circ} \mathrm{N}$ | $95^{\circ} \mathrm{W}$ | 999.5 |
| 16 | $54^{\circ} \mathrm{N}$ | $79^{\circ} \mathrm{W}$ | 998.5 |
| 17 | $56^{\circ} \mathrm{N}$ | $64^{\circ} \mathrm{W}$ | 998.0 |



1. On the station model, using the proper format, record the barometric pressure of the low-pressure center (L) on March 16.


## March 16

2. Calculate the average speed, in kilometers per hour, at which this low-pressure center ( $\mathbf{L}$ ) traveled during the 24 hours between March 14 and March 15.
3. On the map, use the latitudes and longitudes listed in the data table to plot the March 16 and March 17 locations of the center of the low-pressure system (l) by placing an $\mathbf{X}$ at each location.

Base your answers to questions $\mathbf{4}$ and $\mathbf{5}$ on the Atlantic hurricane map below and on your knowledge of Earth science. The arrows on the map show the tracks of various hurricanes that occurred during late summer and early fall.

4. Several of these hurricanes have affected land areas. Describe two actions that people who live in hurricaneprone areas should take in order to prepare for future hurricanes.

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5. Describe one ocean surface condition or atmospheric condition that makes the area over the Atlantic Ocean between $10^{\circ} \mathrm{N}$ latitude and $20^{\circ} \mathrm{N}$ latitude ideal for these hurricanes to form.

Base your answers to questions 6 through 9 on the station models below and on your knowledge of Earth science. The changing weather conditions at a location in New York State during a winter storm are recorded on the station models.
12 noon Thursday 8 p.m. Thursday


| Time and Day | Actual Barometric Pressure <br> $(\mathrm{mb})$ | Cloud Cover (\%) | Wind Direction <br> From the |
| :---: | :---: | :---: | :---: |
| 12 noon Thursday |  |  |  |

6. As this storm approached, the National Weather Service issued a winter storm warning. Identify two items that should be included in emergency preparedness supplies for a winter storm.
7. From 12 noon Thursday until 8 p.m. Thursday, the total amount of snowfall was 12 inches. Calculate the snowfall rate, in inches per hour.
8. State the relative humidity at this location at $8 \mathrm{p} . \mathrm{m}$. Thursday.
9. Complete the table by recording the weather data shown on the station model for 12 noon Thursday.

Base your answers to questions $\mathbf{1 0}$ through $\mathbf{1 2}$ on the weather station model below and on your knowledge of Earth science. The model shows atmospheric conditions at Oswego, New York.

10. Convert the coded air pressure shown on the station model into the actual millibars of air pressure.

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11. Explain how the data on the station model indicate a high relative humidity.
12. Fill in the correct information for each weather variable listed for this station model.

Air temperature: $\qquad$ ${ }^{\circ} \mathrm{F}$

Dewpoint: $\qquad$ ${ }^{\circ} \mathrm{F}$

Wind speed: $\qquad$ knots

Cloud cover: $\qquad$ \%

Base your answers to questions $\mathbf{1 3}$ through $\mathbf{1 6}$ on the weather map in your answer booklet and on your knowledge of Earth science. The map shows air temperatures (in ${ }^{\circ}$ F) at locations in the northeastern United States and part of Canada. Syracuse, New York, is labeled. Line $A B$ represents a stationary frontal boundary.

13. Explain why locations near the Atlantic Ocean have air temperatures that are wanner than locations farther inland.
14. Write the two-letter weather map symbol for the type of air mass that is most likely located north of frontal boundary $A B$.
15. Convert the air temperature at Syracuse from degrees Fahrenheit to degrees Celsius.

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16. On the map, draw the isotherm for $0^{\circ} \mathrm{F}$. Extend each end of the isotherm to the edge of the map.

Base your answers to questions $\mathbf{1 7}$ through $\mathbf{2 0}$ on the map and passage below.

## A Lake-Effect Snowstorm

A snowstorm affected western New York State on October 12 and 13, 2006. A blend of weather conditions caused more than 24 inches of heavy, wet, lake-effect snow, bringing much of western New York to a standstill. The New York State Thruway was closed to traffic between exits 46 and 59 , which are circled on the map. The isolines on the map show the amount of snowfall, measured in inches, resulting from this storm. Points $A$ and $B$ represent locations on Earth's surface.


17. Determine the number of inches of snow that was received in Niagara Falls, New York, from this snowstorm.

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18. Identify the most probable direction from which the wind was blowing to produce the pattern of snowfall shown on the map.
19. Approximately how many miles of this section of the Thruway were closed due to the snowstorm?
20. Identify two hazards to human life or property that can result from a snowstorm of this size.

Base your answers to questions 21 and 22 on the map below, which represents the geographic source regions of two air masses, $X$ and $Y$. The arrows represent the convergence of these air masses, which may result in tornadoes.

## North America


21. A tornado watch or warning is issued for a location in the area labeled Tornado Alley. State one safety precaution that should be taken to avoid possible injury from this tornado.
22. Use the standard two-letter air-mass symbols to identify air-masses $X$ and $Y$.

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23. Base your answer to the following question on the weather graphs below, which show data recorded at Syracuse, New York, as a winter storm moved across the region between December 1 and December 4, 2007. Graph 1 shows air temperatures and dew points. Graph 2 shows barometric pressures.

Graph 1: Air Temperature and Dewpoint at Syracuse, New York


Graph 2: Barometric Pressure at Syracuse, New York


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A radar image of this storm is shown below. The darkest regions on the radar image show areas of precipitation. Letter $L$ marks the location of the center of the low-pressure system. Draw an arrow on the radar image to show the most probable path this winter storm followed. Begin the arrow a letter $L$.


Base your answers to questions $\mathbf{2 4}$ and $\mathbf{2 5}$ on the table below, which shows weather data recorded at Albany, New York.

Data Table

| Location | Temperature <br> $\left({ }^{\circ} \mathrm{F}\right)$ | Dewpoint <br> $\left({ }^{\circ} \mathrm{F}\right)$ | Cloud Cover <br> $(\%)$ | Pressure <br> $(\mathrm{mb})$ | Wind <br> Direction | Wind Speed <br> $(\mathrm{knots})$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Albany | 58 | 36 | 25 | 1017.0 | from the west | 20 |

24. State one reason why rain was unlikely at the time the data was collected. Support your answer by using the data.
25. Complete the station model in your answer booklet using the proper format to accurately represent these six weather conditions.

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26. Base your answer to the following question on the cross section below, which shows two weather fronts moving across New York State. Lines $X$ and $Y$ represent frontal boundaries. The large arrows show the general direction the air masses are moving. The smaller arrows show the general direction warm, moist air is moving over the frontal boundaries.


Earth's surface
Which type of front forms when front $X$ catches and overtakes front $Y$ ?
Base your answers to questions $\mathbf{2 7}$ and $\mathbf{2 8}$ on the four weather station models, $\mathrm{A}, B, \mathrm{C}$, and D , below.
A

B

C


27. What evidence indicates that station $C$ has the highest relative humidity?
28. Convert the air temperature at station $A$ into degrees Celsius.
29. Base your answer to the following question on the four weather station models, $\mathrm{A}, \mathrm{B}, \mathrm{C}$, and D , below.
A

B

C

D


List the letters of the four station models, in order, from the station with the highest air-pressure reading to the station with the lowest air-pressure reading.

## Image

Not Found.

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30. Base your answer to the following question on the weather map below, which shows two fronts associated with a low-pressure system.


On the weather map above, write the air-mass symbols to indicate the most likely locations of the continental polar air mass and maritime tropical air mass that have formed this low-pressure system.

