

NAME: Key

WEATHER NOTES

Log onto YouTube and search for jocrisci channel.

REFERENCE TABLES (Videos 8.1 & 8.2 ESRT 12, 13a, 14b)

1. Use the temperature scales on page 13. (notes-air temperature conversions)

a. 80°C to $^{\circ}\text{F}$ 176°F

~~b. 443 K to $^{\circ}\text{F}$~~

~~c. At what temperature $^{\circ}\text{F}$ does ice melt?~~

d. At what temperature $^{\circ}\text{C}$ does water freeze? 32°F , 0°C

2. Determine the dew point temperature and relative humidity from the tables on page 12

a. What is the **relative humidity** if the **air temperature is 16°C** and the **wet bulb temperature is 10°C** ? 45%
(Dry Bulb)

b. The **air temperature is 5°C** and the **wet bulb temperature is 3°C** . What is the **relative humidity**? 71%
(Dry Bulb)

c. If the **relative humidity is 74%** and the **dry bulb temperature is 20°C** , what is the **dew point temperature**? 15°

3. Use the pressure scales on page 13

a. A pressure of 1017 mb equals 30.03 inches

b. A pressure of 29.5 inches equals 999 mb

c. If a barometer reads 1020 mb and a few hours later a storm passes over the area, give one possible reading of the barometer during the storm. 1028 (pressure rises)

4. Read a station model. (lab-notes)

5. Read the planetary wind diagram on page 14. (notes-planetary winds and moisture belts)

ATMOSPHERIC VARIABLES (Videos 8.3 & 8.4)

1. You must know the relationships between temperature, dew point, relative humidity, and the probability of precipitation. (How clouds form)

2. You must know the relationship between air pressure, wind direction and weather.

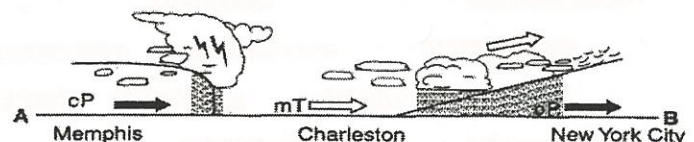


WEATHER MAP ANALYSIS (Videos 8.5 ESRT 13b)

1. Describe the type and source of an air mass affecting the areas in the image to the right.

2. Describe the general weather of both fronts.

3. Forecast the weather for an area.



VIOLENT WEATHER (Videos 8.6 & 8.7)

1. Explain two things that cause a hurricane to lose strength.

2. Describe how large a hurricane is and how long it affects an area.

3. Identify the area from which hurricanes originate.

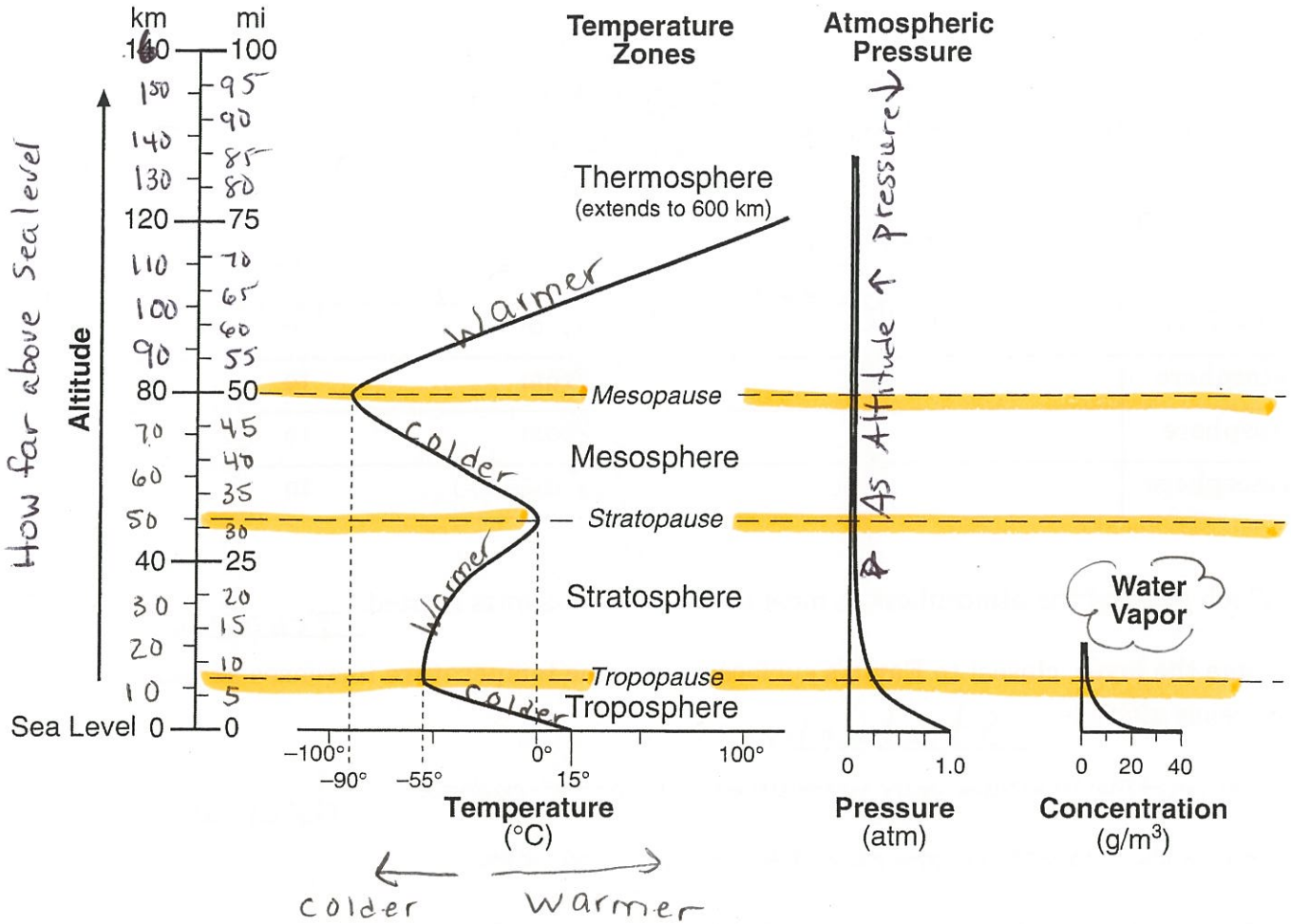
Weather Facts

- Video 8.1 & 8.2 ESRT 13a
1. A **barometer** measures / **air pressure**
 2. **Air pressure** or **barometric pressure** is **caused by** / **weight of the air**
 3. **Cold air is high pressure** because / **the molecules are close together**, sinks and compresses (Heavy)
 4. **Hot air is low pressure** because / **the molecules are far apart**, expands, and cool (**Room for H₂O**)
 5. An **anemometer** measures / **wind speed** ~ **Wind vane** measures / **wind direction**
 6. **Wind is named for** / **the direction it comes from**
 7. **Wind is caused by** / **differences in air pressure** H → L
 8. **Isobars close together** indicate / a fast wind speed --- far apart, calm winds
- Video 8.3 ESRT 14b
9. The weather in a **high** is / **happy, nice, cool and dry** (sunny no precipitation)
 10. The weather in a **low** is / **lousy, bad, warm and wet** (cloudy and precipitation)
 11. The circulation around a **low pressure system** is / **LICC, (Low, Inward, CounterClockwise)**
 12. The circulation around a **high pressure system** is / **HOC (High, Outward, Clockwise)**
 13. **Sea Breeze** / **daytime**, land is hot (**Low Pressure**), ocean is cold (**High Pressure**) winds go H → L
 14. **Land breeze** occurs at / **night** and is the **exact opposite** of the conditions above
 15. **Coriolis effect** / **winds and ocean currents deflected** due to **Earth's rotation**
- Video 8.4 ESRT 12
16. **Sling psychrometer** has a **wet and dry bulb** to measure / **dew point** and **relative humidity**
 17. The **closer air temperature** is to the **dew point** / the **greater the chance of precipitation**
 18. **Dewpoint temperature** is the / **temperature at which the air is saturated (filled) with water**
 19. **Relative humidity** is the / **percent of water in the air**
 20. **100 % relative humidity** / = **precipitation, clouds, and/or fog**
 21. **Warm air is capable of holding more** / **water vapor** than cold air
 22. **Clouds form when** / **warm, moist air rises, expands, cools, & condenses (at the dew point!)**
 23. **Cloud droplets form on tiny dust particles** in the air called / **condensation nuclei**
- Video 8.5 ESRT 13b
24. **Weather systems in the US** usually move / **from west to east (with a hook to the NE)**
 25. **The 500 rule says** / **over 500 add a 9, below 500 add a 10, and always add a decimal**
 26. What is the source region of a **cold and dry (cP)** air mass / **Central Canada**
 27. What is the source region of a **warm and moist (mT)** air mass / **Gulf of Mexico** (warm waters)
 28. **Warm air rises** because / it is **less dense** than cold air! (the molecules are more compact in cold air)
 29. At the **cold front** air is / **very unstable, thunderstorm occur** (short, heavy rain)
 30. In front of a **warm front** air is / **stable long, drizzle occurs** (long, light rain)
- Videos 8.6 & 8.7
31. **Hurricanes form** / over **warm oceans** in summer and autumn
 32. **Hurricanes lose strength** / as they **move over land or cool water**
 33. To **prepare for a hurricane** / **prepare escape route, board up windows, store up food, water, batteries**
 34. **Tornadoes** are / **short lived (a minute or less) small in size** – prepare by practicing where to go during a tornado – **go to the basement or sheltered area**



counterclockwise are low clockwise are high

THE ATMOSPHERE



“Selected Properties of Earth’s Atmosphere”

For the following questions, refer to the Earth Science Reference Tables, page 14

1. In which sphere is most of the water vapor found? Troposphere
2. What happens to atmospheric pressure as altitude increases? Decreases
3. In which sphere does weather occur? Troposphere
4. What happens to the temperature in each sphere as altitude increases? It . . .

Troposphere Decreases Mesosphere Decreases
 Stratosphere Increases Thermosphere Increases

Selected Properties of Earth's Atmosphere: Earth Science Reference Table page 14

Name the boundary that separates each of the following:

- (a) the troposphere and the stratosphere Tropopause
 (b) the stratosphere and the mesosphere Stratopause
 (c) the mesosphere and the thermosphere Mesopause

Layer	Highest Altitude		Temperature Range (°C)	
	Miles	Kilometers	From	to
Troposphere			From	to
Stratosphere			From	to
Mesosphere			From	to
Thermosphere			From	to

- Which layer of the atmosphere is most of the water vapor is located. Troposphere
- Name the layer, closest to Earth's surface, where the temperature increases as you increase altitude Stratosphere
- What happens to atmospheric pressure as you increase altitude. decreases
- What is the atmospheric pressure at sea level 1.0 atm
- What is the temperature at the Tropopause? -55°
- At what boundary is the coldest temperatures found? Mesopause
- Name the boundary where the atmospheric pressure is approximately .25 atms.
Tropopause
- In which layers of the atmosphere can the temperature be 15 °C?
Troposphere & Mesosphere
- What is the highest concentration of water vapor? 40 g/m³
- In what layer is the highest concentration of water vapor found? Troposphere

Mini Lesson 1: Temperature

From the day you were born weather has affected you. What you wear, places you want to go and most things you do can be impacted by the weather. Winter sports need snow, but too much snow can keep you from getting there. Summer activities need sunshine and warmth. No one likes rain at a picnic or when going to an amusement park.

Meteorology is the study of Earth's atmospheric changes, weather. Meteorologists, scientists that study weather, focus on the short term conditions of the atmosphere. There are several factors that affect weather. This makes predicting weather a challenge. Satellites and radar are just some of the latest technology that meteorologists use to help make those predictions. Although these tools are accurate, one small shift in the wind can either bring a storm to your area or send it to a completely different location.

You may recall that energy transfer is the movement of heat. When we think of heat we are referring to temperature. Temperature is the measure of the average kinetic energy. The greater the kinetic energy of a substance the warmer it is. The instrument used to measure temperature is a thermometer. There are three scales used to measure temperature, Fahrenheit ($^{\circ}\text{F}$), Celsius ($^{\circ}\text{C}$), and Kelvin. On a weather map, isotherms are lines drawn to show patterns of temperature. Isotherms connect places of equal temperature.

1. What is meteorology? _____

2. What are the short term conditions of the atmosphere called? _____
3. Why is weather difficult to predict? _____

4. What is temperature? _____

5. Place your two hands together and rub them vigorously for 2 minutes.
6. Describe what happened while you did this. _____

7. Did the kinetic energy (energy in motion) increase or decrease when you rubbed your hands together? _____
8. Did the temperature increase or decrease when you rubbed your hands together? _____
9. What are isotherms? _____
10. What do isotherms connect? _____



Weather Variables

Temperature _____

Instrument used to measure temperature:

Thermometer

Measured in ...

° C

Celsius

° F

Fahrenheit

° K

Kelvin



Shown on a weather map with

Isotherms - lines that connect points of the same temperature

Convert the temperatures below by using the conversion chart in the Earth Science Reference Tables, page 13.

Fahrenheit	Celsius	Kelvin
20	-6	267
159	70	343
		260
	40	
60		
		290
	-40	
		240
75		
	50	

Find the following temperatures:

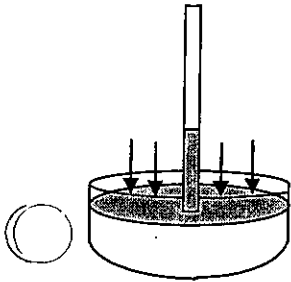
	Fahrenheit	Celsius	Kelvin
Water boils	212	100	374
Water freezes	32	0	273
Body temperature			
Room temperature	68	20	293

Mini Lesson 3: Pressure

Air pressure is caused by the weight of the atmosphere. The higher your elevation, the less air there is above you and the pressure is less. Temperature also affects barometric pressure. As the air is heated, it becomes less dense and rises. Rising air means less pressure because the air is not pushing down as much. A barometer measures barometric pressure in inches of mercury or in millibars. On a weather map, isobars connect places of equal barometric pressure and show patterns in pressure systems. When the isobars are close together there is a high wind. This is a key indicator of how the weather may be changing.

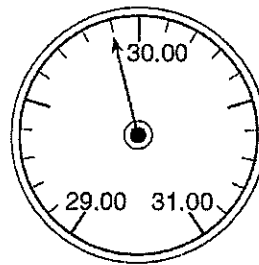
Mercury Barometer

As the air pressure pushes on the surface of the mercury in the dish, the mercury travels up the tube. As pressure increases, the mercury rises up higher in the tube. Warm air rises and the pressure is lower. The air does not push down as much on the mercury and it does not travel as far up the tube. Cold air sinks, causing higher pressure on the dish resulting in the mercury traveling farther up the tube.



Aneroid Barometer

These have a small metal box called an aneroid cell. There is a spring system that expands or contracts due to changes in air pressure. This causes the needle to move.



Need to know

1. What causes air pressure? _____
2. Why is there less pressure as your elevation increases? _____
3. Explain how temperature affects pressure. _____

4. What two units are used in measuring barometric pressure? _____ and _____
5. What are drawn on weather maps to connect places of equal pressure? _____
6. What type of barometer uses an aneroid cell? _____
7. Explain how an increase of pressure causes the mercury to rise in a mercury barometer.

Fact(s) to memorize: 1 - 4

Air pressure How A measure of how closely packed the molecules in the air are.

Cold = Tightly Packed = High
Warm = loosely packed = Low (Room for water)

Instrument used to measure pressure: Barometer

Measured in ... millibars and inches



Shown on a weather map with Isobars - lines that connect points of = pressure

Factors Affecting Air Pressure:

Using the Pressure Conversion Chart in the Earth Science Reference Tables page _____, complete the tables below.

Inches	Millibars
29.06	
29.94	
30.50	
29.44	

Millibars	Inches
1011.0	
1021.0	
1035.0	
991.0	

Normal pressure at sea level is _____ atmosphere and is equal to ...
_____ millibars and _____ inches

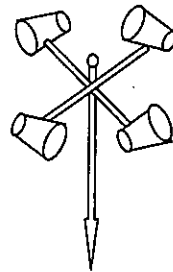
Mini Lesson 4: Wind

Wind is the horizontal movement of air. It is caused by the uneven heating of Earth's surface. Remember, it takes water longer to heat up and cool down than air because it has a higher specific heat and dark surfaces heat and cool faster than light surfaces. These are examples of uneven heating.

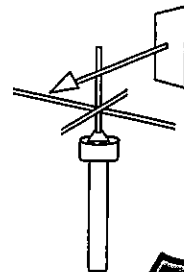
Differences in temperature result in differences in pressure. The greater the difference in pressure, the faster the wind. On a weather map, the closer the isobars the faster the wind speed.

Because wind has two variables, speed and direction, two instruments are used to measure it. Wind direction is named from where the wind is blowing from.

Anemometer
wind speed



Wind Vane
wind direction



Need to know

1. What is wind? _____
2. What causes wind? _____
3. Give two examples of uneven heating? _____
and _____
4. Explain how differences in temperature affects wind speed. _____

5. How are isobars spaced if the wind speed is very fast? _____
6. What two variables does wind have? _____ and _____
7. Name the instrument used to measure wind speed. _____
8. Name the instrument used to measure direction. _____
9. Which direction is the North wind blowing from? _____
10. If a north wind is blowing, what kind of temperatures can you expect? _____
11. Why is wind named from where the wind is blowing from? _____

Pressure and Wind

Fact(s) to memorize: 1 - 8



What instrument is used to measure wind speed?

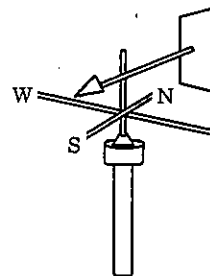
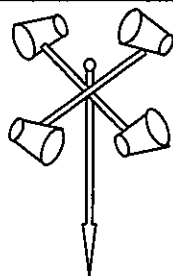
Anemometer Air pressure? Barometer

How are winds named?

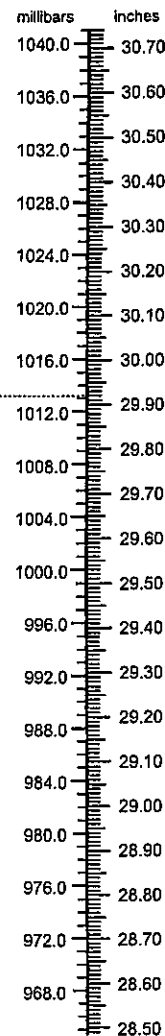
Named for direction they came from

What causes wind?

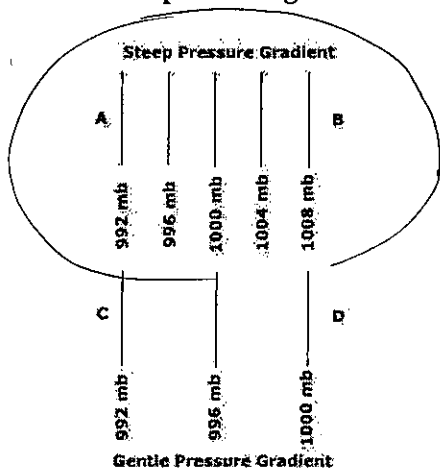
Differences in air pressure



Pressure



Which pressure gradient would result in greater wind velocity?



Bars closer together

Convert the following measurements using the chart on page 13 of the ESRTs.

mb	Inches of Mercury
1007	
	29.44
1022	
	29.35

Wind blows from areas of High Pressure to areas of Low Pressure

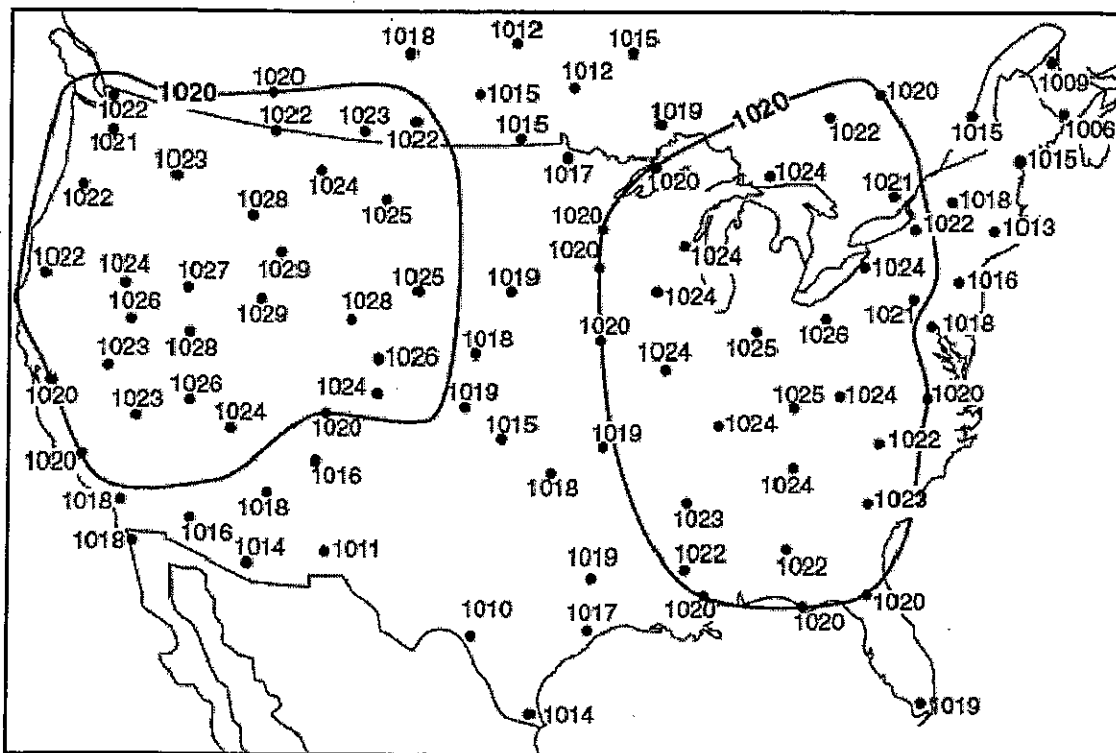
Draw the relationship between air pressure and altitude.

As altitude increases
air pressure decreases
(INDIRECT)

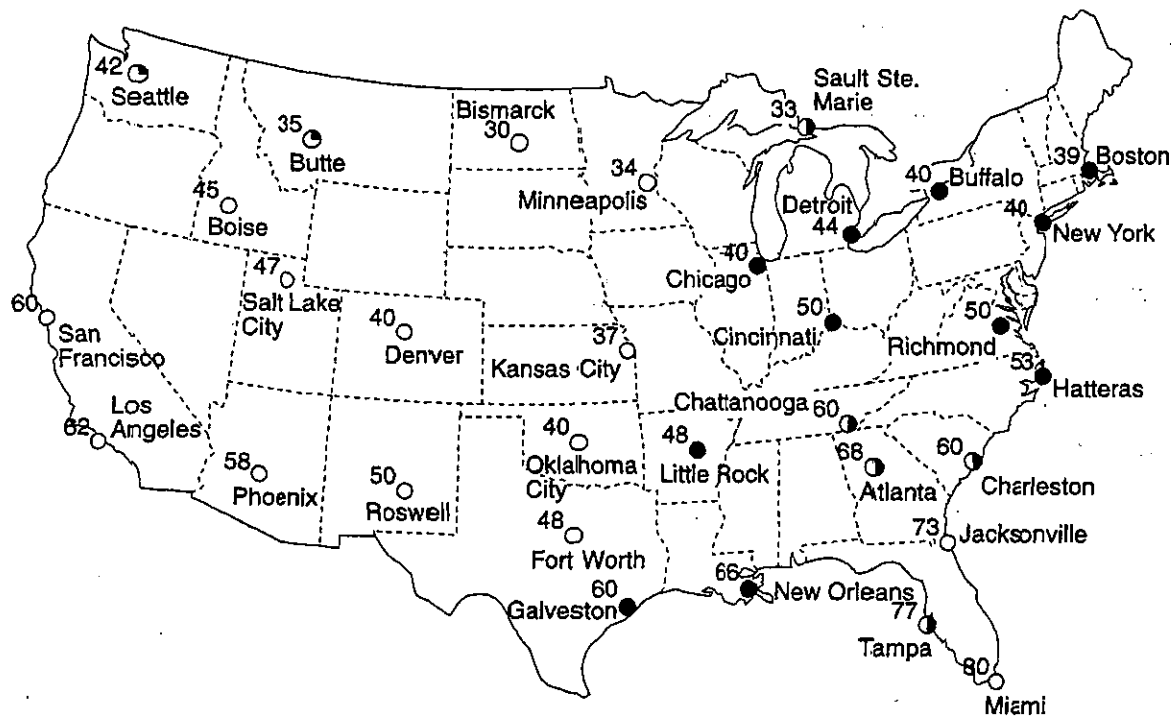


1. Draw the 1024 and 1028 isobar on the map below.

Surface Air Pressures



2. Draw the 30, 40, 50 and 60 isotherm on the map below.

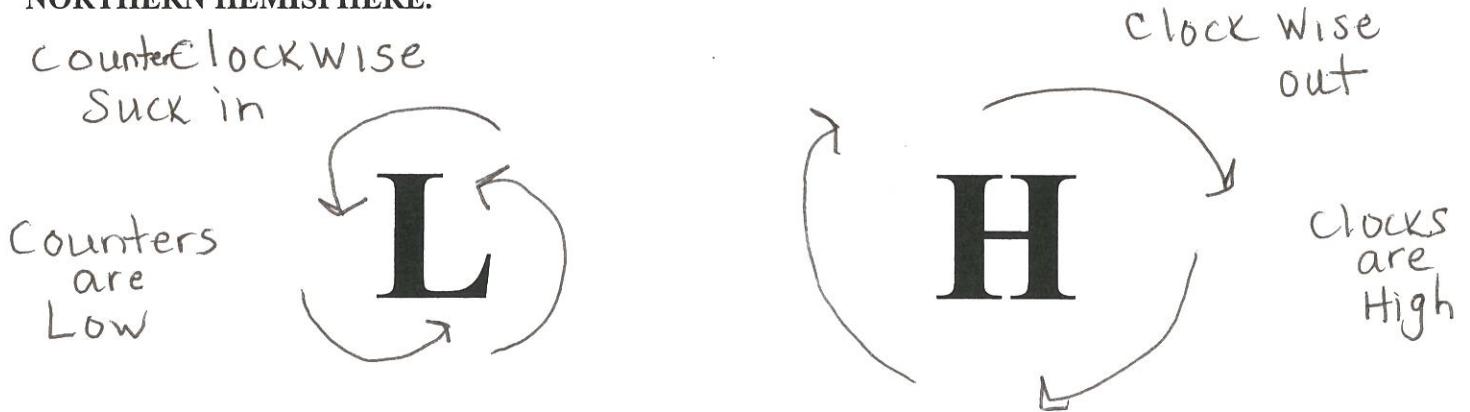




In a high pressure area, air will (rise, sink) because the air is (less, more) dense. This is because the air is (cold, warm) and (rises, sinks). Therefore, clouds CANNOT form.

In a low pressure area, air will (rise, sink) because the air is (less, more) dense. This is because the air is (cold, warm) and (rises, sinks). Therefore clouds are LIKELY to form.

Correctly draw the direction of wind flow around both a high and a low pressure area in the NORTHERN HEMISPHERE.



CHARACTERISTICS OF HIGH AND LOW PRESSURE AREAS:

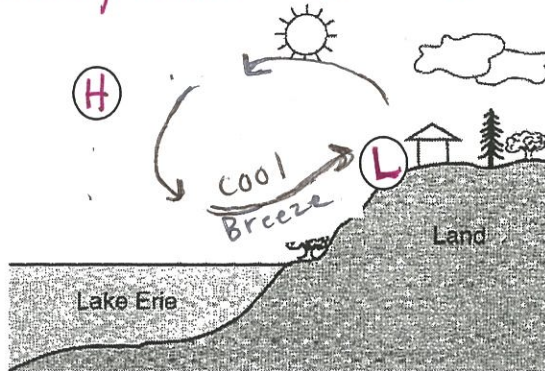
	LOW PRESSURE	HIGH PRESSURE
warm or cold air	Warm	Cold
air rising or sinking	Rising	Sinking
clouds or no clouds	Clouds	No Clouds
clockwise or counterclockwise wind direction	Counter	Clockwise
winds toward or away from the center	toward	away

On the diagrams below, label which one represents a land breeze and which represents a sea breeze. Correctly label on each diagram where the high and low pressure areas would be found.

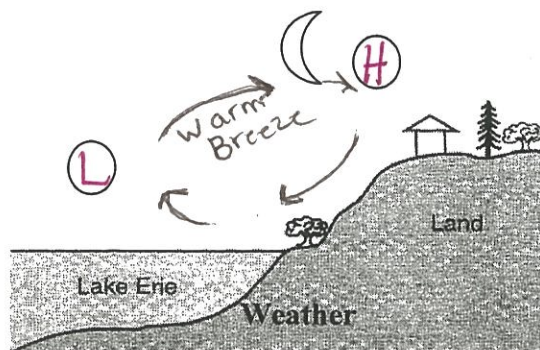
Sea Breeze

ENERGY Moves from High → Low

→ During the day the land is hotter so it is Low pressure. The water is colder and High pressure



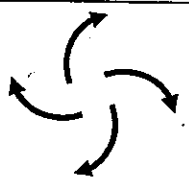
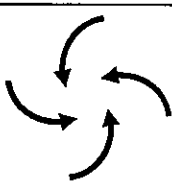
Land Breeze



At night the Land is colder (High) and the water is warmer (Low)

Coriolis Effect - a name for when how the planetary winds and Ocean currents deflect due to the Earth's rotation

Weather Factors Associated with Different Pressure Areas

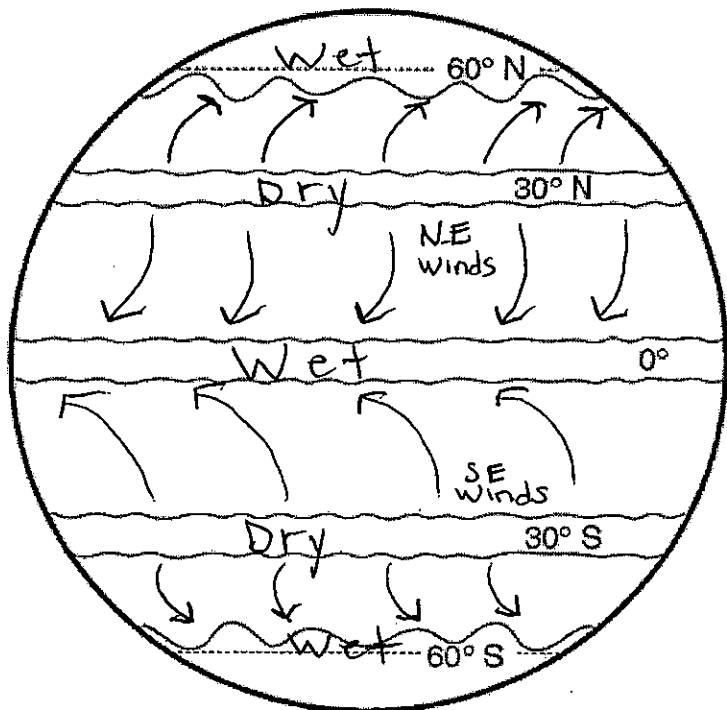
High Pressure	→	Low Pressure
Cool		Warm
Dry		Wet
Sunny		cloudy
		
Clockwise		Counter clockwise
Out		In

Planetary winds: ESRT pg

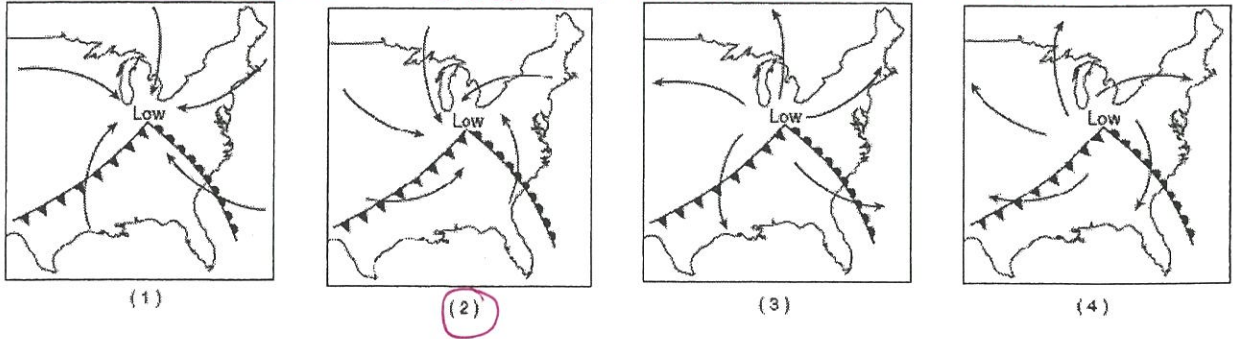
14

Fill in the diagram to the right.

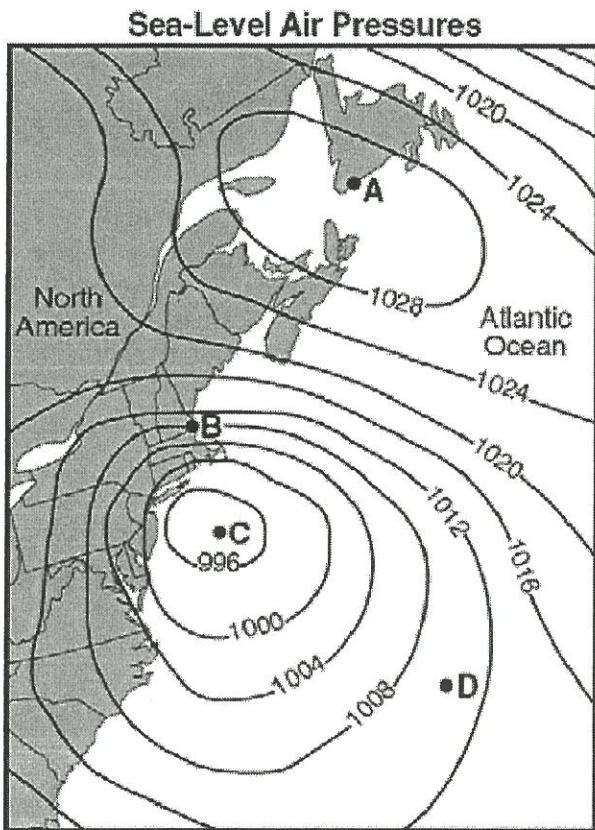
- Draw the wind arrows illustrating the direction and deflection.
- Label the areas that would be wet or dry.
- Label the areas that would be high pressure or low pressure.



1. The arrows on which map best represent the direction of surface winds associated with this low-pressure system? — Counter clockwise + inward



Base your answers to questions 2 through 12 on the map below, which shows sea-level air pressure, in millibars, for a portion of the eastern coast of North America. Points A, B, C, and D are sea-level locations on Earth's surface.



2. What weather instrument was used to measure the air pressures? Barometer
3. Which location (A, B, C, or D) recorded the highest wind speed? C
4. Which location (A, B, C, or D) is in the center of a high pressure area? A
5. Which location (A, B, C, or D) is in the center of a low pressure area? C
6. What is the approximate air pressure of location D? 1010 mb
7. Between points A and B, which direction is the wind blowing? Towards _____
8. Which location (A or C) is the wind blowing counter clockwise? C
9. At which location (A or C) is the wind blowing in a clockwise direction? A

10. In which direction do the prevailing winds carry our weather systems across the United States? East

11. At which location (A, B, C, or D) is the air rising? C

12. At which location (A, B, C, or D) is the air sinking? A

Relative Humidity

The amount of water vapor in the air.

measured in %

When the air is holding as much water vapor as it can, the air is Saturated

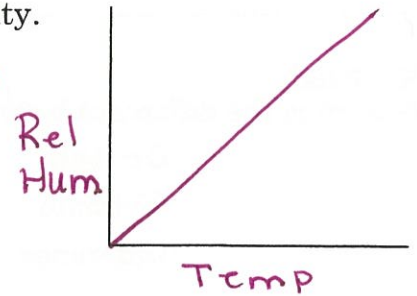
When the air is saturated, the relative humidity is 100%

Temperature & Relative Humidity Have a direct relationship

State the relationship between temperature and relative humidity.

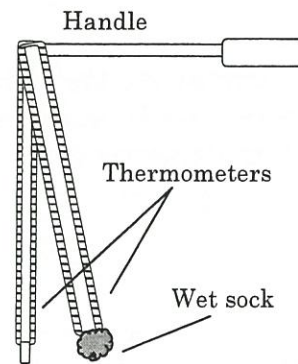
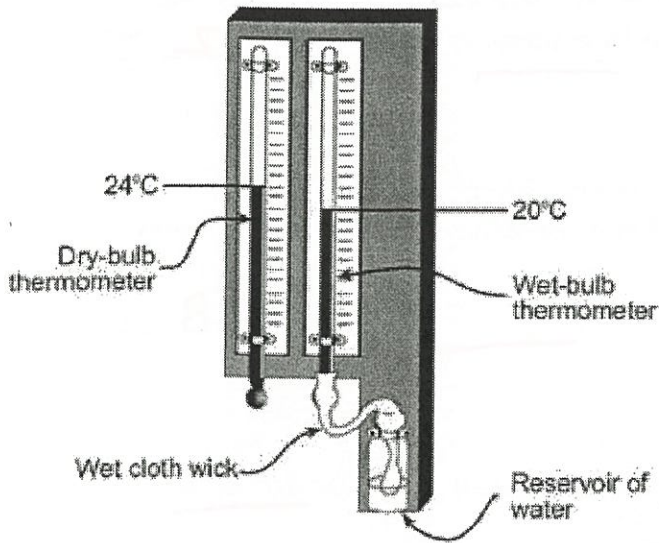
As temperature increases, relative humidity increases

Draw the relationship on the graph to the right.



Instruments used to determine relative humidity:

Sling Psychrometer



Dew point Temperature

The temp at which the air is 100% saturated.

Determining Relative Humidity and Dew point Temperatures

Dry bulb – Actual Temperature

Wet bulb – Therm. with wet sock on it.

When given the wet bulb and dry bulb temperatures, you can determine the dew point temperature and relative humidity by following the directions below.

Use the Dew point Temperature and Relative Humidity charts in the Earth Science Reference Tables on page 12

Example 1: If the dry bulb temperature is 20°C and the wet bulb is 15°C, find the dew point temperature and the relative humidity.

Dew point:

Determine the difference between dry bulb and wet bulb.

Dry bulb	<u>20 *</u>
Wet bulb	<u>15</u>
Difference	<u>5 *</u>

Using the Dew point Temperature chart, find the dry bulb temperature on the dew point chart (left side) and the difference between the wet bulb and dry bulb temperatures (top).

- Match these places within the chart. What is the Dew point Temperature? 12 °C

Relative Humidity:

Same as dew point, except use the Relative Humidity chart. Find the dry bulb temperature on the relative humidity chart (left side) and the difference between the wet bulb and dry bulb temperatures (top).

- Match these places within the chart. What is the Relative Humidity? 58 %

Example 2: Find the relative humidity and dew point temperature when the dry bulb temperature is 14°C and the wet bulb temperature is 9°C.

Dry bulb	<u>14 *</u>
Wet bulb	<u>9</u>
Difference	<u>5 *</u>

What is the Dew point Temperature? 4 °C

What is the Relative Humidity? 50 %

Fill in the following table: Be careful! Make sure you are using the correct chart.

Dry bulb temperature (°C)	Wet bulb Temperature (°C)	Difference between wet/dry bulb	Dew point temperature (°C)	Relative humidity (%)
16	9			
20	12			
4		4		
10		3		
26			6	
-8			-18	
28				31
0				28
	16	2		
	14	10		
		5		58
		8		33
17	13			
25		1		
5		2		
-9	-10			

- What is the dew point temperature if the dry bulb is 24°C and the wet bulb is 22°C? _____ °C
- What is the relative humidity if the dry bulb is 20°C and the wet bulb depression (difference between wet and dry bulb) is 6? _____ %
- What is the relative humidity if the dew point temperature is 6°C and the wet bulb depression is 1? _____ %
- What is the dew point temperature if the wet bulb depression is 6 and the relative humidity is 61%? _____ °C
- A student used a sling psychrometer to measure the humidity of the air. If the relative humidity was 65% and the dry-bulb temperature was 10°C, what was the wet-bulb temperature?
 (1) 5°C (2) 7°C (3) 3°C (4) 10°C

Mini Lesson 2: Clouds

Condensation is the process by which water vapor (gas) changes phase and becomes liquid water. Condensation needs something to form on. This is called condensation nuclei. (Dust)

Clouds are condensation. They consist of water droplets and ice crystals. In order for condensation to occur there must be water vapor present, the air must be saturated and condensation nuclei must be present. Water vapor enters the atmosphere by the process of evaporation. Warm, moist air rises. As the air rises it expands and cools. Once the air has reached the dewpoint, the air becomes saturated. Once this happens, condensation begins to occur. Water droplets form around dust particles that provide the condensation nuclei necessary for clouds to form. Precipitation is any form of water that falls to the Earth's surface. It occurs when the droplets are too big and heavy to remain suspended in the air and fall down towards Earth's surface.

Need to know

1. What are clouds? Condensation
2. What makes up a cloud? Water droplets and ice crystals
3. List the three things necessary for clouds to form.

Condensation Nuclei
Water Vapor
Saturation

4. What is condensation nuclei? Dust
5. Fill in the blanks below to describe how clouds form.
 - warm, moist air rises
 - air expands and cools to the Dewpoint
 - water droplets form on dust Particles
6. When does precipitation occur? When droplets are too big + heavy to stay in the air.
7. What is the difference between condensation and precipitation?

Condensation is when water droplets start to form on dust. Precipitation is when the water falls to the ground.

8. Since water droplets form on dust particles, where does the dust go when it rains?

It goes down to the ground

9. What does precipitation do for the atmosphere? Cleans it

Fact(s) to memorize: 22 & 23

Condensation

Examples:

Three things needed for Condensation to occur:

(1)

(2)

(3)

Density of Air:

Formation of Clouds:

Precipitation –

Examples -

What does precipitation do for the environment?

Weather



Weather

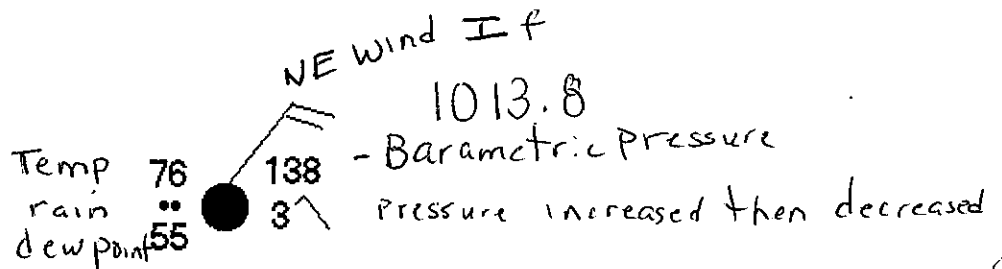
Where does the energy for weather originate? _____

In the United States, the general direction that weather systems move is toward the East.

Station Models

What page of the ESRTs has the key to decode the station model? 13

The temperature and dewpoint are measured in degrees _____.



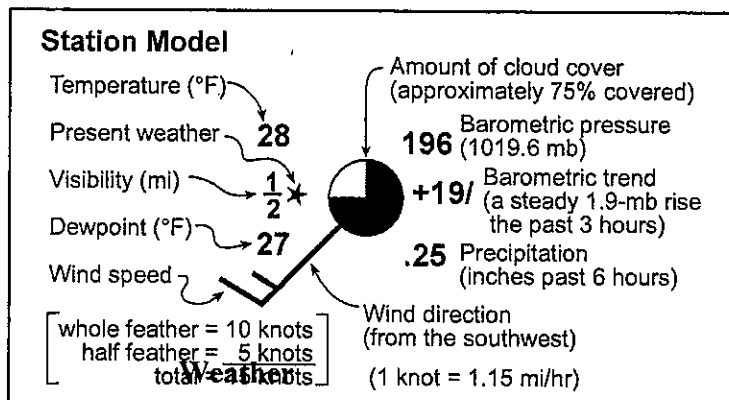
Using the station model above, fill in the chart below using the decoding information from the ESRTs:

Temperature	Dew Point	% Cloud Cover	Air Pressure	Barometric Trend	Wind Direction	Wind Speed
76°	55	100	1013.8	.3	NE	20

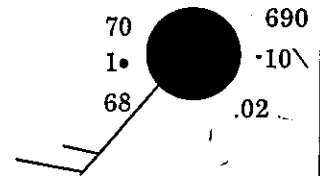
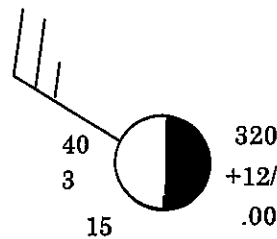
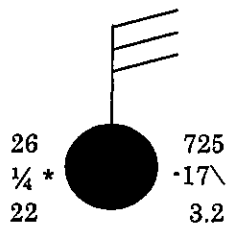
RULE: IF the BP on the station model is less than 500 you add a 10 in front. If its more than 500 you add a 9. You always add a decimal between

the last 2 #s.

These numbers must be converted! Do NOT simply write the numbers above.

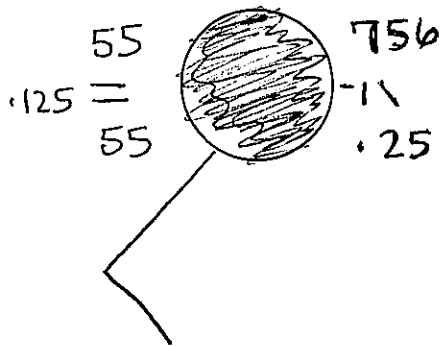


Determine each of the values below by looking at the diagram at the top of each column.

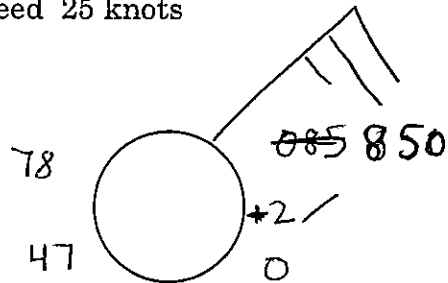


Wind Direction	N	NNE NW	SW
Wind Speed	30 Knots	25 knots	15
Cloud cover	100% ¹⁰	50% ⁰⁷⁰	100% ⁰⁷⁰
Air pressure	972.5 mb	1032.0 mb	969.0 mb
Barometric tendency	-1.7 mb	+1.2 mb	-1.0 mb
Precipitation	3.2 inch	.00 inch	.02 inch
Temperature	26°	40°	70°
Dew Point	22°	15°	68°
Present weather	Snow	/	Rain
Visibility	1/4 mile	3 miles	1 mile

100 % cloudy
 pressure = 975.6 mb
 barometric tendency = falling .1 mb
 precipitation = .25 inches
 temperature 55°
 present weather (fog)
 visibility (.125 miles)
 dew point 55°
 Wind = Southwest
 Wind speed 10 knots



No clouds
 pressure = ~~1008.5 mb~~ 85.0 mb
 barometric tendency = rising .2 mb
 precipitation = 0 inches
 temperature 78°
 present weather (clear)
 visibility (full)
 dew point 47°
 Wind = Northeast
 Wind speed 25 knots



Station Models

On a station model, barometric pressure is ALWAYS written in a three - digit format.

Converting from millibars:

Drop wither the 9 or the 10 in the front of the number and loose the decimal point.

Millibars / Station Model	Millibars / Station Model	Millibars / Station Model
1009.3 mb = 093	1022.2 mb =	994.9 mb =
1084.2 mb = 842	1000.2 mb =	1000.5 mb =
1024.2 mb = 242	989.8 mb =	1008.2 mb =
1091.2 mb = 912	1011.3 mb =	971.4 mb =
1046.5 mb = 465	1007.5 mb =	1031.1 mb =
1049.9 mb = 499	957.6 mb =	961.3 mb =
999.9 mb = 999	1012.3 mb =	974.7 mb =
950.3 mb = 503	986.4 mb =	1033.9 mb =
973.4 mb = 734	962.2 mb =	1000.0 mb =

Converting from the station model format to millibars:

If the first number on the station model is 0 - 4, place a 10 in front of the number.

If the first number on the station model is 5 - 9, place a 9 in front of the number.

Place a decimal point between the last 2 numbers.

Station Model / Millibars	Station Model / Millibars	Station Model / Millibars
146 = 1014.6 mb	015 = mb	080 = mb
457 = 1045.7 mb	623 = mb	978 = mb
986 = 998.6 mb	800 = mb	899 = mb
514 = 951.4 mb	200 = mb	402 = mb
002 = 1000.2 mb	424 = mb	901 = mb
285 = 1028.5 mb	913 = mb	802 = mb
778 = mb	708 = mb	321 = mb
502 = mb	399 = mb	116 = mb
385 = mb	010 = mb	698 = mb

Mini Lesson 5: Air Masses and Fronts

An **air mass** is a large region of the atmosphere with uniform temperature and humidity. Each air mass takes on the characteristics of the area in which it had formed (source region). If it formed over water (maritime) the air would be moist, over land (continental) the air would be dry. An air mass that formed in lower latitudes (south of NY State) the air would be warm (tropical), in higher latitudes the air would be cold (polar). If it formed in very high latitudes the air would be extremely cold (arctic).

As an air mass moves it brings the conditions of the source region with them. For example, an air mass that forms in central Canada is going to be relatively dry (formed over land) and colder (coming from the north). As they travel, the characteristics of the air mass begins to change. Using the previous example, as an air mass moves south it will begin to get a little warmer.

A **front** is the boundary between two different air masses. As a front passes it usually brings a change in temperature, precipitation and change in wind direction. There are four different types of fronts: cold front, warm front, occluded front and stationary. These will be described separately.

Need to know

1. What is an air mass? Large region of the atmosphere with uniform temp + humidity
2. What does the term "uniform" mean when referring to temperature and humidity above? The same
3. What is the area called where an air mass forms? Source region
4. Describe the characteristics of an air mass that forms in the following regions:
Over land Dry In the North Cold
Over water Wet In the South Warm
5. For each of the locations below, circle the temperature and humidity that would be characteristic of an air mass that forms there.
Central Canada: [warm / cold], [wet / dry] Gulf of Mexico: [warm / cold], [wet / dry]
6. What happens to the characteristics of an air mass as it moves over other areas?

7. What is a front? _____
8. What three things might you expect if a front passes?

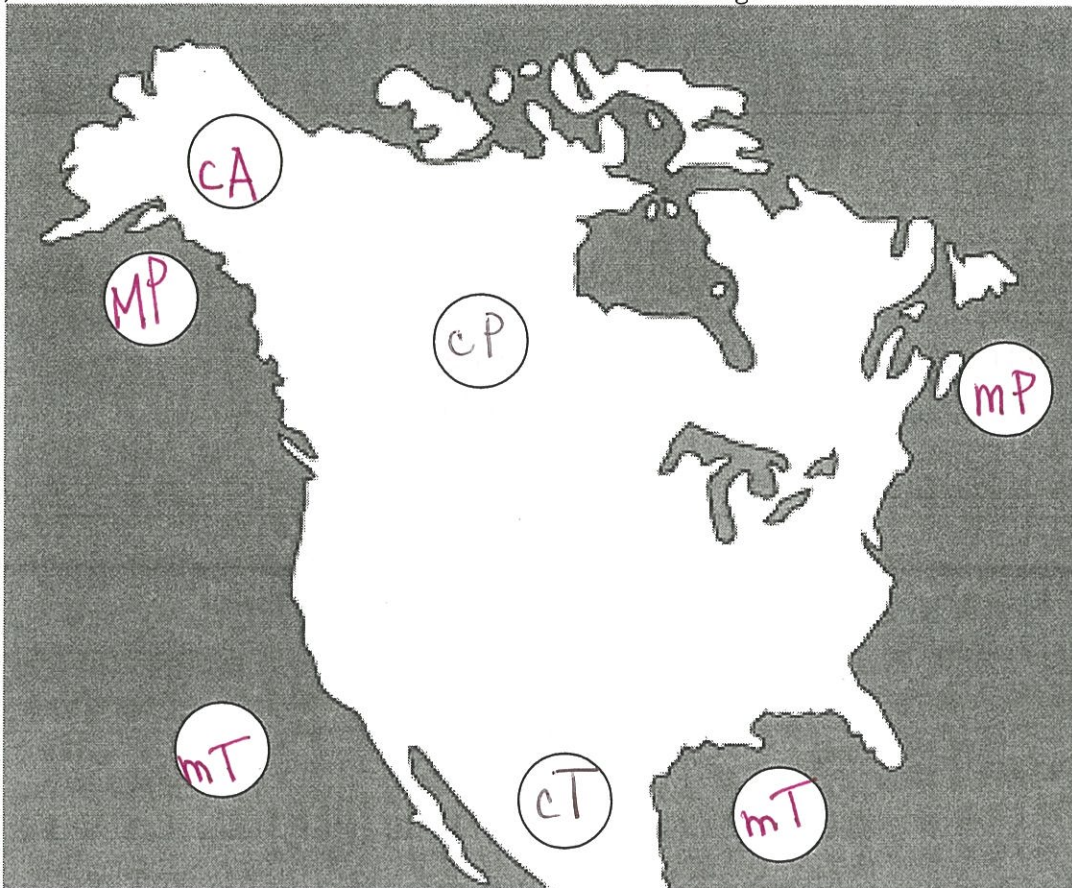
temp change, precipitation, Wind direction change

Air Masses

ESRT – pg 13

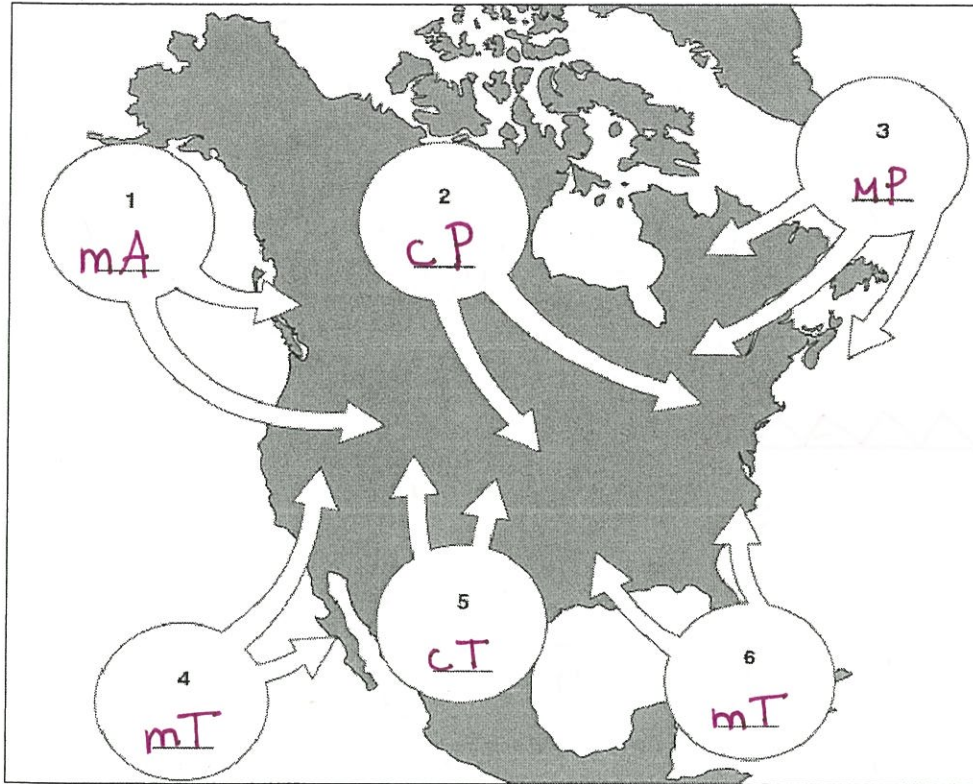
Symbol	Written form	Type of weather
cP	Continental Polar	Dry cold
cT	Continental Tropical	Dry Hot
mP	Maritime Polar	Wet cold
mT	Maritime Tropical	Wet hot
cA	Continental Arctic	Dry very cold

In the map below, write the correct abbreviation (cP, cT, mP, mT) in the corresponding location, to show the characteristics of an air mass that originated there



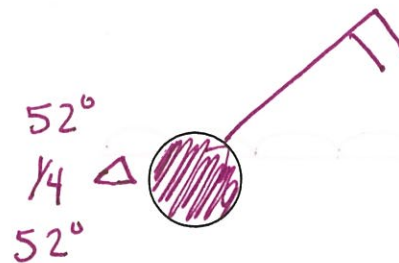
Weather Map Practice

- The map provided below shows six source regions for different air masses that affect the weather of North America. The directions of movement of the air masses are shown. Using the standard two-letter air-mass symbols from the Earth Science Reference Tables, label the air masses by writing the correct symbol in each circle on the map.



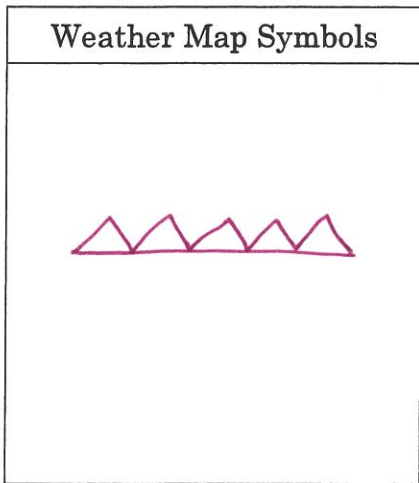
- Using the station model below, draw and label the following information. Cloud cover has been left out. Using the information determine what the coverage would be and shade in the station model.

Wind direction	Northeast
Wind speed	20 knots
Present weather	Hail
Visibility	¼ mile
Temperature	52 °F
Dew point	52°F
Cloud cover	? 100%

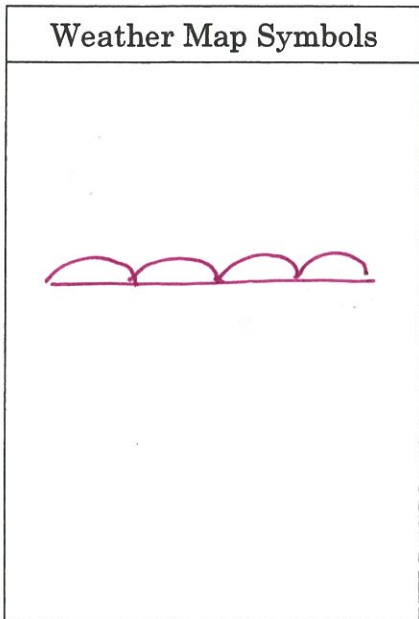


Earth Science Reference Tables page 13



COLD FRONT:

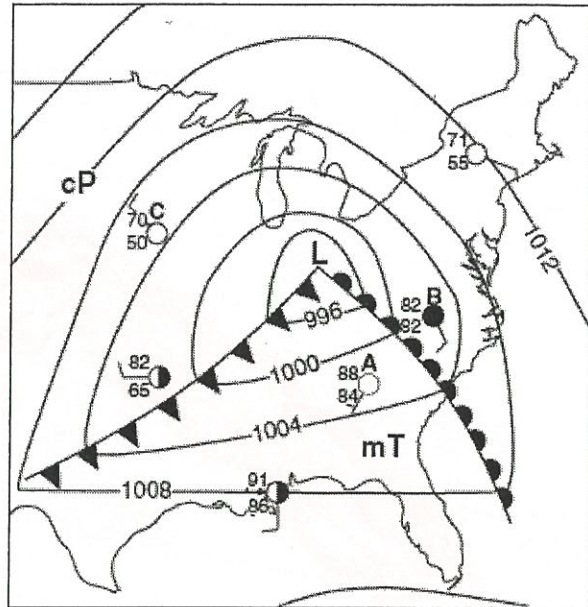


WARM FRONT



Base your answers to questions 3 – 12 on the weather map below. The map shows a low pressure system and some atmospheric conditions at weather stations A, B, and C.

3. What is the symbol for the warm and moist air mass? 
4. What is the symbol for the cold and dry air mass 
5. Where did the warm air mass originate? Gulf
6. Where did the cold air mass originate? Canada
7. Which weather station (A, B, or C) has 100% relative humidity? B
8. Which weather station (A, B, or C) will show colder temperatures within the next couple days? A

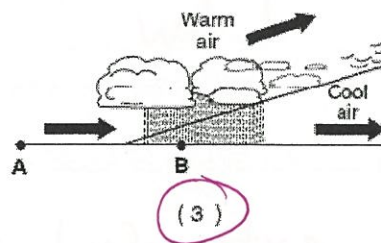
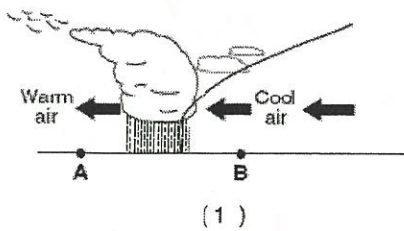


9. In what direction is the wind blowing toward in weather station C? NW

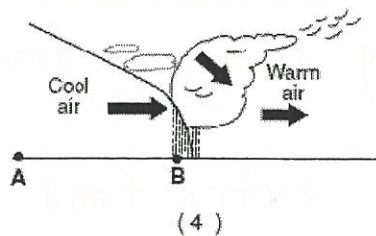
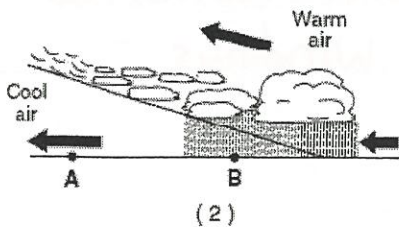
10. List three things that indicate that this is a low pressure area on the map above.

Temp, dewpoint, cloud cover

11. Which cross sections below best represents the air masses, air movement, clouds and precipitation occurring behind and ahead of the warm front located between stations A and B?



Warm

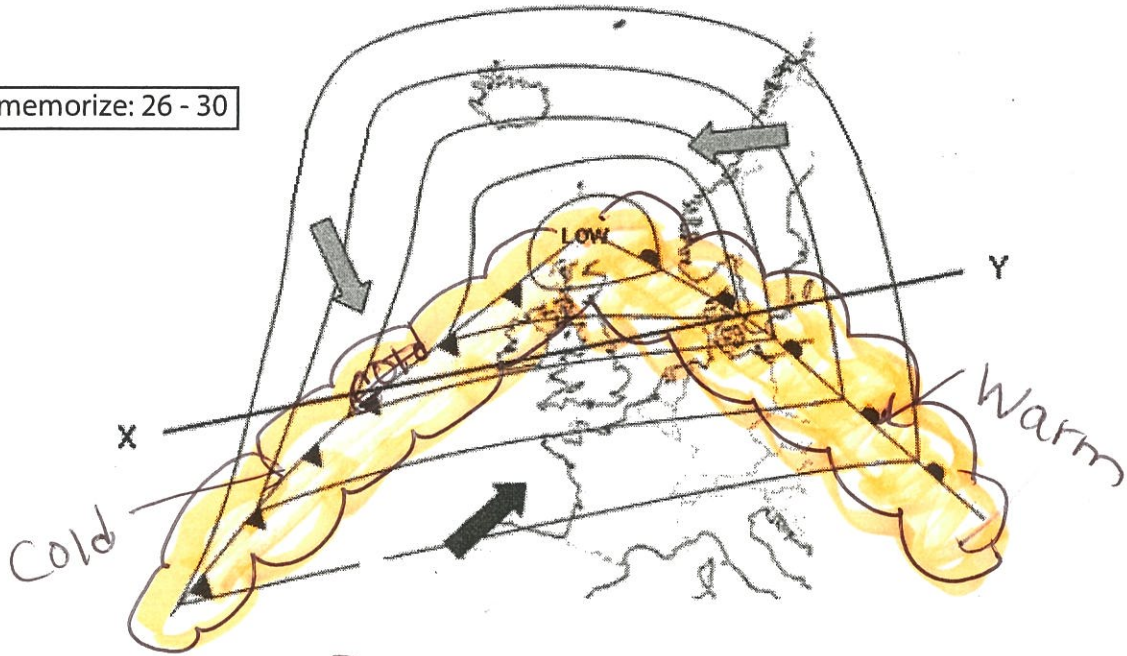


MID-LATITUDE CYCLONE

On the map below, label the warm and cold fronts.

Additionally, write the abbreviations for the three air masses.

Fact(s) to memorize: 26 - 30



Precipitation Occurs along the Front

Hazardous Weather and Safety

Fact(s) to memorize: 31 - 34

Give two other names for hurricanes: Cyclone and Typhoon

Hurricanes are areas of intense Low pressure. (H/L)

Which covers a greater geographic area? hurricanes or tornadoes

Name two safety precautions to take for HURRICANES:

- A. Have extra food, water, batteries
- B. Stay a way from windows

Name two safety precautions to take for TORNADOES:

- A. Have extra food
- B. go in a basement

Mini Lesson 1: Hurricanes

Hurricanes that affect the US usually form in the Northern Atlantic Ocean. As solar radiation warms the ocean surface evaporation increases. The warmer the temperatures, the greater the rate of evaporation. As you may recall, warm, moist air rises, expands and cools to the dew point and clouds form. Energy and water vapor continue to be added to the atmosphere. This creates a low pressure area, known as a tropical depression. If winds are sustained above 39 miles per hour it is considered a tropical storm. If the winds are over 74 miles per hour it becomes a hurricane.

Most hurricanes occur in late summer early autumn because this is when the ocean surface is warmest. They are the most destructive storms. High winds, storm surges (ocean water pushed onto the coast) and major flooding occur. One more thing that adds to the disaster is that tornados can form. A hurricane is sometimes referred to as a cyclone because it is such a large area of low pressure. A typhoon is the same as a hurricane, however forms over the Northwest Pacific Ocean.

Hurricanes are fairly easy to predict because advancements in weather radar and satellite technology allows meteorologists to watch them develop and keep track of their path. Where exactly they hit land is not full proof. If a hurricane appears to pose a threat to your area within 48 hours, a hurricane watch is issued. A warning is issued if conditions are expected within 36 hours.

Category	Winds
1	74-95 mph
2	96-110 mph
3	111-130 mph
4	131-155 mph
5	> 155 mph

When you are ordered to evacuate LEAVE THE AREA.

Need to know:

1. Where do hurricanes form? _____
2. How do clouds form in a hurricane? _____

3. What is added to the atmosphere to fuel the development of a hurricane? _____
4. What is a tropical depression? _____
5. What is the difference between a tropical storm and a hurricane? _____

6. What is the difference between a sustained wind and a wind gust? _____
7. How fast are sustained winds in a category 5 hurricane? _____

Think

Mini Lesson 2: Tornado

Tornados are spiraling columns of air that reach from a cumulonimbus cloud and touch down on Earth's surface. They are formed from thunderstorms. Warm, moist air from the Gulf of Mexico collides with cool, dry air from Canada and creates instability in the atmosphere. As these air masses collide, there is a change in wind direction which causes horizontal spinning to occur. As wind speed increases, rising air within the rising air column tilts. A waterspout is a weak tornado that forms over water.

Tornadoes can occur any time of year but are most common from March through May in the southern states and during the summer for the northern states. Dangers include high winds, downed power lines and flying debris. If you are in a tornado watch area, go to your basement or a first floor interior room (without windows) in your house. If outside, do not get into your car and try to outrun it. Go to a ditch or low area and lay down flat on the ground.

Need to know:

1. What is a tornado? _____

2. What happens when two air masses collide? _____

3. When do tornados generally occur in the southern states? _____
4. When do they occur in the northern states? _____
5. Name three hazards a tornado creates. _____
_____ and _____



6. Give an example of an interior room in your house. _____
7. Why is it not a good idea to try and outrun a tornado?

8. What should you do if you are outside in a park and you see a tornado heading your way.

Mini Lesson 3: Winter Storms

Snow forms when a very cold and dry air mass comes in contact with a warm, moist air mass. As moisture from a warm air mass rises, it changes to snow or ice crystals. Precipitation can also be in the form of sleet, hail or freezing rain. When there is a heavy snow with poor visibility and winds in excess of 35 mph it is considered a blizzard.

Lake effect snow occurs when the cold air mass moves over an open lake or body of water that has not yet frozen. Moisture from the lake rises into the air and is transformed into snow. Frost bite, hypothermia, flying debris, roof collapse, and downed power lines are only a few of the problems associated with winter storms.

During the winter months always travel with blankets and non-perishable food and water in case you are stranded. Dress appropriately, in layers, throughout the winter months. At home, always keep a disaster supply kit.

Need to know:

1. How does snow form? _____

2. Name three types of precipitation, other than snow that may fall during a winter storm.

3. When is a snow storm considered a blizzard? _____

4. List three problems associated with winter storms. _____

5. If traveling by car, what should you always bring? _____

Mini Lesson 4: Thunderstorms and Floods

Thunder is a direct result of lightning. As a stream of electrons flow from cloud to cloud or between a cloud and the ground the surrounding air is super heated and the air molecules rapidly move away from the electron flow. Once the electron stream is completed (lightning) the air molecules move back together. This rapid expanding and contracting of air molecules is what we hear as thunder. Thunderstorms form when there is moist, unstable air that is rising really fast. Typically they are relative small compared to the size of hurricanes or winter storms but they are very dangerous. Lightning actually kills more people each year than tornadoes. Heavy rain from thunderstorms can lead to flash flooding. Strong winds, hail, and tornadoes are also dangers associated with some thunderstorms.

Flash floods occur when a great amount of water is "dumped" in an area. Sources for flash floods include hurricanes, thunderstorms, tsunamis, and a rapid melting of snow. They are deadly and should be taken seriously.

Need to know:

1. What causes thunder? _____

2. Is thunder dangerous? _____

3. Other than lightning, list three other dangers of thunderstorms.

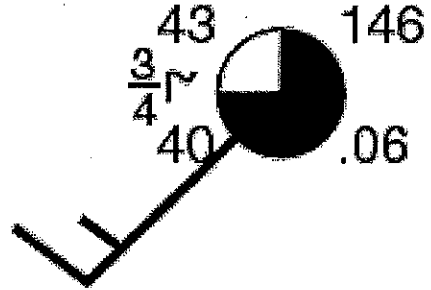


4. Why is a flash flood more dangerous than just a regular flooding?

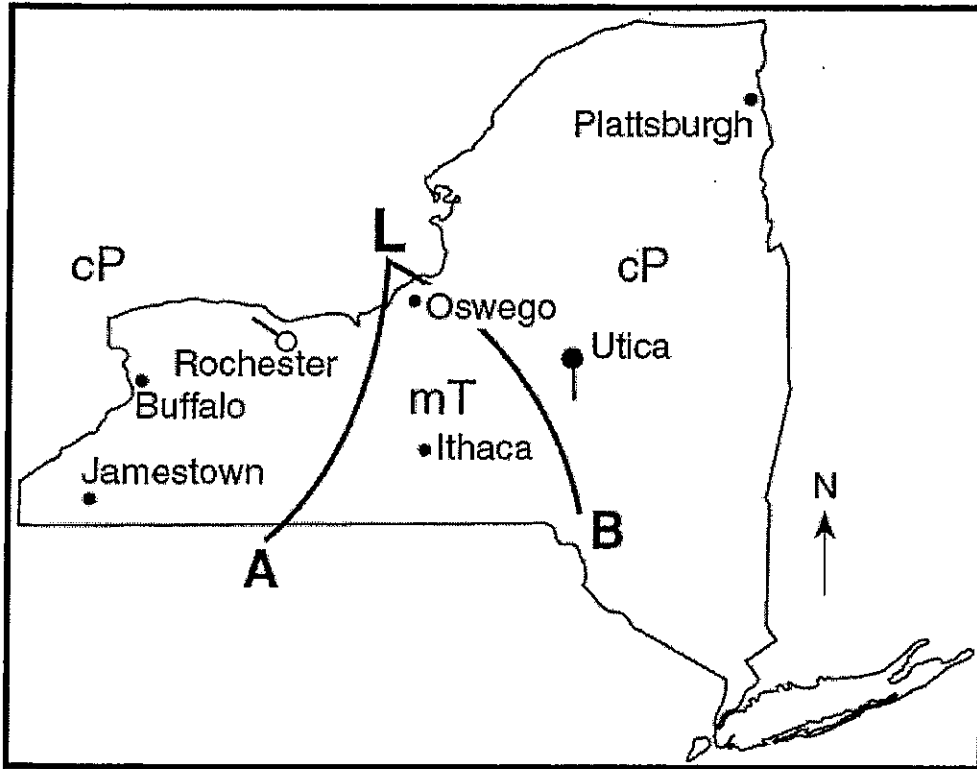
Weather Review

1. Use the station model below to fill in the information.

- Temperature
- Dew Point
- Cloud Cover
- Air Pressure
- Wind Direction
- Wind Speed
- Precipitation
- Visibility
- Current Weather



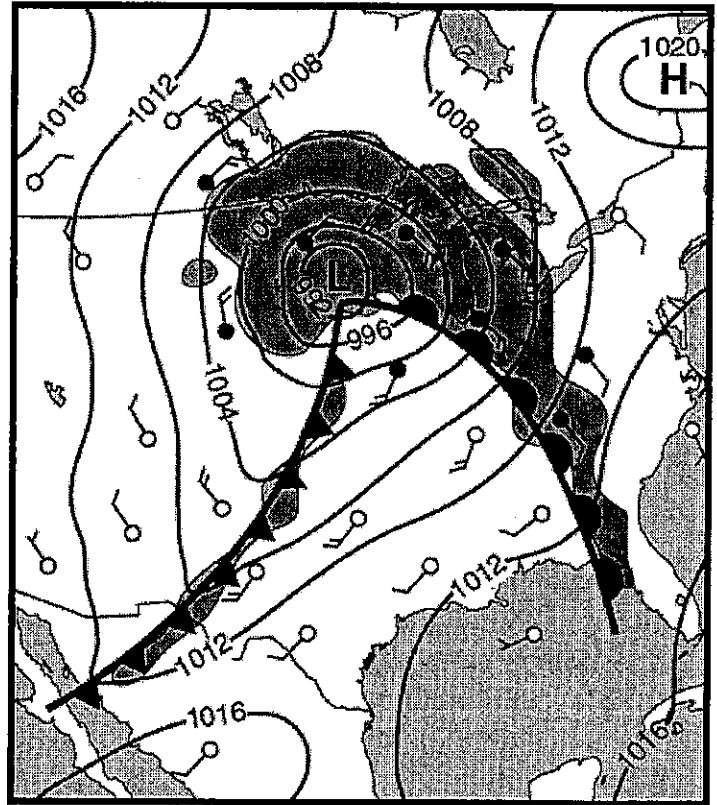
Use the following diagram to answer questions 2-6.



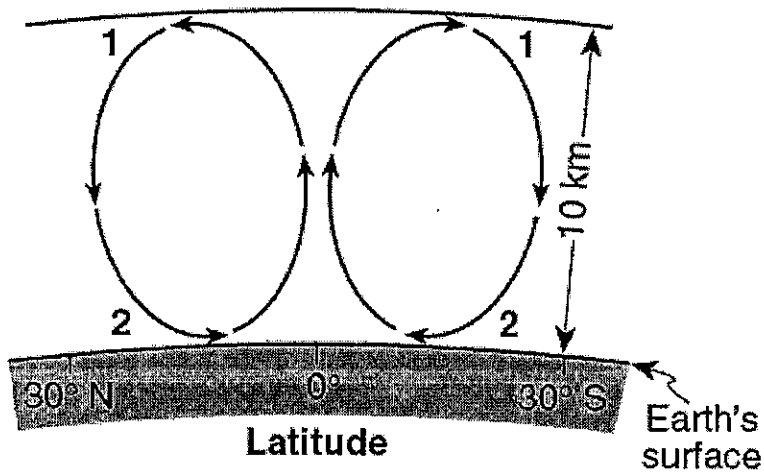
2. Label the lines A and B with the correct frontal symbols.
3. Label the low pressure with the correct wind arrows.
4. Lightly shade the area that is receiving precipitation.
5. What will happen to the temperature in Utica over the next several hours?
6. Where did the air over Buffalo originate?

Use the following diagram to answer questions 7-11.

7. Label the continental polar air mass with a cP.
8. Label the maritime tropical air mass with mT.
9. Label the area with the calmest wind with an X.
10. What is the highest possible air pressure on the map.
11. Which general direction does the LOW pressure usually travel?

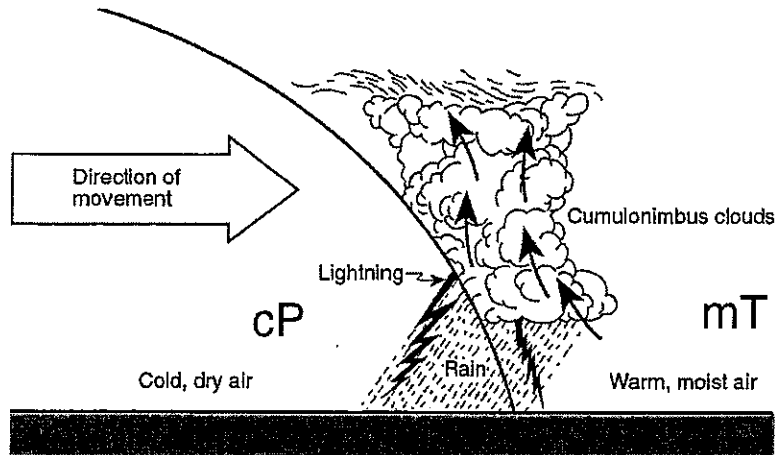


Use the picture below to answer questions 12-14.



12. Which layer of the atmosphere does this picture take place?
13. What happens to the temperature, pressure and water vapor as you move from point 2 to point 1?
14. Label the tropopause.

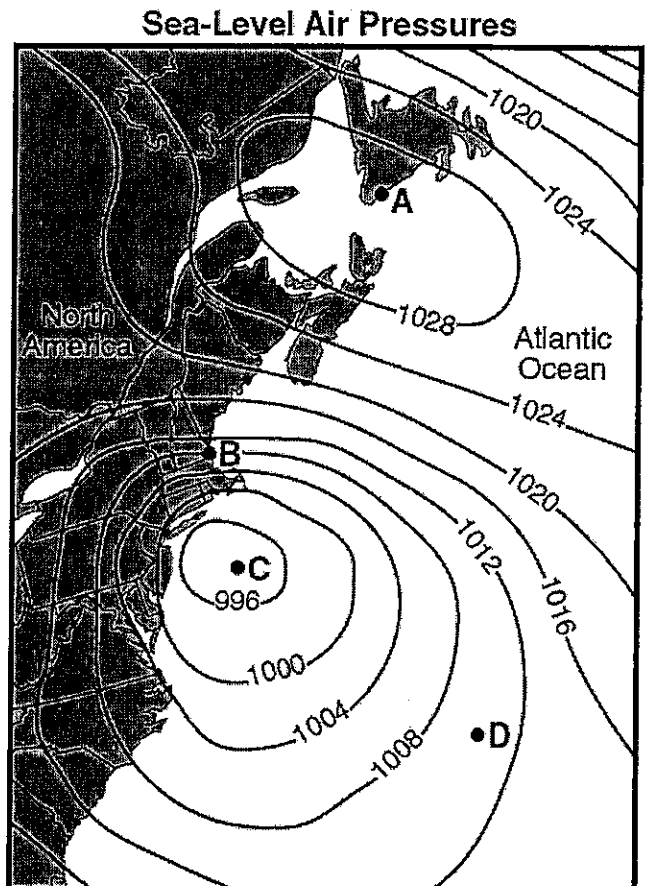
Use the picture below to answer questions 15-17.



15. What kind of front is shown in the above diagram?
16. Describe the process that created the clouds in the diagram?
17. Which direction is this front probably moving?

Use the diagram below to answer questions 18-20.

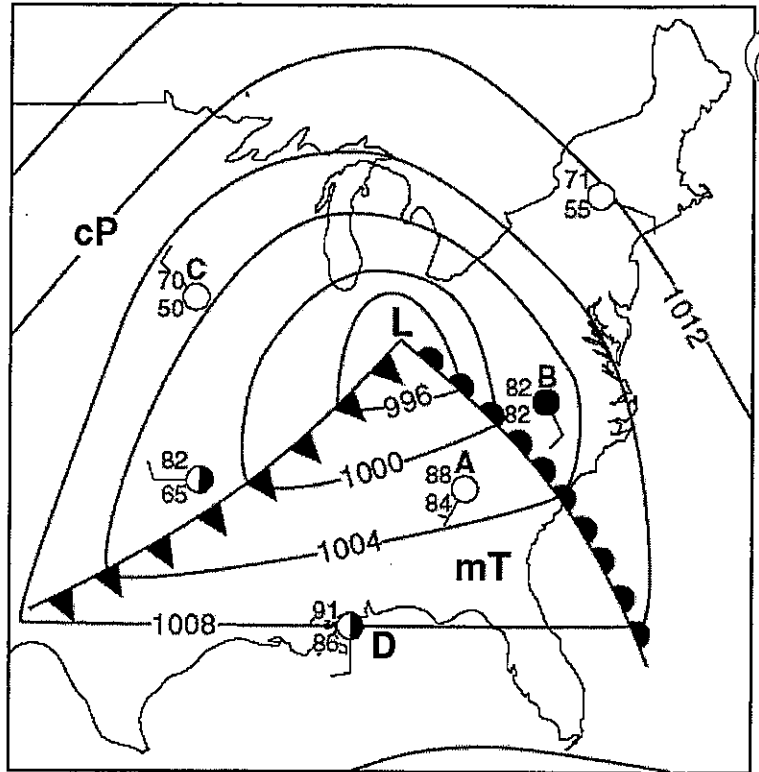
18. What type of pressure system is location A?
19. Which letter has the highest wind speed?
20. What type of pressure system is location C?



Weather

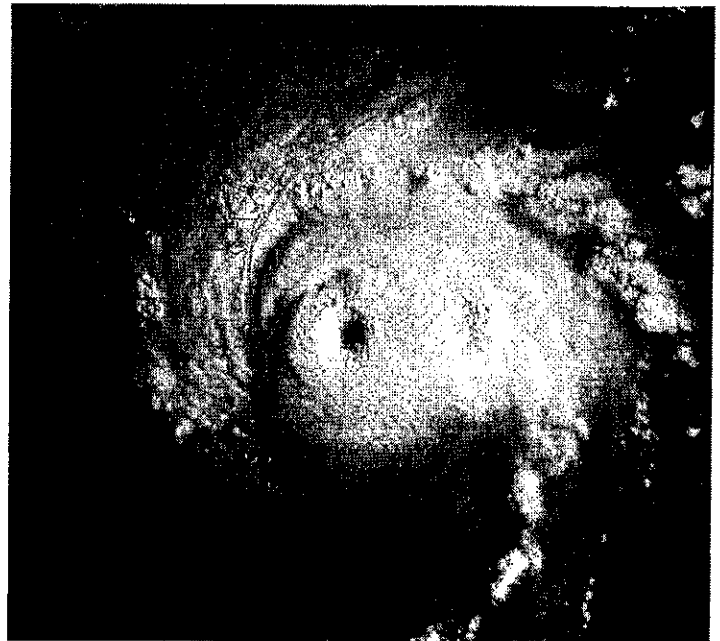
Use the map to the right to answer questions 20-25.

21. What is the temperature at C?
22. What is the cloud cover at A?
23. What is the relative humidity at B?
24. What would the 3 number air pressure code for position D?
25. What will happen to the temperature and The wind direction at location D over the next several hours?



Use the picture to the right to answer questions 26-29.

26. What is the name of this type of storm?
27. Use arrows to show the direction of wind flow around this LOW pressure system.
28. If this storm is in the Gulf of Mexico, name the air mass and describe its characteristics.



29. How can you prepare yourself and your family if this type of storm approaches?

Use the following table to answer questions 30-31.

Air temperature (dry-bulb temperature)	0°C
Relative humidity	81%
Present weather	snow

30. What is the wet-bulb temperature?

31. What is the dew point?

Use the graph below to answer questions 32-35.

32. What is the temperature at 6 pm?

33. What is the relative humidity at 6 am?

34. What is the relationship between temperature and relative humidity?

