EARTH SCIENCE
Fox Lane High school

Name:_____Date: _____

UNIT ONE

Revealing weather variables through hurricanes

*Dedicated to: _____

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ABSTRACT AND RATIONALE

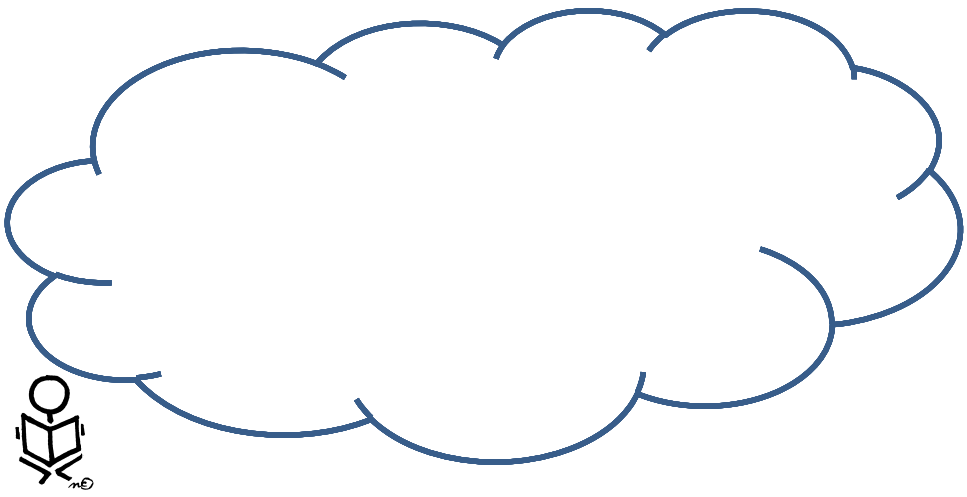
Hurricanes are the only natural disasters with their own names. Each evokes its particular image of disaster. Hurricanes are the same in many ways, yet, like people, each has its own personality. Every year hundred thousands of dollars worth of damage and hundreds of lives are lost as a result of hurricanes in the Atlantic basin. As costal population increases, getting the hurricane message and education to the public is crucial.

TASK STATEMENT/PROBLEM BASED LEARNING/REAL WORLD PROBLEM:

You have been assigned to intern at the National Hurricane Center. What instructions will you give to the coastal residents to prepare for the oncoming hurricane? At what point would you give instruction for evacuation? You will create an informational **brochure** to distribute to community members to explain hurricane formation, possible consequences and how to prepare for a nearby Hurricane landfall. Your brochure should reflect your creative and the breadth of your research but at the same time explain the science to your best ability behind the guiding question.

Guiding Question: How do low pressure cyclones become a hurricane?

What are some questions you have before answering the question?



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Textbook Reading Assignment

Read page#450-455 in your Earth Science textbook. Answer the questions below (specifically for each section of the reading). Remember, try to be honest and not make up any answers. This is a way for us to understand where you are having difficulty.

Page #450

1. Write down three things you learned from the general description of a hurricane

a) _____

b)_____

c) _____

Page#451

2. Write down two questions you might have after reading the section on hurricane formation.

a) _____

b) _____

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4. Write down two questions you have on effects of hurricanes.

a) _____

b) _____

5. Write down three new vocabulary words from the reading and define them.

a) _____

b) _____

c) _____

Page#452

6. How do meteorologists track a hurricane? Explain the difference between a watch and a warning.

_____

_____

_____

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Anticipation Guideline (Hurricane)

Base on your own knowledge; **decide** whether or not each statement below is true (yes) or False (no). For homework, Read page#450-452 in your Earth Science Textbook. Correct your answers base on the reading. If the statement is no, please **indicate** the page# and line# where the correct answer is located in the text. In addition, be sure to **correct** the wrong word in the statement with the correct vocabulary.

Yes	No	**Statements**	Yes	No	Page# Line#
		Air pressure at the center of a hurricane is always high			
		A hurricane gets its energy from the heat of ocean water			
		Hurricanes occur in Pacific Ocean is called typhoons			
		Hurricane winds spiral outward from the low pressure system			
		The eye wall causes great damage as it passes over an area			
		Hurricane begins with a disturbance in the tropics that causes humid air to rise			
		As air rises, it cools and condenses, gaining heat.			
		Hurricane strengthens rapidly once it makes landfall			
		The effect of a hurricane is drought.			

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Hurricane Intro Notes

1. ADV means

_____
_____

2. Zulu time means

_____
_____
_____

3. What characteristic of the ocean over which the hurricanes form seems essential?

_____
_____
_____

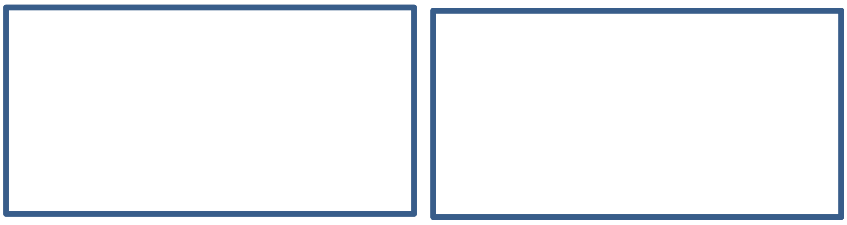
4. How does land play a role in hurricane's behavior/characteristics?

_____
_____
_____

5. What do you notice about the wind speed of Hurricane as air pressure drops?

_____

6. What is the formula for speed?



7. In generally, what direction does hurricanes in the Mid-Atlantic move?

_____

8. As the hurricanes approach the United States, generally, how do their paths change?

_____
_____

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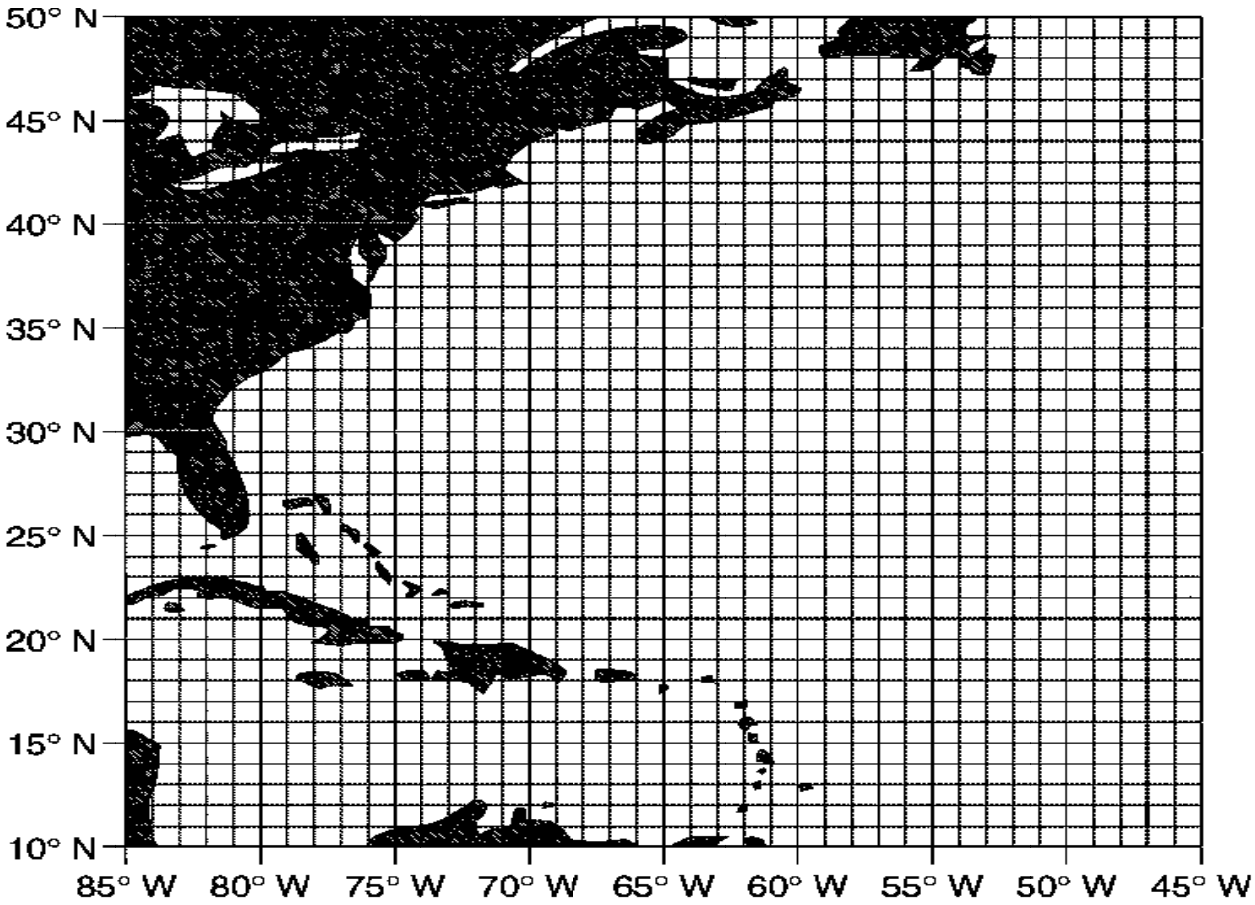
Hurricane Plotting Homework

The data shows recorded information for a major Atlantic Hurricane. **Plot** the position of the Hurricane, **connect** the points and **label** the dates

Data Table I

Latitude (°N)	Longitude (°W)	Date	Wind Velocity (knots)	Air Pressure (millibars)	Storm Strength
14	47	Aug. 24	30	1006	Tropical depression
16	50	Aug. 25	70	987	Category-1 hurricane
19	52	Aug. 26	90	970	Category-2 hurricane
21	59	Aug. 27	80	997	Category-1 hurricane
23	65	Aug. 28	80	988	Category-1 hurricane
25	70	Aug. 29	80	988	Category-1 hurricane
27	73	Aug. 30	65	988	Category-1 hurricane
30	74	Aug. 31	85	976	Category-2 hurricane
32	72	Sept. 01	85	968	Category-2 hurricane
37	64	Sept. 02	70	975	Category-1 hurricane
44	53	Sept. 03	65	955	Category-1 hurricane



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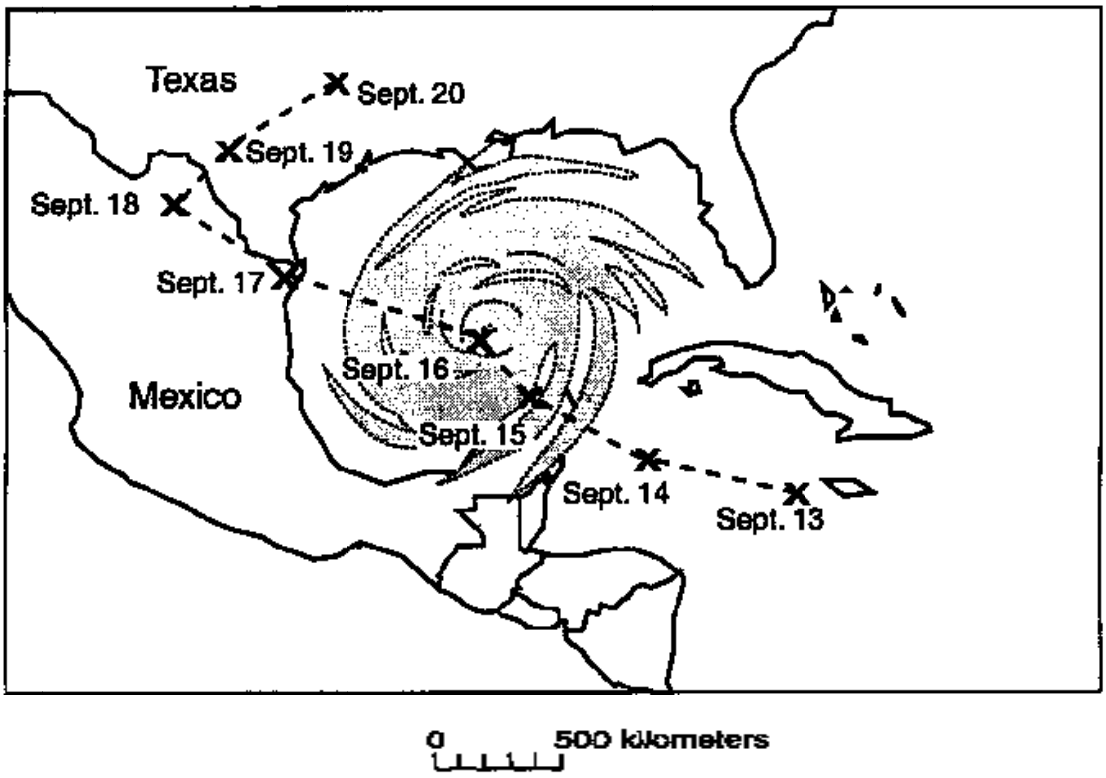
Homework

The picture represents a satellite image of Hurricane Gilbert in the Gulf of Mexico. Each **X** represents the position of the storm on the date indicated



1. Describe one threat to human life and property that could have been caused by the arrival of Hurricane Gilbert along the coastline. _____

2. Give one reason Hurricane Gilbert weakened between September 16 and September 18
_____

3. What is the speed of the hurricane from Sept. 13 to Sept. 16? _____
(Use the boxes below to show work)

Copy the equation (using letters)	**Substitute the value**	**Solve (UNITS)**

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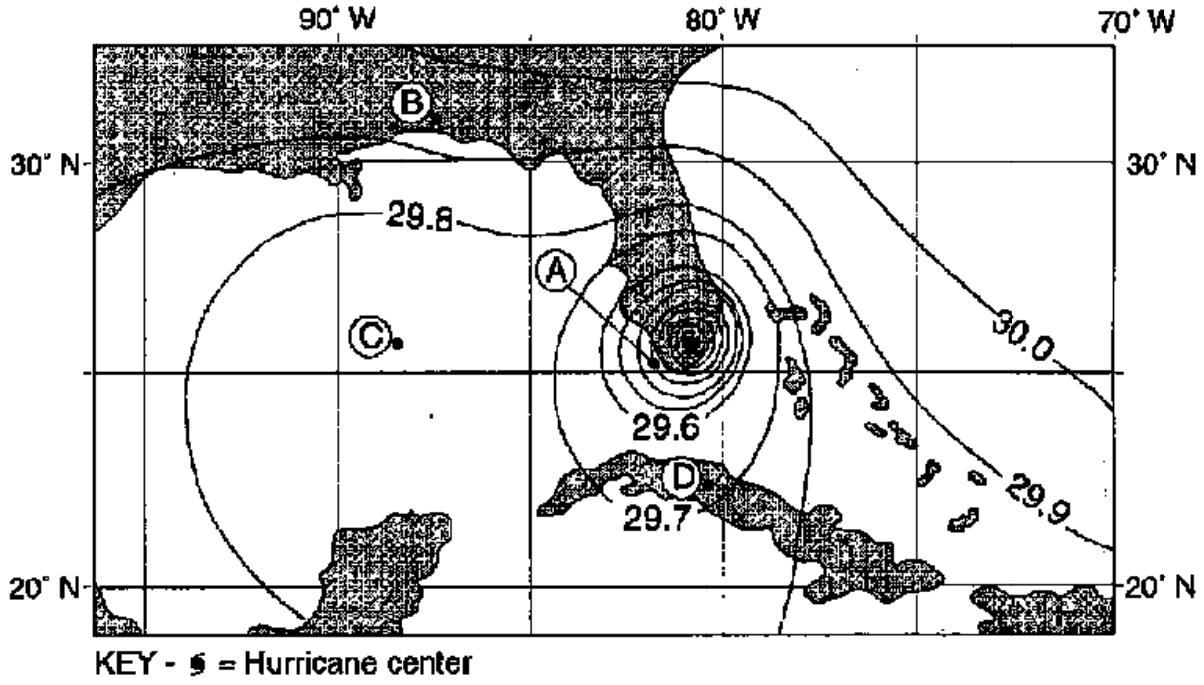
4. The image below shows a hurricane that was located over Southern Florida moving towards the coastline. Letter A represent the center (eye) of the hurricane



#

#

What is the Latitude and Longitude of this hurricane? (Remember, latitude is always first!)

_____ ; _____

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Tornado Homework

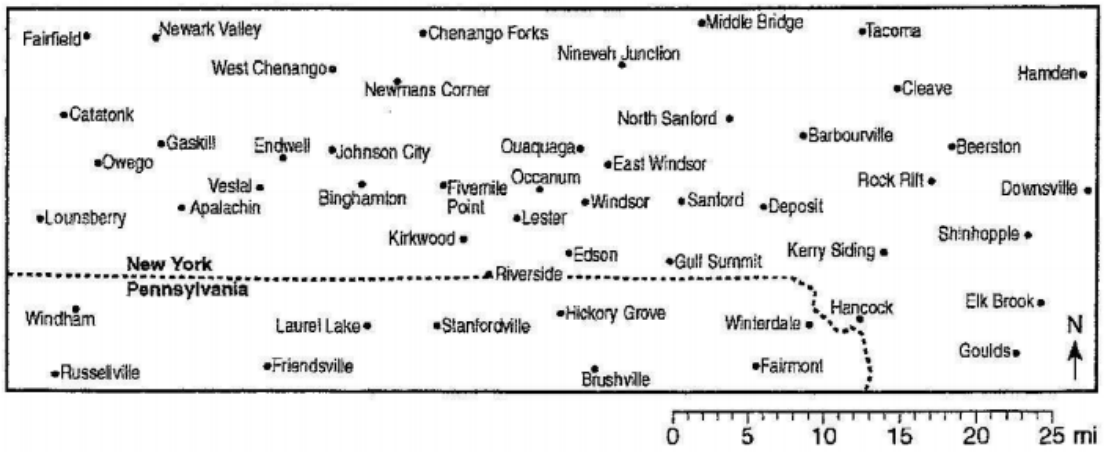
Questions 1 – 4 refer to the following reading.

A small tornado formed and moved through the town of Apalachin, New York, at 5:30pm, producing winds between 40 and 72 miles per hour. The tops of trees were snapped off, and many large limbs fell to the ground. The path of the destruction measured up to 200 feet wide. At 5:45pm, the tornado next moved through the town of Vestal where winds ranged between 73 and 112 miles per hour. Many people experienced personal property damage as many homes were hit with flying material.

At 6:10pm, the tornado moved close to Binghamton, producing winds between 113 and 157 miles per hour. A 1,000 foot television tower was pushed over. Then the tornado lifted off the ground for short periods of time and bounced along toward the town of Windsor. At 6:15 p.m., light damage was done to the trees as limbs fell and small shallow rooted trees were pushed over in Windsor.

The tornado increased in strength again at 6:20pm, as it moved into Sanford. Some homes were damaged as their roots shingles and siding were ripped off. One mobile home was turned over on its side.

The tornado moved through the town of Deposit at 6:30 pm, creating a path of destruction 200 yards. The tornado skipped along hilltops, touching down occasionally on the valley floors. However, much damage was done to homes as the tornado's winds reached their maximum speed of 158 to 206 miles per hour. The tornado weakened and by 7pm, the tornado had finally ended its 1 hour rampage.



1a. Place an x through the point for each of the six towns mentioned in the passage

1b. Connect the Xs with a line in the order that each town was mentioned in the passage

1c. Place an arrow at one end of your line to show the direction of the tornado's movement

2. Describe the air-mass that would be responsible for producing this tornado _____

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3. Calculate the tornado's average rate of travel, in **miles per minute**, between Vestal and Windsor, by using the ESRT formula for Rate.

Copy the equation (using letters)	**Substitute the value**	**Solve (UNITS)**

4. Using the **Fujita Scale** shown below and the information in the reading passage, assign an F-Scale for the tornado as it passed through each town given in the table.

F-Scale Number	Wind Speed (mph)	Type of Damage Done
F–0	40–72	some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards
F–1	73–112	peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed
F–2	113–157	considerable damage; roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light-object missiles generated
F–3	158–206	roof and some walls torn off well-constructed homes; trains overturned; most trees in forest uprooted
F–4	207–260	well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated
F–5	261–318	strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile-sized missiles fly through the air in excess of 100 meters; trees debarked; steel-reinforced concrete structures badly damaged

Town	**F-Scale Number**
Vestal	
Windsor	
Sanford	
Deposit	

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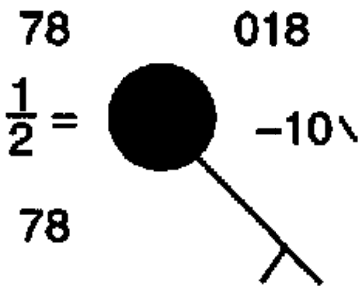
Homework - USE page 14 of your ESRT

1. Base your answers on the weather station model shown below



a) State the possible humidity at this location:_____

b) Decode the pressure (include a unit) : _____

c) State the current weather condition: _____

d) Describe the pressure/barometer trend at this location :

_____

e) What is the wind direction? _____

f) What is the pressure 3 hours ago? _____

2. Draw a station that shows these weather variables

Visibility = 6 miles
Amount of cloud cover = 1/2 or 50%
Air pressure = 1001.1 millibars

3. Name the instrument that measures air pressure _____

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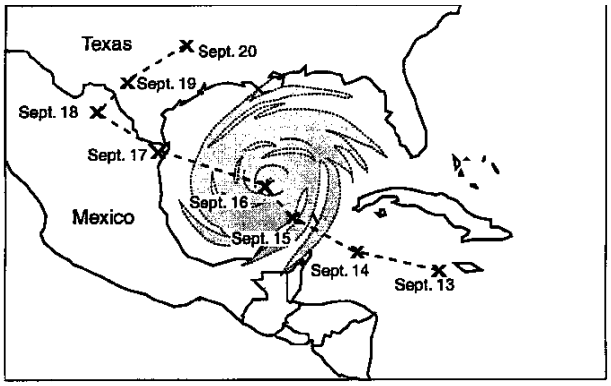
4. The diagram shows Hurricane Gilbert approaching land.

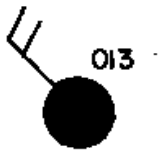


a. How can the coastal residents prepare for the arrival of a hurricane?

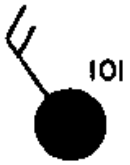
_____

b. What made this hurricane shift in its compass direction after Sep.18? _____

5. A weather station records a barometric pressure of 1013.2mb. Which diagram below would best represent this station?

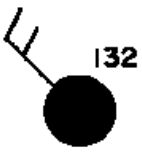


(A)



(B)

(C)



(D)

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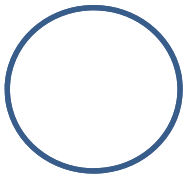
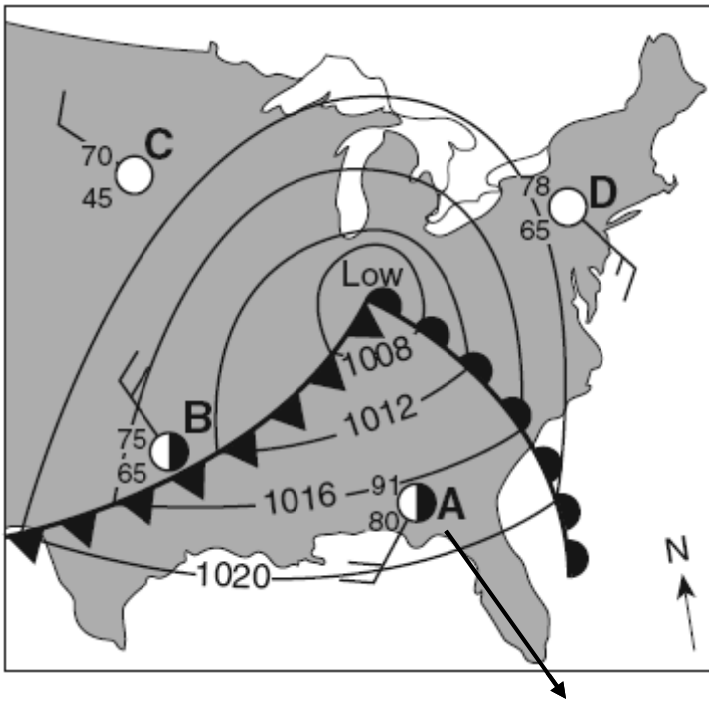
6. Draw a station that would show:
   - ✓ thunderstorm is occurring
   - ✓ Temperature and humidity is both 81°F
   - ✓ Visibility 7 miles
   - ✓ Dewpoint 48°F
   - ✓ Wind Direction from the south
   - ✓ Wind Speed 25 knots



7. The picture below represents a weather map over an area.



a) The circle loops on the diagram is called isobars. If those lines are contour lines, then the value would be elevation. What do you think the values on the circle lines represent in this diagram?

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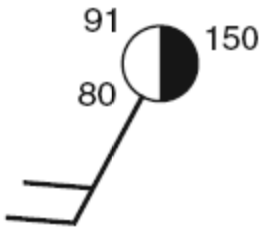
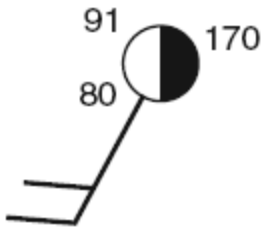
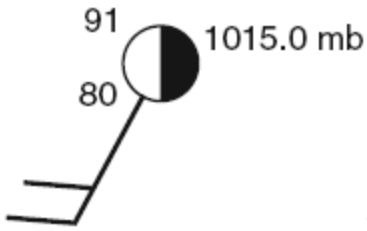
b) Which station model (1-4) represents the weather condition at letter A (**ON THE PREVIOUS DIAGRAM**)



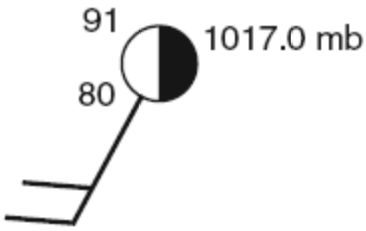
(1)



(2)



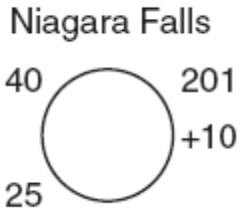
(3)

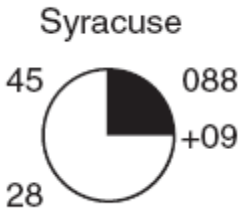


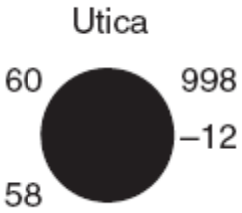
(4)

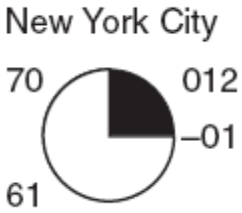
c) Which weather instrument was used to measure wind speed at station *D*?

(1) barometer
(2) thermometer
(3) psychrometer
(4) anemometer









d) Explain how the weather conditions shown on the station models suggest that Utica had the greatest chance of precipitation?_____

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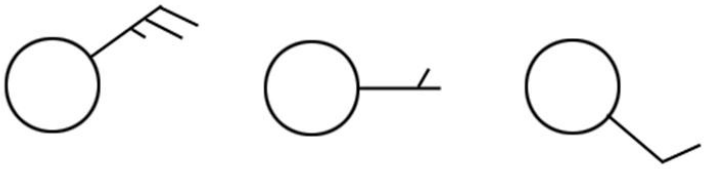
Station Model Notes

Slide#1: WIND (Knots)

Whole Feature = _____Half Feather = _____



_____ _____ _____

Slide#2: BAROMETRIC PRESSURE (Decoding)

196 _____

19.6_____

919.6 1019.6

Which one is below the range of normal pressure? _____

Decode these:

002 993 280 000

Slide#3: BAROMETRIC PRESSURE (Encoding)

1013.5_____

10135 _____

1032.7 987.3 1012.2 1000.1

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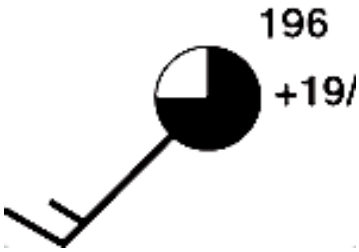
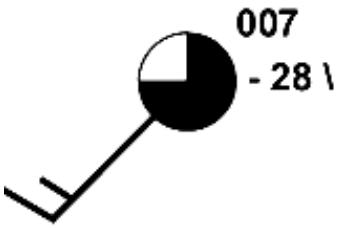
Slide#4: BAROMETRIC TREND/change

+ 19 /

`

What was the pressure 3 hours ago?





Slide#5: DRAW A STATION MODEL

Temperature= 45°F

Dewpoint= 32°F

Wind NE at 20 knots

Overcast

Visibility= 1.5 miles

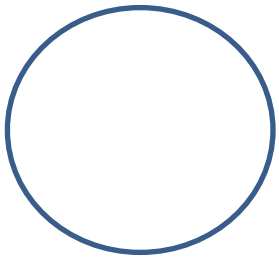
Rain Showers

Pressure Now= 997.3 mb

Pressure 3 hrs. ago= 1000.2mb

Barometer Falling

Precipitation in last 6 hrs.= .53 in.



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Textbook Reading (air pressure & wind)

Read page#414-421 **There will be a reading quiz tomorrow** . The quiz will be mostly on factual information. I will not be quizzing you on the "WHY" piece. I would recommend you to focus on the following pages. You may choose to take notes on the following pages while you are reading. If you would like to show me your notes, you can even use a separate sheet of paper.

Page 414

What are some important passages that you think it's important from the reading?

Page 416

Explain in your own words **HOW** temperature and humidity affect air pressure.

Page 417

What are some important ideas in the section called "what makes the wind blow?"

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Page 418

Describe Coriolis Effect and how it affects wind.

_____
_____
_____

Reading comprehension checklist: In your notes, did you make sure you cover the following subtopics?

- ✓ **Measuring air pressure**
- ✓ **Why does air pressure change?**
- ✓ **What makes the wind blow?**
- ✓ **Measuring wind speed and direction**
- ✓ **What is Coriolis Effect/Force?**

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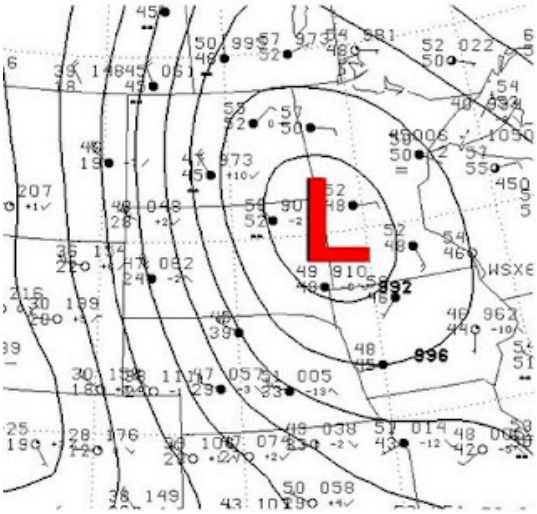
Reading Isobar Lab Notes

1. Define Isolines

_____

_____



a. What does it mean when the isobars are close together?

_____

_____

*Draw a graphic relationship between isobar distance and wind speed

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2. Important idea about wind/air movement!!!!

a. Draw the wind pattern around both H and L pressure systems

L H

b. How does the wind move around a Low pressure?

_____

c. How does the wind move around a High pressure system?

_____

Hurricane Intensity Scale & Fujita Scale

Type	CG	WInds (mph)	Winds (knots)	Pressue (millibars)	Surge (feet)
Tropical Depression	TD	< 39	< 34		
Tropical Storm	TS	39 - 73	34 - 63		
Hurricane	1	74 - 95	64 - 82	> 980	4 - 5
Hurricane	2	96 - 110	83 - 95	965 - 980	6 - 8
Hurricane	3	111 - 130	96 - 113	945 - 965	9 - 12
Hurricane	4	131 - 155	114 - 135	920 - 945	13 - 18
Hurricane	5	> 155	> 135	< 920	> 18

SCALE	WIND SPEED	POSSIBLE DAMAGE
F0	40-72 mph	Light damage: Branches broken off trees; minor roof damage
F1	73-112 mph	Moderate damage: Trees snapped; mobile home pushed off foundations; roofs damaged
F2	133-157 mph	Considerable damage: Mobile homes demolished; trees uprooted; strong built homes unroofed
F3	158-206 mph	Severe damage: Trains overturned; cars lifted off the ground; strong built homes have outside walls blown away
F4	207-260 mph	Devastating damage: Houses leveled leaving piles of debris; cars thrown 300 yards or more in the air
F5	261-318 mph	Incredible damage: Strongly built homes completely blown away; automobile-sized missiles generated

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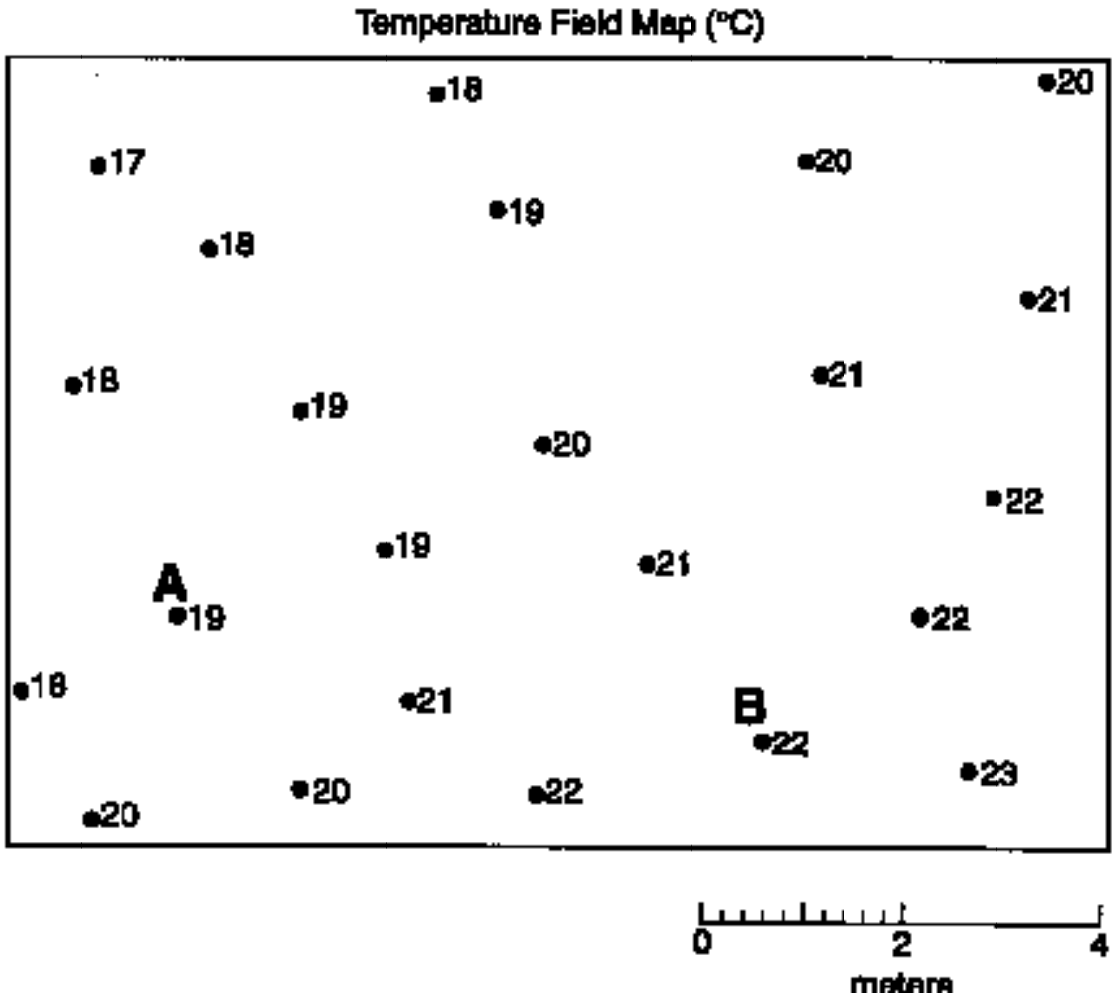
Homework

Draw 3 isotherms - 19°C, 20°C and 21°C.

(**Temperature Gradient) =** $\frac{\Delta \text{ in Temp}}{\text{Distance}}$



1. Use the scale to determine the **temperature gradient** from point A to B

Equation Symbol	Substitute the value	Solve with units with units

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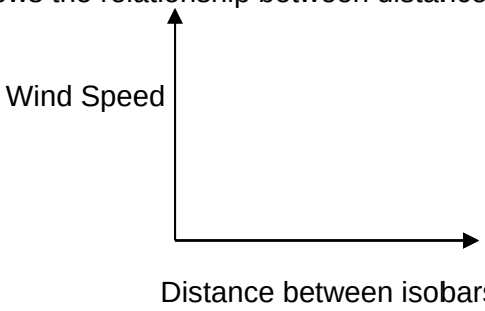
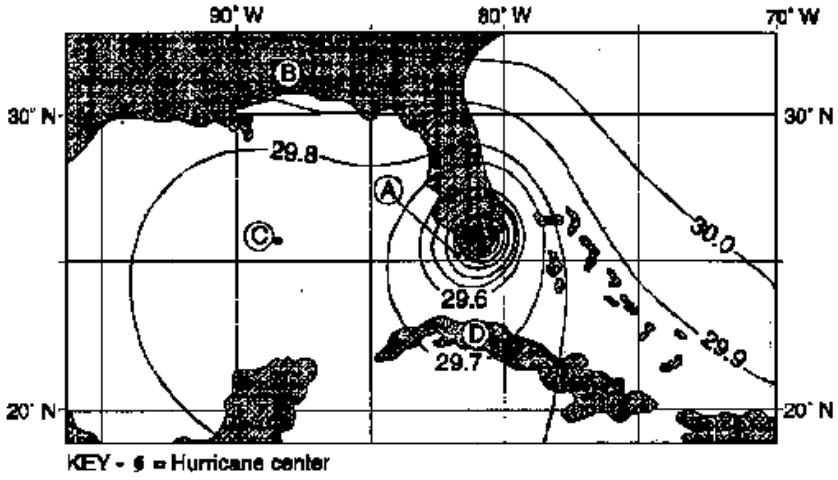
1. **Draw a X** on the map that shows the steepest gradient

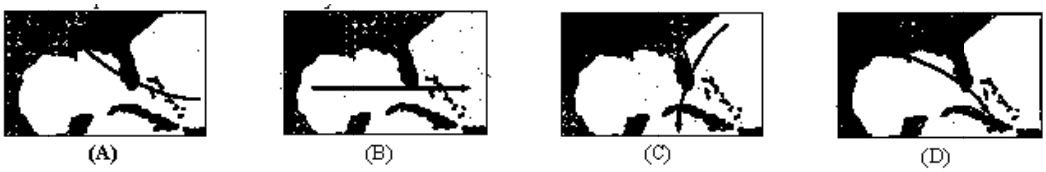
2. Draw a graph that shows the relationship between distance between isobars and wind speed. (On the back)



3. The map shows a hurricane approaching land. A represents the center of the hurricane.



a) Which path would this hurricane most likely to take?



b) What is the air pressure at location C? _____

c) What is the pressure interval on the map? _____

d) In your own words, describe what pressure gradient is _____

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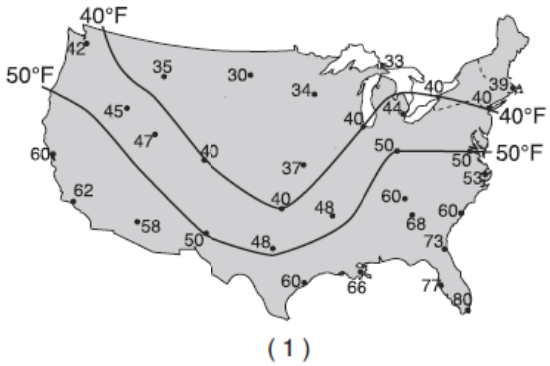
1.The map below represents the center of a low-pressure system indicated by **L**. The 1000-millibar (mb) isobar is drawn around the center of this low-pressure system.

Directions:

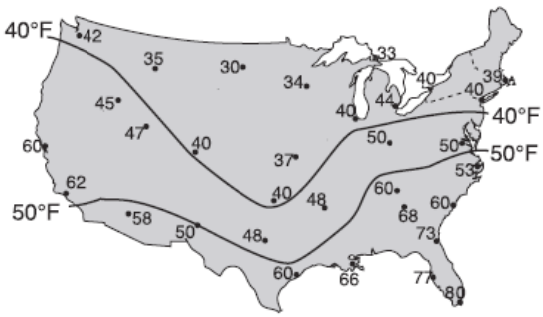
a. On the diagram below, draw *two* additional isobars around the outside of the 1000-mb isobar in a way that indicates that the strongest winds are west of the low-pressure center.

b. Identify *one* factor that usually causes many low-pressure centers to generally move from west to east across the United States.

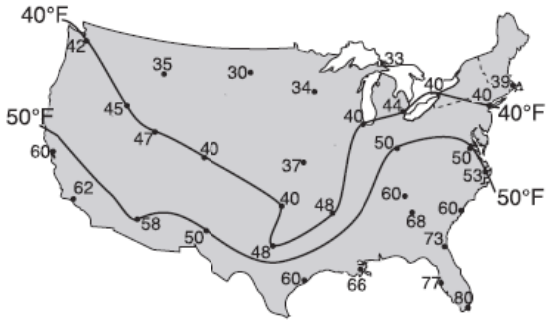
2. The weather map shows the air temperatures recorded at the same time at cities across the United States. Which map correctly shows the location of the 40°F and 50°F isotherms?



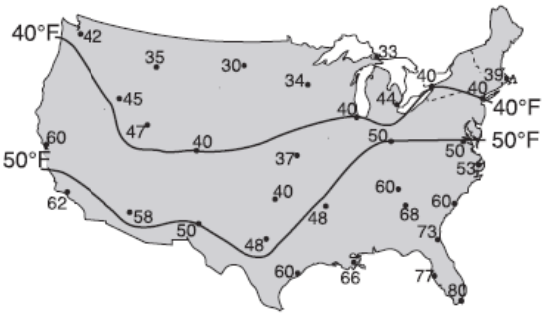
(1)



(3)



(2)



(4)

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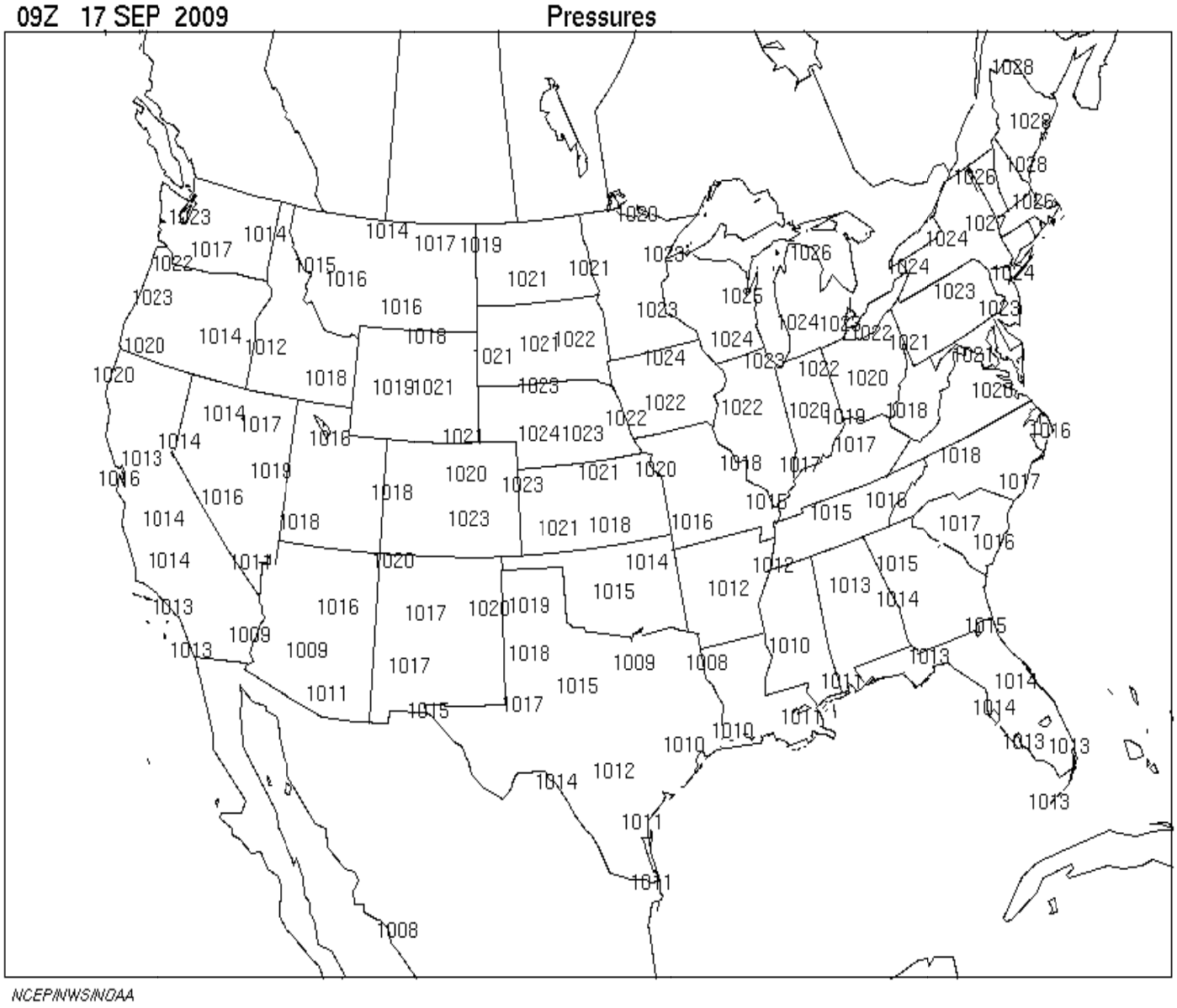
Draw an isobar of 1014mb, 1016mb, 1018mb, and 1023mb



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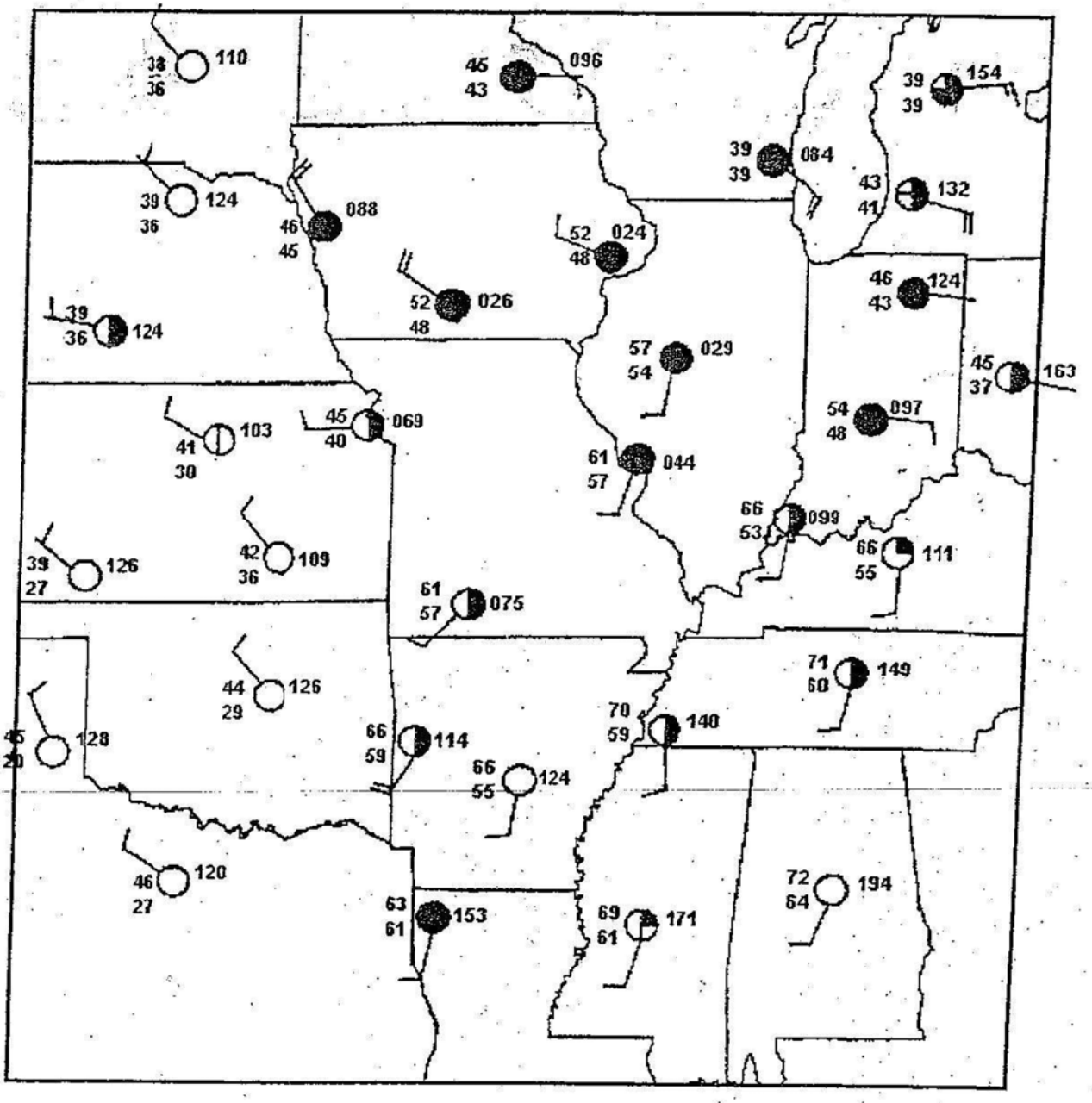
Draw isotherms at 45°, 55°, and 65° F



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Notes on Planetary Wind

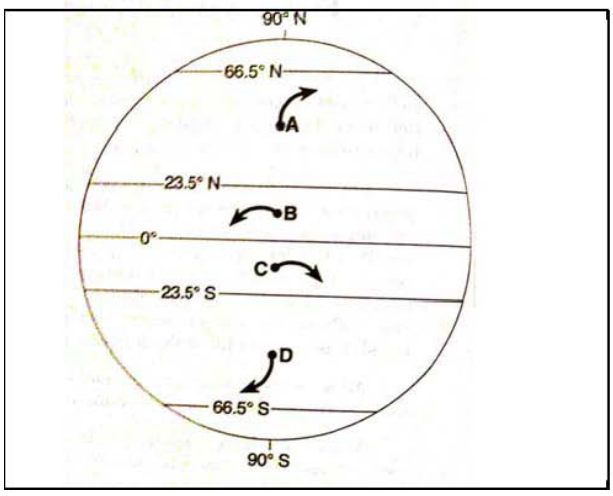
1. Define Planetary Wind: _____

2. Which Planetary wind affects the direction of the weather system in the U.S? _____

3. At what latitude do most of the hurricanes start too shift or turn in compass direction? _____

4. This curvature of the wind pattern due to Earth's rotation is called: _____

Example Problem from regents exam (2012): The arrows on the **left** diagram below show changes in the direction of surface winds at four lettered locations, A, B, C and D on Earth.



4a) The arrows at which location correctly shows a deflection of the wind that could be due to the Coriolis effect? _____

Explain

4b) Which page of the ESRT can you use to help you with this question? _____

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Monsoon Notes

What is a monsoon? _____

Where does it occur? _____

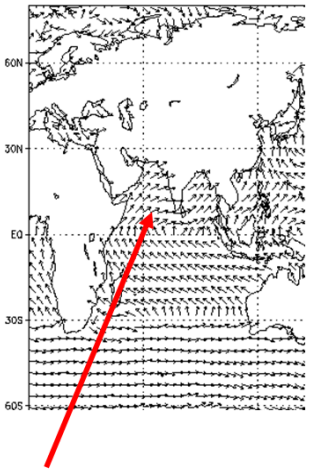
Strength of impact? _____

How do they occur?

_____

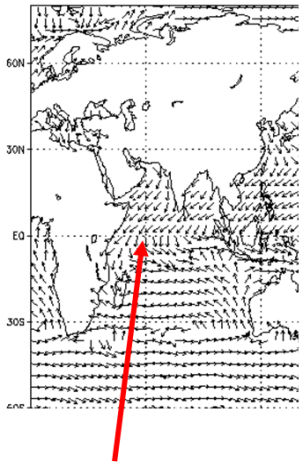
_____

June-August winds
(SW monsoon)

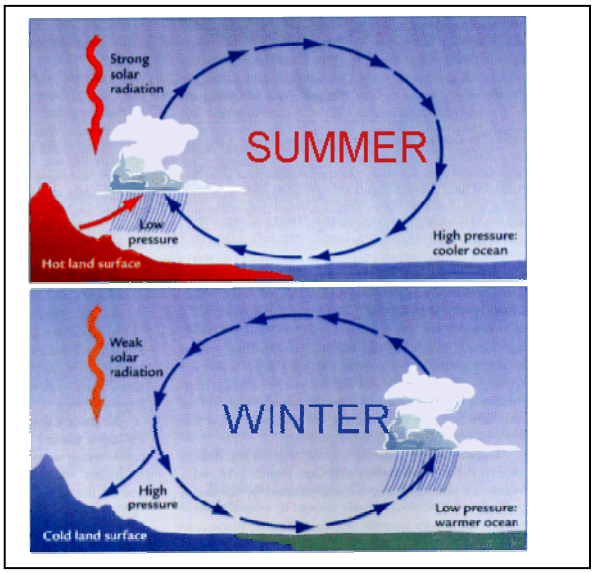


SW monsoon winds

Dec-Feb winds
(NW monsoon)



NE monsoon winds



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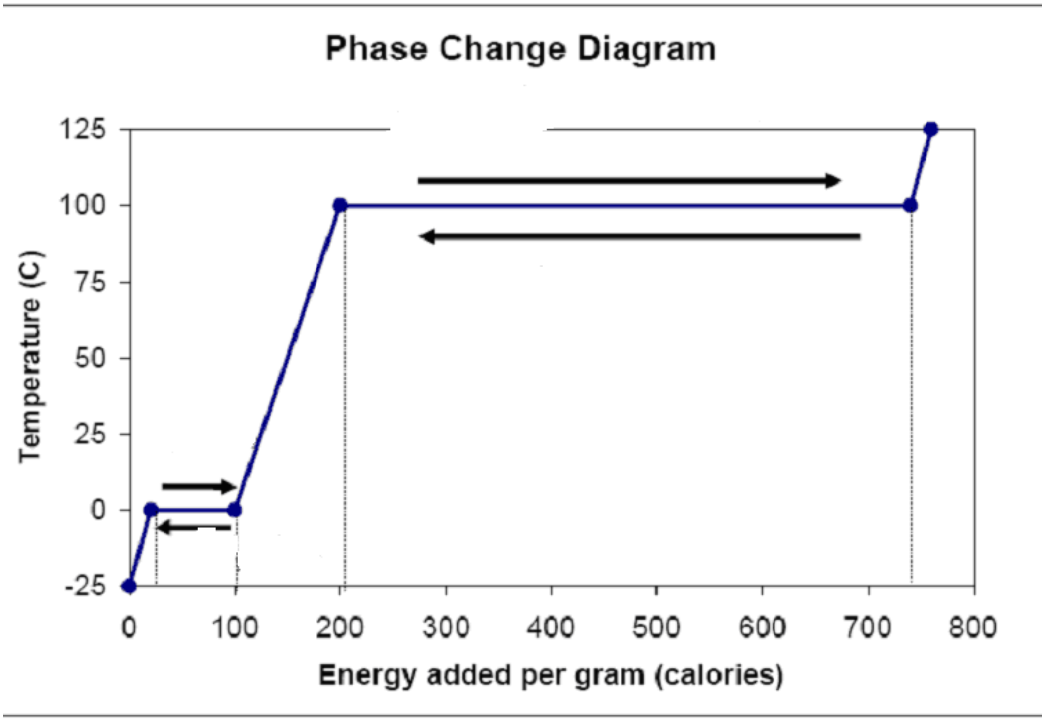
Phase change of liquid notes



Properties of Water

Heat energy gained during melting	334 J/g
Heat energy released during freezing	334 J/g
Heat energy gained during vaporization	2260 J/g
Heat energy released during condensation	2260 J/g
Density at 3.98°C	1.0 g/mL

in the
ou find

1. During the phase change, temperature _____What's changing, is the _____gained or released.

2. Which phase change process requires the most energy gained?

_____

3. Which phase change process requires the least amount of energy gained

_____

4. Which phase change process releases the most amount of energy?

_____

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5. How do we increase the rate of evaporation of that beaker of water in the animation?

_____

_____

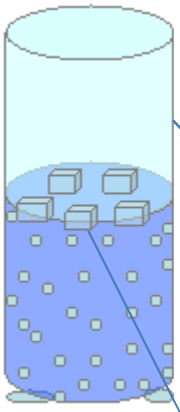
6. What makes water reverse its process from evaporation? What causes condensation to start?

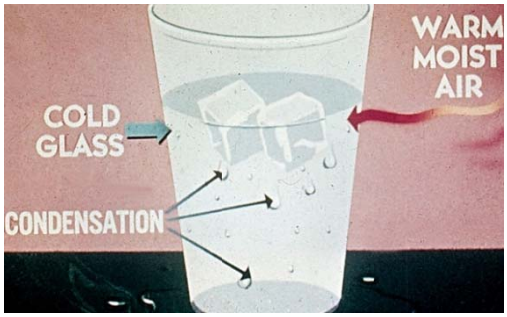
_____

_____

7. Examples of condensation in nature are: _____
   Example of sublimation in nature: _____
   Example of vaporization in nature: _____

UNDERSTAND CONDENSATION





_____

_____

_____

_____

_____

_____

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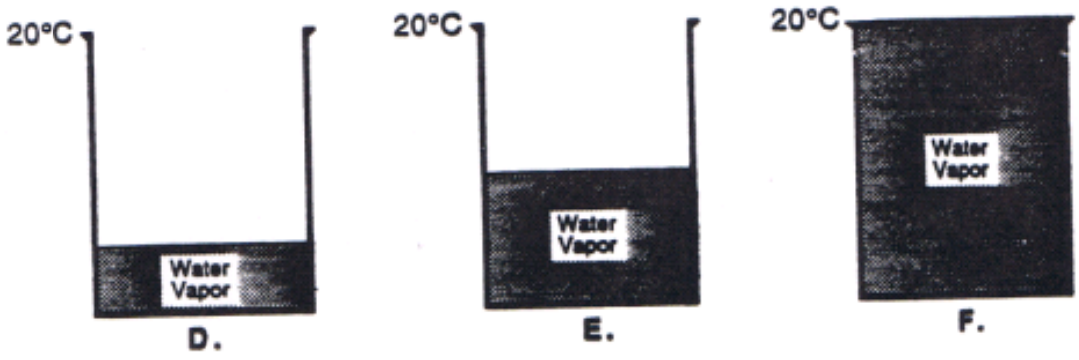
1. **Define Relative Humidity**

_____
_____
_____

2. **Define absolute humidity**

_____



Function of a **psychrometer**: _____

Your observation: _____

Wet Bulb (Evaporation process) = _____

What kind of weather would **slow down** the evaporation? _____

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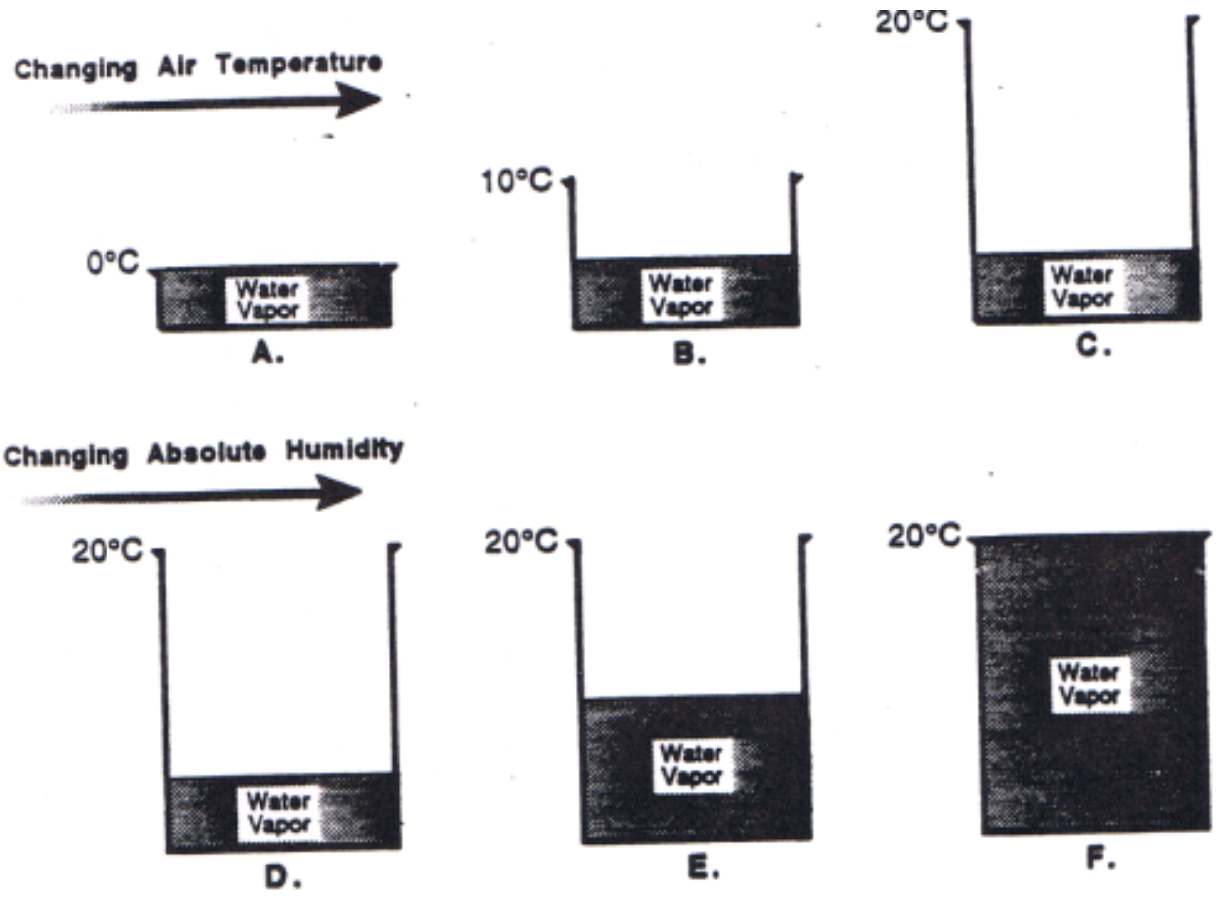

1. What does dew point depend on? _____

2. As the air temperature increases, dew point remains the same, what happens to the relative humidity?

   _____

3. As the air temperature increases, dew point remains the same, what happens to the air capacity?

   _____

4. Look at the picture c, how can air be saturated in this example?

   _____

5. In order to have condensation, **dew point and air temperature** must be _____

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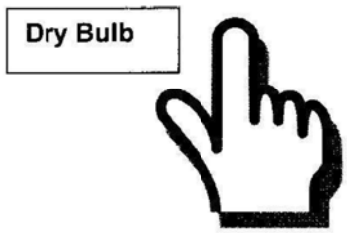
How to find Dew Point and Relative Humidity

STEP #1 Find dry bulb	
STEP #2 Subtract	
STEP #3 Intersect	

Example: **Dry bulb** is 16°C. **Wet bulb** is 10°C.

What is the dew point?_____

What is the relative humidity? _____

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Name:_____Date: _____

Name_____
by C.Burrows

Date_____

Use your Earth Science Reference Tables to complete this chart.

#	Dry-Bulb Temp.	Wet-Bulb Temp.	Difference	Dewpoint	Relative Humidity
1	4	2			
2	10	6			
3	18	12			
4	24	18			
5	28	18			
6	0	-3			
7	-2	-5			
8	-8	-10			
9	-14	-16			
10	-16	-17			
11	-10	-12			
12	4			-4	
13	14			-2	
14	24			10	
15	8			3	
16	18			-5	
17	20				58
18	12				67
19	4				70
20	0				63
21	-8				13
22	3	1			
23	11	6			
24	15	9			
25	21	17			
26	27	23			

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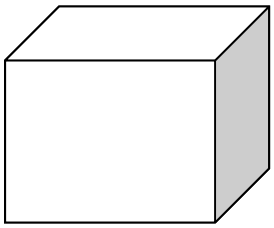
Notes and Homework

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

Summarize/describe: _____

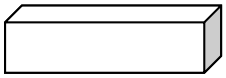


Mass of the cushion: _____

_____

Density =

Volume of the cushion: _____ _____



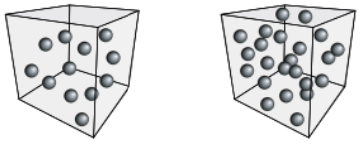
Predict: What happens to the density: _____

New mass: _____

_____ New Density: _____

New Volume _____

Describe the operational definition of Density <u>FOR HOMEWORK!</u>



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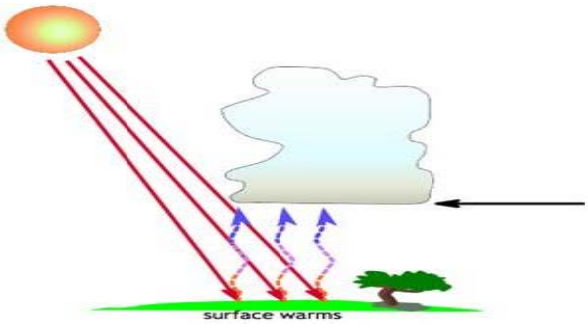
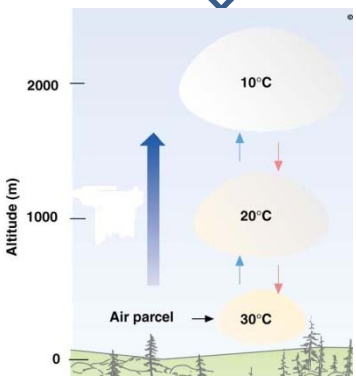
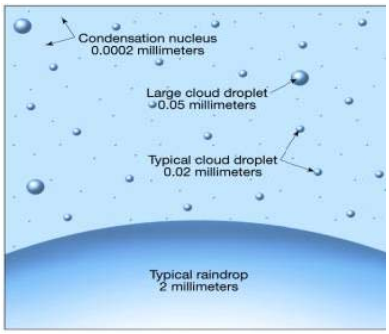
Cloud formation Notes

3 Ingredients and Steps of Cloud Formation







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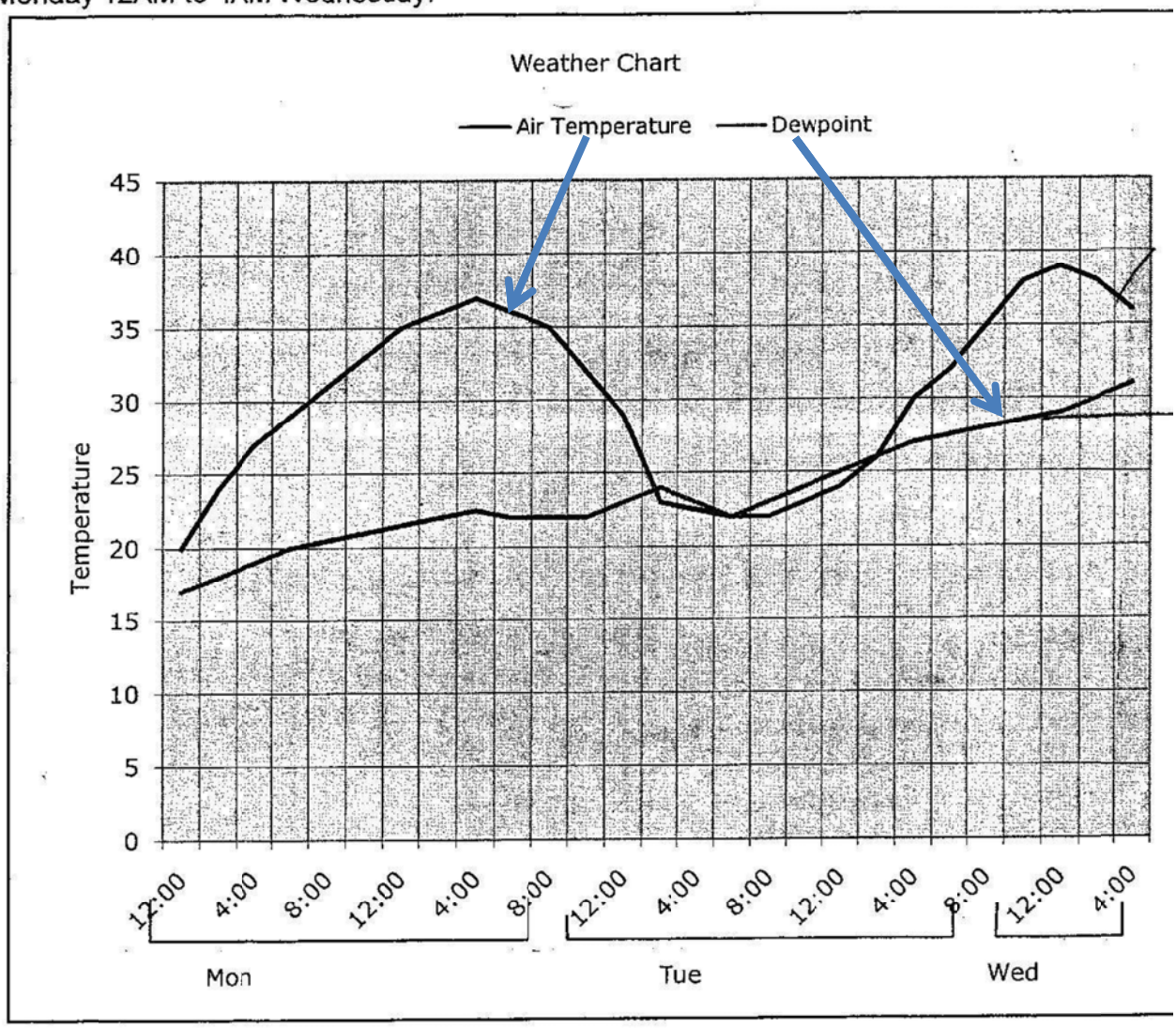
Name:_____Date: _____

Answer the following questions by analyzing the graph which shows weather data from Monday 12AM to 4AM Wednesday.



1. Indicate the date and the time in which the air is least humid
2. When is the relative humidity the highest in the graph shown?
3. What is approximate the relative humidity on 2pm Tuesday?
4. When does the graph show the air first become saturated?
5. Between what hours was rain most likely to occur?

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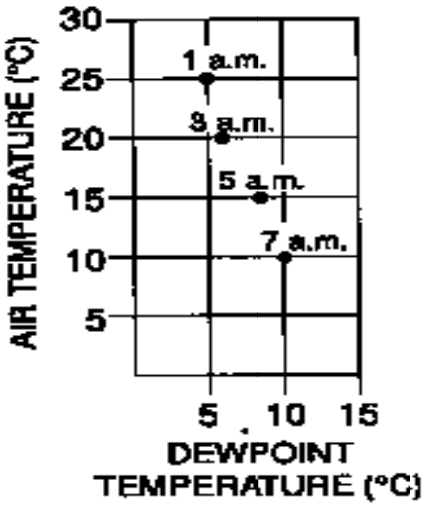
Homework

1. As the dew point temperature of a sample of air decreases, the amount of moisture in that sample of air_____

2. Which gas in the atmosphere has the most influence on day to day weather change?

   a) Nitrogen b)oxygen c) carbon dioxide d) water vapor

3. The graph shows the air temperature and dew point temperature at one location for four different times during one morning



   a. **At what time was the chance of precipitation the greatest? _____**
   b. **How do you know from the data?_____**

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4. The chart below shows the air temperature and the dew point temperature near the ground at a given location for four days.

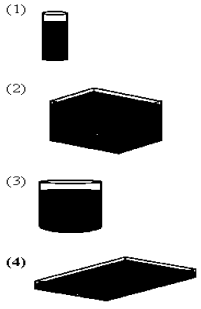
Day	Air Temperature (°C)	Dewpoint Temperature (°C)
1	20	11
2	18	17
3	16	14
4	20	13

Which Statement best supports the data?

a) Relative Humidity was highest on day 1
b) The greatest amount of water vapor was in the air day 2
c) The base level formation of clouds was the highest on day 3
d) The chance of precipitation was greatest on day 4

5. What type of weather supports the greatest amount of evaporation?_____

6. Which of the pictures show the fastest evaporation rate?



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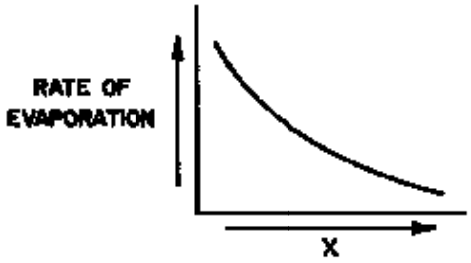
5. Moisture is evaporating from a lake into stationary air of a constant temperature. As more moisture is added to this air, the rate of which water will evaporate will probably

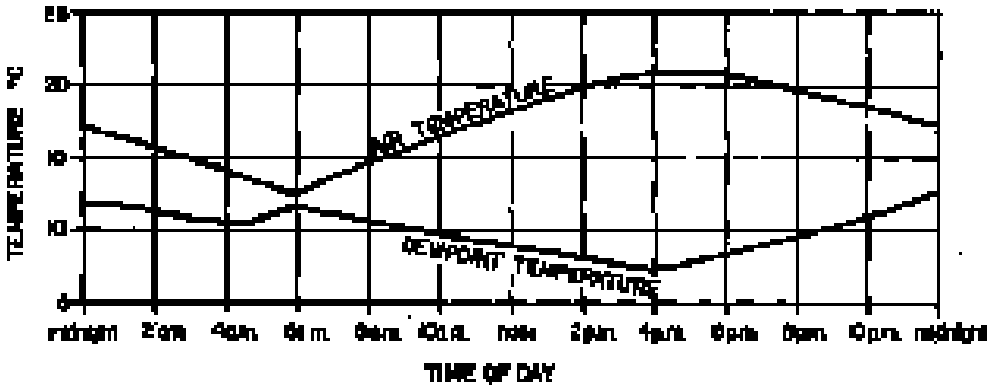
   a) Decrease
   b) Increase
   c) Remains the same

6. What should be on the x axis of the graph?



   a) Temperature
   b) Wind velocity
   c) Surface area
   d) Moisture content of air

7. The graph **below** shows the change of air temperature and dew point temperature. At what time was the relative humidity the lowest? _____



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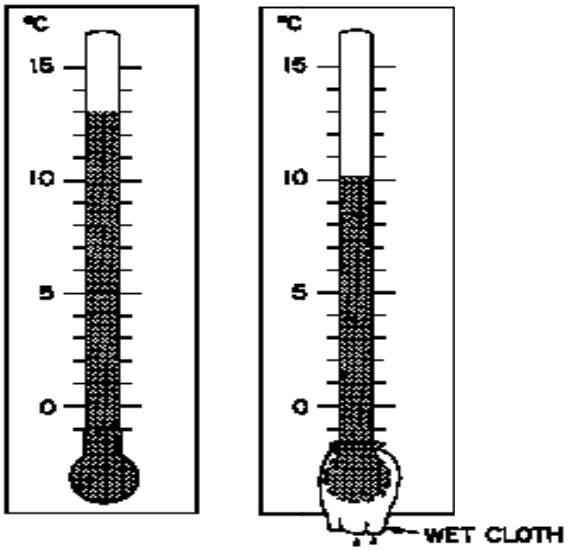
8. The diagram shows a wet bulb and a dry bulb. What is the dew point? _____



9. What is the wet bulb temperature when the air temperatures 16°C and the relative humidity is 71%?
_____

10. Which event occurs when air is cooled to the dew point?

a) Freezing
b) Evaporation
c) Condensation
d) Transpiration

11. Sketch a correct graph that shows the correct relationship between the variables?

ɔability

ːipitation

Difference btw air temperature and dew point

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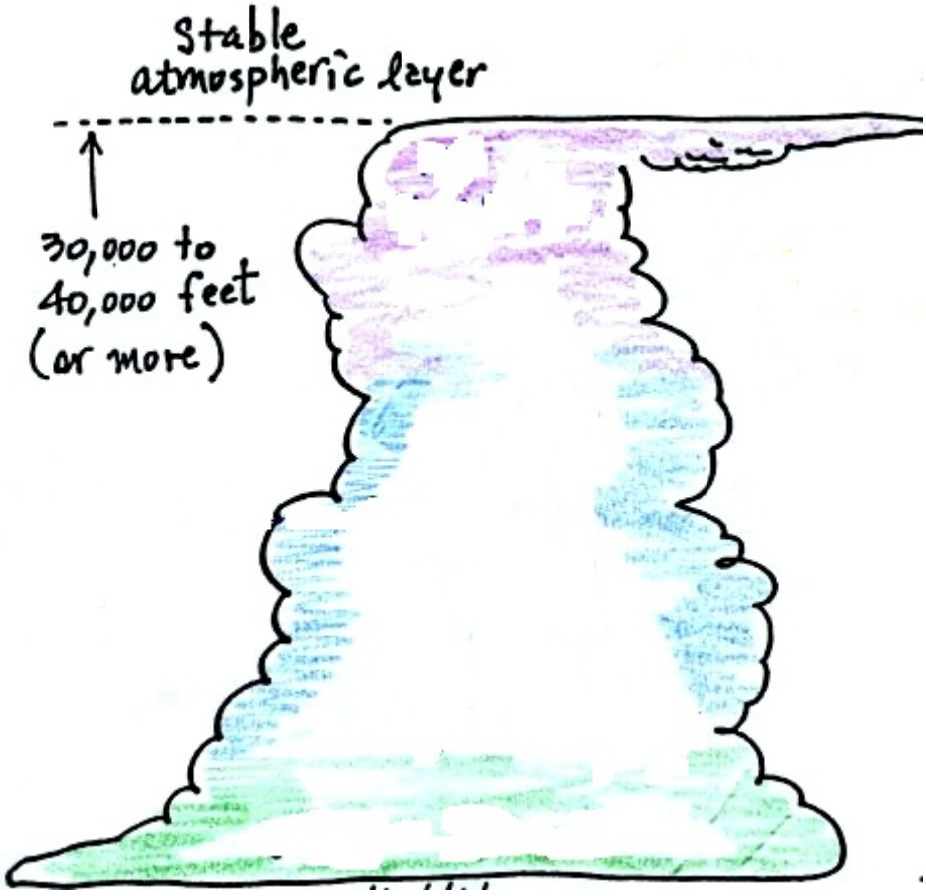
Name:_____Date: _____

How water powers the hurricane



Rubric for Hurricane Unit/Learning objectives and Key Vocabulary

INDICATORS	JUST STARTING Novice	GETTING THERE Apprentice	YOU'VE MADE IT Practitioner	ABOVE AND BEYOND Expert
Station Model	Interpret weather conditions from different station models by using the reference table	**Decode barometric pressure** and temperature from the station model	☐ Decode and **encode** station models ☐ Decode **present weather** symbols from the reference table ☐ Draw a station model from given variables	*Practitioner Plus* Decode, encode and draw station models from weather maps Calculate the **barometric trend** and pressure three hours ago from a station model
Air pressure gradient and wind	Define **air pressure** Explain the cause of air flow Define **wind vane** Define **psychrometer** Define **anemometer** Define **a cyclone**	Model the graphical relationship between air **pressure gradient** and wind speed Describe **wind pattern** around high and low pressure systems	☐ Model the graphical relationship between air pressure gradient and wind speed ☐ Calculate air pressure gradient from an **isobar** map ☐ Explain the relationship between air pressure and wind vs. air pressure gradient vs. wind speed ☐ Draw and identify the wind pattern around high and low pressure systems ☐ Identify **sea breeze and land breeze** ☐ Explain the reason for **monsoons**	*Practitioner Plus* Explain the relationship between air pressure and other variables such as density, humidity, and temperature both graphically and pictorially Draw, label and explain the formation of sea breeze and land breeze
Humidity	Define dew point and relative humidity Find **dew point and relative humidity** using the Earth Science Reference Table	Explain how a ps;ychrometer works Determine the dew point and relative humidity interchangeably from different data given	☐ Articulate the phase change process & how it dictates the weather and causes cloud formation, rain, **dew and frost** ☐ Collect and interpret data using a psychrometer ☐ Explain the relationship between dew point, air temperature and relative humidity	*Practitioner Plus* Make connections between energy conservation and hurricane intensity Make connections between phase change of liquid process and **cumulonimbus clouds**
Mapping, graphing and calculation skills	Generate an isoline map from given data Identify an area of high wind speed from the **isoline** map	Calculate the pressure or temperature gradient from an isoline map Sketch a graph to show the relationship between different weather variables.	☐ Draw and interpret weather maps ☐ Plot and interpret **pressure gradient profile** and wind speed of a hurricane ☐ Calculate the **speed** and pressure gradient of a hurricane with correct units ☐ Calculate the speed of a hurricane	*Practitioner Plus* Draw the resultant wind **vector** around a pressure system using the sum of coriolis force and pressure gradient vector