

Name: _____ Section: _____ Date: _____

EXERCISE C: ATMOSPHERIC PRESSURE, WIND AND CIRCULATION

REFERENCE: Textbook: Geosystems: An Introduction to Physical Geography
Ch.6 Atmospheric and Oceanic Circulations

LINKS: Remember to check the links on-line; they may help!

PURPOSE: The purpose of this laboratory exercise is to review the phenomena that govern air pressure and determine wind speed and direction. This lab will prepare you for weather map interpretation and weather predictions. It will also provide you the skills necessary for giving a technical critique of the movie “Twister”!

KEY TERMS AND CONCEPTS:

*Hint: Be able to define and compare-contrast each of these terms for your exams!

| | | |
|--------------|-------------------------------|------------------|
| air pressure | Pressure Gradient Force (PGF) | geostrophic wind |
| barometer | Coriolis Force (CF) | interpolation |
| gravity | Friction Force (FF) | |

Part I. Air Pressure

1. Air pressure is the weight (force over a unit of area) of the atmosphere. Barometers are instruments used to measure air pressure. Normal sea-level air pressure (measured at latitude 45 and temperature 9°C) may be expressed as 760 mm or 29.9 inches or 1013 mb.

(a) Convert these pressure readings to equivalents given that:

$$1 \text{ inch} = 25.4 \text{ mm} = 33.9 \text{ mb}$$

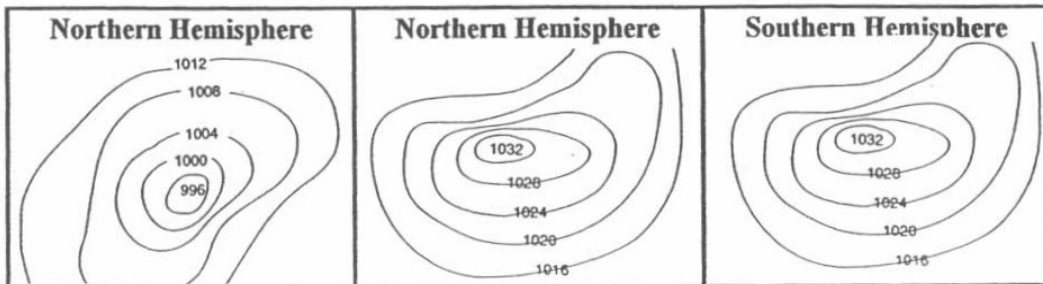
| | inches | mb | mm |
|-------------------------|--------|-------|-------|
| Typical storm | 29.2 | | |
| Normal at sea-level | | | 760 |
| Normal at 3050 m | | 711.4 | |
| Normal at 5.65 km | | | 380.6 |
| Normal near troposphere | 6.5 | | |

(a) Describe the trend in pressure as altitude increases. Give two other phenomena that change with altitude.

3. There is an eternal battle between the pressure gradient force and the Coriolis force. The Coriolis effect keeps the wind from flowing directly down the pressure gradient (to lower pressure) and the pressure gradient prevents the Coriolis force from turning the wind back up the pressure slope (to higher pressure). Where these two factors are in balance, the wind moves parallel to the isobars and is a geostrophic wind. Actually, upper atmosphere winds are almost geostrophic meaning they flow almost parallel to the isobars. Friction complicates their movement near the ground.

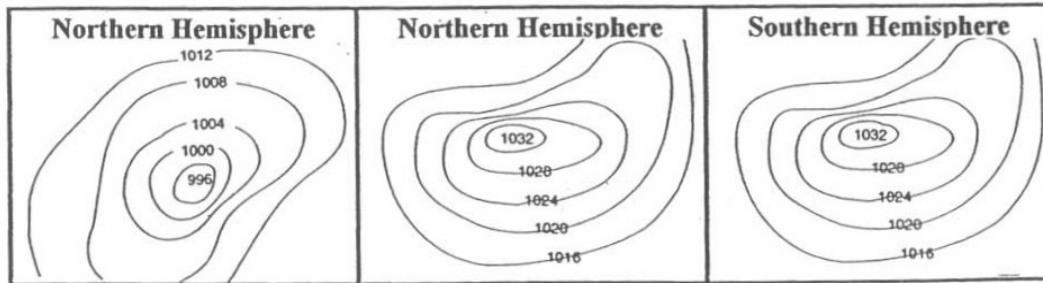
Draw arrows to show the direction of the forces indicated in the following diagrams:

(a) Pressure gradient force (HINT: wind moves perpendicular to the isobars)

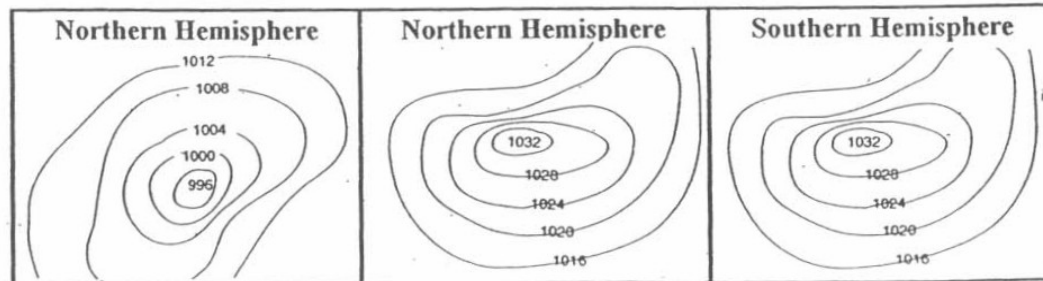


(b) PGF & CF (HINT: wind moves parallel to the isobars)

In the upper atmosphere, what is the name of these winds? _____



(c) Pressure gradient, Coriolis, and friction forces (HINT: these are surface winds)



Part III: Air Pressure Maps and Wind Predictions

1. The map (p.19) of the south-central United States shows barometric pressures measured in millibars (mb) standardized to sea-level. The map labels show only the last two digits of the measured pressures. So, the map label “19” corresponds to a barometric pressure of 1019 mb, the map label “20” corresponds to 1020 mb *etc.*

(a) On the air pressure map (p.19), draw isobars (lines connecting points of equal pressure). Draw the isobars at 4 mb intervals, starting with 1004 mb. Remember: isobars are like lines on a topography map - they do not cross.

HINT: To draw the 1008 isobar, first locate all points labeled “08”. Next identify the approximate location of 1008 mb points that are not explicitly labeled on the map. 1008 mb will occur between two adjacent points when one of the points has a pressure greater than 1008 and the other point has a pressure less than 1008. Estimate the position of the 1008 mb point between them (*e.g.*, if 1006 and 1010 are next to each other on the map, then 1008 should be half way between them even though it is not indicated on the map). This estimation process is called interpolation. Now connect the labeled and estimated 1008 mb points to make the 1008 mb isobar.

(b) Once the isobars are complete, indicate “L” and “H” for the low and high pressure cells, respectively.

(c) Interpret the conditions for Boulder:

(i) Mark a star on the map to indicate the location of Boulder

(ii) Approximate pressure _____ mb

(iii) Wind direction _____

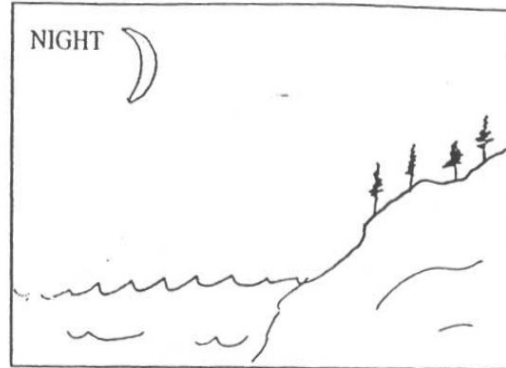
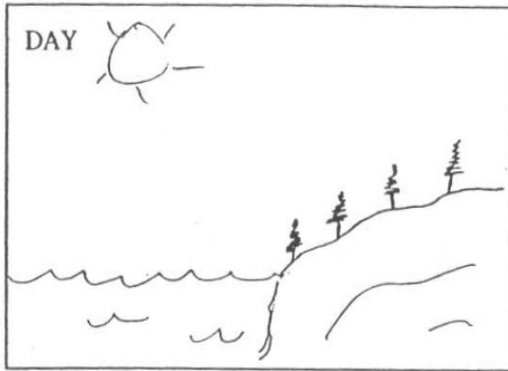
(iv) Barometer: rising or falling _____

(v) Weather: likely improving or deteriorating _____

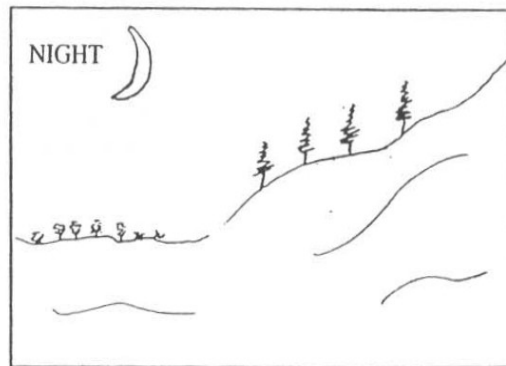
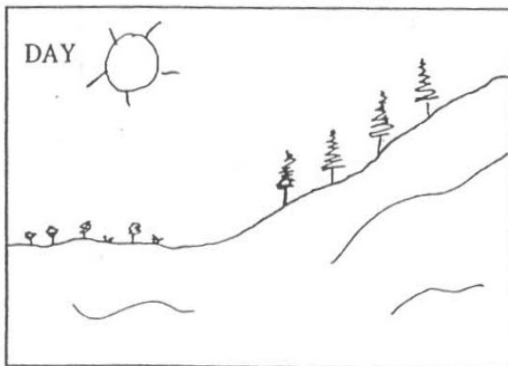
(HINTS: 1. Winds are named according to the direction from which they come or their origin. 2. Recall that in North America, weather systems tend to move from west to east due to the influence of the jet stream and prevailing westerlies.)

2. For each of the following situations: (i) label areas of high and low temperature and areas of high and low pressure, (ii) deduce and sketch the air movements, vertical (rising and sinking), and horizontal flow.

LAND & SEA BREEZES



MOUNTAIN AND VALLEY BREEZES



LOCAL CONVECTION

