**Title: Applying Vectors Solutions to Navigation**

**Link to Outcomes:**

- **Problem Solving** — Students will use polar charts to determine position, vectoring in variables such as speed and direction/bearing of wind and/or other ships or aircraft.
- **Communication** — Students will cooperatively use the telephone or computer to gather information from flight service stations or National Weather Service to determine vector solutions.
- **Reasoning** — Students will follow logical mathematical reasoning. They will plot and solve vector solutions on a polar chart.
- **Connections** — Students will compare alternative methods for determining vectors with standard trigonometric methods.
- **Measurement** — Students will use a ruler relative to the scale set on the polar chart and protractor to measure degrees. (Scale may be knots, miles or kilometers)
- **Geometry** — Students will use tools common to geometric construction, namely the straight edge and protractor. Extentions could include figuring the hypotenuse of the wind triangle (the resultant).
- **Arithmetic Operations** — Measurement using a ruler.
- **Number Relationships** — Students will develop a sense of the relationship between the distances of nautical, statute miles and kilometers.

**Brief Overview:**

This lesson involves the use of polar charts to draw vectors to solve a wind triangle and other resultants.

**Grade/Level:**

This unit is primarily for students taking trigonometry courses in grades 11 and 12. It may be used with grades 7-12 as appropriate.

**Duration/Length:**

This unit takes approximately two two three class periods.

**Prerequisite Knowledge:**

Students need a basic understanding of compass headings in degrees and should be able to plot vectors in scale.

**Objectives:**

Students will:

- plot the bearing and distance vector on a polar chart.
- plot vectors for wind direction and speed on the polar chart.
- plot the sum or **resultant** of the bearing and wind vectors.
- find the magnitude and direction of the resultant of two vectors using trig functions.
- find the magnitude and direction of the resultant of the vectors mentioned in one and two above using a navigational calculator (E6B).

**Materials/Resources/Printed Materials:**

- polar charts
- straight edge or ruler
- protractor
- graphing calculator
- calculator
- E6B nativational calculator
- overhead projector
- overlays of polar chart for projector

**Development/Procedures:**

- Day One: Define vector and explain polar chart nomenclature using overhead projector and overlays (see attached masters). Practice plotting various ranges and bearings on handouts of polar charts. Discuss and demonstrate relative motion (i.e., when one body or object is moving at a different speed or in a different direction than another body). Ask for examples of relative motion and develop a definition. Explain and demonstrate wind speed and direction. Define the resultant of two or more vectors (the second vector begins where the first finished) using examples and overlays.

- Dav Two: Students will apply procedures learned in Day One to solve the wind triangle by determining true wind direction (as opposed to apparent wind direction from the moving aircraft), when aircraft course and speed are known and relative wind direction (as it appears in the aircraft) is known.

- Dav Three (Optional): Students will be made familiar with the E6B navigational calculator. They will then practice the procedures learned on Day Two using the E6B in order to determine true wind, aircraft ground speed, drift angle and magnetic heading/course.

**Evaluation:**

The teacher wil circulate around the classroom as the students work and check on the procedures and results. When the assignment is completed, students will compare and explain the results.

**Extension/Follow Up:**

Extension is included above as it refers to trigonometry applications and E6B utilization.

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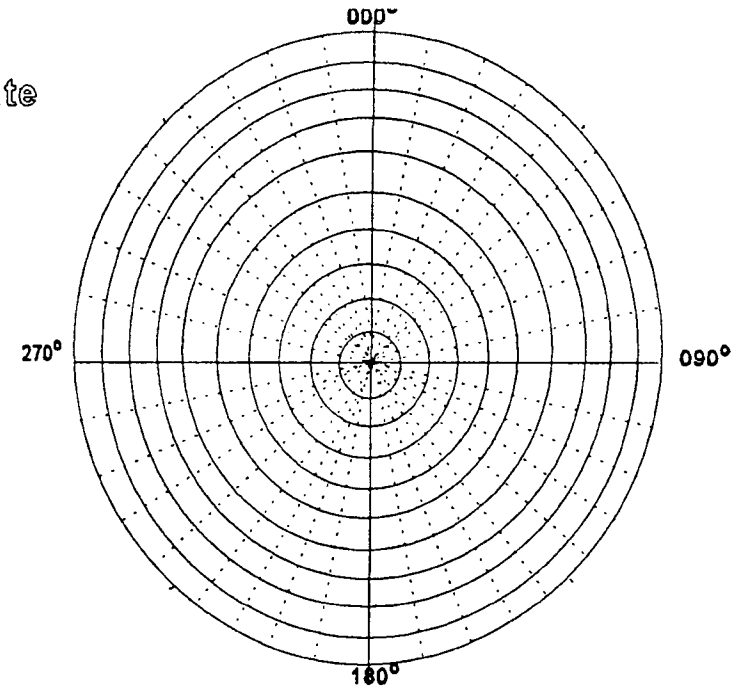
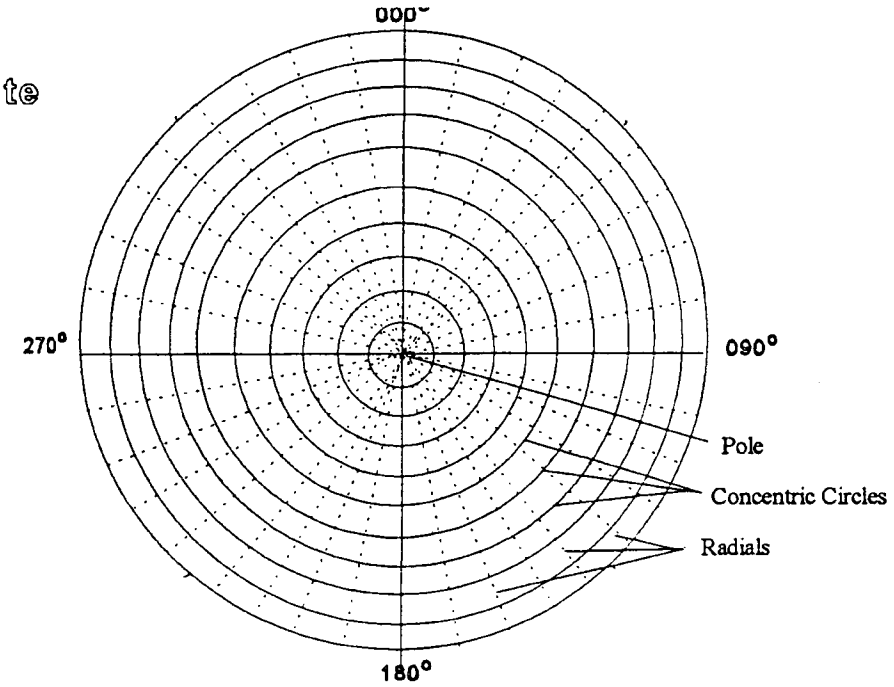
Name _____ Date _____ Section _____

Polar
Coordinate
Chart



# Polar Coordinate Chart