Navigation Lab Procedures

Name:_________________ Lab Day and Time:_____________ Instructor:__________

1. Distance on a Nautical Chart

For these exercises you will use NOAA Chart # 18746, San Pedro Channel. Place the chart flat on the table. You will also need a pair of dividers. **NOTE:** Do not write on the charts!

For each exercise, you should use the vertical scale (latitude) to determine the distance (Figure 6). One degree equals 60 nautical miles, one degree equals 60 minutes, and one minute equals one nautical mile. You should be able to interpolate the scale to 0.01 nautical miles. Thus, your measurements should be reported to a precision of 0.01 nm. Using the dividers and the latitude scale, measure the distances requested below.

________ From Fl G 4s 9M “3” horn at Dana Point harbor entrance to R “2SJR” Fl R 2.5s WHIS whistle buoy off Dana Point

________ From R “2SJR” Fl R 2.5s WHIS whistle buoy off Dana Point to Fl G 6 s 44ft 6m “3” Horn at end of Newport Beach jetty

________ From Fl G 6 s 44ft 6m “3” Horn at end of Newport Beach jetty to Fl G 2.5 s 21 ft 5 M “1” light at Avalon Harbor, Santa Catalina Island via the ferry route

________ From Fl G 2.5 s 21 ft 5 M “1” light at Avalon Harbor, Santa Catalina Island to Fl 5 s 50 ft 20M Horn at entrance to San Pedro Bay via the ferry route

________ From Fl 5 s 50 ft 20M Horn at San Pedro Bay entrance to G “1” Fl G 4s light at Isthmus Cove, Santa Catalina Island via the ferry route

________ Width of the Northbound Coastwise Traffic Lane from the Gulf of Catalina to San Pedro Bay

________ Length of Santa Catalina Island from east to west end (longest dimension)
Width of Santa Catalina Island from Long Point to China Point
narrowest width of Santa Catalina Island at the isthmus

2. Depth on a Nautical Chart
Because they are used in navigation, nautical charts also provide important depth information. As you look at the chart, find the small black number printed across the water areas. These are depths reported in fathoms. The fathom (fa) is an old English measurement for depth. One fathom equals six feet. Depth is also presented on these charts as a series of contour lines. Each line represents a specific depth profile. On American nautical charts, the heights of land areas are shown in feet. Find the depth near each of the following locations. Give the depth in Fathoms (fa), Meters (m) and Feet (ft).

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Follow the 50 fathom contour line off shore of San Pedro and Newport Beach. Look at the areas between that line and the shore. Describe the differences between these two offshore areas.

Over the last 20,000 years sea level has risen about 120 meters (about 60 fathoms). How much would sea level have to decrease to allow you to walk to Catalina Island without getting your feet wet?

3. Location on a Nautical Chart
In the following exercise you will determine latitude and longitude of several points from the scale on the edges of the nautical chart. After determining the location, place one point of your dividers into that point. Next, place the other point of the dividers into the nearest longitude or latitude line (shown as fine black line on the chart). You now have the distance between your point and the known latitude or longitude “trapped” on your dividers. Move your dividers to the edge of the chart and place one point into the known latitude or longitude and read the unknown measurement from the scale. By convention, latitude is
always given before longitude. In addition, you must state in which hemispheres your location falls. For example, on the San Pedro Bay Chart, the latitude and longitude of Black Jack Mountain on Santa Catalina Island is 33°23.20’N 118°24.12’W.

Find the latitude and longitude of each of the following points on the nautical chart. Report your position to within 0.01 degrees.

Lat. __________ Fl (2) 20s 185ft 24M Horn at Point Vincente
Long. __________

Lat. __________ End of sewer outfall SW of Capistrano Beach
Long. __________

Lat. __________ Fl 4s 31ft A Buoy off Huntington Beach
Long. __________

Lat. __________ Mouth of the Santa Ana River
Long. __________

Lat. __________ Fl 6s 212ft 10M PA Santa Catalina East End Light
Long. __________

4. Direction on a Nautical Chart

Direction must have a point of reference. On a nautical chart that may be true north or magnetic north. Locate a compass rose on the chart; Figure 7 is an example. On the rose you will see an inner and outer ring of angular measurements. The outer ring (true compass) has a star at the vertical point, zero degrees. The inner ring (magnetic ring) may be rotated from the outer ring. The amount of rotation is the difference between true north (actual direction to the North Pole) and the magnetic north pole.

Direction is usually called heading by mariners. To find a heading, you connect two points with a line and then use parallel rulers to refer that line to the nearest compass rose. On Figure 8, a true compass heading of 70° is shown. If the heading given is referenced to the magnetic compass, an “M” is placed after it. For example, the magnetic heading shown in Figure 8 is about 58°M. Using the parallel rulers, find the correct compass headings, both true and magnetic, for each of the following cruises. Note: Do not draw lines on the chart. Use the provided ferry routes, or, if the route is shorter than the parallel rulers’ length, simply use the rulers to define the route.

True  Magnetic

Figure 8. A compass rose
From Dana Point Harbor mouth to Avalon Bay, Santa Catalina Island via the ferry route

From Isthmus Bay, Santa Catalina Island to the Long Beach Light via the ferry route

From Newport Beach Harbor Mouth to Avalon Bay, Santa Catalina Island via the ferry route

From Fl G 2.5s 21ft 5M light in Avalon Bay, Santa Catalina Island to Fl 6s 71ft 10M light at Long Point, Santa Catalina Island

From Long Beach Light, San Pedro Bay to the Marine Cemetery at 33° 37.01 N 118° 18.11' W

5. Navigating a Course: Using Vectors

The speed of ships is measured as nautical miles per hour. This unit is typically called the knot. Thus a speed of ten nautical miles per hour is 10 knots. When a ship is traveling on the ocean, it has both a speed and direction, or velocity, a vector quantity. Vectors can be represented by arrows whose lengths represent the magnitude of the vector. The heading is represented by the direction of the arrow. Vectors can also be used to represent the speed and direction of currents. And most importantly, vectors can be added graphically to solve several problems in navigation.

For instance, consider a ship (shown in Figure 9) that is heading west (270°) at 8 knots across a south bound current at 4 knots. What is ship’s actual course? Most people will know that the ship will travel somewhat southwest, but we can use vectors to determine the actual heading and final position. The method is fairly simple. First construct a line that represents the ships velocity (vector). The line should be directed west and the length should be 8 units. Next, from the tip of the ship’s velocity arrow construct the current velocity (vector) arrow, due south and 4 units long. Finally, as shown in Figure 9, construct the resultant arrow that goes from the ship’s starting point to the tip of the current arrow. The resultant arrow shows the ship’s actual course (which you know you can transfer to a compass rose with the parallel rulers) and its length is the ship’s actual speed.

This method can be used to solve this type of problem no matter what the compass heading. If a ship has a heading of 240° and a speed of 10 knots and it crosses a current with a heading of 190° with a speed of 3 knots, what is the position of the ship after two hours? We can proceed as we did above. First construct the ship’s vector, 20 nautical
miles long (since the time is 2 hours at 10 knots) with a heading of 240°. Next, from the tip of the ship’s vector construct the current arrow 6 nautical miles long (2 hours at 3 knots) with a heading of 190°. Finally, connect the tail of the ship’s arrow with the tip of the current arrow to find the actual course and final position, as shown in Figure 10.

Let's try a simple navigation problem. Consider a ship that begins its voyage at the starting point shown in Figure 11. Using your parallel rulers and dividers, plot the course of the ship over the three stated “legs” of this cruise.

1. From the starting point the ship travels northward on a true heading of 10° for one hour at 6 knots. During this time there is a 4 knot current flowing east on a heading of 80°. Label the final position as point “A.”
   What was the ship’s actual course during this leg of the cruise? _______

2. From point “A”, the ship travels southward on heading of 170° for one hour, however, its speed has dropped to 4 knots. The same current (as in 1) is in effect along this leg of the cruise. Mark the ship’s position at the end of this leg “B.”

3. The current has died down a bit, it is now 2.25 knots with a slight change in direction to 90°. The ship leaves point B and travels for two hours at 3 knots on a heading of 330°. Mark the final position of the ship as point “C.”
What was the ship’s actual course during this leg of the cruise? _______

In Figure 12 you see a region of Santa Catalina Island near the north side of the isthmus. Your job is to construct a series of legs that will complete the following cruise. Travel to each point may require several legs.

Your ship has a top speed of 6 knots. You may use any speed between 2 and 6 knots. The Davidson Countercurrent is active today. It is traveling to the southeast, heading 130°, at 2 knots. Plot and show all vectors on the chart. Indicate what each vector represents (i.e. current, ship’s heading, and actual course) and the speed and time on each vector. You should try for the fewest number of course changes.

Begin at point “A” in Isthmus cove. Travel to point “B” in Fourth of July Cove.

Next, travel to point “C” on the north side of Ship Rock.

From Ship rock travel south to point “D” east of Bird Rock.
Now find a way to get into Fisherman’s Cove, point “E”.

Finally, return to point “A”, the dock at Isthmus Cove.
Pre Lab Quiz

1. What is the position of the boat dock in Figure 1?

2. What is the heading from the house to the surfing beach?

3. What is the heading from the surfing beach to the favorite fishing spot?

4. What is the distance from Mt Junk to the shipwreck (straight line)?

5. What is the distance from Mt. Junk to the boat dock?

6. If your boat travels at 5 miles per hour, how long will it take to get home (back to the house) from the favorite fishing spot?

7. What is the distance in nautical miles covered by one longitudinal degree of arc along the equator?

   in statute miles?

   in kilometers?

8. What is the circumference of the earth at the equator in nautical miles?