NAVIGATION WORKBOOK
1210 Tr

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INTRODUCTION

Scope

These exercises are designed to help small-craft navigators hone their skills in both routine and special circumstances. They are practical exercises in chart reading and plotting, position fixing, dead reckoning, compass work, and the use of special publications such as Chart Catalogs, *Tide Tables*, *Current Tables*, *Light Lists*, Notices to Mariners, *Chart No. 1*, *Navigation Rules*, and *U.S. Coast Pilots*.

These exercises can be incorporated into an ongoing navigation course or used by individuals on their own. This book along with a text book of choice would then make up a self-study course. The chapters of this workbook correlate with those of the book *Inland and Coastal Navigation, 2nd edition* by David Burch, but other books can also provide the necessary background.

The level of these exercises is about that required in the USCG Masters license exam for 100 GT, which in turn is about the same as that used in coastal navigation certification exams from the U.S. Sailing Association, American Sailing Association, Royal Yachting Association, and the Canadian Yachting Association.

Chart 1210 Tr

The exercises in this book that require a chart use NOAA chart 1210 Tr, Martha's Vineyard to Block Island including Western Approach to Cape Cod Canal. This is one of several NOAA training charts. This one is frozen in time to about 1990, but is otherwise similar to the standard navigation chart of this region (No. 13218), which is updated weekly, as are all NOAA charts now that they are all Print on Demand (POD). For training exercises, it is best to use the training chart version 1210 Tr, so all details match the exercises.

The 1210 Tr is available at most NOAA chart dealers and from several online outlets (see Appendix A3.). This is the most popular of all training charts, used by most navigation schools in the US. Consequently it has been bulk printed by commercial companies and is available for less cost than the POD version.

Except for this paper chart that must be purchased separately, all other resource materials are provided in the Resources section, which includes excerpts for all publications needed.

You can also work the exercises with an electronic version of 1210 Tr, and for that solution we have an extended discussion in Appendix A1, which includes a source for the echart. We encourage mariners to solve the charting exercises using both paper charts and electronic charts. Also provided are a few tips on the use of ECS (electronic charting system) for solving navigation problems.

Terminology

All references to miles are nautical miles. Sometimes this is stated as miles other places as "nmi." One nautical mile is about 6,000 ft. (Exact is 1 nmi = 1852m = (1852x100/2.54)/12 ft, which is about 6076.115 ft.)

General phrases like "north of" or "due east of," etc, always refers to true directions, unless otherwise specified. Wind directions are labeled by the source of the wind, i.e. north wind flows from north to south, sea breeze blows from the sea toward the land. Wind waves and currents, on the other hand, are labeled with the true direction they flow toward. (Swells, as opposed to wind waves, are labeled by the direction they come from.)

Magnetic Variation

The magnetic variation on the 1210 Tr chart (frozen in 1990) covers magnetic variations that vary from 15.0 W to 15.5 W. To simplify the exercises, however, we use a fixed value of 15.0 W for all locations of the chart, and for all exercises.

Tides and Currents

Because the design of the NOAA *Tide Tables* and *Tidal Current Tables* have changed to some extent since the time of the 1210 Tr chart, we have chosen to use more modern values for the related exercises. Tide and current data provided are from 2011.

Tools of the Trade

These are the basic plotting tools used in marine navigation. There are many alternatives, but these are the most common by far, worldwide, on all vessels.

Dividers

Dividers are used to measure the distance between two points, and also to help align parallel rulers or plotters. There are several styles. Shown here is a type of "speed bow." You can interchange one of the points with a pencil lead for drawing circles of position or other arcs.

A "bow" is a tool that will hold its point separation once set, and it is set by a rotating knob in the center of the tool—as opposed to conventional dividers which are just pulled open or squeezed closed. A "speed bow" is one that you can pull open or close by hand without having to use the center knob. In other words, you can override the fine control of the center knob by firmly pulling or pushing on the legs themselves.

This particular model has become the dividers of choice for the vast majority of professional navigators worldwide because of its ease of use and accuracy. This economic model is called (appropriately) "ultra light dividers."

Parallel Rulers

This is a tool that lets you draw one line parallel to another, some distance away from it. To use it, align one edge of the rulers with the base line, and then holding down that side of the tool, move the other side to the location of the new line. If the new location cannot be reached in one step, then you walk the rulers across the page to the destination.

It takes a bit of practice to manipulate these without slipping, but after some practice it is quite easy. There are numerous styles and sizes of these. A simple design, in clear plastic with small cork anti-slip pads, 15 inches long is a popular and functional option.

Weems Plotter

An alternative to parallel rulers is a rolling tool called a parallel plotter, or more specifically, the Weems parallel plotter, named after its inventor. These are designed to roll without sliding, which they generally do fairly well, with little practice. Unfortunately, rolling plotters do not work well near the edges of charts or over folds in the chart. A solution is always also carry parallel rulers underway and use the Weems plotter whenever possible, but immediately switch to parallel rulers if need be. On a large chart table (or kitchen table) many navigators find this tool faster and easier to use than parallel rulers.

Triangles

The most accurate chart plotting is often done with two matching navigation triangles. They take a bit more practice to master, but the larger protractor scale and more positive positioning does enhance the accuracy. They are popular with professional mariners.

Three-Arm Protractor

Other applications are possible, but the main function of this tool is to plot a fix from two horizontal sextant angles, which is faster than the compass and ruler plotting.

For more Help

Check starpath.com/1210tr for news and resources related to this book as well as contact with the authors. Comments and suggestions will be much appreciated and addressed promptly. Training aids are available as well as links to navigation schools and navigation certification associations around the world that offer basic and advanced training in marine navigation. Links to local classes from US Power Squadrons and USCG Auxiliary are also provided.

Plotting tools. *Dividers, parallel rulers, Weems Plotter, triangles, 3-arm protractor*

CHAPTER 2 – NAUTICAL CHARTS AND CHART READING

These exercises require some version of Chart No 1. *A full version of this and other publications are online (starpath.com/navpubs). An older version is printed on the reverse side of 1210 Tr. It could be helpful to skim through the Coast Pilot excerpts in the Resources section to become more familiar with the chart. Use the* Light List *or* Coast Pilot *Indexes from the Resources section to locate aids, marks or regions as needed. Use magnetic variation of 15.0° W for all locations on this chart, for all questions in this book. It will be very instructive to download a full copy of the latest* Light List *and read the Introduction (about 20 pages).*

2-1. Concerning the 1210 Tr training chart... (A) What is the latest revision date of this chart? (B) What is the title of the chart? (C) What map projection is used for this chart? (D) What scale is the chart? (E) Are soundings in feet, fathoms, or meters? (F) What is the chart datum (reference level) for soundings? (G) What is the chart datum (reference level) for elevations? (H) What are the precise Lat and Lon boundaries (ie top and bottom Lats; right and left Lons)? (I) What is the precise height and width of the chart in nautical miles? (J) Around the edges of the chart is the notice "LORAN-C OVERPRINTED." What does this indicate? (K) What modern chart is the nearest to same coverage as 1210 Tr?

2-2. Aligned north-south along longitude 71° 24' is a series of seven White and Orange buoys. What is the purpose of these buoys?

2-3. South of Martha's Vineyard's Gay Head there is an island called "Nomans Land". This island lies within a rectangle labeled "Prohibited Area." Does Note A tell us what the restrictions are for this area? If yes, what are the restrictions? If not, where would one find the applicable restrictions?

2-4. What is the land mass appearing in the southwest corner of the chart?

2-5. What is the name of the reef off the west end of Cuttyhunk Island?

2-6. What is the name of the shoal, approximately 5 miles in length, which runs along the south part of Vineyard Sound, extending westward from the right edge of the chart?

2-7. What is the name of the point where the Massachusetts/Rhode Island state border meets the sea?

2-8. What is the identification of the radio tower located a little more than a mile east of Newport, Rhode Island?

2-9. Immediately west and south of the Brenton Reef Buoy there is a depth contour line. What depth does this line represent?

2-10. Why are no soundings given in Narragansett Bay?

2-11. There are three compass roses depicted on the chart. Per each compass rose, what year was the magnetic variation surveyed?

2-12. As of the year of magnetic survey (and as depicted on each rose), what was the maximum difference in variation between the three roses?

2-13. As of the year of survey, what was the predicted annual change in Variation at each rose location?

2-14. What is the name of the channel that forms the first leg of the south entrance to the Cape Cod Canal?

2-15. What is the name of the next channel leg entering the Canal?

2-16. What is the name of the ledge about a mile south of Sakonnet Point?

2-17. What is the name of the ledge about a mile south and slightly east of Warren Point?

12-18. Running from near the tower at Gooseberry Neck across to the west end of Cuttyhunk Island is a dotted line that is labeled. How is this line labeled?

2-19. What is the significance of this line?

2-20. Nashawena Island has a prominent landmark charted. What is it?

2-21. In Vineyard Sound there are areas marked with a circled E and a circled F. What are these, and why do you think they are there?

2-22. Running south southeast from New Bedford are two parallel dotted lines marked Note C. What do these lines indicate?

2-23. There is a Caution notice near the west edge of the chart, approx. Lat 41° 32' N, Lon 71° 30' W. To what does this notice refer?

2-24. How many locations of unexploded depth charges can you find on the chart?

2-25. What is the name of the island just NE of Cuttyhunk and NW of Nashawena?

2-26. What is the name of the point that forms the southern shore of West Falmouth Harbor?

2-27. What charted fixture is located on the west end of Wings Neck, just east of the entrance to Cape Cod Canal?

2-28. Some major navigation aids on the chart such as the Buzzards Light are depicted as having radio beacons, a technology now out of use. Referring to the *Light List*, what modern technology replaces most of these?

10-39. The rule regarding lookouts applies...

(A) in restricted visibility.
(B) between dusk and dawn.
(C) in heavy traffic.
(D) All of the above.

10-40. When taking action to avoid collision, you should...

(A) make sure the action is taken in enough time.
(B) not make any large course changes.
(C) not make any large speed changes.
(D) All of the above.

10-41. A vessel transferring cargo while underway is classified by the Rules as a vessel...

(A) not under command.
(B) in special circumstances.
(C) restricted in her ability to maneuver.
(D) constrained by her draft.

10-42. Which vessel is "underway" under the Rules of the Road?

(A) A vessel at anchor with the engine running.
(B) A vessel with a line led to a tree onshore.
(C) vessel drifting with the engine off.
(D) A vessel aground.

10-43. You are on watch in the fog. The vessel is proceeding at a safe speed when you hear a fog signal ahead of you. The Rules require you to navigate with caution until the danger of collision is over and to...

(A) slow to less than 2 knots.
(B) reduce to bare steerageway.
(C) stop your engines.
(D) begin a radar plot.

10-44. In order for a stand-on vessel to take action in a situation, she must determine that the other vessel...

(A) is restricted in her ability to maneuver.
(B) has sounded the danger signal.
(C) is not taking appropriate action.
(D) has not changed course since risk of collision was determined.

Nav Rules Part C. Lights and Dayshapes

10-45. At night, a barge being towed astern must display...

(A) red and green sidelights only.
(B) a white sternlight only.
(C) sidelights and a sternlight.
(D) one all-round white light.

10-46. Which of the following may be used as a distress signal?

(A) Directing the beam of a searchlight at another vessel.
(B) A smoke signal giving off orange colored smoke.
(C) A whistle signal of one prolonged and three short blasts.
(D) International Code Signal PAN.

10-47. A pilot vessel on pilotage duty at night will show sidelights and a sternlight...

(A) when at anchor.
(B) only when making way.
(C) at any time when underway.
(D) only when the identifying lights are not being shown.

10-48. A vessel which displays the day signal as shown in DIAGRAM 6 is engaged in...

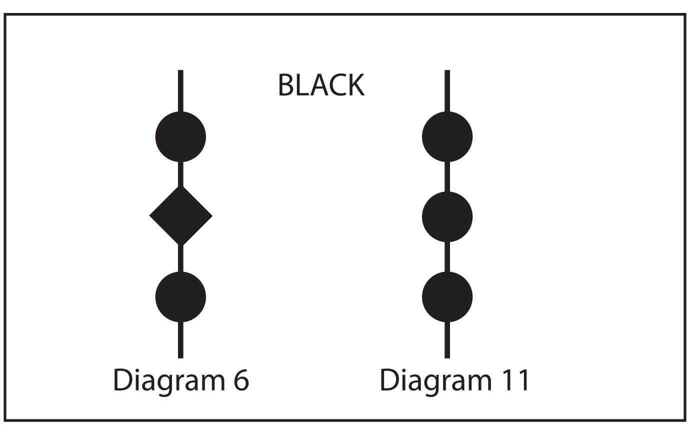
(A) submarine cable laying. (B) pilotage duty.
(C) fishing. (D) mine sweeping.

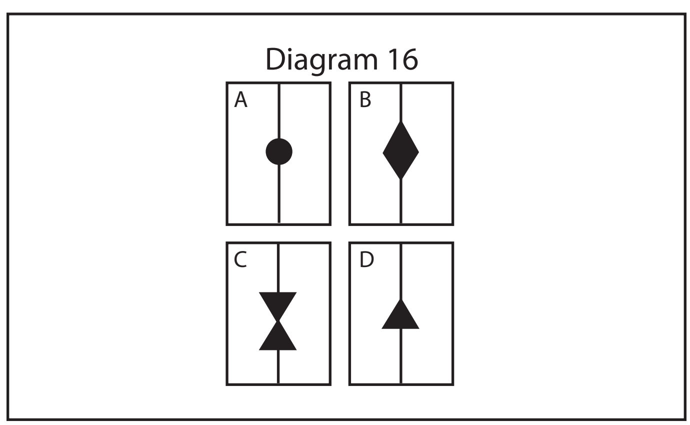
10-49. A vessel displaying the dayshapes illustrated in DIAGRAM 11, is...

(A) towing. (B) conducting underwater operations.
(C) drifting. (D) aground.

10-50. Which vessel must show forward and after masthead lights when making way?

(A) A 75-meter vessel restricted in her ability to maneuver.
(B) A 100-meter sailing vessel.
(C) A 150-meter vessel engaged in fishing.
(D) A 45-meter vessel engaged in towing.





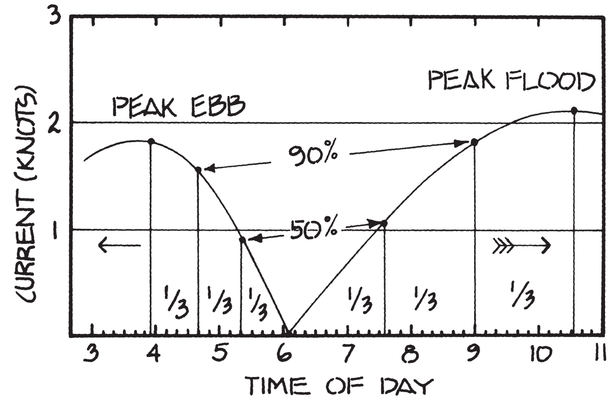
RESOURCES

The following are excerpts from standard resources used in navigation. The Light List and Coast Pilot also have custom made indices, which just cover the sections excerpted. Page numbers from the original Tide and Current Table pages are included on the samples as they are cross referenced. Book page numbers are in the headers of each page.

Resources Contents

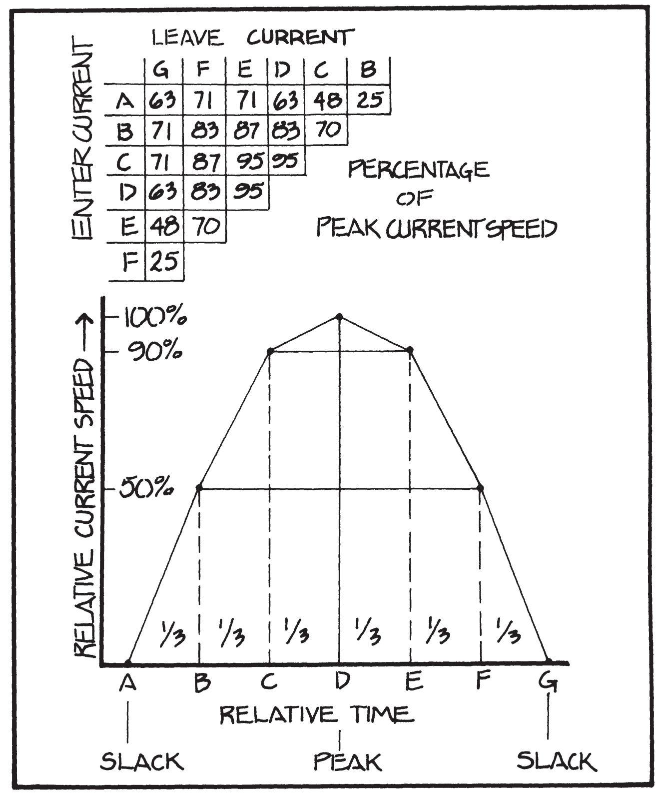
Current Sailing Resources

The 50-90 Rule for figuring current speeds between slack and peak flow



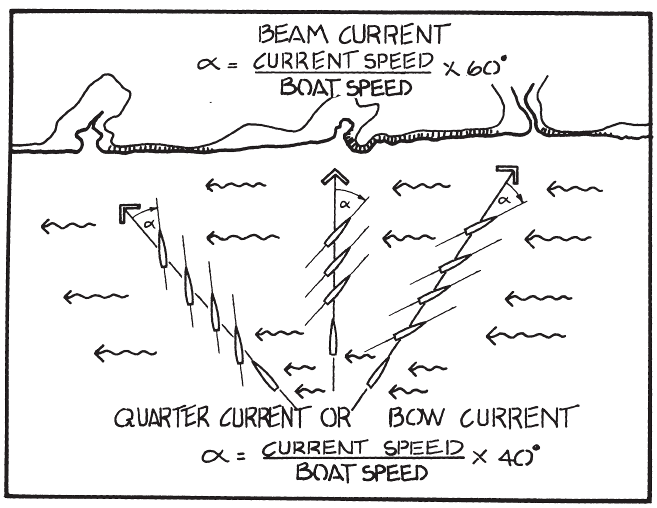
Divide the time between slack water and peak flow into three steps. In many cases, each step will be approximately one hour long. During the first step the current increases to 50 percent of its maximum value, and during the next step it increases to 90 percent of its maximum value. The same procedure will reproduce the fall in current speed after maximum flow.

Use of the 50-90 Rule to estimate the effect of a changing tidal current on net progress



Divide the duration of the cycle into six parts, then use data from the inset to find the constant current speed that is equivalent to the changing current of the cycle. Sailing in a current with a peak speed of 3 knots from relative point B to point E, the current would be increasing from 1.5 knots to 3 knots and then decreasing to 2.7 knots during this time. From the inset, you can assume that this will move the boat as if in a constant current of 0.87 times 3, or 2.6 knots. Note that staying in a current from slack to peak (A to D) or slack to slack (A to G) is equivalent to sailing in a constant current of 0.63 times the peak current speed.

The 40-60 approximation for estimating current set



The rule works adequately well for set angles up to 42° or so, which is equivalent to limiting its use to currents that are less than some three quarters of your boat speed. In most cases, knowledge of current speed and direction is not accurate enough to justify precise vector solutions. This formula is useful and easy to remember. Bow and quarter currents take less of a correction, but they are the same in each case. The only difference is the resulting SMG. Bow currents slow you down, quarter currents speed you up. Bow, beam, and quarter current directions are defined for this application with the boat pointed toward the destination, as in the starting position shown on each route.

These three resources are from the text *Inland and Coastal Navigation, 2nd edition* (Starpath Publications, 2013)

Charts covered in Chapter 5. Training chart 1210 Tr extends to the west, into Chapters 6 and 7.

groups; the southerly group is the larger. Numerous covered rocks are well away from the visible part of the danger. A narrow ledge covered 5 to 14 feet extends about 0.4 mile northward from the visible part of Hen and Chickens. A buoy is north of the ledge. Old Cock, a rock awash, and The Wildcat, covered 5 feet and unmarked, are in the southern shoal area. The south edge of the shoal is marked by a buoy. Strangers are advised to stay outside the 5-fathom curve in this vicinity.

(71) **Sow and Pigs Reef**, much of which is dry or awash, extends about 1.5 miles west-southwestward from Cuttyhunk Island. Its outer end is marked by a lighted bell buoy. An unmarked rock strewn shoal, covered 20 feet, is 0.9 mile westward of Cuttyhunk Island. Numerous obstructions and rocks were reported to extend as much as 3 miles southward of Sow and Pigs Reef.

(72) **Ribbon Reef**, a detached ledge covered 18 feet, is about 1.5 miles northwestward of Cuttyhunk Island.

(73) **Mishaum Ledge**, a group of several rocky spots with a least depth of 8 feet, extends about 1.7 miles southward of Mishaum Point. It is marked by a lighted gong buoy off its southeast end. A lighted bell buoy marks a rocky shoal covered 22 feet about 1 mile north-northwestward of the north end of Penikese Island. An unmarked rocky shoal covered 18 feet is 0.5 mile north of the island.

Currents

(74) The tidal currents in the passages between Buzzards Bay and Vineyard Sound have considerable velocity and require special attention. At Buzzards Bay Lighted Gong Buoy 3, the tidal current is rotary, turning clockwise. Tide rips occur when a sea is running against the current. Maximum velocities are about 0.5 knot. Minimum velocities average about 0.2 knot.

Charts 13236, 13229 (& 1210 Tr)

(75) **Onset Bay**, between **Sias Point** on the north and **Hog Neck** on the south, is the approach to the village of Onset. A dredged marked channel leads westward from Cape Cod Canal along the southerly side of the bay to a turning basin off the village. Two anchorage areas, one on each side of the channel, are at the head of the channel.

(76) **Wickets Island** is a high and wooded islet in the middle of the bay. The buoys in the entrance channel are frequently towed under because of the strong currents. A rock, covered 9 feet, is near the channel entrance about 75 yards northeast of Hog Island Channel Light 21. In 1981, two rocks, covered 4 to 5 feet, were reported on the north edge of the channel between Buoys 2 and 4; caution is advised.

(77) **East River** empties into Onset Bay southeast of Onset. A draft of 4 feet can be taken to **Broad Cove** above the highway bridge which connects Onset and Long Neck. The bridge has a fixed span with a clearance of 11 feet.

Coast Pilot Chapter 5 Index

off. At 10 miles off the land is above the horizon by an angle of arctan(100/60000) = 0.095° = 5.7'. This is a very small angle, but definitely visible in clear skies. You would likely see this by eye in clear weather before you could pick it up on radar. (B) This is almost a trick question, i.e. if the visible range of the land is 4 miles how far can you see it (assuming it is above the horizon)? Answer 4 miles. This is the definition of visibility.

3-37. Using our estimate of luminous range: (5/10) × 5 + 1 = 3.5 nmi.

3-38. (A) One approach to this is to just skim through the Light List and look at a lot of buoys to see what they average. Typical values are 4 to 6 nmi, with a few at 3 and 7. Thus we can call 5 nmi an average buoy nominal range. (B) Heights of buoys vary quite a bit, but 12 ft might be an average for the typical lighted buoy. So from an eye height of 9 ft we have a geographic range of about sqrt(9) +sqrt(12) = 6.5 or so, which shows that it is the light brightness that is usually the limit, which would be about 5 miles. In practice this would likely take binoculars to spot them on this limit on a clear night.

3-39. This is another example of bobbing a light, which works remarkably well for bright lights that are not very high. It means we are located very near the geographic range of the light. In this case sqrt(27) + sqrt(12) = 8.7 nmi visible, but sqrt(27) +sqrt(7) = 7.8 not visible. We are about 8 miles off with this light is shining out very brightly to 19 miles just over our head.

3-40. Woods Hole chart is number 13235.

3-41. (LL#16055) (A) 41° 30.8' N, 70° 50.1' W (B) 41° 30.55' N, 70° 49.9' W (C) About a quarter of a mile.

3-42. International.

3-43. (CP15) The Traffic Separation Scheme is not buoyed.

3-44. (LNM p2) Avoid the area or transit at 10 knots or less.

3-45. (LNM p2) (B) Immediately upon arrival into the United States.

3-46. (LNM p3) None; the sound signal is inoperative.

3-47. (LNM p3) None; the light is extinguished.

3-48. (LNM p4) A minimum separation of 0.5 nmi.

3-49. (LNM p4) The buoy no longer exists; it has been removed from the Light List.

3-50. (LNM p5) Samples of things to check for safe nav prep: (1) charts, (2) crucial pubs, (3) manuals of all nav instruments, (4) spare light bulbs, (5) waypoints entered into handheld GPS as back up, (6) printed course plan, (7) check of all radios, (8) teach others to use the radios, (9) good binoculars, (10) radio schedule of weather broadcasts, (11) some equivalent of Marine Weather Services Charts... amongst others.

3-51. (CP 77) 4 ft.

3-52. Navigation Rules, Tide Tables, Current Tables, Coast Pilot, and Light List.

3-53. It depends on the light. Check the *Light List*. Those on 24 hours are described as: "Lighted throughout 24 hours." Check an example Nobska Point Light, whereas a comparable light at Gay Head is not on all the time.

CHAPTER 4 – COMPASS USE

4-1. (A) The correcting direction is C to M using deviation or M to T using variation. If deviation is east, then it is added to C to get M, If variation is east, then it is added to M to get T. The rule is meant to remind us that if the correction is west, we subtract it when correcting. (B) Can Dead Men Vote Twice (at elections, for add east correcting), or going the other way: TV makes dull companion (add whiskey, for add west uncorrecting.)

4-2.

	A	*B*
T	330	330
V	15 W	15 W
M	345	345
D	0	4 E
C	345	341

4-3. The inner ring is magnetic bearing marked off in compass points, 11.25° = 1 point. This bearing system and feature of nautical charts is rarely, if ever, used these days.

4-4. This natural range is 113 T = 128 M, so 125 C means a deviation of 3° E.

4-5. (A) deviation = 0°. (B) You can say nothing at all. It might be zero as well, but could be 5 or 10° E or W. Deviation has to be measured on all headings. You might say, "It is probably zero because I just had the compass adjusted last week and it was zero on all headings," but even that could be wrong if one of the adjustment magnets fell out, which is a not unheard of Murphy's-Law possibility.

4-6.

#	*Comp*	*Dev*	*Mag*	*Var*	*True*
1	296	**0°**	**296**	16° W	280
2	**009**	5° E	014	21° E	**035**
3	354	8° W	**346**	**21° E**	007
4	276	**0°**	276	10° W	**266**
5	**098**	5° W	093	**21° E**	114
6	138	**4° W**	**134**	4° E	138
7	**006**	0°	006	21° W	**345**
8	028	0°	**028**	**21° E**	049
9	351	**4° E**	355	17° E	**012**

5-2. (A) 8.3 kts (B) 24 + 10.4 = 34.4h enroute at 5 kts = 172 nmi.

5-3. 15 kts / 24h = 0.625 kts.

5-4. (37 × 60) / 4 = 555m = 9h 15m.

5-5. (A) 22.0 hr, (B) 24h 9m.

5-6. 55 / 9 = 6.11 kts.

5-7. 3h 40m = 220m; (12 × 60) / 220 = 3.27 kts.

5-8. 4.14 kts.

5-9. (A) 8.57m = 8m 34 sec (B) 1.32 kts error (C) Indicated speed is 23% higher than actual. Actual is 19% lower than indicated. (D) 3.24 kts

5-10. (A) 5.25 kts (B) If 1 sec fast, then speed = 7 kts; if 1 sec slow, then speed = 4.2 kts.

5-11. Time = 3h 38m.

5-12. Total tacking distance = 18 × 1.5 = 27 nmi; at 6 kts = TTE 4h 30m.

5-13. Upwind leg total tacking distance = 4 × 1.5 = 6 nmi; at 6 kts = 1h enroute; plus 8 nmi at 6 kts = 1h 20m. TTG is 2h 20m.

5-14. (A) D 12.3, C 241 M, 1h 54m, (B) D 7.8, C 291 M, 1h 34m, (C) D 15.6, C 075 M, 2h 10m, (D) D 3.1, C 103 M, 0h 39m, (E) 1801.

5-15. (A) 28.4, 298 T, (B) 4h 03m, (C) Stbd tack 25.0 + port tack 13.4 = total distance 38.4 nmi. Time = 5h 32m. Using shortcut: 1.5 × 28.4 = 42.6 (or 6h 05m), which is mathematically (42.6/38.4) about 11% over estimate, however in practice this will always be an underestimate, i.e. the factor of 1.5 is a good practical estimate. (D) Three tacks. Legs are 10.7 + 11.4 + 14.3 + 2.0 = Total distance 38.4 nmi. This distance is exactly the same as with minimal tacks; therefore the time would be identical. (E) The new wind lifts us to the mark, so the sooner we get into it the better. The layline to the mark once we get to pure northerlies crosses 71° 10'W at about 41° 15' N, so we would not waste time on a port tack, but take the lifting starboard tack to the west which would gradually lift us to the point where we would be on a tight reach to the mark by the time we hit the northerlies. In short, we get there on one starboard tack with speed increasing. Assuming we just make 7 kts the whole way at hull speed (ie do not gain much when falling off), we would sail about 8 west, get lifted to the layline over the next 8 or so miles, then reach 14 to the mark, for a total of roughly 30 miles. (F) Neglecting the wind forecast and staying on wrong tack the most time, we might sail west 1 mile to clear the island, then north 11 then west for 13.5 or so and then a final reach of about 10 miles in the new wind, for a total of 34.5. In practice it might be worse if we ignored the fact we were getting lifted as we did proceed west.

In summary, steady NW wind we had 38.4 miles, taking advantage of the wind we got this down to 30 miles, and not taking full advantage it was about 34.5 nmi. The time lost with poor tactics would be about 4.5/7 = about 36 min.

5-16. One approach: choose a minimum speed with good steerage, say 3 kts. Compute how far you would go in 10 minutes at 3 kts: d = 3 × 10/60 = 0.5 nmi; then consider this the circumference of the circle, and since c = pi × diameter, we get a circle diameter of 0.5/pi = 0.16 nmi = 0.16 × 6000 = 960 ft = 320 yd. So you would have to be some 400 yards into safe water in all directions to make the turn.

To execute something like this, we might divide 360 by 15 to get 24 steps around the compass, 000, 015, 030, 045, etc, and then say that we are going to hold each course for 10 min/24 = 0.417 min = 25 seconds. Then watching a stop watch, head off at 000 for 25 seconds, turn to 015 for 25 seconds, etc and you should trace out a circle of about 320 yards diameter, probably a bit larger, in about 10 minutes, maybe longer.

5-17. (A) C 204 M. (B) 5126.2. (C) 5137.0. (D) Bearing 098 M. (E) Course 288 M. (F) 5153.0.

5-18. Leg 1 is 26 minutes at 7 kts = 3 nmi, Leg 2 is 45m at 4.0 kts = 3.0 nmi. (A) Return course is 053 M. (B) ETA is 1146.

5-19. (A) 41° 25.1' N, 71° 09.1 W' (B) 2.2 nmi (C) 148 M (D) Set is 133 T, drift 0.6 kts. (E) No. For this to be the true current, even assuming that there were no other sources of error in the DR, it is unlikely the current was constant in speed and direction for 3 hours in this region. Looking at the shape of the coastline along this course, it is unlikely that this is true in this case. The current north and south of Martha's Vineyard is driven by a significant flow north of Long Island, but the current nearer the coast of Massachusetts and Rhode Island is considerably sheltered from the main flow. The effects of the real current in this exercise are cumulative, the final result from averaging the current speed and direction during the overall trip. This type of DR offset is often referred to as an "error current." (F) No, the recorded speeds are roughly and consistently about 4% higher than the corresponding SMGs. (ie 38m for 3.8 mi = 6.0; 34m for 3.7 mi = 6.5, 87m for 10.1 mi = 7.0 and 56m for 7.0 mil = 7.5). Normally the log and knotmeter have the same calibration, so if one is off the other is off by the same amount and we would not see any difference here. So either there is an offset in the knotmeter readout somehow, or we are simply overestimating the averages we recorded. We can't really blame the timekeeping, since the intervals are much different, but the offset is near constant. What we learn is we must when we can, get to a measured mile in light air and still water and study this more, and of course check the manual to see if this unit does have separate calibrations for log and knotmeter.

CHAPTER 6 – PILOTING

6-1. (A) 41° 28.6' N, 70° 52.6' W. (B) 41° 29.3' N, 70° 51.8' W. (C) This is a 0.6 nmi error.

6-2. (A) A fix. (B) 41° 23.3' N, 70° 50.6' W.

Exercise 8-53 Answers							
Current Tables		*Table 3*				*50-90 Rule*	
EST	*Speed*	*Intervals*	*Cycle*	*Factor*	*Current*	*Current*	*Factor*
0443	0.0				0.0	0.0	
0543		1h 00m	3h 34m	0.45	1.0	1.2	0.5
0630		1h 47m	3h 34m	0.75	1.7	1.6	0.7
0717		2h 34m	3h 34m	0.9	2.1	2.1	0.9
0817	2.3				2.3	2.3	
0917		2h 14m	3h 14m	0.9	2.1	2.1	0.9
0954		1h 37m	3h 14m	0.72	1.7	1.6	0.7
1031		1h 00m	3h 14m	0.6	1.4		0.5
1131	0.0				0.0	0.0	
1231		1h 41m	2h 41m	0.8	-1.4	-1.5	0.9
1251		1h 21m	2h 41m	0.7	-1.2	-1.2	0.7
1312		1h 00m	2h 41m	0.6	-1.0	-0.9	0.5
1412	-1.7				-1.7	-1.7	

6-3. A measurement on the navigation chart shows the west edges of the two islands form a range at 192 M at the same moment the helm compass indicated 180. Therefore, we conclude that your magnetic course was 192 M when your compass course was 180 C. Using the mnemonic "TVMDC add West" shows the 12° difference must be subtracted, and thus the deviation on a southerly heading 12° East.

6-4. (A) 41° 15.1' N, 71° 26.1' W; (B) Although the problem stated magnetic course 305, how accurately can this truly be known at the helm? Then there are a number of potential radar inaccuracies depending on how well aligned the radar is on your vessel, and there is an inaccuracy introduced because of the beam width of the radar. Lastly, just how precise can bearings taken with a hand bearing compass be?

6-5. (A) 41° 21.4' N, 71° 08.9' W. (B) Most westerly 'fix' 41° 20.2' N, 71° 17.1' W. (C) Most easterly 'fix' 41° 21.3' N, 71° 06.9' W. (D) The distance from most westerly to most easterly possible 'fix' is 6.28 nmi, hardly a precise solution. (E) First, that some hand bearing compasses do not allow precision measurement; it's also a good lesson to take bearing fixes, if using just two, at about 90° apart.

6-6. Your actual location in presumed safe water is 41° 20.0' N, 70° 52.5' W. With 1.9 miles to go at 8 knots, you will be wrecked on the charted rocks in less than 14 minutes.

6-7. (A) The 60 ft contour line offers safe water and a fairly steady track to the entrance. (B) If the sea is calm, the gong would not sound, as it is wave motion that activates the clappers. In wind, it might not be audible. (C) As you near the Passage entrance the sea bed smooths somewhat, so following a particular sounding will become less sure. And as the shore just NW of Beavertail Point nears, a very careful watch must be maintained.

6-8. 2 fathom = 12 feet, so depth at that location at low water would be 14 feet.

6-9. (A) 41° 13.7' N, 71° 33.2' W, about a half mile NE of Grove Point, Block Island. (B) On the rocks. (C) In about 6 minutes, or about 1412. (D) A close fit of the depth profile is fairly accurate; but for sure, if the depth continues to shoal to 30 feet, it is doubtless time to turn east toward safe water and come up with an alternate navigation strategy.

6-10. (A) No MORE than (B) 130 M.

6-11. About 9 miles. (6° is 10% = 4.5 nmi × 2 = 9 nmi).

6-12. The terminology 'from a DR position' in this context means simply that you don't know exactly where you are, but you have an approximate location only. And as this problem gives you only a single landmark, it must be a running fix problem. Plot the first bearing to the spire, then plot a 284° course line intersecting somewhere – literally anywhere - along that first bearing line. Plot the second bearing line. Measure off along the course line the distance run in the time between observations = 1 hour at 5 knots = 5 nmi. Then advance the first bearing line to the distance run. Your position is where the second bearing line intersects the advanced first bearing line. (A) 41° 16.8' N, 70° 46.4' W. (B) This is indeed a fix, an Rfix, at 1845.

6-13. (A) 42°. (B) 338° M. (C) Distance off the light = distance run when the angle has doubled = 1.7 nmi.

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