Southern Region, B.S.A.
Yachting Initiative
Program Elements

# PILOTING ESSENTIALS

**Learning Objectives:**

As a result of this session the participant should:

- Be familiar with the characteristics of a Nautical Chart.
- Be aware of the functionality of the Magnetic Compass.
- Be familiar with Piloting Instruments.
- Understand the basic Piloting techniques.
- Be familiar with position determination and Dead Reckoning.
- Have and experience of plotting positions (fixes) in a laboratory environment.

**Resources:**

Boating Skills & Seamanship, Eleventh Edition, U.S. Coast guard Auxiliary, Chapter 7
The Squadron Boating Course 2001, The United States Power Squadrons, Section 5, 7, 9,11, 13
Chapman Piloting Seamanship & Small Boat Handling, 62nd Edition, Hearst Marine Books, Chapter 17, 18, 19, 20
Dutton's Navigation and Piloting, 14th Edition, Naval Institute Press, By Elbert S. Maloney
Dutton's Problems and Answers in Navigation and Piloting, 2nd Edition, Naval Institute Press, By Elbert S. Maloney
Piloting & Dead Reckoning, 4th Edition, Naval Institute Press, Capt. H.H. Shufelt, USNR (Ret), & G. D. Dunlap
Chart No. 1, USA, NAUTICAL CHART, Symbols Abbreviations and Terms, NOAA & NIMA, Paradise Cay Publications

**Material and Equipment:**

Equipment Items
Overhead Projector, as required by instructor
Hand-held Magnetic Compass
Hand-held Range Finder (Accurate to 500 yards)
7 x 50 Binoculars
Stop Watch
Flashlight with a Red Filter
Universal Plotting Sheets (50 Sheets per pad)

Depth Sounder (For Display, if available)
1 Chart - Mercator Projection (For Display)
1 Chart -Polyconic Projection (For Display)
1 Chart - Gnomonic Projection (For Display)
Various Coastal and Inland Charts and Maps (For Display)

Plotting Tool Kit (Per Crew)
15” Parallel Ruler
6” Divider
Chart Protractor

Additional Instruments (Per Crew)
2 45 Degree Triangles
Course Plotter
Drafting Compass
Fine-lead (.5 mm) pencils with medium-soft lead
Good quality erasers

Material Items
Provide one copy for each participant:
Piloting Publications Handout
Useful Equations and Conversion Tables Handout
Piloting Laboratory Exercises Handout

**Instructor Qualification:**

U.S. Coast Guard Auxiliary Trainer presence required for USCGAUX Certificate Program
U.S. Power Squadron Instructor, Council Venturing Trainer or equivalent

**Time Allocation:** 3 Hours

**Session Plan:**

**Classroom Session (1 Hours)**

1. **Module Introduction.**
   a. Introduce yourself and each member of the module staff.

   b. Explain the objectives of this module.

   c. Inform participants the Piloting Publications handout will be distributed after the nautical chart presentations with the laboratory handouts prior to the beginning of the laboratory session.

2. **Basic Chart Concepts and Characteristics.**
   a. Explain the following chart concepts and characteristics and reference the Chart No. 1 Nautical Chart, Symbols and Abbreviations document for additional details.
      1. Geographic Coordinates
      2. Direction
      3. Compass Rose
      4. Distance

5. Latitude and Longitude Scales
6. Chart Colors
7. Lettering Styles
8. Water Features
9. Depths and Depth Curves
10. Dredged Channels
11. Bottom and Shoreline Characteristics
12. Land Area Features
13. Man-made Features

b. Mention briefly the following charts and chart scales available and that the latest chart edition should be used.

1. Sailing Charts (1:600,000)
2. General Charts (1:150,000 to 1:600,000)
3. Coast Charts (1:50,000 to 1:150,000)
4. Lake Charts (1:50,000 to 1:500,000)
5. Harbor Charts (1:5,000 to 1:50,000)
6. Small Craft Charts (1:10,000 to 1:40,000)
7. Marine Facility charts (1:10,000 to 1:40,0000)
8. Great Lakes Charts
9. River Charts
10. Pilot Charts

c. Describe the chart projection characteristics for the following.

1. Mercator Projection
2. Polyconic Projection
3. Lambert Conformal Projection
4. Gnomonic Projection

3. **Magnetic Compass.**

a. Describe briefly how a compass works including basic compass construction and compass card markings.

b. Describe briefly some of the following compass selection criteria.

1. Can the compass be mounted in a location for comfortable viewing
2. Can the compass card be easily read and is appropriately marked
3. Does the card rotate smoothly through any course change
4. Are there built-in compensating magnets and night lighting provisions
5. Is there a significant parallax error when reading compass from the side

c. Describe briefly some of the operational concerns regarding compass installation.

1. Explain Keel Line and Lubber Line mounting
2. Make sure the compass has been zeroed in
3. Check for magnetic influences (instruments, gauges, radios)
4. Check for electrical influences and vibration (use full rpm range of engine)

d. Explain Compass Variation and Deviation.

e. Explain the following compass calculations.
*[Mention that for small non-steel boats the deviation should be 0 or less than 2 degrees.]*

1. Compass Error (CE)
2. Applying variation and deviation
3. The "TVMDC" diagram

4. **Piloting Instruments.**

a. Describe the use of the following measurement tools.

1. Hand-held compass
2. Hand-held range finder
3. Stop Watch
4. Binoculars
5. Depth Sounder (if available)
6. Flashlights (Red Filters)

b. Mention briefly the following precision and accuracy expectations for small boating.

1. Direction (Small boats seldom steer closer that 2 or 3 deg. of intended course)
2. Distance (A tenth of a nautical mile – 200 yards)
3. Time (Nearest minute)
4. Speed (Either a knot or mile per hour)
5. Position (Nearest tenth of a minute of latitude and longitude)
6. Rounding Numbers (Hundreds to Tenths)

5. **Piloting Laboratory Session Preparation.**

a. Distribute the "Useful Equations and Conversion Tables" and "Piloting Laboratory Exercises" Handouts.

b. Describe briefly the following Chart Plotting Tools to be used in the laboratory session.

1. Parallel Rulers
2. Course Plotters
3. Course Protractors
4. Drafting Triangles
5. Dividers
6, Drafting Compass
7. Pencils and Erasers

c. Discuss briefly the dimensions of piloting for the following parameters.

1. Direction (True, Magnetic, Compass in degrees and common decimal fractions)
2. Distance (Statute and Nautical Miles)
3. 24 Hour Clock
4. Time Zones

5. Speed (Miles per Hour)
6. Position (Relative, Geographic)
7. Depths and Heights (Depths in Feet, Fathoms; Heights in Feet, Meters)

**Classroom Laboratory Session (2 Hours)**

1. **Position Determination.**
   a. Define the terms used plotting a position.
      1. Line of Position (LOP)
      2. Bearing
      3. Relative Bearing
      4. Range (As a LOP)
      5. Fix
      6. Running Fix (Rfix)
      7. Estimated Position

   b. Describe the effect of using one, two, three LOPs in determining a fix.
      1. Value of a single Line of Position
      2. Using two Lines of Position
      3. More than two Lines of Position
      4. Labeling the Fix

2. **Piloting Fundamentals Exercises.**
   a. Have the crew (3 to 6 members) do Exercises 1 through 13 using the Useful Equations and Conversion Tables Handout as an aid.

   b. Provide support to the crew while they are working the exercises, as required.

   c. After completion of the exercises, review the exercises and provide the correct answer, as required.

   d. Answer any questions on the Piloting Fundamentals Exercises prior to proceeding to the Visual Piloting Exercises.

3. **Dead Reckoning.**
   a. Discuss briefly the three principles of Dead Reckoning (DR).
      1, A DR track is always started from a known position
      2. Only true courses steered are used for a DR track
      3. Only the speed through the water is used for determining distance traveled and the DR position along the track

   b. Discuss Plotting Standards and Standard Labeling.
      1. The label for any line is placed along the line
      2. The label for any point should not be along any line
      3. The direction label is placed above the track line
         (The letter C, 3-digit direction, the letter M (magnetic) or C (compass)

4. Speed label along the track line is placed below the track line
5. A fix is shown as a dot with circle around it with the exact time
6. A calculated DR position is shown as a dot with a half circle along the track line

c. Explain and discuss the D, T and S Formula and calculations.

d. Explain the Alternative Method 60D T and S Formula

4. **Visual Piloting Exercises.**

a. Have the crew (3 to 6 members) do Exercises 1 through 4 using the Useful Equations and Conversion Tables Handout as an aid.

b. Provide support to the crew while they are working the exercises, as required

c. After completion of the exercises, review the exercises and provide the correct answer, as required.

d. Have the crew do Exercise 4, then review the exercise and provide the answers

e. Have the crew do Exercise 5, then review the exercise and provide the answer

f. Have the crew do Exercise 6, then review the exercise and provide the answer

g. Have the crew do Exercise 7, then review the exercise and provide the answer

h. Answer any questions on the Visual Piloting Exercises

**Visual Piloting Laboratory Preparation**

*Note: In preparing the Universal Plotting Sheets, the geographic coordinates are arbitrarily scaled to enable the plotting of points; they do not represent any actual geographic locations.*

1. Exercise 1.
Prepare a Universal Plotting Sheet # 1 in the following manner;
Label the mid-latitude 33 degrees North and the central-meridian 79 degrees West.
Plot the following points:
Light A: Lat. 33 degrees 17 minutes North, Lon. 78 degrees 53 minutes West
Light B: Lat. 33 degrees 11 minutes North, Lon. 79 degrees 14 minutes West
Light C: Lat. 33 degrees 02 minutes North, Lon. 78 degrees 56 minutes West
Tower T: Lat. 32 degrees 55 minutes North, Lon. 79 degrees 20 minutes West

2. Exercises 4.
Prepare a Universal Plotting Sheet # 3 in the following manner;
Label the mid-latitude 18 degrees South, and the central meridian 122 degrees West.
Plot the following points:
Light G: Lat. 18 degrees 57.0 minutes South, Lon. 122 degrees 20.0 minutes West
Tower H: Lat. 17 degrees 39.0 minutes South, Lon. 121 degrees 44.0 minutes West

3. Exercise 5.
Prepare a Universal Plotting Sheet # 4 in the following manner;
Label the mid-latitude 18 degrees South, and the central-meridian 122 degrees East
Plot the following points:
Light J: Lat. 17 degrees 46.0 minutes South, Lon. 11 degrees 00.0 minutes East

4. Exercise 6.
Prepare a Universal Plotting Sheet # 5 in the following manner;
Label the mid-latitude 41 degrees North, and the central meridian 55 degrees West
Plot the following points:
Light K: Lat. 41 degrees, 02.0 minutes North, Lon. 55 degrees 25.0 minutes West
Light L: Lat. 40 degrees 55.0 minutes North, Lon. 54 degrees, 52.0 minutes West

5. Exercise 7.
Prepare a Universal Plotting Sheet # 6 in the following manner;
Label the mid-latitude 35 degrees North and the central-meridian 19 degrees East
Plot the following points:
Light M: Lat. 34 degrees 35.0 minutes North, Lon. 19 degrees 40.0 minutes East
Light N: Lat. 35 degrees 20.0 minutes North, Lon. 20 degrees 10.0 minutes East

**Answers – Piloting Fundamentals**

1 (a) 32.0 statute miles; (b) 12.6 nautical miles
2 (a) 39 feet; (b) 22 fathoms
3 (a) 0356; (b) 1414; (c) 1234; (d) 0018
4 (a) 14 degrees 12 minutes; (b) 35 degrees 36 minutes
5 (a) 42 degrees 44 minutes; (b) 37 degrees 52 minutes;(c) 2564 minutes; (d) 2272 minutes
6 (a) 247 degrees; (b) 000 or 360 degrees; (c) 033 degrees; (d) 165 degrees
7 - 2 degrees West
8 - 227 degrees Compass Course
9 - TVMDC CE Table

| T | V | M | D | C | CE |
|---|---|---|---|---|---|
| 114 | 6W | 120 | 3W | 123 | 9W |
| 040 | 7W | 047 | 2E | 045 | 5W |
| 225 | 6E | 219 | 3E | 216 | 9E |
| 303 | 2W | 305 | 2E | 303 | 0 |
| 002 | 4E | 358 | 6W | 004 | 2W |
| 278 | 5E | 273 | 5E | 268 | 10E |
| 234 | 3W | 237 | 10E | 227 | 7E |

10. (a) True; (b) True; (c) False; (d) False; (e) True; (f) True; (g) False
11 - 86 yards
12 (a) 9.4 miles; (b) 36.9 miles
13 (a) 7.7 knots; (b) 10.5 knots

**Answers – Visual Piloting**

*Note: Individual solutions of problems involving plotting may have a difference of a few tenths of a minute of latitude and/or longitude: such variances from the stated answers are acceptable.*

1 (a) 1610 DR: Lat. 33 degrees 12.0 minutes North; Lon. 78 degrees 41.3 minutes West
1 (b) 1610 Fix: Lat. 33 degrees 14.4 minutes North; Lon. 78 degrees 44.3 minutes West
1 (c) 1123 Fix: Lat. 32 degrees 47.5 minutes North; Lon. 78 degrees 58.9 minutes West
1 (d) 1228 Fix: Lat. 33 degrees 02.8 minutes North; Lon. 78 degrees 52.1 minutes West
2 (a) 144 degrees; (b) 292 degrees; (c) 039 degrees
3 (a) 067 degrees; (b) 216 degrees; (c) 026 degrees
4 (a) 1120 RFix: Lat. 17 degrees 47.8 minutes South; Lon. 121 degrees 42.8 minutes West
4 (b) 1620 RFix: Lat. 17 degrees 46.2 minutes South; Lon. 121 degrees 42.8 minutes West
5 - 1130 RFix: Lat. 17 degrees 52.6 minutes South; Lon. 11 degrees 18.0 minutes East
6 - 1745 RFix: Lat. 41 degrees 00.8 minutes North; Lon. 54 degrees 42.9 minutes West
7 (a) 1542 DR: Lat. 35 degrees 11.2 minutes North; Lon. 20 degrees 15.3 minutes East
7 (b) 1542 RFix: Lat. 35 degrees 09.3 minutes North; Lon. 20 degrees 10.0 minutes East

# PILOTING PUBLICATIONS HANDOUT

**NATIONAL OCEAN SERVICE (NOS)**
National Oceanic and Atmospheric Administration (NOAA)
NOS is responsible for preparing charts and documents relating to United States waters.

For information about NOS charts, publications and activities:

NOAA, National Ocean Service
Attn: Information Products and Services Section, N/OES334
1305 East-West Highway
Silver Spring, Maryland 20910-3233
301.713.2815
Fax: 301.713.4500

For nautical charts and publication purchases:

Distribution Branch (N/ACC 3)
National Ocean Service
Riverdale, Maryland 20737-1199
301.436.8301 or 800.638.8972; Fax 301.436.6829

*Nautical Chart Catalogs* (List of charts of U.S. waters)
1. Atlantic and Gulf Coasts
2. Pacific Coast, Hawaii, Guam, and Samoan Islands
3. Alaska and Aleutian Islands
4. Great Lakes and Adjacent Waterways

*United States Coast Pilots*

| ATLANTIC COAST | PACIFIC COAST |
|---|---|
| 1. Eastport to Cape Cod | 7. California, Oregon, Washington, and Hawaii |
| 2. Cape Cod to Sandy Hook | 8. Alaska, Dixon Entrance to Cape Spenser |
| 3. Sandy Hook to Cape Henry | 9. Alaska, Cape Spenser to Beaufort Sea |
| 4. Cape Henry to Key West | |
| 5. Gulf of Mexico, Puerto Rico, Virgin Islands | |
| GREAT LAKES | |
| 6. The lakes and Their Connecting Waterways | |

*Tide Tables*
1. Europe and West Coast of Africa (including Mediterranean Sea)
2. East Coast of North and South America (including Greenland)
3. West Cost of North and South America (including Hawaii)
4. Central and western Pacific Ocean and Indian Ocean

*Current Tables,*
*Tidal Current Charts,*
*Tidal Current Diagrams*
*Chart No. 1, Nautical Chart Symbols, Abbreviations, and Terms*

**U.S. COAST GUARD**

*Navigation Rules, International-Inland* (COMDTINST. M16672.2A)
*Light Lists*

I. Atlantic Coast from St. Croix River, Maine to Ocean City Inlet, Maryland
II. Atlantic Coast from Ocean City Inlet, Maryland to Little River Inlet, South Carolina
III. Atlantic Coast from Little River Inlet, South Carolina to Econfina River, Florida and the Greater Antilles
IV. Gulf of Mexico, from Econfina River, Florida to Rio Grande, Texas
V. Mississippi River Systems
VI. Pacific Coast and Pacific Islands
VII. Great Lakes

*Notice to Mariners*

*Weekly Notices to Mariners* (Free)
Director
Defense Mapping Agency
Combat Support Center, Code IMA
Washington, D.C. 20315-0010

*Local Notice to Mariners* (Free)

FIRST COAST GUARD DISTRICT
Commander, U.S. Coast Guard
First Coast Guard District
408 Atlantic Avenue
Boston, Massachusetts 02110
617.223.8480

ELEVENTH COAST GUARD DISTRICT
Commander, U.S. Coast Guard
Eleventh Coast Guard District
Coast Guard Island
Alameda, California 94501
510.437.3324/5

FIFTH COAST GUARD DISTRICT
Commander, U.S. Coast Guard
Fifth Coast Guard District
431 Crawford Street
Portsmouth, Virginia 23704
757.398.6287

THIRTEENTH COAST GUARD DISTRICT
Commander, U.S. Coast Guard
Thirteenth Coast Guard District
915 2nd Avenue
Seattle, Washington 98174
206.220.7237

SEVENTH COAST GUARD DISTRICT
Commander, U.S. Coast Guard
Seventh Coast Guard District
Brickell Plaza Federal Building
909 S. E. First Avenue
Miami, Florida 33131-3050
305.415.6670

FOURTEENTH COAST GUARD DISTRICT
Commander, U.S. Coast Guard
Fourteenth Coast Guard District
300 Ala Moana Boulevard
Honolulu, Hawaii 96850
808.541.2121

EIGHTH COAST GUARD DISTRICT
Commander, U.S. Coast Guard
Eighth Coast Guard District
501 Magazine Street
New Orleans, Louisiana 70130
504.589.6298

SEVENTEENTH COAST GUARD DISTRICT
Commander, U.S. Coast Guard
Seventeenth Coast Guard District
P.O. Box 25517
Juneau, Alaska 99802
907.463.2065

NINTH COAST GUARD DISTRICT
Commander, U.S. Coast Guard
Ninth Coast Guard District
1240 E. 9th Street
Cleveland, Ohio 44199
216.902.6001

**DEFENSE MAPPING AGENCY**
**HYDROGRAPHIC/TOPOGRAPHIC CENTER (DMAHTC)**
This center is responsible for providing navigation publications for foreign waters

*Charts*
*Sailing Directions* (similar to NOS *Coast Pilots*)
*Radio Navigation Aids* (Publication 117)
*List of Lights* (Publications 110 to 116)
*Pilot Charts*
*Handbook of Magnetic Compass Adjustment* (Publication 226)

**U.S. NAVAL OBSERVATORY**
Primarily of interest to celestial navigators

*Air Almanac*, HO 249
*The American Nautical Almanac*
*Astronomical Almanac*
*Almanac for Computers*

**U.S. ARMY CORPS OF ENGINEERS**

The U.S. Army Corps of Engineers is responsible for charts on the inland rivers as follows:

*Lower Mississippi and Tributaries, and below the Ohio River.*

U.S. Army Corps of Engineers
P.O. Box 60
Vicksburg, Mississippi 39180
601.634.5000

*Middle and Upper Mississippi and Illinois Waterway to Lake Michigan*

U.S. Army Corps of Engineers, North Central Division
111 North Canal Street. Room 1216
Chicago, Illinois 60606-7205
312.353.6317

Missouri River and Tributaries

U.S. Army Corps of Engineers, Missouri River Division
12565 West Center Road
Omaha, Nebraska 68144-3869
402.697.2550

*Ohio River and Tributaries; Pittsburgh Pennsylvania to the Mississippi River and Tennessee and Cumberland Rivers*

U.S. Army Corps of Engineers
550 Main Street
P.O. Box 1159
Cincinnati, Ohio 45201
513.684.3002

*Black Warrior, Alabama, Tombigmee, Apalachicola, Chattahoochee, Flint, and Pearl Rivers, the Gulf Intracoastal Waterway from New Orleans to St. Marks, Florida.*

U.S. Army Corps of Engineers
P.O. Box 2288
Mobile, Alabama 36628
205.690.2511

*McClellan-Kerr Arkansas River system*

U.S. Army Corps of Engineers
P.O. Box 867
Little Rock, Arkansas 72203-0867
501.324.5551

U.S. Army Corps of Engineers
1645 S. 101st East Avenue
Tulsa, Oklahoma 74128-4629
918.669.7366

**NATIONAL WEATHER SERVICE**
National Oceanic and Atmospheric Administration (NOAA)

*Marine Weather Services Charts*

**Superintendent of Documents**
**U.S. Government Printing Office**
**Washington DC 20402**

Provides publications such as:
U.S. Coast Guard Light List
Navigation Rules International – Inland (COMDTINST. M16672.2A)
Marine Weather Services Charts
The American Nautical Almanac

**TENNESSEE VALLEY AUTHORITY**
Produces charts for its reservoirs, and the Tennessee River and its tributaries.

Tennessee Valley Authority
Maps and Engineering Section
416 Union Avenue
Knoxville, Tennessee 37902-2111
616.632.2921

Tennessee Valley Authority Map Store
1101 Market Street
Chattanooga, Tennessee 37402-2801
423.751.6277
Fax: 423.751.6740

**CANADIAN CHARTS**

*East Coast and Great Lakes*

Canadian Hydrographic Service
615 Booth Street
Ottawa, Ontario K1A OE6
613.9955.4520

*Pacific Coast and Western Arctic*

Canadian Hydrographic Service
P.O. Box 6600
Sydney, British Columbia V8L 4BZ
604.656.8358

*Tide and Current Tables*

Chart Distribution Office
Canadian Hydrographic Service
Department of Fisheries and Oceans
P.O. Box 8080
1675 Russell Road
Ottawa, Ontario K1G 3H6
613.998.4931
Fax: 613.998.1212

*Notice to Mariners*

Marine Navigation Services Director
Canadian Coast Guard
Department of Fisheries and Oceans
Ottawa, Ontario K1A 0N7
613.990.3016
Fax: 613.991.4982

*General Charts and Maps*

Energy Mines and Resources
Canada Map Office
580 Booth Street
Ottawa, Ontario K1A 0E4
613.952.7000

**Private Publishers**
Reproduce nautical charts, many in chart kit form.

# USEFUL EQUATIONS AND CONVERSION TABLES HANDOUT

### Distance – Speed – Time (Equations)

D = S x T, S = D / T, T = D / S

Where D is distance in nautical miles (statute miles)
S is speed in knots (miles per hour)
T is time in hours and decimal fractions

### Distance – Speed – Time (Alternative Method Equations)

60 x D = S x T', S = (60 x D) / T', T' = (60 x D) / S

Where T' is time in minutes and decimal fractions

### Rules for Applying Compass Deviation & Variation

*Definitions*
True heading differs from Magnetic heading by Variation
Magnetic heading differs from Compass heading by Deviation
Compass heading differs from True heading by Compass Error
Compass Error is the algebraic sum of Variation and Deviation

| True Heading | Variation | Magnetic Heading | Deviation | Compass Heading | Compass Error |
|---|---|---|---|---|---|
| T _____ | V _____ | M _____ | D _____ | C _____ | CE _____ |

*Uncorrectiing* (True Heading to Compass Heading) →
ADD Westerly Variations & Deviations
SUBTRACT Easterly Variations & Deviations

Correcting (Compass Heading to True Heading) ←
ADD Easterly Variations & Deviations
SUBTRACT Westerly Variations & Deviations

By placing the given information in the corresponding blanks, the unknown values can easily be computed following the rule of form.

### True – Relative Bearings

True Bearing = Relative Bearing + True Heading
Relative Bearing = True Bearing – True Heading

## UNIT CONVERSION

- nautical miles x 1.15 = statute miles
- statute miles x .87 = nautical miles
- nautical miles x 1,882 = meters
- meters x .00054 = nautical miles
- nautical miles x 2,026 = yards
- yards x .00049 = nautical miles
- statute miles x 1,609 = meters
- meters x .00062 = statute miles
- statute miles x 1,760 = yards
- yards x .00057 = statute miles
- meters x 1.094 = yards
- fathoms x 6 = feet
- feet x .16667 = fathoms
- fathoms x 1.828 = meters
- meters x .5468 = fathoms

## Rule of Thumb

Roughly 7 nautical miles equals 8 statute miles, so you can covert nautical to statue by multiplying nautical miles by 8 and dividing the product by 7. To reverse the conversion: statute miles times 7, then divide the product by 8. A nautical mile has about 2000 yards which is close enough for quick calculations.

# PILOTING LABORATORY EXERCISES HANDOUT

## PILOTING FUNDAMENTALS

1 (a) Convert 27.8 nautical miles to statute miles _____

(b) Convert 14.5 statue miles to nautical miles _____

2 (a) Convert 6.5 fathoms to feet _____

(b) Convert 132 feet to fathoms _____

3. State the following times in the 24-hour clock system:

(a) 3:56 a.m. _____ (b) 2:14 p.m. _____

(c) 12:34 p.m _____ (d) 12:18 a.m. _____

4. What is the difference in latitude between (Answer in degrees and minutes):

(a) 46 deg. 19 min. North and 32 deg. 7 min. North _____

(b) 20 deg. 19 min. North and 15 deg. 17 min South _____

5. What is the difference in longitude between (Answer in degrees and minutes):

(a) 146 deg. 18 min. East and 103 deg. 34 min. East _____

(b) 152 deg. 27 min. West and 169 deg. 41 min. East _____

(Answer in total minutes)

(c) 146 deg. 18 min. East and 103 deg. 34 min. East _____

(d) 152 deg. 27 min. West and 169 deg. 41 min. East _____

6. State the reciprocal of:

(a) 067 degrees _____ (b) 180 degrees _____

(c) 213 degrees _____ (d) 345 degrees _____

7. The true heading is 010 degrees, but the magnetic heading from the compass rose in the chart reads 012 degrees. What is the variation? _____

8. The desired magnetic heading for your boat is 225 degrees; the deviation table shows 2 degrees West deviation for this heading.

What compass course should be steered. _____

9. Fill in the blanks in the table below:

| T | V | M | D | C | CE |
|---|---|---|---|---|---|
| 114 | 6W | _____ | 3W | _____ | _____ |
| _____ | 7W | _____ | 2E | 045 | _____ |
| _____ | 6E | 219 | 3E | _____ | _____ |
| 303 | _____ | 305 | _____ | 303 | _____ |
| 002 | 4E | _____ | 6W | _____ | _____ |
| _____ | _____ | _____ | 5E | 268 | 10E |
| 234 | 3W | _____ | _____ | _____ | 7E |

10. With respect to various chart projections, state whether the following statements are true or false.

(a) On a Mercator chart rhumb lines are straight. _____

(b) On an oblique gnomonic chart great circles are straight lines. _____

(c) On a Mercator chart the scale is the same at all latitudes. _____

(d) On a Mercator chart a great circle is a straight line. _____

(e) On a Lambert conformal chart meridians are straight lines. _____

(f) On a Mercator chart parallels of latitude are parallel straight lines. _____

(g) On a Mercator chart meridians are straight lines the converge in the direction of the nearest pole. _____

11. Using the relationship of 2,000 yards to one nautical mile, what error is introduced for a distance of 3.4 miles? _____

12 (a) How far will your boat, moving at 16.5 knots travel in 34 minutes? _____

(b) in 2 hours 14 minutes? _____

13 (a) What speed is a boat making that covers 1 mile in 7.8 minutes? _____

(b) in 2 hours 14 minutes? _____

## VISUAL PILOTING

1. Using Universal Plotting Sheet # 1:
(a) The DR position of your boat at 1500 is [Lat. 33 degrees 30 minutes North, Lon. 78 degrees 35 minutes West]; the course is 196 degrees, speed 16 knots.
What is the 1610 DR position? _____

(b) At 1610 the bearing of Light A is 289 degrees; the bearing of Light C is 218 degrees. Based on these two bearings,
What is the 1610 fix? _____

(c) At 1123, another boat observes Lights A and C in line, with Tower T bearing 292 degrees.
What is this boat's 1123 fix? _____

(d) At 1228 the operator of this vessel observes Light C to bear 259 degrees and concurrently measure distance by a range finder as 3.5 miles.
What is the 1228 fix? _____

2. A boat is on a heading of 114 degrees. A series of relative bearing are taken as follows: (a) 030 degrees, (b) 178 degrees, (c) 285 degrees. What are the true bearings? (a) _____ (b) _____ (c) _____

3. Convert the following true bearings to relative bearing for a boat heading of 302 degrees. (a) 009 degrees, (b) 158 degrees, (c) 328 degrees
(a) _____ (b) _____ (c) _____

4. Using Universal Plotting Sheet # 3:
(a) Your boat is on course 062 degrees, speed 15 knots: its 0900 DR position is [Lat. 18 degrees 08.0 minutes South, Lon. 122 degrees 16.0 minutes West].At 0920 a bearing of 300 degrees is taken on Light G; no other landmark is available at this time. At 1120 a bearing of 351 degrees is taken on Tower H. Advance the 0920 LOP and determine the 1120 running fix.
The fix is _____

(b) Your boat is on course 062 degrees, speed 15 knots: its 1400 DR position is [Lat. 18 degrees 08 minutes South, Lon. 122 degrees 16 minutes West]. At 1420 the distance to Light G is 9.5 miles: no accurate bearing can be taken. At 1620 the bearing of Tower H is 351 degrees. Advance the 1420 circle of position and determine the 1620 running fix.
The fix is _____

5. Using Universal Plotting Sheet # 4:
Your boat is on course 062 degrees, speed 16 knots; its 0900 DR position is [Lat. 18 degrees 08.0 minutes, Lon. 10 degrees 44.0 minutes East]. At 0915 a bearing of 032 degrees is taken on Light J. At 1130 another bearing is taken on Light J of 291 degrees.
What is the running fix? _____

6. Using Universal Plotting Sheet # 5:
Your boat is on course 062 degrees, speed 18 knots; the 1600 DR position is [Lat. 40 degrees 52 .0 minutes North, Lon. 55 degrees 20.0 minutes West]. At 1610, Light K bears 333 degrees. At 1700, the course is changed to 084 degrees, speed remains at 18 knots. At 1745, Light L bears 230 degrees.
What is the 1745 running fix? _____

7. Using Universal Plotting Sheet # 6:
Your boat is on course 040 degrees, speed 20 knots: its 1300 DR position is [Lat. 34 degrees 40.0 minutes North, Lon. 19 degrees 30.0 minutes East]. At that time a bearing of 105 degrees was taken on Light M. At 1415 the course was changed to 080. At 1454 a course of 040 war resumed, but the speed was reduced to 16 knots. At 1542, Light N bears 000 degrees.
(a) What is the 1542 DR position? _____

(b) What is the 1542 running fix? _____

Resource: Dutton's Problems and Answers in Navigation and Plotting, 2nd Edition, Elbert S. Maloney, Naval Institute Press