NONRESIDENT
TRAINING
COURSE

TIME CONVERSION

NAVEDTRA 14252

PREFACE

About this course:

This is a self-study course. By studying this course, you can improve your professional/military knowledge, as well as prepare for the Navywide advancement-in-rate examination. It contains subject matter about day-to-day occupational knowledge and skill requirements and includes text, tables, and illustrations to help you understand the information. An additional important feature of this course is its reference to useful information in other publications. The well-prepared Sailor will take the time to look up the additional information.

Any errata for this course can be found at https://www.advancement.cnet.navy.mil under Products.

History of the course:

- *Oct 1992: Original edition released.*
- *May 2003: Administrative update released. Technical content was not reviewed or revised.*

Published by
NAVAL EDUCATION AND TRAINING
PROFESSIONAL DEVELOPMENT
AND TECHNOLOGY CENTER
https://www.cnet.navy.mil/netpdtc

POINTS OF CONTACT	ADDRESS
• E-mail: fleetservices@cnet.navy.mil • Phone: Toll free: (877) 264-8583 Comm: (850) 452-1511/1181/1859 DSN: 922-1511/1181/1859 FAX: (850) 452-1370	COMMANDING OFFICER NETPDTC N331 6490 SAUFLEY FIELD ROAD PENSACOLA FL 32559-5000

TABLE OF CONTENTS

ASSIGNMENT QUESTIONS follow Index.

TOPIC 1

TIME THEORY

The development of high-speed transportation and communications has reduced the relative size of the earth to the extent that people can now travel from North America to Europe in less than 3 hours; a message can be sent from any place on the earth and arrive at any other place in seconds; and weapons of every description can be deployed from subsurface, surface, air, and space platforms. As this technology was emerging, it became apparent that nations could no longer think in terms of local times and conditions. A standard time reference covering the entire world was needed. Without a standard time system, a routine airline flight plan for a Paris-to-San Francisco flight might read like this:

Depart Paris—1200 Local Time
Arrive London—1130 Greenwich Mean Time
Depart London—1200 Greenwich Mean Time
Arrive New York—0950 Eastern Standard Time
Depart New York—1050 Eastern Standard Time
Arrive Denver—0930 Mountain Standard Time
Depart Denver—1000 Mountain Standard Time
Arrive San Francisco—0930 Pacific Standard Time

In computing the elapsed time for the flight, or for any part of it, individual calculations are necessary to adjust for time zone changes. There also might be changes for daylight saving time (DST) or other local differences. Time computations are easier if all times are computed on a common worldwide basis. Then, our flight plan is simplified, looking like this:

Depart Paris—1100 Greenwich Mean Time
Arrive London—1130 Greenwich Mean Time
Depart London—1200 Greenwich Mean Time
Arrive New York—1450 Greenwich Mean Time
Depart New York—l550 Greenwich Mean Time
Arrive Denver—1630 Greenwich Mean Time
Depart Denver—1700 Greenwich Mean Time
Arrive San Francisco—1730 Greenwich Mean Time

GREENWICH MEAN TIME (GMT)

To meet the need for standardization, the international GMT system was developed. All countries of the world adopted its use.

GLOBAL DIVISION AND DESIGNATORS

To compute time differences, you need to understand the international GMT system. In this system, the surface of the earth is divided into 24 zones, each extending through 15° of longitude, with the initial zone lying between longitudes 7½° east and 7½° west of the prime meridian. (*Longitude* is the name given to the imaginary lines that run lengthwise, north and south, between the North and South Poles. They have east and west designators.) The time system is named after Greenwich, England, because the zero meridian passes directly through that town. Each zone represents a different time in the 24-hour-day cycle, with a 1-hour variation between each time zone. To further aid in zone referencing, each time zone has a numerical, a literal (letter) and, to aid in the mathematical computation, a "+" or a "-" designator.

Numerical Designators

The zero meridian *(prime meridian)* is the imaginary line running down the center of the initial time zone; thus, this time zone is designated "0" (zero) in the numbering system. The remaining zones are numbered consecutively, 1 through 12, both east and west of 7½° longitude, through 180° longitude. The longitudes of 180° east and 180° west are the same imaginary line. This meridian is the *International Date Line.*

Let's pause to consider what appears to be a contradiction. We stated that the earth is divided into 24 time zones; however, we have accounted for 25 zones (12 east of zone 0, 12 west of zone 0, and zone 0 itself, a total of 25 zones). This contradiction will be resolved later in the discussion of the International Date Line and the requirement to have a point at which we shift from one day to another. For now, let's agree there are only 24 time zones.

Literal (Letter) Designators

In addition to all zones having an assigned number, each zone also has a letter designator. The initial time zone, again because of its division by the zero meridian, is designated zone "Z" or ZULU. (Use the phonetic alphabet to pronounce the letters of the time zones.)

With 25 designators, we use every letter of the English alphabet except "J." See figure 1-1. Like the numbering system, the letters begin with the ZULU (0) time zone and progress to the east and west, consecutively. The zones to the east of ZULU are lettered "A" through "M" (ALFA through MIKE) and the zones to the west of ZULU are lettered "N" through "Y" (NOVEMBER through YANKEE). Remember, beginning at ZULU and reading from left to right, we have zones ALFA through MIKE (eastern hemisphere). Returning to ZULU and reading from right to left, we find zones NOVEMBER through YANKEE (westem hemisphere). Don't forget to omit "J" in the eastern hemisphere.

Designators "+" and "-"

Each zone has a designation of either "+" or "-" in addition to the numerical and literal designators. In time-conversion computations, you will see the reason for these designators.

Learning the "+" and "-" designation system is easy. All zones of the western hemisphere have the designation "+." All zones of the eastern hemisphere have the designation "-". see figure 1-1.

PHYSICAL CHARACTERISTICS OF TIME ZONES

With the exceptions of zones MIKE and YANKEE, which we will discuss later, each time zone spans 15° of longitude, with the 24 principal meridians bisecting (dividing in half) each zone. At the equator, each degree of longitude spans 60 nautical miles (NMs). Thus, a time zone spans 900 NMs (15 × 60 = 900).

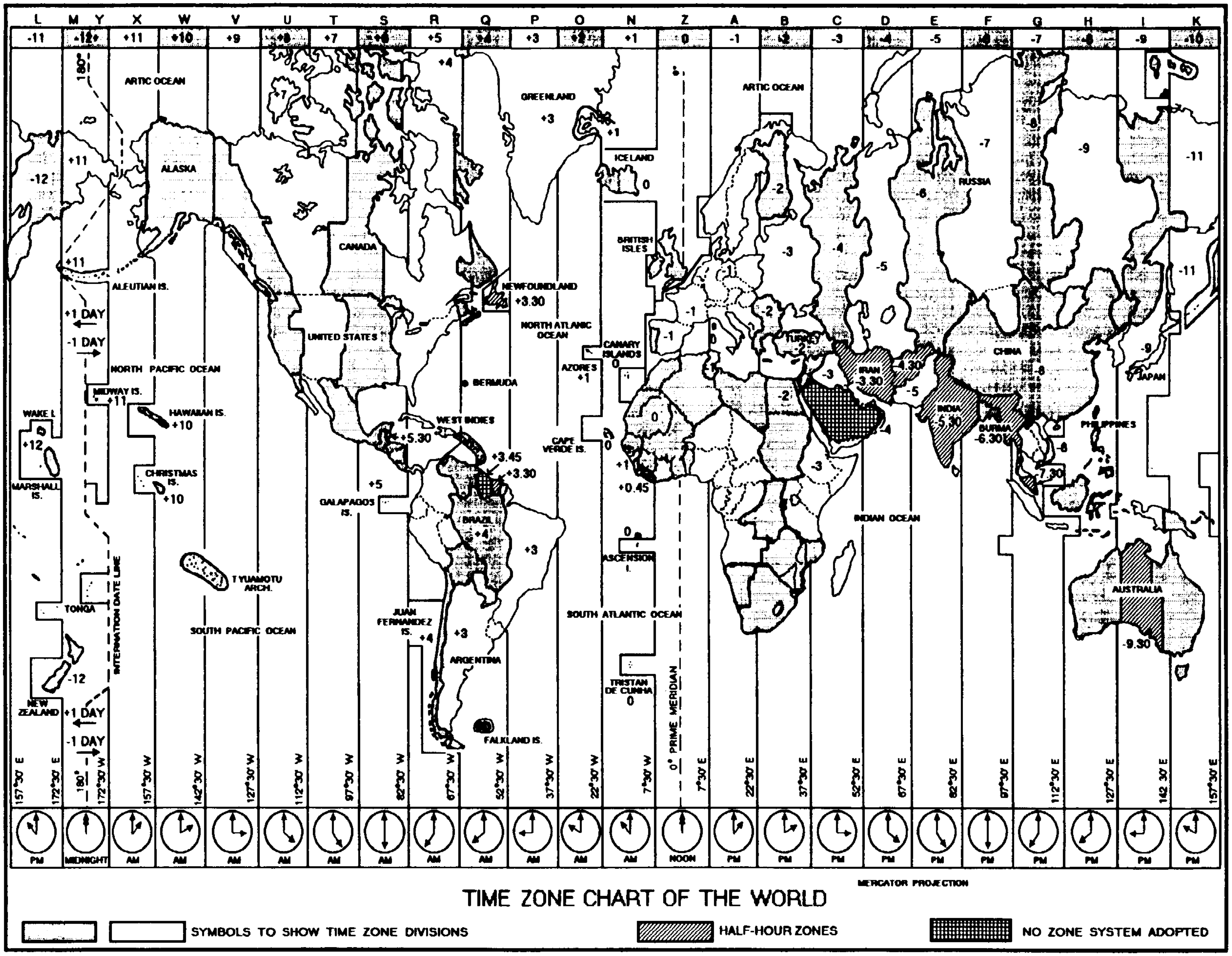

Figure 1-1.—Time zone chart of the world.

NOTE: Remember, only at the equator is each degree of longitude equal to 60 NMs. The natural curvature of the earth causes a narrowing of the zones as the north or south latitude increases. The length of a degree of longitude gets progressively smaller the farther it is from the equator.

Time zones generally correspond with the principal meridians; however, sometimes they deviate from their geographical meridians, especially on land areas. This is common along coastlines, in mountain ranges, and along country borders. These deviations keep time constant wherever possible throughout countries, states, cities, and island chains. See figure 1-1.

EXPRESSION OF TIME

The U.S. military services, as well as most foreign countries, use the international 24-hour system for expressing time. This method uses a four-digit group, with the first two digits denoting the hour, and the second two digits indicating the minutes. Thus, 6:30 A.M. becomes 0630; noon becomes 1200; 6:30 P.M. becomes 1830. Midnight is expressed as 0000, never as 2400. One (1) minute past midnight is 0001. The time designation 1327Z shows that it is 27 minutes past 1:00 P.M., GMT.

To express the day of the month along with the time, we use a six-digit group. These six digits are nothing more than a four-digit time, preceded by two digits indicating the date. This six-digit group is a *date-time group* (DTG). The DTG 171327Z indicates the 17th day of the month at 1327Z.

The date element of the DTG always has two digits. This means the dates from the 1st through the 9th of the month must be preceded by a zero (0) to meet this requirement (for example, 011327Z, 021327Z, or 031327Z). Should a month other than the current one be intended, the standard abbreviation for the month desired follows the DTG (for example, 011327Z JAN, 121327Z FEB, or 211327Z MAR).

In each of the above examples, the times were expressed in ZULU time. This is to make you think in terms of ZULU, since ZULU zone time is the standard time for military communications . All messages, reports, and letters containing times, use ZULU time. This enables all mobile platforms and shore stations to know at what time the subject of the correspondence occurred. It becomes simply a matter of converting the ZULU time of the occurrence to the local time.

Obviously, there are occasions when time must be expressed as local. In these instances, the literal designator for the local zone is used in exactly the same manner as the ZULU designator was used. For example, in the UNIFORM time zone, 171327U would indicate the 17th day of the current month, 27 minutes past 1300 local time.

INTERNATIONAL DATE LINE

The International Date Line divides the eastern and western hemispheres. It is an imaginary line located exactly 180° east longitude and 180° west longitude of the prime meridian. At this point, we must understand the special circumstances surrounding zones MIKE and YANKEE.

Each time zone has a numerical, a literal, and a "+" or a "-" designator, and zones MIKE and YANKEE are not exceptions. There is, however, a very important difference between zones MIKE and YANKEE and all other time zones. To understand this difference, look at zones MIKE and YANKEE as a *single* time zone of 15° of longitude, half (7½°) in the eastern hemisphere, and half in the western hemisphere. Although the two halves of this zone share a common number (12) each half has its own literal and "+" or "-" designator. The eastern hemisphere’s half is designated MIKE -12; the western hemisphere’s half is YANKEE + 12.

Now we come to a very important point in our discussion. Since we are considering the MIKE and YANKEE zones to be a single zone, it follows that the time in MIKE is *always* the same as that in YANKEE. This is where the International Date Line comes into play, for whenever this line is crossed, whether from east to west or from west to east, the *day must change.* Since we have already established that there is a 1-hour difference between each of the 24 time zones, it is clear that there is always a situation where it is a day earlier or later in one part of the world than it is in another.

> RULE: IT IS ALWAYS THE SAME TIME IN ZONE MIKE AS IT IS IN ZONE YANKEE, BUT IT IS *NEVER* THE SAME DAY.

A final point of discussion involving the International Date Line and zones MIKE and YANKEE is the "gaining" or "losing" of a day as the line is crossed. This is not a problem. "Gaining" or "losing" is nothing more than a question of semantics and should not be used in time conversion conversation.

The formula for determining whether to add or subtract one day from the current day at the time of departing one hemisphere for another is:

> When you cross the International Date Line, apply the sign of the departed hemisphere. For example, to go from the MIKE zone into the YANKEE zone, subtract one day. MIKE is in the eastern (or the "-") hemisphere. To go from the YANKEE zone into the MIKE zone, add one day. YANKEE is in the western (or the "+") hemisphere. From "-" to "+," subtract; from "+" to "-," add. Another method is simply to remember to add a day when crossing the line westbound and subtract a day when crossing eastbound.

ZONE-TO-ZONE PROGRESSION

At this point, we will discuss one more area needed for time calculation. It is directional flow and the addition or subtraction of an hour when progressing from one time zone into another. Probably the best way to remember whether to add or to subtract the hour is to take the case of the four time zones spanned by the United States (ROMEO through UNIFORM).

Most of us have, at some time or other, watched a sporting event being played on the West Coast while we were physically located on the East Coast. In cases where the contest was held in the late afternoon or early evening in California, it was frequently dark in New York. Obviously, it was earlier in the day in California than it was in New York. Therefore, we can say with confidence that whenever traveling from a westerly direction toward a point eastward, we must add an hour each time we pass from one time zone into another. The opposite is also certainly true. When traveling from an easterly direction toward a point westward, we must subtract an hour for each new zone entered. This rule will hold true regardless of your location in the world: west to east—add, east to west—subtract. Additionally, when the 0000 hour is reached, the day changes accordingly.

TOPIC SUMMARY

It is *absolutely essential* that you understand each of the points covered thus far in this manual before attempting to convert time. The following is a short review of these principles. Test yourself. If you do not fully understand any of them, go back and reread the related section.

1. The international Greenwich mean time (GMT) system was named for the town of Greenwich, England, as the town is located directly on the prime meridian, the point of reference for the entire system.

2. The surface of the earth is divided into 24 time zones, each spanning 15° of longitude.

3. The initial zone is zone 0 (ZULU) and spans the area 7½° longitude east and 7½° longitude west of the prime meridian (a total of 15°).

4. Each zone differs in time by 1 hour.

5. Each zone has a numerical, a literal, and a "+" or a "-" designator (exception: ZULU zone (0) does not have a "+" or "-" designator).

6. The zones are numbered 1 through 12, outwardly from zone 0, throughout both the eastern and western hemispheres.

7. The zones east of ZULU are lettered ALFA through MIKE, omitting JULIETT, and each has a "-" designator.

8. The zones west of ZULU are lettered NOVEMBER through YANKEE, and each has a "+" designator.

9. At the equator there are 60 nautical miles (NMs) in a degree and each time zone spans 900 NMs; a time zone spans 15° of longitude (exception: MIKE and YANKEE—each span 7½° of longitude).

10. The U.S. Navy uses the international 24-hour time system, expressed in four digits; DTGs are formed by preceding the four-digit time with a two-digit number expressing the day.

11. The International Date Line separates the designators MIKE and YANKEE (-12 and +12). The date will always change when crossing this line, regardless of the direction of crossing. When you cross the line, apply the sign of the departed hemisphere.

12. MIKE and YANKEE are one time zone of 15° longitude, sharing the same numerical designator (12). MIKE is the eastern 7½° of longitude of this zone; YANKEE is the western 7½° of longitude.

13. The time will change by 1 hour whenever a new time zone is entered: east to west, subtract 1 hour; west to east, add 1 hour.

14. The day changes to the next or previous day once 0000 is reached, depending upon the direction of travel.

15. The time is always the same in MIKE as it is in YANKEE, but it is *never* the same day.

REFERENCES

Communications Instructions General, ACP 121(F), Annex A, Joint Chiefs of Staff, Washington, DC, 15 April 1983.

TOPIC 2

TIME-CONVERSION COMPUTATION

With U.S. naval ships and aircraft deployed throughout the world, time computation becomes a matter of concern to virtually every naval member. Communicators use ZULU time in messages and other record communications. It is extremely important that you know how to make time conversions from local to ZULU time and from ZULU to local time. Those involved in collection, processing and reporting, and traffic analysis must be able to make quick and accurate time conversions throughout their working day.

CONVERSION FROM LOCAL TIME TO ZULU TIME

We know the ZULU time zone has the numerical designator zero (0). At this point, the "+" or "-" assigned to each of the other zones comes into play. To convert the local time to ZULU time, simply add or subtract as indicated by the sign (+ or -) of the local time zone.

For example, we are in Pensacola, Florida, and wish to assign a date-time group (DTG) to a message. We will have to use ZULU time for the message. Pensacola is in the SIERRA time zone and is designated +6. The local date and time is 191045S (the 19th of the month at 10:45 A.M.). Since the SIERRA time zone is +6 (Pensacola local time), add 6 to the local time of 1045. Our answer is the conversion of 191045S to ZULU time 191645Z.

Our problem looks like this:

```
191045S (local DTG)
  +6     (Pensacola is in zone +6)
-------
191645Z (ZULU DTG)
```

NOTE: Remember, the +6 must be placed under the "hours" of the local DTG.

RULE: FROM LOCAL TIME TO ZULU TIME—APPLY THE SIGN.

To check ourselves for complete understanding, let's take one more example of converting local time to ZULU time. This time we are in Kamiseya, Japan, and wish to assign a DTG to an outgoing message. First, we have to know the zone designation for Kamiseya—INDIA (-9). The date and time in Kamiseya is 101800I. Using our formula, we apply the "-" sign and subtract the local zone (9) from the local time:

```
101800I (local DTG)
  - 9    (Kamiseya is in zone -9)
-------
100900Z (ZULU DTG)
```

These examples can help you convert local time to ZULU time from any place in the world. The only variations that you will encounter involve the International Date Line and daylight saving time (DST), each of which will be treated separately later.

CONVERSION FROM ZULU TIME TO LOCAL TIME

The conversion from ZULU time to local time is the reverse procedure of local to ZULU. For example, you are in San Diego, California, and receive a message from Washington, D.C., with a DTG of 101800Z. If you want the Washington local time of message origination, you need to know the zone designations for Washington—ROMEO +5. Then, apply the formula. Change the sign from +5 to -5 and subtract the 5 hours from the ZULU time of the message:

101800Z (ZULU DTG)
- 5 (Washington zone with "+" reversed)
———
101300R (local DTG)

RULE: FROM ZULU TO LOCAL—
REVERSE THE SIGN.

To check ourselves, let's work another example of converting ZULU to local. The U.S. Ambassador to Japan has received a message from the U.S. Secretary of State concerning the latter's plans to visit Tokyo. The Secretary has indicated an arrival time of 210830Z. The Ambassador's problem is one of diplomacy: Should he arrange a luncheon or an evening meal for the arrival of the distinguished guest? We need not concern ourselves with the geographic location of the Secretary of State because he used ZULU time. However, we must know the location and designators for Tokyo—INDIA (-9). Armed with this knowledge, apply the formula. We reverse the local sign (change the -9 to a +9), and work the math:

210830Z (ZULU arrival time)
+9 (local zone with "-" reversed)
———
211730I (local arrival time)

Forget the soup and sandwiches, he'll be there for supper!

NOTE: You may see some commercially produced time zone charts with the numerical zone designators reversed ("+" for the eastern hemisphere and "-" for the western hemisphere). Don't let this confuse you. Remember, in the eastern hemisphere the time will always be later than ZULU and in the western hemisphere it will always be earlier than ZULU.

COMPUTING TIME IN GEOGRAPHIC POSITIONS

Coordinates is a general term for numbers representing the degrees, minutes, and seconds of a geographic position. The correlation of time and geographic coordinates is a critical skill for members of the intelligence community. Once you have learned to convert time from local to ZULU and from ZULU to local, the conversion using positional coordinates is a simple matter.

Let's consider a typical position report. A position report is normally sent as two sets of numbers. The first set of numbers is the latitude (north or south). The second set of numbers is the longitude (east or west) and is the set that we use in time conversion. Normally, the longitude of a position report (the second set of numbers) is sent as a five-digit group. The first three digits of this group indicate the geographical degrees; the last two are the minutes. The group is followed immediately by an "E" (east) or a "W" (west) to indicate the hemisphere. For example, 115°30´W indicates the location is 115 degrees and 30 minutes west of the prime meridian.

There are 180° of longitude to the west of Greenwich and 180° longitude to the east (180°W longitude and 180°E longitude = International Date Line—the 180th meridian). Each degree can be broken into 60 minutes.

As stated above, the five-digit longitude is normal; however, sometimes you will encounter a seven-digit longitude. This is simply a further breakdown of the minutes into seconds. One minute contains 60 seconds. When this occurs, the first three digits indicate degrees; the next two digits indicate minutes; and the last two digits indicate seconds. In any event, the longitude of a position will place the target into a specific time zone.

To determine this zone, we'll use a hypothetical position report sent in chatter: 12°35´N 072°42´W. We may disregard the first set of numbers (latitude) and concern ourselves only with the second set of numbers (longitude). The "072°" represents the number of degrees of longitude from the prime meridian (Greenwich) and the "42´" is the number of geographical minutes from the 072 degree line (72nd meridian). The "W" tells us that the target is located to the west of the prime meridian, in the western hemisphere.

NOTE: Remember, a time zone spans 15° of longitude, with the ZULU zone divided into 7½° of longitude east and 7½° of longitude west of the prime meridian.

The first step in our computation is to draw a graphic chart showing the western half of the ZULU time zone. Now, label the western border of the ZULU time zone (7½° west longitude, or 007°30´W). We must now continue our chart, proceeding outward from ZULU, labeling the western borders of each of the time zones until we reach a point where the hypothetical longitude is equaled or exceeded. For example, the western border of zone

NOVEMBER is 022°30´W (007°30´ + 15°);

OSCAR is 037°30´W;

PAPA is 052°30´W;

QUEBEC is 067°30´W; and

ROMEO is 082°30´W.

Once we reach the first meridian to exceed the longitude (in this case, ROMEO zone's western border is the first of the western borders to exceed our longitude of 072°42´W), we need go no further with our labeling. See figure 1-1. Longitude 072°42´W falls to the west of zone QUEBEC, but not past zone ROMEO. Our longitude falls within the ROMEO zone, or zone +5.

After determining the time-zone designation for our target, we apply or reverse the sign, depending upon whether we want to determine the ZULU time from local time, or the local time from ZULU time. Longitudes in the eastern hemisphere are handled in the same way, except that the eastern borders are used instead of the western borders.

Let's look at another example. This time we will establish the target's time-zone designators (its longitudinal parameters). An unlocated ship sends its local time as 0945. Your local time is 1345B. The first step in solving this problem is to convert your local time to ZULU. Use the formula, FROM LOCAL TO ZULU—APPLY THE SIGN. All you have to do is subtract your time zone from your local time to arrive at ZULU. Zone BRAVO is -2. By subtracting the local time zone of -2 from your local time of 1345B, you arrive at ZULU time—1145Z. Since it has been established that it is 1145Z, and the target operator has given his local time as 0945, all you need to do is subtract the smaller figure from the larger. The difference will equate to the time zone of the target.

$$\begin{array}{r} 1145 \\ -0945 \\ \hline 0200 \end{array} \quad \text{(or +2 time zone)}$$

After all, if it is 1145Z in BRAVO zone, it must also be 1145Z in OSCAR and in all other zones.

COMPUTATIONS INVOLVING THE INTERNATIONAL DATE LINE

In our discussions of the International Date Line, we covered two very important points which bear repeating:

1. It is always the same time in zone MIKE as it is in zone YANKEE—it is *never* the same day.
2. When you cross the International Date Line, apply the sign of the *departed* hemisphere to determine whether to add or to subtract a day. Keep in mind that whenever we cross the line, the day *must* change.

To illustrate the effect that the International Date Line has upon a DTG, let's assume that we are flying from Tokyo to San Francisco. We begin by listing the facts that we must know about each place:

1. The time zone designators of Tokyo—INDIA (-9).
2. The time zone designators of San Francisco—UNIFORM (+8).
3. The date and time of departure from Tokyo—20 April, at 0800I.
4. The flying time is 13 hours.

THE PROBLEM: What will be the local time and date when we land in San Francisco?

To solve this problem, make a graphic chart showing each of the time zones between Tokyo and San Francisco, labeling each zone with its designators. See figure 1-1. (Don't forget to label the International Date Line.) Using our roughly drawn chart, let's fill in the times between Tokyo (-9) and the Date Line. Since we are moving in an easterly direction we add 1 hour upon entering each new time zone.

We have now reached the International Date Line and find that, before crossing the line, the local time is 201100M. We cross the line, departing - 12 and entering + 12. Using our formula for crossing the International Date Line, we apply the sign of the departed hemisphere and subtract 1 day—it is now the 19th of April. As stated before, the hour will remain the same in YANKEE (1100Y) as it was when we departed MIKE—only the day changes.

Now let's leave YANKEE and continue adding 1 hour for each new zone. Remember, it is now the 19th, NOT the 20th, as it was when we left Japan.

As we arrive in San Francisco's time zone (UNIFORM), the local time is 191500U. However, this is NOT the answer we are seeking. All we have determined thus far is that when it is the 20th of April at 0800 local time in Tokyo, it is the 19th of April at 1500 local time in San Francisco. We are not finished with the problem until we have added the flying time to the local time in San Francisco. By adding the 13 hours flying time, we find that our arrival time in San Francisco should be 200400U.

COMPUTATIONS INVOLVING DAYLIGHT SAVING TIME (DST)

In computing time conversions, you will frequently encounter problems where one or both of the zones are using DST. Since the purpose of this time modification is to extend the daylight hours (primarily in the summer months), all we have to do is to understand what is done to establish this time.

DST is simply the setting of the clocks in a particular area ahead 1 hour, thus extending the onset of darkness by that margin. Whenever we encounter a problem involving DST, we work the problem according to the methods outlined above, then subtract 1 hour. This will give us the normal time for that zone. If we are asked to solve a time-conversion problem for a time zone using normal time and instructed to give the answer in DST, we work the problem and add 1 hour to obtain the time in DST.

TIME-CONVERSION WORKING AIDS

Most of us have seen charts or maps of the world showing time zones. These are handy tools to have when computing time. Obviously, we can’t be expected to carry charts or maps around in our back pocket everywhere we go. The Navy has a 4" × 6" working aid, the time-conversion table. It is small enough to carry in your wallet and is readily available at most field stations. Also, there are many commercially produced materials. Some of these are better than others.

TIME-CONVERSION TABLE

The time-conversion table has 24 horizontal rows depicting the 24 hours of the day, and 25 vertical columns showing the 25 time zone designators. See table 2-1. Notice that zones MIKE and YANKEE are identical, with the exception of the day.

To use the time-conversion table, find the zones in question along the horizontal row at the bottom of the table and go up the vertical column of the known time zone. Then find the corresponding vertical position of the unknown zone. You now have the time of the unknown zone in relation to the known zone. It’s as simple as that.

COMMERCIAL TIME-CONVERSION AIDS

The commercially produced time-conversion aids, primarily designed to aid the tourist, are inadequate for military and communications use. They generally disregard zone designators and the computation processes. Figure 2-1 shows a typical tourist-oriented, time-conversion aid and is included in this manual only as an example of these aids.

We have discussed time-conversion working aids only to advise you that there are shortcuts. There are no shortcuts to professionalism, however, and each of the time-conversion aids has its shortcomings. Did you notice that the time-conversion table is of no help in establishing positional locations of targets? Additionally, if you are on a direct-support platform, or at an isolated duty station where the time conversion table is not available, the success of your mission might well depend upon your ability to compute time.

TOPIC SUMMARY

If any one of these areas is unclear to you, go back to the discussion and master that procedure.

1. To determine ZULU time from local time, apply the sign ("+" or "-") and add or subtract the numerical designator to or from the local time’s hours.
2. To determine local time from ZULU time, reverse the sign ("+" or "-") and add or subtract the new numerical designator to or from the ZULU time’s hours.
3. In problems involving geographical positions:
    a. Latitude is irrelevant for figuring time; use only the longitude.
    b. Use all five digits of the longitude (seven digits, if given).
    c. Proceed in an easterly or westerly direction from the prime meridian, according to the "E" or "W" designation.
    d. Make a rough, graphic chart to establish the zone in which a given longitude falls.
        (1) Enter the longitudinal coordinates for the ZULU zone (007°30´E or 007°30´W).

Table 2-1.—Time-Conversion Table

PREVIOUS DAY							SAME DAY																	
1800	**1900**	**2000**	**2100**	**2200**	**2300**	**2400**	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800
1900	**2000**	**2100**	**2200**	**2300**	**2400**	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900
2000	**2100**	**2200**	**2300**	**2400**	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000
2100	**2200**	**2300**	**2400**	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100
2200	**2300**	**2400**	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200
2300	**2400**	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300
2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400
0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	**0100**
0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	**0100**	**0200**
0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	**0100**	**0200**	**0300**
0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	**0100**	**0200**	**0300**	**0400**
0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	**0100**	**0200**	**0300**	**0400**	**0500**
0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	**0100**	**0200**	**0300**	**0400**	**0500**	**0600**
0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	**0100**	**0200**	**0300**	**0400**	**0500**	**0600**	**0700**
0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	**0100**	**0200**	**0300**	**0400**	**0500**	**0600**	**0700**	**0800**
0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	**0100**	**0200**	**0300**	**0400**	**0500**	**0600**	**0700**	**0800**	**0900**
1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	**0100**	**0200**	**0300**	**0400**	**0500**	**0600**	**0700**	**0800**	**0900**	**1000**
1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	**0100**	**0200**	**0300**	**0400**	**0500**	**0600**	**0700**	**0800**	**0900**	**1000**	**1100**
1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	**0100**	**0200**	**0300**	**0400**	**0500**	**0600**	**0700**	**0800**	**0900**	**1000**	**1100**	**1200**
1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	**0100**	**0200**	**0300**	**0400**	**0500**	**0600**	**0700**	**0800**	**0900**	**1000**	**1100**	**1200**	**1300**
1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	**0100**	**0200**	**0300**	**0400**	**0500**	**0600**	**0700**	**0800**	**0900**	**1000**	**1100**	**1200**	**1300**	**1400**
1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	**0100**	**0200**	**0300**	**0400**	**0500**	**0600**	**0700**	**0800**	**0900**	**1000**	**1100**	**1200**	**1300**	**1400**	**1500**
1600	1700	1800	1900	2000	2100	2200	2300	2400	**0100**	**0200**	**0300**	**0400**	**0500**	**0600**	**0700**	**0800**	**0900**	**1000**	**1100**	**1200**	**1300**	**1400**	**1500**	**1600**
1700	1800	1900	2000	2100	2200	2300	2400	**0100**	**0200**	**0300**	**0400**	**0500**	**0600**	**0700**	**0800**	**0900**	**1000**	**1100**	**1200**	**1300**	**1400**	**1500**	**1600**	**1700**
SAME DAY								NEXT DAY																
Y +12	X +11	W +10	V +9	U +8	T +7	S +6	R +5	Q +4	P +3	O +2	N +1	Z 0	A –1	B –2	C –3	D –4	E –5	F –6	G –7	H –8	I –9	K –10	L –11	M –12

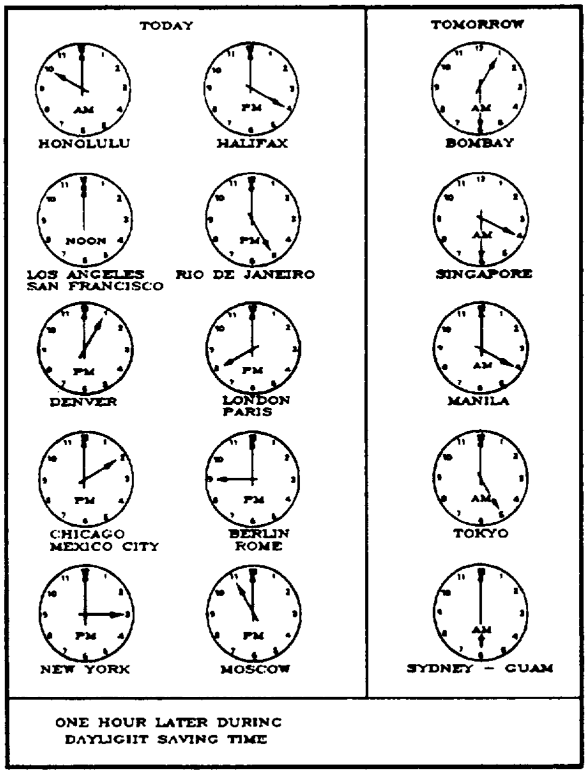

Figure 2-1.—Typical commercial time-conversion aid.

(2) When traveling from the eastern or western border of zone ZULU, add 15° for each new zone; place this new longitudinal coordinate at the eastern or western meridian of the zone, as required.

e. Solve the time problem like any other problem after placing the target into the zone corresponding to its longitudinal coordinates.

4. In problems involving the use of a target's local time to establish its longitudinal parameters:

a. Convert your local time to ZULU.

b. Work from ZULU time to derive the local time of the target.

c. Place the target within its geographic zone once the local time is determined.

5. In problems involving the International Date Line:

a. Separate the MIKE and YANKEE zones.

b. Label both "+" and "-" designators (MIKE is "-"; YANKEE is "+").

c. It is always the same time in MIKE as it is in YANKEE, but *never* the same day.

d. The day must change each time the International Date Line is crossed.

e. Apply the sign of the *departed* hemisphere when crossing the line to determine whether to add or to subtract a day.

6. In problems involving daylight saving time (DST):

a. When time is given in DST, work the problem in normal fashion, then subtract 1 hour to arrive at the zone's normal time.

b. When the zone's normal time is given, work the problem in the usual fashion, then add 1 hour to determine DST.

REFERENCES

Communications Instructions General, ACP 121(F), Annex A, Joint Chiefs of Staff, Washington, DC, 15 April 1983.

TOPIC 3

GEOGRAPHY AND PLOTTING

To gain a greater knowledge of time theory and time conversion computations, we must have a complete understanding of the Earth, upon which we navigate and travel.

Reference points for locating objects on the Earth have been established by general agreement among maritime nations. The North and South poles are at the ends of the axis on which the Earth rotates. Imaginary lines (an infinite number of them) running through the poles and around the Earth are called *meridians.* They divide the Earth into sections. The Equator is an imaginary line around the Earth that bisects every meridian and divides the Earth in half: the Northern Hemisphere and the Southern Hemisphere. Meridians and the Equator are called *great circles* because they each divide the world into halves. Any circle drawn around the Earth so as to divide it into equal parts is called a *great circle.*

Measurement along a meridian is expressed in degrees, minutes, and seconds of arc. Each degree contains 60 minutes (´); each minute, in turn, contains 60 seconds (″).

MERIDIANS

For every degree around the Earth, there is a meridian. There are 360 of them 60´, or 3600″, apart. The starting point for numbering meridians is the one passing through the Royal Observatory at Greenwich, England.

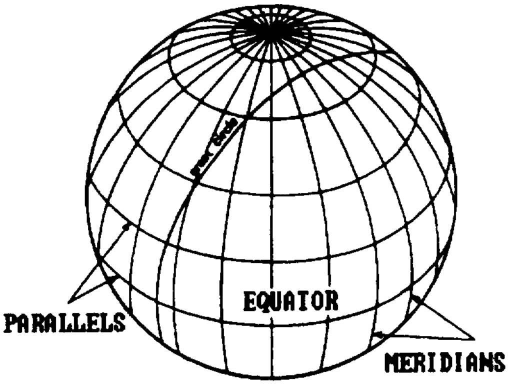

Figure 3-1.—Meridians and parallel

The Greenwich meridian is number 0. Meridians run east and west from 0 to the 180th meridian on the opposite side of the Earth. The complete circle formed by the 0 and the 180th meridians, like the Equator, divides the Earth into two exact halves: the Eastern Hemisphere and the Western Hemisphere. Every meridian runs *true* north and south.

PARALLELS

We need a second set of imaginary lines to complete our coordinate system. These lines are formed by planes that are parallel to the plane passing through the Earth at the Equator. The lines on the Earth resulting from cutting it with these parallel planes are circles called *parallels.* The starting point for numbering these parallels is the Equator. They are numbered from 0 to 90 north and south of the Equator. The system is shown in figure 3-1.

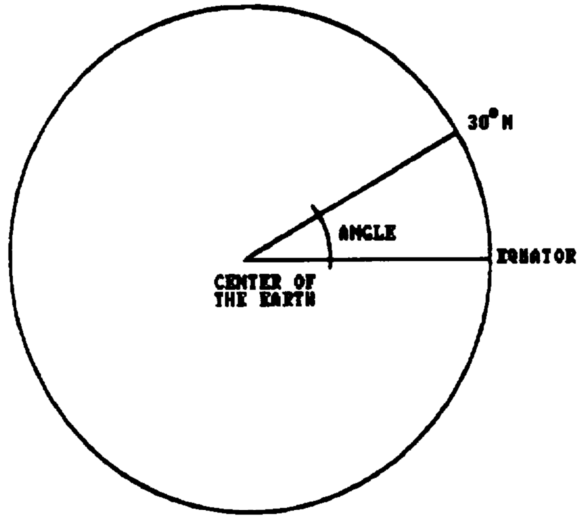

Figure 3-2.—Measuring parallels of latitude.

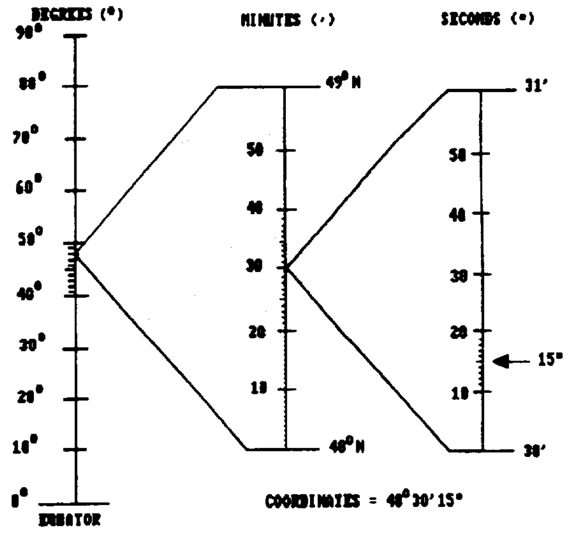

Figure 3-3.—Degrees, minutes, and seconds.

GEOGRAPHIC COORDINATES

You must use the concepts of direction and distance to locate points. Primitive man probably did this in relative terms, using aids such as the directions of the rising and setting sun, forward and backward, and left and right. He probably expressed distance in terms of travel time in relation to his own location. A universal system, however, must have some unique reference or starting point. If we designate such a point, then we can state the location of every other point in terms of direction and distance from it. The most widely accepted system of locating a point on the Earth's surface uses lines of latitude and longitude known as *geographic coordinates.* Coordinates allow us to provide an answer to the question "Where is it?"

LATITUDE

When you draw a grid on a globe, you must have a starting point. Unlike drawing a grid on a piece of paper where you can start in a corner or at the center, drawing a grid on a globe requires that you have a starting point that everybody accepts. The point of origin for latitude is the Equator. The Equator is an imaginary line, with a numerical value of 0°, running east and west around the center of the Earth.

Latitude locates a place relative to the Equator. Because the numbering of lines of latitude begins with 0 at the Equator and increases towards the poles, we must show whether the latitude of a place is north or south of the Equator.

The value of a line of latitude is determined by the angle formed by drawing a line from the Equator to the center of the Earth, and then back out to the surface of the Earth. See figure 3-2. Since the value of any angle would be constant all the way around the Earth, a line drawn on the Earth's surface connecting all the points that are formed by the angle would be parallel to the Equator. For this reason, latitude is commonly referred to as a *parallel of latitude.* Since 90° is straight up or down in relation to the Equator, the North and South poles are 90°. Therefore, you have latitude running from 0° to 89° north or south of the Equator.

Each degree is subdivided into *minutes*(′). For instance, between 48° and 49° north latitude, there are 60 minutes. If you were locating a point that was halfway between 48° and 49° north latitude, it would be at 48 degrees, 30 minutes north (48°30´N). See figure 3-3. Each minute is subdivided into *seconds* (″). For instance, between 30´ and 31´) there are 60 seconds. So if you were locating a point that was one-quarter of the way between 30´ and 31´, it would be at 48 degrees, 30 minutes, 15 seconds north (48°30´15″N). Again, see figure 3-3.

The military writes coordinates using a system called *military notation* without the symbols °, ´, or ″. This system uses 6 numbers plus a letter to indicate north or south. The coordinate 48°30´15″N would be written 483015N. When a position has less than 10° of latitude in its coordinate designation, a zero is added to the left of the degree number. In other words, latitude will have two digits. Seven degrees of latitude appears as 07 in the designation. Likewise, two digits designate minutes and seconds: for example, 030704N or 801708S.

NOTE: In geographic coordinates, always write the latitude first.

LONGITUDE

The point of origin for the vertical lines (longitude) on American and British maps is an imaginary line running from the North Pole to the South Pole through Greenwich, England. Like the Equator, it has a numerical value of 0 degrees. It is called the *Greenwich meridian* or the *prime meridian.* Many foreign maps do not use this line as the zero reference. For example, French maps use the Paris meridian, and Italian maps use the Rome meridian. Data from foreign maps must be examined to determine the prime meridian in use.

The prime meridian and the 180th meridian divide the Earth into two equal vertical parts—the Eastern Hemisphere to the right of the prime meridian and the Western Hemisphere to the left of the prime meridian.

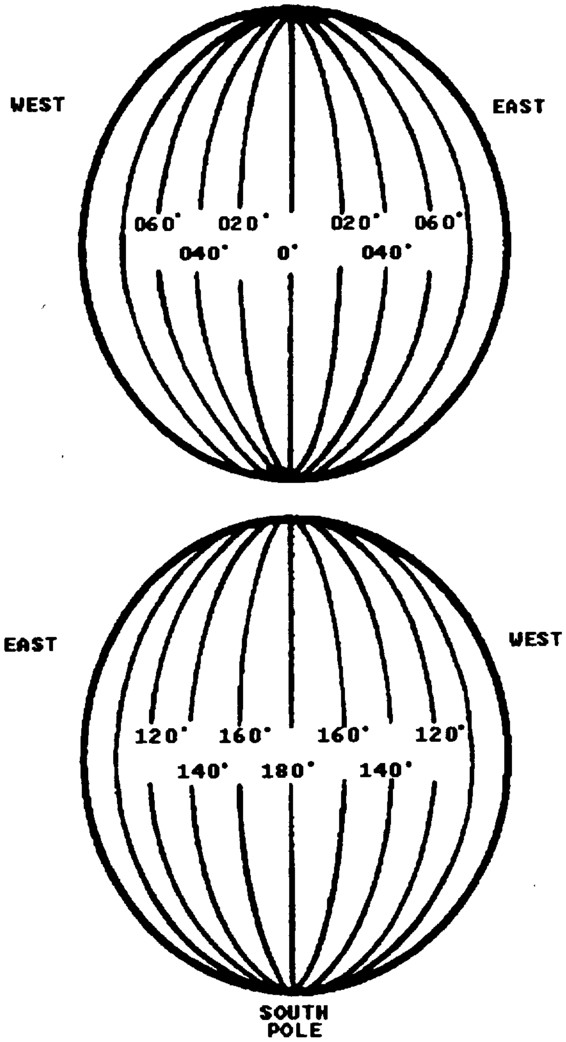

Figure 3-4.—Meridians of longitude.

All of the other lines of longitude are simply called *meridians.* See figure 3-4.

Longitude measurements are relative to the prime meridian. Because the numbering of meridians begins with 0° at the prime meridian and increases to both the east and the west, we must show whether the longitude is east or west of the prime meridian.

The value of a meridian is determined by the angle formed by drawing a line from the Equator, at the point where the prime meridian crosses it, to the center of the Earth, and then back out to another point on the Equator. See

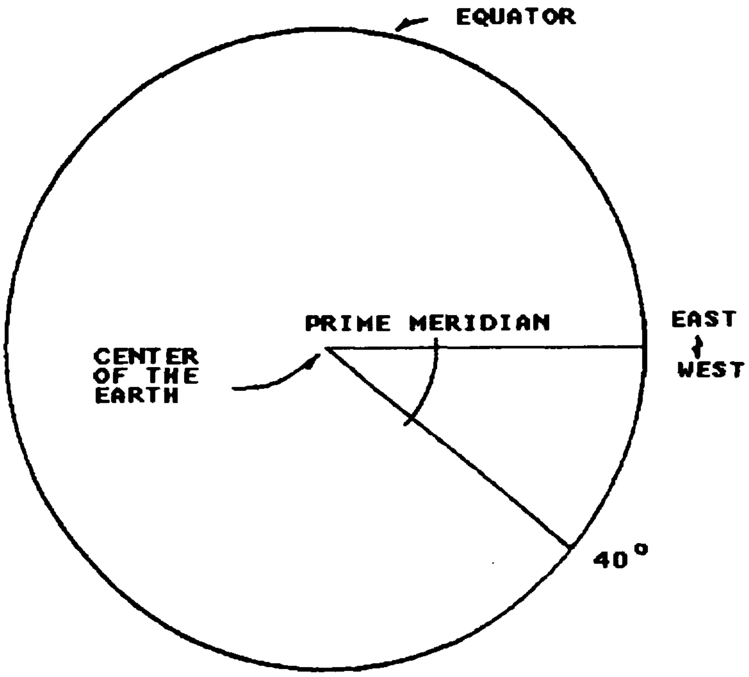

Figure 3-5.—Measuring meridians.

figure 3-5. The angle formed by the intersection of those two lines is the value assigned to that meridian. In this way, the angles are measured around the Earth in both an east and a west direction until you reach 180°. Since there are 180° on each half of the globe, you have a circle of 360°.

Each degree of longitude is subdivided into minutes and seconds in the same manner as latitude. However, remember two things about longitude:

1. West longitude is measured from right to left on a map; east longitude is measured from left to right.
2. When you write longitude in military notation, use seven numbers plus a letter to indicate east or west. When a position has less than 100° of longitude, a zero is added to the left of the degree number; less than 10°, two zeros are added. For example: 0074321W for 7 degrees, 43 minutes, 21 seconds west.

DIRECTION

We usually indicate direction from true north. We give directions in degrees, measured clockwise from true north, or 000°T. We state courses and bearings in three digits. In other words, 45 degrees is 045 (zero four five). Seldom is it necessary to consider compass direction to a value smaller than a degree, even though each degree contains 60 minutes of 60 seconds each.

A true bearing is the direction of an object from the observer, measured clockwise from true north. A relative bearing is the direction of an object measured clockwise from the ship’s bow. Objects seen by lookouts are reported in terms of relative bearings by degrees. See figure 3-6.

The *reciprocal* a bearing is its opposite; that is, the point or degree on the opposite side of the compass from the bearing. For example, the reciprocal of 180° is 000°. When you obtain a bearing on an object, the bearing from the

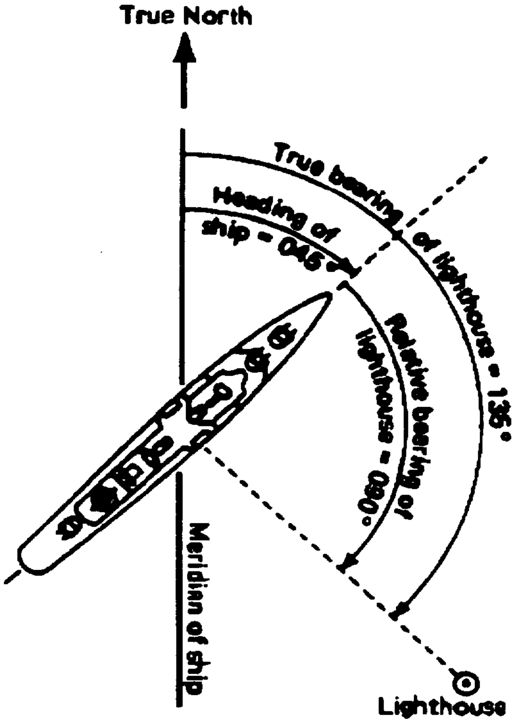

Figure 3-6.—True and relative bearings.

object to you is the reciprocal of the bearing from you to it. To find the reciprocal of any bearing expressed in degrees less than 180°, simply add 180° to the bearing. If the bearing is 050°, its reciprocal is 050° plus 180° or 230°. If your bearing is greater than 180°, subtract 180°.

In addition to true and relative direction measurement, there are other common references, such as measurement from the *magnetic pole* and grid reference lines on charts. However, all direction measurement systems are based on the degrees in a circle or points on a compass rose.

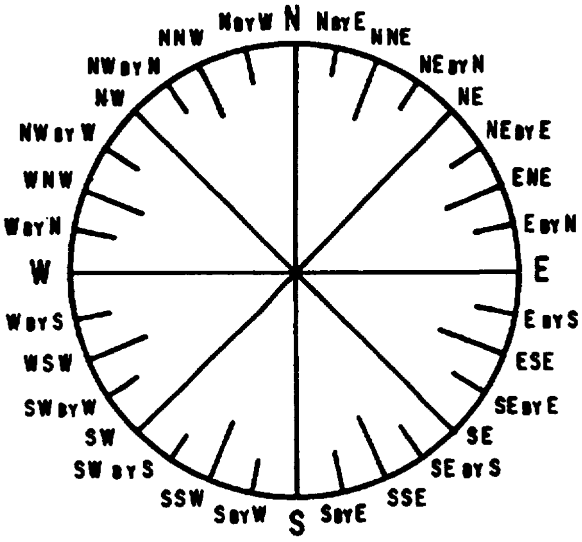

Figure 3-7.—The mariner's cardinal point system.

The Cardinal Point System

For centuries, navigators used a system of compass readings, called *compass points,* to indicate direction. An observer would use the *cardinal* points of the compass (north, south, east, and west) and intervening points between each cardinal point to indicate the direction of an object. Figure 3-7 shows the 32 relative bearings by points around a ship. The cardinal point system may be used when a high degree

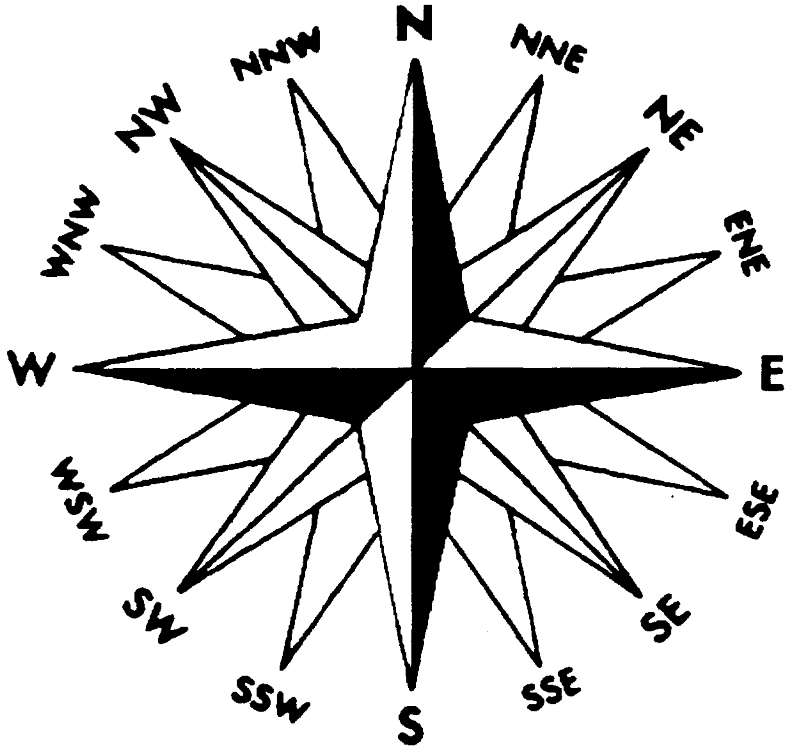

Figure 3-8.—The mariner's cardinal point system.

of accuracy is not required. Only the *rules of the road* and some harbor pilots and coastal merchant mariners still express direction in points. Figure 3-8 shows a *compass rose* with 16 points of the compass.

The Azimuth System

The azimuth system measures direction by dividing a circle into 360 equal parts, called *degrees,* and subdividing each degree into minutes and seconds. We measure direction in degrees, minutes, and seconds clockwise from north in a horizontal plane. Some marine compasses show both the cardinal point and the azimuth figures on their cards. Figure 3-9 shows a compass card with the azimuth system and eight cardinal points superimposed on it. In this figure, the subdivisions of a degree are not shown. For most navigational purposes, subdivisions of a degree are not necessary.

MAPS, CHARTS, AND PROJECTIONS

To become knowledgeable in geography and plotting, an understanding of maps, charts, and projections is extremely helpful. We will discuss these in the following paragraphs.

MAPS

A map is a graphic representation of selected features of the Earth's surface, drawn to scale. A map is a compact data base—an information storage and retrieval system—that does not require machine action. Instead, the skilled map reader retrieves information from the map.

From another viewpoint, maps are two-dimensional models of the Earth. Topographic maps are three-dimensional models that show elevation by using contour lines.

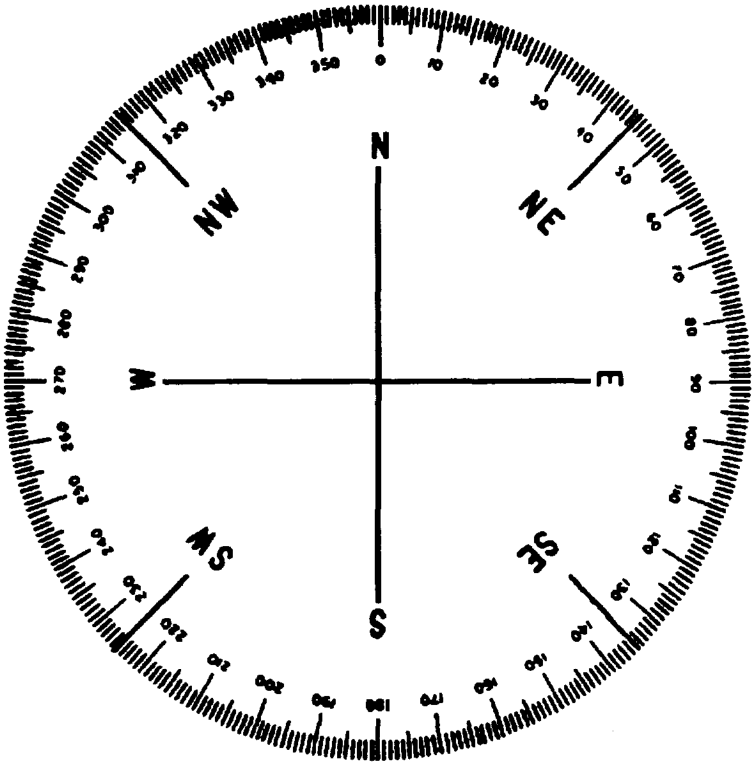

Figure 3-9.—Compass card.

The graphic representations on maps may consist of

- lines and symbols of various colors;
- drawings of landforms, called *physiographic diagrams;* or
- photographs with the addition of lines and colors to emphasize features.

CHARTS

A chart is a special-purpose map, generally designed for a form of navigation, such as air navigation. There is a difference between charts and maps. Maps show land areas, political subdivisions, and topography. A chart details water areas and has reference lines on it to allow the navigator to graphically plot information. A hydrographic chart provides information such as water depths and locations of navigational aids. An air navigation chart may show land, but it provides the air navigator with elevations as well as the locations of navigational aids.

PROJECTIONS

A projection is a method of representing a three-dimensional object on a two-dimensional surface. Cartographers (map makers) use projection techniques to build maps or charts; however, it is impossible to project a three-dimensional object upon a two-dimensional surface without distortion. The type of projection they use depends on the area to be represented and the use of the map or chart.

Distortion cannot be avoided, but it can be controlled. Map makers have created several projections to represent the Earth's surface on a plane. In any projection, they establish a network of lines corresponding to geographic coordinates. This network of lines

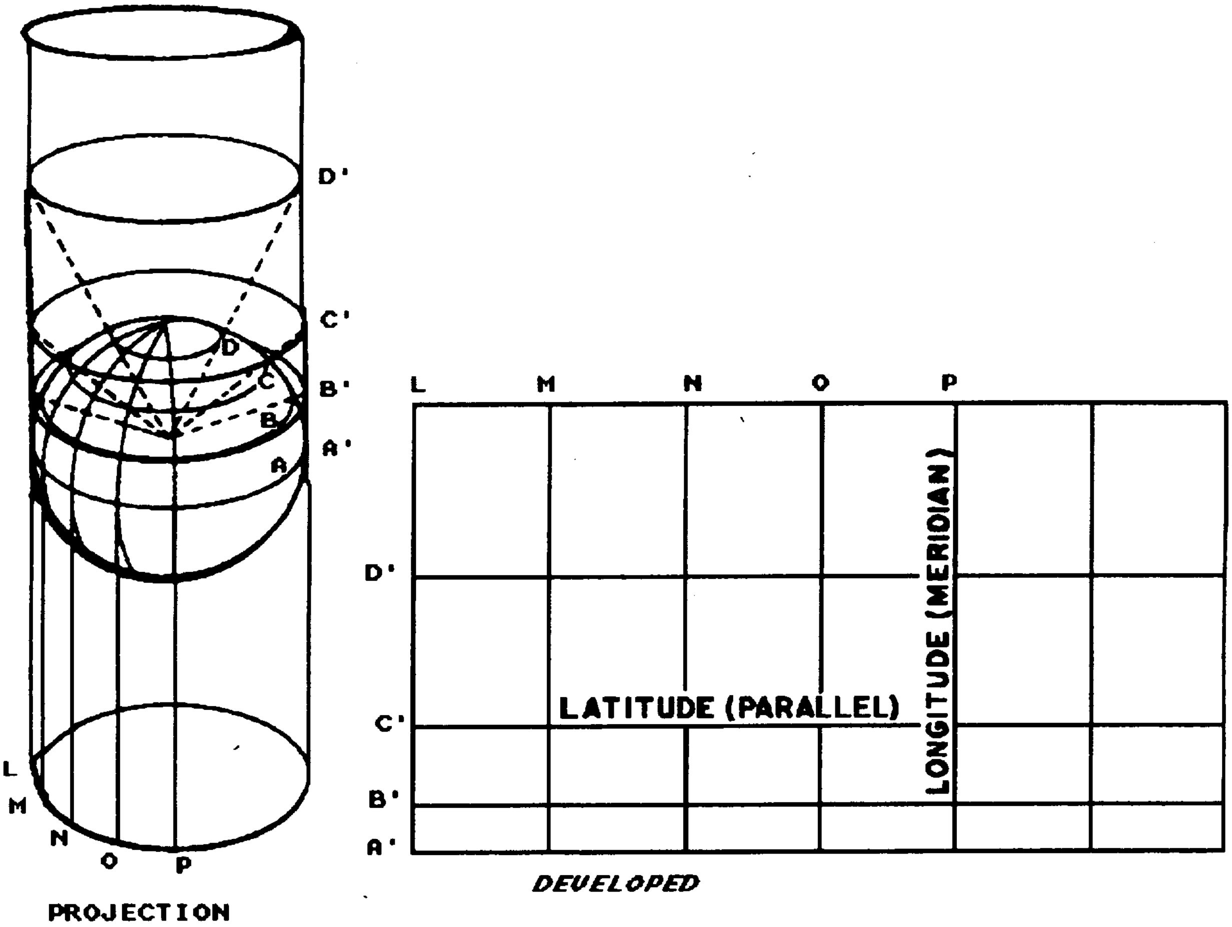

Figure 3-10.—A Mercator projection.

enables them to place each detail. To use a chart effectively, we must understand the purpose of the projection system and its good and bad features.

The Mercator projection, the most common method of making nautical charts, was developed by a Flemish cartographer in the sixteenth century. The Mercator chart is projected by fast placing a cylinder around the Earth, tangent at the Equator. Planes are passed through the meridians and projected to the cylinder upon which they appear as parallel lines of longitude. Lines are drawn from the center of the Earth to the cylinder passing through the parallels to locate the lines of latitude on the cylinder. Then, the cylinder is cut lengthwise and flattened. See figure 3-10.

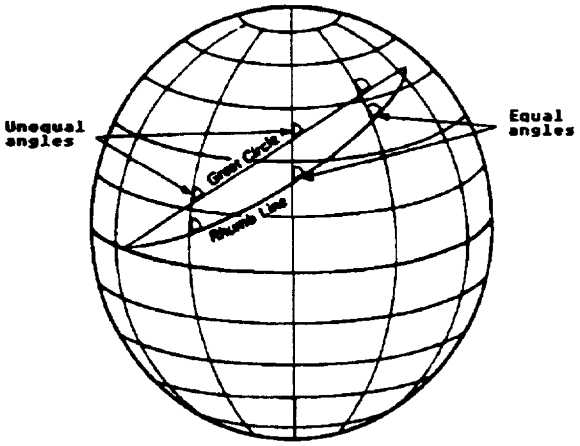

Figure 3-11.—The difference between a great circle and a rhumb line on the Earth's surface.

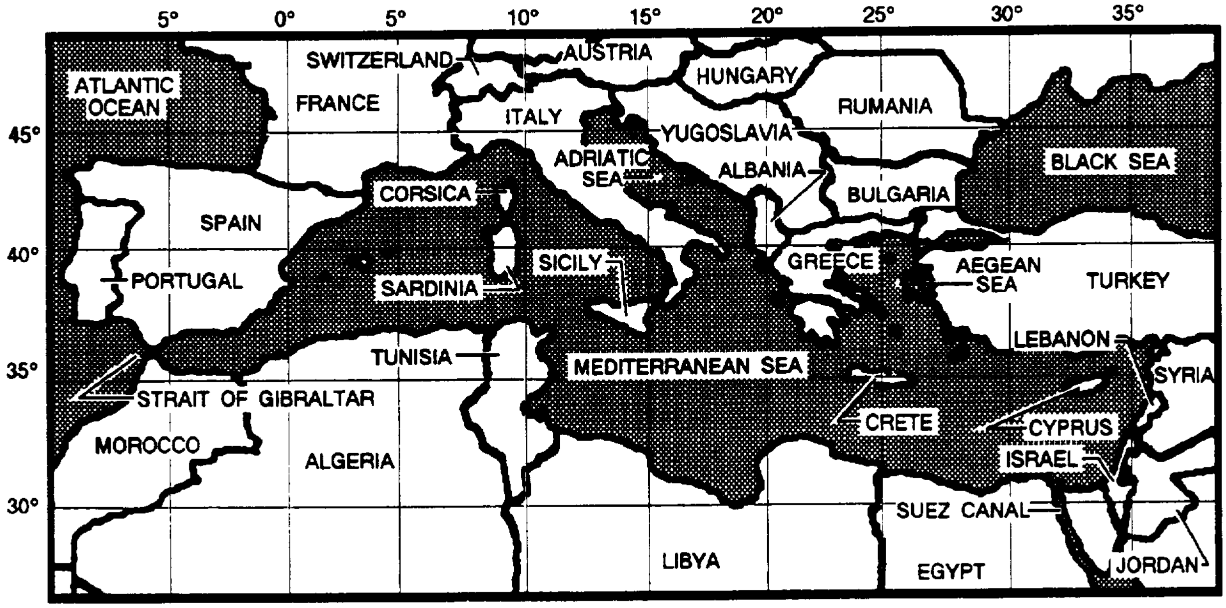

Figure 3-12.—Mediterranean Sea.

The resulting horizontal and vertical lines form a simple Mercator projection. In the production of today's Mercator charts, parallels are spaced by mathematical formulae. The advantage of a Mercator projection is that it is a conformal chart, showing true angles and true distance. A rhumb line (a line that makes the same angle with all intersected meridians) plots as a straight line on a Mercator chart. See figure 3-11. On a Mercator chart, meridians are parallel. A disadvantage of a Mercator chart is the distortion at high latitudes. At the poles, meridians actually converge; however, they are parallel on the chart. Greenland, in the higher latitudes on a Mercator chart, appears larger than the United States, although it is much smaller. Even in the high latitudes though, the distortion on a Mercator projection does not prevent the measurement of true distance.

AREAS OF INTEREST

We will conclude with a brief discussion of some of the more important U.S. Navy operating areas. These include the Mediterranean Sea, the Middle East/Persian Gulf area, and the Western Pacific.

MEDITERRANEAN SEA

The nearly landlocked Mediterranean Sea has been an influential factor in world affairs throughout history. The Navy's Sixth Fleet operates from the Strait of Gibraltar at the western end of the Mediterranean, to the shores of Israel, Lebanon, and Syria at the eastern end. See figure 3-12. The Strait of Gibraltar is a vital choke point between the Mediterranean and the Atlantic Ocean, as is the Suez Canal, which provides access from the Mediterranean to the Red Sea and the Indian Ocean beyond.

MIDDLE EAST/PERSIAN GULF

The U.S. Navy has significantly increased its role in this volatile area. The Commander, Joint Task Force Middle East, located at Bahrain, is augmented by ships of both the Atlantic and Pacific Fleets. Atlantic Fleet ships enter the Red Sea via the Suez Canal and then proceed through the Gulf of Aden to the North

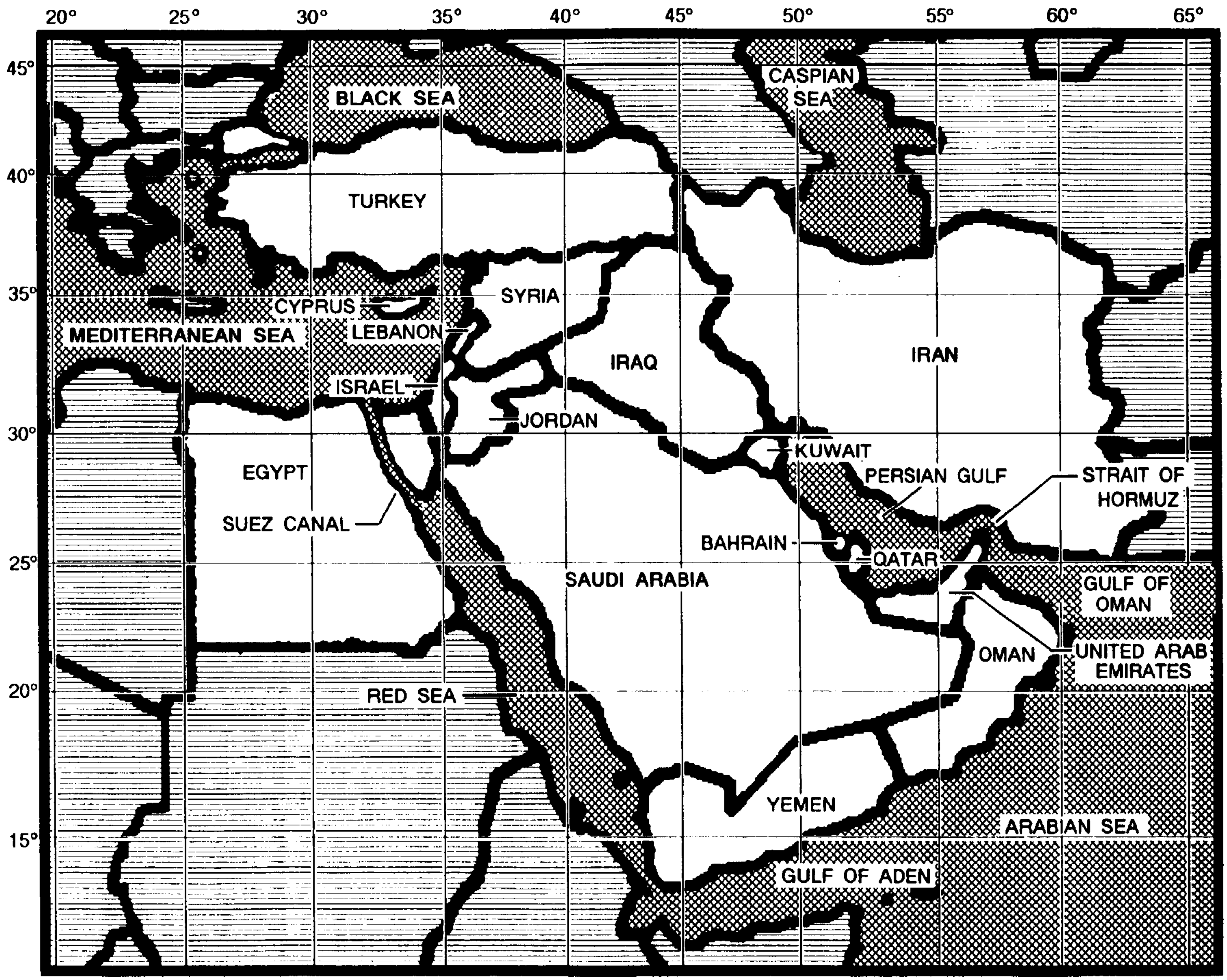

Figure 3-13.—Middle East.

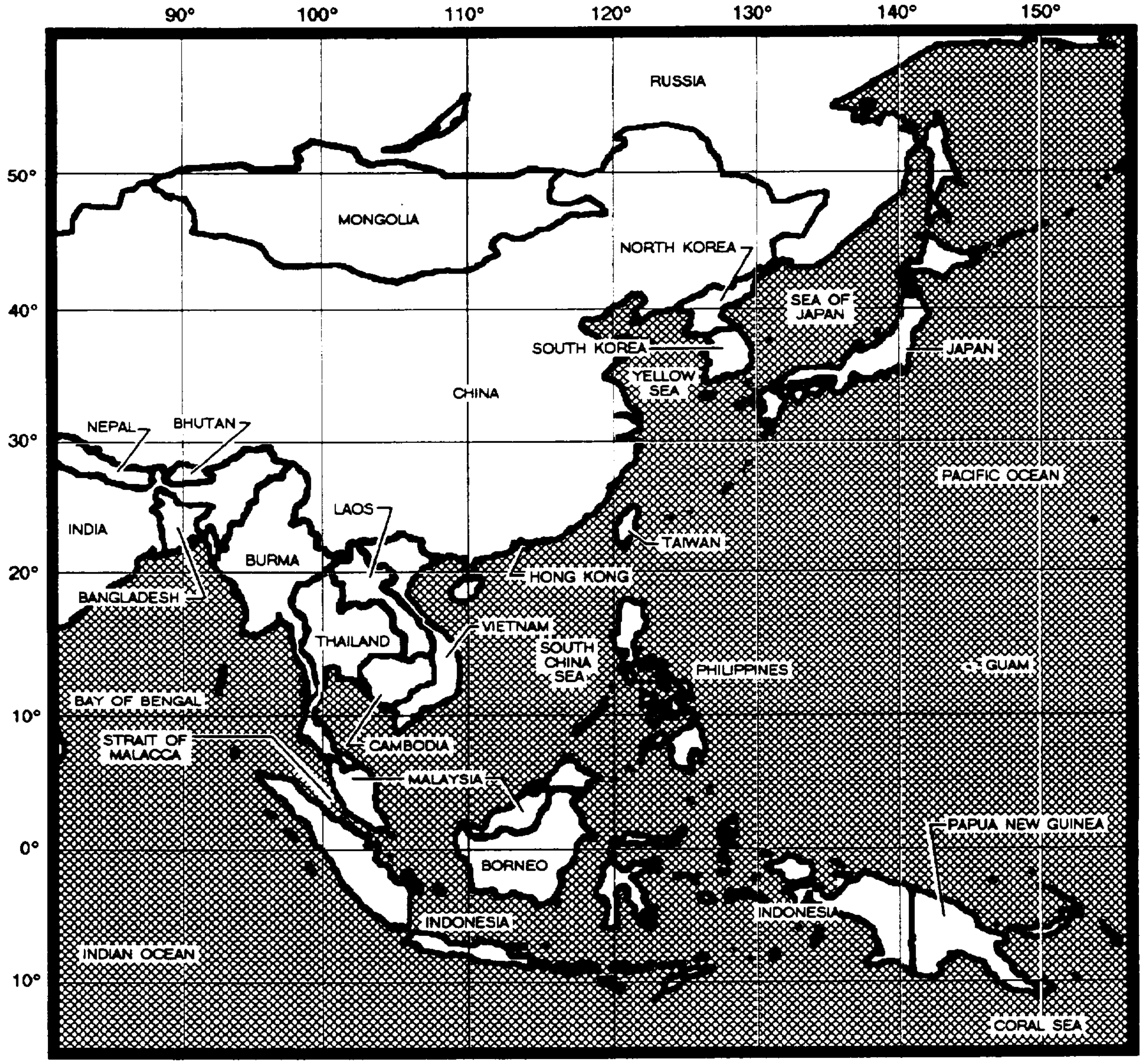

Figure 3-14.—Western Pacific.

Arabian Sea/Gulf of Oman. To enter the Persian Gulf (also referred to as the Arabian Gulf), ships must navigate another strategic choke point, the Strait of Hormuz. See figure 3-13.

WESTERN PACIFIC

The U.S. Seventh Fleet, headquartered in Yokosuka, Japan, is responsible for this large area. See figure 3-14. A carrier battle group is homeported in Yokosuka to quickly respond to any regional tensions. Our naval presence in the Southeast Asia area is changed somewhat now with the loss of our base in Subic Bay, Republic of the Philippines. Many of those support activities have relocated to Guam. Continued presence in the area is important to protect the Strait of Malacca, the passage between the South China

Sea, and the Indian Ocean. Pacific Fleet ships enroute to the Arabian Sea/Persian Gulf transit this strait. It is also an important commercial route. Most of the tankers carrying Mideast oil pass through it on their way to Pacific ports.

REFERENCE

Analysis and Reporting—Analysis Tools, NSGTP 683-14-44-90, Naval Education and Training Program Management Support Activity, Pensacola, Florida, 1990.

INDEX

ASSIGNMENT 1

Textbook Assignment: *Cryptologic Technician Training Series, Time Conversion*, A95-23-00-92, Topics 1, 2, and 3.

Learning Objective: Recognize concepts of time zone theory and time computation.

1-1. What is another name for the 180th meridian?

1. Equator
2. Prime Meridian
3. Greenwich Meridian
4. International Date Line

1-2. Except for time zones MIKE and YANKEE, how many degrees of longitude span each time zone?

1. 12
2. 15
3. 18
4. 25

1-3. Time zone designations use 25 of the 26 letters of the English alphabet. What letter is NOT used?

1. A
2. J
3. Q
4. X

1-4. In time zone problems, the ZULU time zone (0) has a "+" designator.

1. True
2. False

1-5. At the equator, each degree of longitude spans how many nautical miles?

1. 60
2. 150
3. 600
4. 900

1-6. What letter combination is correct in the statement that follows?

Time zones in east longitude are
A B
designated (plus) (minus) and must
C D
be (added to) (subtracted from) local

time to obtain Greenwich mean time.

1. A; C
2. A; D
3. B; C
4. B; D

1-7. A message originated at 191045S should be assigned what ZULU DTG?

1. 190445Z
2. 190545Z
3. 191545Z
4. 191645Z

1-8. When you cross the International Date Line from the eastern hemisphere into the western hemisphere, you always subtract a day.

1. True
2. False

1-9. It is always the same time, but never the same day, in time zones NOVEMBER and YANKEE.

1. True
2. False

1-10. At the equator, what is the approximate width, in nautical miles, of a time zone?

1. 500
2. 900
3. 1500
4. 1800

1-11. When the local time in Tokyo, Japan, is 210600I, what is the local DTG in Pensacola, Florida (time zone SIERRA)?

1. 201500
2. 201600
3. 212000
4. 212100

1-12. Washington, D.C. (39N 077W) is in what lettered time zone?

1. QUEBEC
2. SIERRA
3. ROMEO
4. UNFORM

1-13. What is the local DTG in zone PAPA at 1700A?

1. 1300
2. 1400
3. 2000
4. 2100

1-14. What is the local DTG in zone DELTA when it is 032200Q?

1. 040600
2. 042200
3. 030600
4. 031400

1-15. The ZULU time zone passes through which of the following countries?

1. Finland
2. England
3. Australia
4. Commonwealth of Independent States (former Soviet Union)

1-16. What letter combination is correct in the statement that follows?

The continental United States

(CONUS) spans four time zones

which are designated zones
A B
(E through H) (R through U)
C
and are numbered (+5 through +8)
D
(-5 through -8).

1. A; C
2. A; D
3. B; C
4. B; D

1-17. If it is 1500U on 30 September, what is the local DTG in time zone MIKE?

1. 291900 SEP
2. 301100 SEP
3. 011000 OCT
4. 011100 OCT

1-18. It is 100500 local time in zone +2. What will be the local DTG, 10 hours later, in zone -4?

1. 092300
2. 101000
3. 101100
4. 102100

1-19. A ship at 3840N 11221E is in what time zone?

1. +7
2. +8
3. -7
4. -8

1-20. When the time in Manila is 120600H, what is the local DTG in Denver (time zone TANGO)?

1. 111500
2. 131500
3. 122100
4. 112100

1-21. What is the local DTG at 14400E when it is 0430 local time on 1 October at 17500W?

1. 300630
2. 010230
3. 020130
4. 020230

1-22. If it is 0300 local time on 31 May aboard a ship in the North Atlantic (2200W), what is the local DTG in Moscow (-3 time zone)?

1. 302300 MAY
2. 310700 MAY
3. 310800 MAY
4. 310700 JUN

1-23. It is 0500Z on 7 March. What is the local DTG in Honolulu (2720N 15642W)?

1. 071500
2. 071400
3. 061900
4. 061800

1-24. A message transmitted at 051000I from Tokyo is received in Washington, D.C., (3800N 07730W) one hour later. What is the local DC DTG at the time of receipt?

1. 052300H
2. 060000H
3. 042000R
4. 042100R

1-25. Your ship is at 0105N 05000E. An unidentified submarine has been located at 0045N 06930E. Approximately how many nautical miles is your ship from the submarine?

1. 585
2. 975
3. 1170
4. 1950

1-26. A ship is at 0027N 04230W at 102300Z. What is the local DTG aboard the ship?

1. 102000C
2. 102000P
3. 110200C
4. 110200P

MAYDAY.YPOS.T.ONIS34-5.N0.8-30.17/0415

FIGURE 1A

IN ANSWERING QUESTION 1-27, REFER TO FIGURE 1A.

1-27. On 17 January at 0215Z, a radioman aboard the USS *WHITE PLAINS* intercepted the garbled position report in figure 1A from a vessel in distress. Assuming the transmission time (0415) reflects the local time at the vessel's position, what is the probable longitude?

1. 01830E
2. 02830E
3. 01830W
4. 02830W

1-28. A message originated in Moscow (-3 time zone) at 200625Z was received by a ship in the +12 time zone at 211325Y. How long was the message en route?

1. 1 hour and 25 minutes
2. 28 hours
3. 31 hours
4. 43 hours

1-29. An airplane departs Kennedy Airport (N.Y.) at 1130 local time on 14 June for Pakistan (time zone ECHO). If the flight time is 14 hours and 17 minutes, what is the local DTG when it arrives in Pakistan?

1. 142047
2. 141747
3. 151147
4. 151447

...DE... 0003N 1.505. 090 014 1705 K

FIGURE 1B

YOU ARE ABOARD A COAST GUARD CUTTER ON PATROL IN THE PACIFIC. YOUR RADIOMAN HAS JUST RECEIVED THE PARTIAL POSITION REPORT IN FIGURE 1B FROM AN UNIDENTIFIED VESSEL. THE TIME OF RECEIPT IS 220706Z AND THE POSITION OF YOUR CUTTER IS 0005N 17130W. USE THIS INFORMATION AND FIGURE 1B TO ANSWER QUESTIONS 1-30 THROUGH 1-32.

1-30. What was the local DTG aboard your ship at the time the position report was received?

1. 211406
2. 212006
3. 221406
4. 222006

1-31. Assuming the time of the position report (1705) reflects the local time at the unidentified vessel's location, what is the correct longitude?

1. 15505W
2. 15505E
3. 17505W
4. 17505E

1-32. The unidentified vessel is in what time zone?

1. KILO
2. LIMA
3. XRAY
4. WHISKEY

1-33. You depart San Francisco by ship at 0857 local time on 28 June for Japan. The time en route is 11 days, 12 hours and 37 minutes. What is the local DTG in Japan (time zone INDIA) when you arrive?

1. 092134 JUL
2. 100634 JUL
3. 101434 JUL
4. 111434 JUL

1-34. A ship at 3500N 04520W is in what time zone?

1. +3
2. +4
3. -3
4. -4

1-35. A missile launched at 0800Z on 1 May impacts 35 minutes later at 3950N 17630E. What is the local DTG in the target area at impact?

1. 301935 APR
2. 302035 APR
3. 011935 MAY
4. 012035 MAY

THE PRESIDENT OF THE UNITED STATES HAS JUST SENT AN URGENT COMMUNIQUE FROM THE WHITE HOUSE TO THE AMBASSADOR TO BRAZIL IN RIO DE JANEIRO. THE DTG OF THE MESSAGE IS 212205Z. RIO DE JANEIRO IS SOUTH OF THE EQUATOR IN TIME ZONE PAPA.

FIGURE 1C

IN ANSWERING QUESTIONS 1-36 AND 1-37, USE THE INFORMATION IN FIGURE 1C.

1-36. What was the ZULU DTG in Rio de Janeiro when the communique was originated?

1. 220105
2. 220205
3. 211905
4. 212205

1-37. What was the local DTG in Washington, D.C., when the message was originated?

1. 211705
2. 212005
3. 220305
4. 220705

1-38. You are onboard the USS *CONSTELLATION* which is transiting the Pacific east to west. Your current position is 0027N 17820W. You receive a report of an unidentified aircraft at 0030N 15540E. Approximately how many nautical miles separate the carrier from the unidentified aircraft?

1. 400
2. 720
3. 1560
4. 1880

1-39. When time is given in daylight saving time, you add one hour to arrive at the zone’s "normal" time.

1. True
2. False

1-40. Your parents are on vacation in Sydney, Australia, (time zone KILO) and have told you they will call you at 0630 on 1 June (Australia time). You are in San Angelo, Texas, (time zone SIERRA) and the CONUS is currently on daylight saving time. At what local San Angelo DTG will your parents call?

1. 311430 MAY
2. 311530 MAY
3. 010230 JUN
4. 012230 JUN

1-41. Assume that you are stationed in Hawaii (time zone WHISKEY) and your detailer told you to call on 30 June to check on your next set of orders. At what local DTG should you place your call to contact your detailer on 30 June at 1500 local Washington, D.C. time?

1. 301000 JUN
2. 302200 JUN
3. 010100 JUL
4. 011100 JUL

1-42. At 1100Z, a French ship using zone CHARLIE time sends a message to your ship stating that their commanding officer will be visiting your ship at 1500. How much time does your ship have to prepare for the VIP visit?

1. 1 hour
2. 2 hours
3. 3 hours
4. 4 hours

1-43. Assume you are planning a TAD trip to Tokyo, Japan (time zone INDIA). You are scheduled to depart Los Angeles, California at 0800 local time on 30 April. Your flight to Japan will take 10 hours. What local DTG should you tell your point of contact to meet you at Tokyo's International Airport?

1. 300100 APR
2. 291100 APR
3. 010100 MAY
4. 011100 MAY

1-44. If a missile was fired at 1316 local time on 4 February from a location in time zone INDIA and the impact area had a longitude of 17700E, what would be the local DTG in the impact area when the missile hits if the flight time is 16 minutes?

1. 041032Y
2. 041032M
3. 041632M
4. 041632Y

AS YOUR BATTLE GROUP PATROLS IN THE PACIFIC AT 0015N 17015W AT 2245Z ON 30 APRIL, YOUR PICKET DESTROYER LOCATES AN ENEMY AIRCRAFT CARRIER AT 0026N 17145E.

FIGURE 1D

IN ANSWERING QUESTIONS 1-45 THROUGH 1-47, REFER TO FIGURE 1D.

1-45. At the time the position of the enemy carrier was obtained, what was the approximate distance between it and your battle group?

1. 620 NMs
2. 1080 NMs
3. 1440 NMs
4. 1880 NMs

1-46. What was the local DTG at the position of the enemy carrier at 302245Z?

1. 300945 APR
2. 301245 APR
3. 010845 MAY
4. 010945 MAY

1-47. What was the local DTG at the position of your battle group at 302245Z?

1. 301145 APR
2. 301245 APR
3. 011045 MAY
4. 010945 MAY

1-48. A Russian ship departs Vladivostock (time zone -9) at 101327 local time and arrives in Vancouver, B.C., (time zone +8) exactly twelve days later. What was the arrival time of the vessel?

1. 210600H
2. 212027U
3. 230600H
4. 232027U

1-49. At 0915Z on 22 December, the USS *LONG BEACH*, located at 4130N 16845W, launched a surface-to-surface missile. Forty-five minutes later, a helicopter observed the splash-down of the missile at 4045N 17015E. What was the local DTG in the impact zone at the time of splash-down?

1. 212100X
2. 222000L
3. 222100L
4. 230700M

Learning Objective: Identify geographic reference and direction systems.

1-50. Which of the following is a characteristic of the prime meridian?

1. It passes through the Royal Observatory at Greenwich, England
2. It runs true north and south
3. It divides the Eastern and Western Hemispheres
4. Each of the above

1-51. Which of the following imaginary lines is a parallel that divides the Earth in half into Northern and Southern Hemispheres?

1. The Prime Meridian
2. The Great Circle
3. The Equator
4. The 180th Meridian

1-52. The latitude of a given point locates that point relative to its distance from the equator.

1. True
2. False

1-53. In geographic coordinates, each degree is divided into which of the following subunits?

1. 30 minutes
2. 30 seconds
3. 60 minutes
4. 60 seconds

1-54. Which of the following designations represents a point that is two-thirds of the way from 35° north to 36° north latitude?

1. 352000N
2. 352020N
3. 354000N
4. 354020N

1-55. A person traveled from Greenwich, England, until reaching a meridian designated 90°. In which of the following directions could the person have traveled?

1. East only
2. West only
3. East or west
4. North

1-56. A relative bearing is the direction of an object measured clockwise from which of the following reference points?

1. The ship's bow
2. Magnetic north
3. The object
4. True north

1-57. What is the reciprocal of 280°?

1. 090
2. 100
3. 180
4. 200

1-58. A ship steaming at an azimuth of 315° is headed in which of the following directions?

1. Northwest
2. Southeast
3. Northeast
4. Southwest

Learning Objective: Recognize characteristics of maps and charts.

1-59. Which of the following phrases defines a chart?

1. A chart details land areas only
2. A chart is a map that is used only by navigators of ships
3. A chart is the background upon which a map, showing a portion of the earth's surface, is superimposed
4. A chart details water areas and is used primarily for navigation

1-60. Map makers use which of the following methods to represent three-dimensional objects on a two-dimensional surface?

1. Hydrographics
2. Geographic coordinates
3. Topography
4. A projection

1-61. In the construction of a Mercator chart, the surface of the Earth is projected upon which of the following shapes?

1. A plane tangent to the Earth
2. A sphere tangent to the equator
3. A cylinder tangent to the equator
4. A cone tangent to the pole

1-62. Which of the following phrases describes the appearance of meridians on a Mercator projection?

1. Vertical lines that are parallel and equally spaced
2. Parallel lines whose spacing increases as longitude increases
3. Straight lines that intersect at the poles
4. Curved lines that bend toward the point of tangency

1-63. Which of the following is a disadvantage of a Mercator chart?

1. Distortion near the equator
2. Distortion at high latitudes
3. True distance cannot be measured
4. Parallel spacing is distorted

Learning Objective: Identify geographic areas that hold interest to the Navy.

1-64. What is the choke point that a ship must navigate to pass from the Atlantic Ocean to the Mediterranean Sea?

1. Suez Canal
2. Strait of Hormuz
3. Strait of Malacca
4. Strait of Gibraltar

1-65. What U.S. Navy fleet operates in the Mediterranean Sea?

1. Second
2. Third
3. Sixth
4. Seventh

1-66. The island of Crete in the Mediterranean Sea is located nearest to which of the following coordinates?

1. 3125N 03015E
2. 3900N 00430E
3. 3500N 02500E
4. 3430N 03500E

1-67. A ship entering the Red Sea via the Suez Canal will steer what approximate heading to reach the Gulf of Aden?

1. SSE
2. ENE
3. S
4. SW

1-68. The eastern side of Saudi Arabia is bordered by what body of water?

1. Arabian Sea
2. Red Sea
3. Gulf of Oman
4. Persian Gulf

1-69. Ships entering the Persian Gulf from the Gulf of Oman must navigate what strategic choke point?

1. Suez Canal
2. Strait of Hormuz
3. Strait of Malacca
4. Bab el Mandeb

1-70. Your ship is located at 1830N 05945E. Which of the following countries is closest to your location?

1. Oman
2. Saudi Arabia
3. Egypt
4. Iraq

1-71. What strategically important body of water lies between Japan and Korea?

1. Pacific Ocean
2. Yellow Sea
3. Sea of Japan
4. South China Sea

1-72. What U.S. Navy fleet is responsible for operations in the Western Pacific area?

1. Second
2. Third
3. Sixth
4. Seventh

1-73. A ship departing Guam on a heading of 350° is most likely destined for which of the following countries?

1. Philippines
2. Indonesia
3. Japan
4. Taiwan

1-74. The Strait of Malacca is an important passage between which of the following two bodies of water?

1. Pacific Ocean and Sea of Japan
2. Pacific Ocean and South China Sea
3. South China Sea and Indian Ocean
4. Indian Ocean and Coral Sea

1-75. Your ship is near 1800N 11200E on a heading of 015°. Which of the following ports of call will you soon be visiting?

1. Manila, Philippines
2. Hong Kong
3. Tokyo, Japan
4. Jakarta, Indonesia