LAB EXERCISE

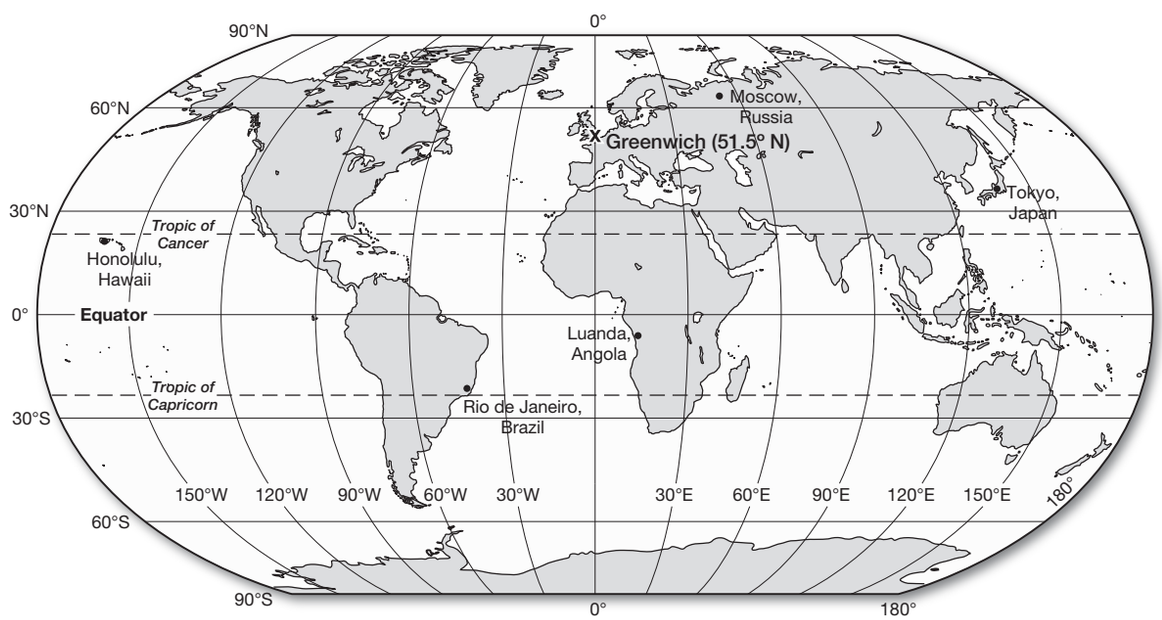
2 The Geographic Grid and Time

SECTION 1

1. Locate and give the geographic coordinates for the following cities (to a tenth of a degree if your atlas maps are detailed enough) or identify the cities from the given coordinates. The answers to a) and d) are provided for you in bracketed italics.

	City	Latitude and Longitude
a)	Greenwich, London, England	[*51.5°N 0°*]
b)	Rio de Janeiro, Brazil	***22.5° S 43.3° W***
c)	Your state's/province's capital city	***55.8° N 37.6° E***
d)	[*Tokyo, Japan*]	35.7°N 139.7°E
e)	***Luanda, Angola***	8.8°S 13.2°E
f)	***Honolulu, Hawaii***	21.3°N, 157.8°W

On the map grid in Figure 2.1, plot the coordinates in items 1 (a) through (f) above, and label the city names.



▲ Figure 2.1 **Plotting coordinates**

2. Using your knowledge of latitude and longitude, find and circle the errors in the following geographic grid coordinates. Rewrite the coordinates correctly in the space to the right. You do not have to locate these on a map. The first error is identified with a box.

   a) DMS format Lat. 57° [86′] 24″ S, Long. 149°02′(63″)N _____ [*minutes cannot exceed 60′*]

   b) DD format Lat.(105.03°)W, Long.(93.99°)E _____ ***Lat. 05.03° N or S, Long. 86.01° W***

3. If you were halfway between the equator and the South Pole and one-quarter of the way around Earth to the west of the Prime Meridian, what would be your latitude and longitude?

   45° S, 90° W

4. You are at 10°N and 30°E; you move to a new location that is 25° south and 40° west of your present location. What is your new latitudinal/longitudinal position?

   15° S, 10° W

5. You are at 20°S and 165°E; you move to a new location that is 45° north and 50° east from your present location. What is your new latitudinal/longitudinal position?

   25° N, 145° W

6. What is the antipode of your current location?

   personal answer, depending upon students' locations

7. If you wanted to dig through the center of the Earth and come up in Beijing, China, where should you start digging?

   39° S 64° W

SECTION 2

Latitude and Longitude Values

1. From the table, you can see that latitude lines are evenly spaced, approximately 111 km (69 miles) apart at any latitude. Using these values as the linear distance separating each degree of latitude, the distance between any given pair of parallels can be calculated. (*Note: Locations must be due north-south of each other.*) For example, Denver is approximately 40° north of the equator (arc distance). The linear distance between Denver and the equator can be calculated as follows:

   40° N to 0° = 40° × 111 km/1° = 4440 km

   or

   40° N to 0° = 40° × 69 miles/1° = 2760 miles

   Using these same values for a degree of latitude and an atlas for city location, calculate the linear distance in km and miles between the following sets of points (along a meridian):

   a) Mumbai, India, and the equator _____ ***19° × 111 km/1° = 2109 km or, 19° × 69 mi/1° = 1311 mi***

   b) Miami, Florida, and 10° south latitude _____ ***26° × 111 km/1° = 2886 km or, 26° × 69 mi/1° = 1794 mi***

   c) Edinburgh, Scotland, and the 5th parallel north

   51° × 111 km/1° = 5661 km or, 51° × 69 mi/1° = 3519 mi

   d) Your location and the equator _____ ***Personal answer***

2. The table also shows that the linear distance separating each 1° of longitude decreases toward the poles. For example, at 30° latitude each degree of longitude is separated by slightly more than 96 km (nearly 60 miles), and at 60° latitude, the linear distance is reduced to approximately half that at the equator. For each of the following latitudes, determine the linear distance in km and in miles for 15° of longitudinal arc (along a parallel): The first answer is provided for you in bracketed italics.

		km	miles
a)	30° latitude:	[*15° × 96.49 km = 1447 km*]	[*15° × 59.96 mi = 899 mi*]
b)	40° latitude:	***15 × 85.40 km = 1281 km***	***15 × 53.07 = 796 mi***
c)	50° latitude:	***1075.50 km (15 × 71.70 km)***	***668.25 mi (15 × 44.55 mi)***
d)	60° latitude:	***837 km (15 × 55.8 km)***	***520.05 mi (15 × 34.67 mi)***

3. Again using Table 2.1, what is the linear distance in km and miles along the parallel at your latitude from your location to the prime meridian?

Personal answer

4. What is the approximate linear distance of the following angular distances, at your present latitude?

	km	miles
One degree	***Personal answers***	
One minute of longitude		
One second of longitude		
A tenth of a degree		
One hundredth of a degree		

5. John Harrison's chronometer (a clock giving Coordinated Universal Time), lost 5 seconds during the 81-day voyage from England to Jamaica. Given that Earth rotates through 15° in 1 hour, how many degrees of longitude would the ship be off, with an error of 5 seconds? How many kilometers and miles would that be, assuming 111 km per degree of longitude?

0.02 degrees, 2.3 km or 1.4 mi

Precision and accuracy are two related concepts regarding measurements. *Precision* refers to the number of significant digits in a measurement, while *accuracy* refers to how close a measurement is to the actual figure. Giving a distance measurement as 2 km is less precise than giving it as 2.0 km or 2.00 km. If you were going to meet a friend in the Lake Nakuru National Park in Kenya, and that person's location were 0°, 36°E, how many square kilometers would you have to look through? Your friend's location is precise to 1°, so you would have to look for the person in an area 1° by 1°. At this location, 1° of both longitude and latitude are approximately 111 km (69 mi), so you would have to look for your friend in 12,321 km^2 (4761 mi^2).

6. How large an area would you have to look through if your friend's location were given 10 times as precisely, as 0.0°, 36.0°E?

123.21 km^2 (45.54 mi^2)

7. Write your friend's location with sufficient precision so that you would only have to look in an area 111 m by 111 m.

0.000°, 36.000°E

SECTION 3

Time, Time Zones, and the International Date Line

1. From the map of global time zones in Figure 2.2, determine the present time in the following cities: (For your time, use the starting time of the lab.)

Moscow ***Personal answers*** Los Angeles _____

London _____ Honolulu _____

Chicago _____ Mumbai _____

2. You may not always have a time zone map available, but by remembering the relationship of 1 hour for every 15° of longitude, you can easily calculate the difference in time between places. Indicating and using the standard meridians to determine time zones, solve the following problems. The first answer is provided for you in bracketed italics. Show your work:

a) If it is 3 A.M. Wednesday in Vladivostok, Russia (132°E), what day and time is it in Moscow (37°E)? [*The controlling meridian for Moscow is 105° away from Vladivostok's controlling meridian of 135°E* (135° − 30° = 105° *difference*). *Since Earth rotates 15° per hour, Moscow is 7 hours earlier than Vladivostok (105° difference / 15° rotation per hour = 7 hours time difference*), *therefore if it is 3* A.M.*Wednesday in Vladivostock it is 8* P.M. *Tuesday in Moscow.*]

b) If it is 7:30 P.M. Thursday in Winnipeg, Manitoba, Canada (97°W), what day and time is it in Harare, Zimbabwe (31°E)?

Calgary is at 114° W, it is closest to the 120°W standard meridian – Pacific Standard Time. However, Calgary uses Mountain Time based on the 105° W meridian, which would put Harare only 9 hours later than Calgary.

c) If you depart from San Francisco International Airport at 10:00 P.M. on Tuesday, what day and time will you arrive in Auckland, New Zealand (175°E), assuming a flight time of 14 hours?

8 a.m. Thursday

3. If there is a difference of 15° of longitude for each hour of time, how much difference in time is there for 1° of longitude? for 1′ of longitude?

4 minutes of time (1 hr or 60 min ÷ 15)

4 seconds of time (1′ = 1/60 of 1°; 4 seconds = 1/60 of 4 min)

4. What is the standard (controlling) meridian for your time zone (75°—Eastern, 90°—Central, 105°—Mountain, 120°—Pacific, 135°—Alaska, other)?

Personal answer

How many degrees of longitude separate you from this standard controlling meridian?

Personal answer

How does your distance from the standard meridian affect the difference between the time on your clocks and actual Sun (solar) time? (Calculate the difference between standard and Sun time using the answer you determined in #3 above).

Personal answer

5. Assume the time on your watch, showing local standard time, is 4:15 P.M. A chronometer reads 2:15 A.M. What is your longitude?

150° W

6. Does your community adopt daylight saving time? What are the dates for adjusting clocks in the spring and fall?

Personal answer

7. What time does your physical geography lab start

a) according to standard time? ***Personal answers***

b) according to daylight saving time? _____

c) in UTC? _____
(24-hour clock time in Greenwich, England; e.g., 3:00 P.M. = 15:00 hours)