Name: _____ **Laboratory Section:** _____

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LAB EXERCISE 2
The Geographic Grid and Time

Lab Exercise and Activities

SECTION 1

Earth's Geographic Grid

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 e) are provided for you in bracketed italics. Once you have identified the cities and found the coordinates, plot the coordinates in items 1 (a) through (h) above on the map grid in Figure 2.1, and label the city names.

	City	Latitude and Longitude
a)	Greenwich, London, England	*[51.5°N 0°]*
b)	Rio de Janeiro, Brazil	***22.5°S 43.3°W***
c)	Sydney, Australia	***33.8°S 151.2°E***
d)	Your state's/province's capital city	
e)	*[Tokyo, Japan]*	35.7°N 139.7°E
f)	***Luanda, Angola***	8.8°S 13.2°E
g)	***Honolulu, Hawaii***	21.3°N, 157.8°W
h)	***Ushuaia, Argentina***	54.8°S, 68.3°W

2. 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?

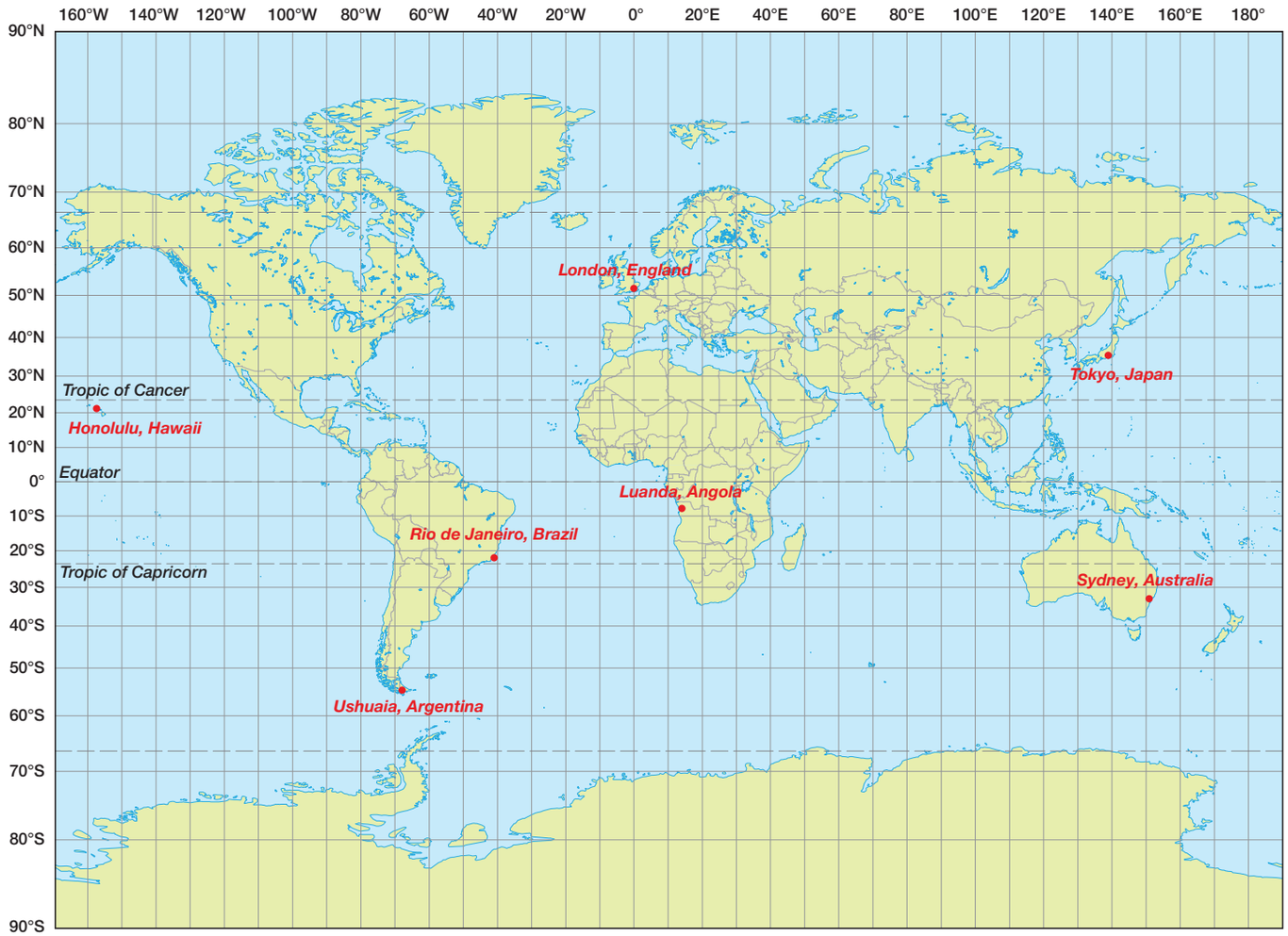
45°S, 90°W

3. 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

4. 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



▲ **Figure 2.1** Plotting coordinates

The antipode is the point on the opposite side of Earth from another point. You may have heard that if you dig straight down, you'll eventually reach China. Setting aside the difficulties of digging through the molten iron outer core of Earth, you wouldn't end up in China if you started digging from the United States.

To find the antipode of a location, you'll need to find both the latitude and longitude of the antipode. To find the antipodean latitude, convert the location's latitude to the opposite hemisphere. If the latitude is 50°N, it's antipodean latitude is 50°S. With longitude, the antipode is always 180° away. To find the antipodean latitude, simply subtract the location's latitude from 180° and change it to the other hemisphere. To find the antipodean longitude of 120°W, subtract 120° from 180°, and change it to the Eastern Hemisphere to find 60°E.

5. What is the antipode of your current location?

Personal answer, depending upon students' locations

6. 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 kilometers 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 5° 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 kilometers 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 kilometers 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. How large an area would you have to look through if your friend's location were given as 0.00°, 36.00°E?

   1.23 km²

6. 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. Which of the following standard (controlling) meridians is the standard 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

Calculate the difference between standard and Sun time using the answer you determined in no. 3 above. How many minutes ahead or behind your standard meridian are you?

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. 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

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

Personal answer

8. 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)