Solution to Quiz 2

Question 1

Consider the following data frame of points along the US border:

```
library(ggplot2)
us_map <- map_data("usa")
head(us_map, 3)

##      long      lat group order region subregion
## -101.4078 29.74224     1     1   main      <NA>
## -101.3906 29.74224     1     2   main      <NA>
## -101.3620 29.65056     1     3   main      <NA>
```

Q: If you wanted to use this data to map the outline of the United States without converting the data to a spatial object, how would you map aesthetics in the `ggplot` call, and which geom would you add?

A: For the aesthetics, I would map `long` to `x`, `lat` to `y`, and `group` to `group`. I would then add a path geom.

Code:

```
ggplot(data = us_map, aes(x = long, y = lat,
                          group = group)) +
  geom_path() +
  theme_bw()
```

Question 2

Q: If you have a SpatialPointsDataframe object that you would like to use for mapping, why might you want to convert it to a data frame object and how would you do it?

A: You may want to convert it because some plotting and mapping methods, include `ggplot2` and `ggmap`, will only input a data frame.

To convert it, you could use the `fortify` function from `gplot2`.

Question 3

Q: Which of the following are geographic tasks can you do using functions from the `ggmap` package?

A:

(1) Geocode addresses or other locations by inputting a character string with the address or location and getting back latitude and longitude listings using the Google Maps API.

Code:

```
geocode("Supreme Court of the United States")
## A tibble: 1 x 2
## lon    lat
## <dbl> <dbl>
##   1 -77.0  38.9
```

(2) Plot a ggmap object using the `ggmap` function.

Code:

```
library(ggmap)
maps_api_key <- Sys.getenv("GOOGLEMAPS_API_KEY")
register_google(key = "AIzaSyCc6OdfbbzkOAmcnhMemRzUcYHN5SUYMSM")
beijing <- get_map("Beijing", zoom = 12)
ggmap(beijing)
```

(3) Get a base map for a certain location from GoogleMaps to which you can later add points, polygons, and other shapes.

Code:

```
get_map("Baltimore County", zoom = 10,
        source = "stamen", maptype = "toner") %>%
  ggmap() +
  geom_polygon(data = baltimore, aes(x = long, y = lat, group = group),
               color = "navy", fill = "lightblue", alpha = 0.2) +
  geom_point(data = serial, aes(x = long, y = lat, color = tower)) +
  theme_void() +
  scale_color_manual(name = "Cell tower", values = c("black", "red"))
```

(5) Compute map distances using Google Maps.

Code:

```
mapdist("Baltimore, MD",
        "Washington, DC") %>%
  select(from, to, miles)
## A tibble: 1 x 3
## from          to             miles
## <chr>         <chr>          <dbl>
##   1 Baltimore, MD Washington, DC  40.2
```

Question 4

The following code uses `ggmap` to plot the walking route between the US White House and the US Capitol Building:

```
library(ggmap)
inauguration_route <- route(from = "US Capitol Building",
                            to = "White House",
                            structure = "route",
                            mode = "walking")
inaug_route_map <- get_map("Metro Center, Washington DC",
                           zoom = 14) %>%
  ggmap(extent = "device") +
  geom_path(data = inauguration_route,
            color = "darkred", size = 1.1)
```

Say you have the following data frame with the addresses of a few hotels:

```
library(dplyr)
dc_hotels <- data_frame(address =
                c("1401 Pennsylvania Ave NW, Washington DC",
                  "1331 Pennsylvania Ave NW, Washington DC")) %>%
  bind_cols(geocode(dc_hotels$address))
dc_hotels

##                                      address       lon      lat
##                                        <chr>     <dbl>    <dbl>
##   1401 Pennsylvania Ave NW, Washington DC -77.03227 38.89660
##   1331 Pennsylvania Ave NW, Washington DC -77.03084 38.89636
```

Q: How would you create a new map with these hotels added as points?

A:

```
inaug_route_map +
  geom_point(dc_hotels, aes(x = lon, y = lat))
```

Question 5

Q: What is a shapefile?

A: A format for saving spatial data. The format is not specific to R, but shapefiles can be read into or written from R using functions from packages like rgdal.

Question 6

Q: Why might you get an error running the following code?

```
library(ggmap)
get_map("Washington, DC")
```

A: Your computer is offline. The get_map function using the Google Maps API to pull the requested map into R. The function cannot post the request or receive the requested map if your computer is not online.

Question 7

TRUE or FALSE: To use data you have cleaned in R to create an interactive plot, you must export the data and code the interactive plot in JavaScript.

Q: FALSE

Question 8

Q: In which of the following formats can you interact (zoom, pan, open popups) with a map created using the `leaflet` package?

A:

(1) If you include the leaflet output in an R Markdown document that is rendered to HTML.

(2) If you run the leaflet code in RStudio.

(3) If you render the leaflet object in a Shiny App.

Question 9

You have data with spatial locations (e.g., sampling sites for a study) that you want to use to create an interactive leaflet map.

Q: Which of the following statements is true?

A: (4) The data can be in either a data frame with columns for latitude and longitude or a SpatialPoints object.

Question 10

Say you use the following code to plot a choropleth of murder arrests per 100,000 people in US states in 1973:

```
library(ggplot2)
library(dplyr)
USArrests %>%
  mutate(region = tolower(rownames(USArrests))) %>%
  left_join(map_data("state"), by = "region") %>%
  ggplot(aes(x = long, y = lat, group = group, fill = Murder)) +
  geom_polygon() +
  theme_void()
```

Q: Which of the following statements are true about this code?

A:

(1) The code is using piping (using `%>%` from the `dplyr` package) to clean up and join together geospatial data (state borders) with the USArrests data frame, and then piping this into `ggplot2` functions to create the map.

(2) The theme is added to the ggplot object to prevent x- and y-axes, x- and y-axis labels, and the background grid from being included on the final map.

(3) The group aesthetic is mapped to the group column in the data to create separate polygons for each state and to prevent unwanted lines between the borders of different states.