Provide a R notebook with code for all problems.

Problem 1: (15 points)

A population distribution is known to have standard deviation 20. Determine the p-value of a test of the hypothesis that the population mean is equal to 50, if the average of a sample of 64 observations is

(a) 52.5
(b) 55.0
(c) 57.5

Problem 2: (20 points)

The following data summary was obtained from a comparison of the lead content of human hair removed from adult individuals that had died between 1880 and 1920 with the lead content of present-day adults. The data are in units of micrograms, equal to one-millionth of a gram.

	1880-1920	Today
Sample Mean	48.5	26.6
Sample Standard Deviation	14.5	12.3
Sample size	30	100

- Do the above data establish, at the 1 percent level of significance, that the mean lead content of human hair is less today than it was in the years between 1880 and 1920? Clearly state what the null and alternative hypotheses are.
- What is the p-value for the hypothesis test in part (a)?

Problem 3: (20 points)

The following A method for measuring the pH level of a solution yields a measurement value that is normally distributed with a mean equal to the actual pH of the solution and with a standard deviation equal to .05. An environmental pollution scientist claims that two different solutions come from the same source. If this were so, then the pH level of the solutions would be equal. To test the plausibility of this claim, 10 independent measurements were made of the pH level for both solutions, with the following data resulting.

Measurement A	Measurement B
6.24	6.27
6.31	6.25
6.28	6.33
6.3	6.27
6.25	6.24
6.26	6.31
6.24	6.28
6.29	6.29
6.22	6.34
6.28	6.27

(a) Do the data disprove the scientist's claim? Use the 5 percent level of significance

(b) What is the p-value?

Problem 4: (45 points)

It is known that if a signal of value μ is sent from location A, then the value received at location B is normally distributed with mean μ and standard deviation 2. That is, the random noise added to the signal is an N(0, 4) random variable. There is reason for the people at location B to suspect that the signal value $\mu = 8$ will be sent today.

a. (15 points):

1. **(1 point)**: State the null hypothesis
2. **(3 points):** Test this hypothesis if the same signal value is independently sent five times and the average value received at location B is $X = 9.5$.
3. **(3 points):** Test this hypothesis if the same signal value is independently sent five times and the average value received at location B is $X = 8.5$.
4. **(3 points):** Test this hypothesis if the same signal value is independently sent five times and the average value received at location B is $X = 11.5$.

b. (15 points):

1. **(1 point)**: Assume that the true signal mean is 10. State the alternate hypothesis
2. **(6 points)**: Calculate probability of Type II error. Recall the definition of Type II error: Probability of accepting the null hypothesis when the alternate hypothesis is true.
3. **(4 points):** Calculate the power of the test.

c. (15 points): (How many signals need be sent so that the .05 level test of $H_0: \mu = 8$ has at least a 75 percent probability of rejection when true mean $\mu = 9.2$?