1. A researcher wishes to compare the mean weight gains associated with two diets. Available for the investigation are 12 animals from 4 litters. Identification numbers and litter numbers are provided for the animals in the table below.

Litter Number	1	1	1	2	2	3	3	3	3	4	4	4
ID Number	1	2	3	4	5	6	7	8	9	10	11	12

Suppose the researcher randomly assigns diet A to litters 1 and 4 and diet B to litters 2 and 3. The weight gain of each animal is recorded after 21 days.

   (a) What are the experimental units in this experiment?

   (b) What are the observational units in this experiment?

   (c) State the number of replications for each treatment.

   (d) Suppose that exactly 4 replications are needed for each treatment. Provide an alternative design for this experiment. Use the random digits below when assigning treatments. Be clear about which animals are to receive which treatments. Explain how you arrived at your assignments and why you chose to design the experiment as you did.

   Random Digits:

       87023   65750   41495   74627   48728   03222   24111   00190   87090   03468   40874   07437

2. For each expression below, determine a value for c that will make the expression as small as possible.

   (a) $(2 - c)^2 + (8 - c)^2 + (12 - c)^2 + (9 - c)^2 + (4 - c)^2$

   (b) $|2 - c| + |8 - c| + |12 - c| + |9 - c| + |4 - c|$

   (c) How is the value for c that you chose in part (a) related to the data points 2, 8, 12, 9, 4?

   (d) How is the value for c that you chose in part (b) related to the data points 2, 8, 12, 9, 4?

3. A horticulturist was investigating the phosphorous content of tree leaves from three different varieties of apple trees (A, B, and C). For each variety, leaf samples were taken from each of 8 trees. The phosphorous content in the leaf sample was separately measured for each tree. One sample from variety C was inadvertently destroyed before the phosphorous measurement could be taken. Thus there were 8 phosphorous measurements for each of varieties A and B, and 7 phosphorous measurements for variety C. The mean and variance of phosphorous measurements for each variety are provided below.

Variety	Mean	Variance	Sample Size
A	72	312	8
B	68	310	8
C	55	321	7

   (a) Provide an ANOVA table with columns for *Source*, *Degrees of Freedom*, *Sum of Squares*, and *Mean Squares*.

   (b) Do you think the leaves of all three varieties have the same mean phosphorous content? Provide a test statistic and an approximate p-value to support your answer.

(c) The variances of the phosphorous measurements provided in the table above are not identical for all three treatments. Is this a violation of one of the assumptions of the test conducted in part (b)? Explain.

(d) Determine a 95% confidence interval for the mean phosphorous content of leaves from trees of variety C.

4. Suppose you are going to conduct an completely randomized experiment to compare the mean response for a control treatment to the mean response for a new treatment. Based on past work, you expect the responses to be normally distributed within each treatment group and the variation of responses within each treatment group to be about 9 unit^2. If the new treatment changed the response by 1 unit, it would be important to be able to detect that difference. How many replications would be needed in each treatment group to ensure that the probability of detecting a difference in means of 1 unit would be at least 80%? Assume that you would declare a difference present if the two-sided p-value for a two-sample t-test was less than 0.05. Use the SAS program *power.sas* to help answer this question.