***Choose the one best answer for each question below by writing the corresponding letter in the blank to the left of the question. Each question is worth 1 point.***

**1.** What symbol is used to represent the sample standard deviation?

\_\_\_\_\_ **A.**  **B.**  **C.**  **D.** x **E.** s

**2.** What symbol is used to represent the population mean?

\_\_\_\_\_ **A.**  **B.**  **C.** n **D.** x **E.** s

**3.** What symbol is used to represent the sample size?

\_\_\_\_\_ **A.**  **B.**  **C.** n **D.** x **E.** s

**4.** What symbol is used to represent the probability of making a type II error?

\_\_\_\_\_ **A.**  **B.**  **C.**  **D.** x **E.** 

**5.** What type of error (if any) is rejecting a false H0?

\_\_\_\_\_ **A.** Egregious **B.** Power **C.** Type I **D.** Type II **E.** Not an error

***Answer questions 6-10 in the provided space. Please write legibly.***

1. **[5 pts]** What is the definition of a p-value and how is it used to make a decision about H0?
2. **[5 pts]** Completely describe three major differences between a population distribution and a sampling distribution**.**
3. **[5 pts]** Describe choices that you, as a researcher, can make to reduce the margin-of-error. Which is the best choice to make (statistically) **and why**?
4. **[5 pts]** Describe choices that you, as a researcher, can make to decrease the probability of making a Type II error. Which is the best choice to make (statistically) **and why**?
5. **[6 pts]** Suppose the following sets of sample means were taken from a population with a mean of 200.

Set #1. – 188.8, 189.3, 190.9, 191.0

Set #2. – 171, 184, 200, 215

Set #3. – 191.5, 193.4, 205.7, 209.4

Set #4. – 198, 199, 201, 202

Identify which set from above **best** represents each situation below.

* 1. Accurate and most precise. \_\_\_\_\_\_\_\_\_
  2. Inaccurate and most precise. \_\_\_\_\_\_\_\_\_
  3. Inaccurate and least precise. \_\_\_\_\_\_\_\_\_

***Answer questions 11-15 in the space provided. Please write legibly, clearly label each answer, and show your work (including R code) where appropriate.***

***You may find the following R hints useful.***

**library(NCStats)**

**distrib(val,mean=meanval,sd=sdval,lower.tail=FALSE,type=”q”)**

where

* **val** is a value of the quantitative variable (x) or an area (i.e., percentage, but entered as a proportion)
* **meanval** is the population mean ()
* **sdval** is the standard deviation () or error (SE; i.e., use **sdval/sqrt(nval)**, where **nval** is sample size.]
* **lower.tail=FALSE** is included for “right-of” calculations
* **type=”q”** is included for reverse calculations

1. **[20 pts]** A city planner assumes that the time it takes to plow a city block on snow days is slightly right-skewed with a mean of 45 seconds and a standard deviation of 28 seconds. Use this information to answer the questions below to three decimal places. *If you choose not to answer the question, carefully and specifically explain why.*
2. What is the probability that the mean block plow time for 40 blocks is greater than 55 seconds?
3. What is the probability that the mean block plow time for 60 blocks is between 50 and 55 seconds?
4. What is the probability that a block is plowed in less than 30 seconds?
5. What is the probability that the mean block plow time for 10 blocks is less than 50 seconds?
6. What is the IQR for the mean block plow time of 50 blocks?
7. For the following two questions, use HA: ≠120, =30, n=20, =0.10, andx=145, and assume that the population distribution is slightly right skewed.
   1. **[5 pts]** Compute the p-value and **[2 pts]** make a decision about HO from your p-value.
   2. **[5 pts]** Compute an appropriate confidence region and **[2 pts]** *with a complete sentence* interpretation of your confidence region.
8. **[5 pts]** Students in an Ecology class were tasked with determining the mean diameter-at-breast-height (dbh) of Ironwood trees on Northland’s Maxwell Property. How many trees should the students measure if they are told to estimate the mean dbh to within 3 cm with 95% confidence and assuming the same standard deviation (=15 cm) as last year’s class.
9. Keepers at the Duluth Zoo are required by regulation to provide alternative stimuli for the zoo’s polar bear if the mean time that it spends interacting with the current stimuli (e.g., a ball that is filled with food treats) falls below 120 minutes per day in the previous year. To assess the need to change stimuli, the keepers recorded the time the bear spent with the current stimuli for a random sample of 30 days over the last year. The mean time with the stimuli for those 30 days was 110.4 minutes. The keepers assume from previous observations that the distribution of time spent with the stimuli by the zoo’s polar bears is right-skewed with a standard deviation of 42 minutes. The keepers will use these results, at the 10% level, to determine if they must provide alternative stimuli for the polar bear. Use this information to answer the questions below.
   1. **[6 pts]** What are the null and alternative hypotheses? [*Make sure to define the parameter.*]
   2. **[5 pts]** Compute the p-value and, **[3 pts]** *with a complete sentence*, make a decision from the keeper’s perspective.
   3. **[5 pts]** Construct an appropriate confidence region and, **[3 pts]** *with a complete sentence*, interpret your confidence region from the keeper’s perspective.
   4. **[4 pts]** *With complete sentences*, define a Type I and a Type II error for this study from the keeper’s perspective.

**(MORE ON THE NEXT PAGE)**

1. **[4 pts]** Compute  assuming HA: <120, =30, n=20, =0.01, and the actual  is 100. *Use three decimals for all intermediate values and your final answer*.