Read each question very carefully. You are permitted to use a calculator on all portions of this exam. You are NOT allowed to use any textbook, notes, cellphone, or laptop on either portion of the exam. No part of this exam may be removed from the examination room.

In order to receive full credit for the free response portion of the exam, you must:
1. Show legible and logical (relevant) justification which supports your final answer.
2. Use complete and correct mathematical notation.
3. Include proper units, if necessary.

You have 1 hour 30 minutes to complete the entire exam.

On my honor, I have neither given nor received inappropriate or unauthorized information during this exam.

Student’s Signature: ____________________________

Do not write below this line.

<table>
<thead>
<tr>
<th>Free Response Problem</th>
<th>Possible Points</th>
<th>Points Earned</th>
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<td>2a</td>
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<td>Free Response</td>
<td>49</td>
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<td>Multiple Choice</td>
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<td>Test Total</td>
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Multiple Choice: (Questions 1 - 17) Answer the following questions on the scantron provided using a #2 pencil. Bubble the response that best answers the question. Each multiple choice correct response is worth 3 points. For your record, also circle your choice on your exam since the scantron will not be returned to you. Only the responses recorded on your scantron will be graded.

1. The auto parts department of an automotive dealership sends out a rate of 7 special orders daily. What is the probability that, for any day, the number of special orders sent out will be exactly 3 assuming the number of special orders are independent?
   
   A) \( \frac{7^3e^{-7}}{3!} \)
   
   B) \( \frac{3^7e^{-3}}{7!} \)
   
   C) \( \binom{7}{3} 0.5^3 0.5^4 \)
   
   D) Cannot solve with this information

2. The life of light bulbs (X) is distributed normally. The standard deviation of the lifetime is 20 hours and the mean lifetime of a bulb is 580 hours. Find the probability of a bulb lasting for at most 622 hours. Give the appropriate probability statement.
   
   A) \( P(X < 622) \)
   
   B) \( P(X \leq 622) \)
   
   C) \( P(Z < 2.10) \)
   
   D) All of the above
   
   E) A and C only

3. Given the following question what is the correct probability statement? A statistician calculates that 9.3% of American adults have Type 2 diabetes. If the statistician is right, what is the probability that the proportion of people with Type 2 diabetes in a sample of 150 American adults would be at least 8%?
   
   A) \( P(p > 0.08) \)
   
   B) \( P(p > 0.093) \)
   
   C) \( P(\hat{p} < 0.08) \)
   
   D) \( P(\hat{p} \geq 0.08) \)
   
   E) \( P(p < 0.08) \)

4. Find the area under the normal curve to the left of \( z = -1.76 \). (Note: calculations using table or calculator may differ slightly due to rounding)
   
   A) 0
   
   B) 0.0392
   
   C) 0.9608
   
   D) 0.4608
5. A certain chemical process reaction has a Uniform Distribution from 1 minute to 7 minutes. What is the probability that the process will react before 5 minutes?

A) 0.7143  
B) 0.6667  
C) 0.8333  
D) 0.5714  
E) 0.3333

6. Find the area under the normal curve between \( z = 0.24 \) and \( z = 2.61 \). (Note: calculations using table or calculator may differ slightly due to rounding)

A) 0.5994  
B) 0.4006  
C) 0.5948  
D) 0.0045  
E) 0.0241

7. Determine whether or not the distribution is a probability distribution and select the reason why or why not.

<table>
<thead>
<tr>
<th>( x )</th>
<th>-3</th>
<th>6</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>( P(X = x) )</td>
<td>0.31</td>
<td>0.16</td>
<td>0.1</td>
</tr>
</tbody>
</table>

A) Yes, since the probabilities lie inclusively between 0 and 1 and the sum of the probabilities is equal to 1.  
B) No, since at least one of the probability values is greater than 1 or less than 0.  
C) No, since the sum of the probabilities is not equal to 1.  
D) No, since values of at least one random variable is less than 0.  
E) Yes, since the probabilities lie inclusively between 0 and 1

8. A well-mixed cookie dough will produce cookies with a mean of 5 chocolate chips apiece. If the number of chocolate chips per cookie follows a Poisson Distribution what is the probability of getting a cookie with at most 3 chips?

A) \( \frac{5^3e^{-5}}{3!} \)  
B) \( \frac{5^0e^{-5}}{0!} + \frac{5^1e^{-5}}{1!} + \frac{5^2e^{-5}}{2!} + \frac{5^3e^{-5}}{3!} \)  
C) \( \frac{3^5e^{-5}}{5!} \)  
D) \( 1 - \left[ \frac{5^0e^{-5}}{0!} + \frac{5^1e^{-5}}{1!} + \frac{5^2e^{-5}}{2!} \right] \)
9. A researcher wishes to conduct a study of the color preferences of new car buyers. Suppose that 40% of this population prefers the color brown. If 10 buyers are randomly selected, what is the probability that no one would prefer brown?

A) \( \binom{10}{0} \cdot 0.4^{10} \cdot 0.6^{0} \)

B) \( \binom{10}{0} 0.4^{0} 0.6^{10} \)

C) \( 1 - \binom{10}{0} 0.4^{0} 0.6^{10} \)

D) \( \binom{10}{0} 0.6^{0} 0.4^{10} \)

10. Find the value of \( z \) such that 0.09 of the area lies to the left of \( z \).

A) -1.34

B) 1.34

C) 0.46

D) 0.54

11. A courier service company wishes to estimate the proportion of persons in various states that will use its services. Suppose the true proportion is 0.04. If 208 are sampled, what is the probability that the sample proportion will differ from the population proportion by NO more than 0.03? (Round your answer to 4 decimal places)

A) 0.2296

B) 0.4592

C) 0.8023

D) 0.0271

E) 0.9729

12. The standard deviation of the scores on a skill evaluation test is 123,201 with a mean of 1528 points. If 343 tests are sampled, what is the probability that the mean score of the sample will be less than 29 points? (Note: calculations using table or calculator may differ slightly due to rounding)

A) 0.50

B) 0.41

C) 0.23

D) 0.01

13. Classify the following as either a discrete random variable or a continuous random variable.

The number of words in your textbook.

A) Discrete

B) Continuous
14. A statistician calculates that 7% of Americans own a Rolls Royce. If the statistician is right, what is the probability that the proportion of Rolls Royce owners in a sample of 527 Americans would be greater than 9%? (Round your answer to 4 decimal places)

A) 0.9641  
B) 0.0359  
C) 0.3050  
D) 0.6950  
E) 0.5100

15. Determine whether or not the given procedure results in a binomial distribution.
Surveying 40 people to determine which brand of soft drink is their favorite.

A) Yes  
B) No

16. The weights of steers in a herd are distributed normally. The standard deviation is 100 lbs and the mean steer weight is 1300 lbs. Find the probability that the weight of a randomly selected steer is between 1169 and 1400 lbs. (Note: calculations using table or calculator may differ slightly due to rounding)

A) 0.0468  
B) 0.7462  
C) 0.0951  
D) 0.1587

17. A real estate agent has 14 properties that she shows. She feels that there is a 30% chance of selling any one property during a week. The chance of selling any one property is independent of selling another property. Select computations of the probability of selling at least 2 properties in one week.

A) \( \binom{14}{2} \times 0.3^2 \times 0.7^{12} \)

B) \( \binom{14}{0} \times 0.3^0 \times 0.7^{14} + \binom{14}{1} \times 0.3^1 \times 0.7^{13} + \binom{14}{2} \times 0.3^2 \times 0.7^{12} \)

C) \( 1 - \left[ \binom{14}{0} \times 0.3^0 \times 0.7^{14} + \binom{14}{1} \times 0.3^1 \times 0.7^{13} + \binom{14}{2} \times 0.3^2 \times 0.7^{12} \right] \)

D) \( 1 - \left[ \binom{14}{0} \times 0.3^0 \times 0.7^{14} + \binom{14}{1} \times 0.3^1 \times 0.7^{13} \right] \)
1. (9pts) A family is trying to decide between two different investment plans. In the long run, which plan has the higher payout?

Show your work, state which plan has the higher payout, and explain why.

<table>
<thead>
<tr>
<th>Plan A</th>
<th></th>
<th>Plan B</th>
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<tbody>
<tr>
<td>$x$</td>
<td>$p(x)$</td>
<td>$x$</td>
</tr>
<tr>
<td>$5000$</td>
<td>$0.4$</td>
<td>$-10,000$</td>
</tr>
<tr>
<td>$50,000$</td>
<td>$0.28$</td>
<td>$15,000$</td>
</tr>
<tr>
<td>$90,000$</td>
<td>$0.32$</td>
<td>$90,000$</td>
</tr>
</tbody>
</table>
2. Brian is a basketball player that has a 46% chance of making a free throw. Brian is going to shoot 8 free throws for practice, assuming all his free throw shots are independent of one another, what is the probability that…..

a. (3pts) Brian makes exactly 6 free throws? Write correct probability statement, show work, and write answer to 4 decimal places.

b. (3pts) Brian makes at least 3 free throws? Write correct probability statement, show work, and write answer to 4 decimal places.

c. (3pts) Brian makes at most 2 free throws? Write correct probability statement, show work, and write answer to 4 decimal places.
3. A company produces optical-fiber cable with a rate of 0.4 flaws per 100 feet.

a. **(5pts)** What is the probability that there will be less than 2 flaws in 100 feet of cable? Define the random variable (ie. X represents ….), write the correct probability statement, show work, and write answer to 4 decimal places.

b. **(5pts)** What is the probability that there will be exactly 3 flaws in 1600 feet of cable? Define the random variable, write the correct probability statement, show work, and write answer to 4 decimal places.
4. A humanities professor assigns letter grades on a test according to the following scheme.
   - A: Top 7% of scores
   - B: Scores below the top 7% and above the bottom 56%
   - C: Scores below the top 44% and above the bottom 19%
   - D: Scores below the top 81% and above the bottom 6%
   - F: Bottom 6% of scores

Scores on the test are normally distributed with a mean of 70.1 and a standard deviation of 9.2.

a. **(5pts) Find the minimum cut off score required for a B.** Round your answer to the nearest whole number.
   
   **Show work and clearly state answer.**

b. **(5pts) Find the maximum cut off score required for a D.** Round your answer to the nearest whole number.
   
   **Show work and clearly state answer.**
5. The mean life of a television set is 134 months with a standard deviation of 16.19 months. Assume lifetimes of television sets are normally distributed.

   a. (5pts) What is the probability of a randomly selected television set will last more than 129.2 months? Show work, give correct probability statement, and give answer to 4 decimal places.

   b. (5pts) If a sample of 95 televisions is randomly selected, what is the probability that the sample mean would be less than 129.2 months? Show work, give correct probability statement, and give answer to 4 decimal places.

6. (1 pt) If your scantron is correctly bubbled with a #2 pencil, with your correct XID, your correct test version, AND the front of your test is completed with your signature on the academic integrity statement, you earn 1 point. END OF TEST