EXAM 1  
Fall 1999  
Seat Number  
Student ID  

DIRECTIONS: Read each question carefully at the beginning of the exam period. Ask for help if the question is unclear. The number in parentheses by each question is the points for that question. Enough space is given for each question for a complete answer. Partial credit is given for partial answers. Please fill in your name and student ID now!!

You may need the following section of the Chi-square table for \( p = 0.05 \).

<table>
<thead>
<tr>
<th>d.f.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi-Square</td>
<td>3.84</td>
<td>5.99</td>
<td>7.82</td>
<td>9.49</td>
<td>11.07</td>
<td>12.59</td>
<td>14.07</td>
<td>15.51</td>
<td>16.92</td>
<td>18.31</td>
<td>19.68</td>
</tr>
</tbody>
</table>

1. (12) Short Answer. Answer each of the following questions in the space provided. You will be counted off for explanations that require more than two sentences.
   a) (4) In Meiosis, which division is equational (circle one) First __Second_ Why is it called equational?
   b) (2) What happens to the DNA during Mitotic Prophase.
      DNA condenses in preparation for division
   c) (2) What happens to the DNA during Mitotic S Phase.
      DNA is replicated.

   Your instructor said in class that heritability is not immutable. Consider yield in soybeans, with a heritability of 40% in the University fields at Clayton.
   d) (2) Describe one way he could decrease heritability.
      Decrease \( V(h) \) by inbreeding / Increase Environmental Variability
   e) (2) Describe one way he could increase heritability.
      Increase \( V(h) \) by outbreeding / Decrease Environmental Variability

2. (8) Give the name for the type of inheritance for these characteristics:
   a) \textbf{X-linked recessive} Hemophilia in Humans
   b) \textbf{Autosomal recessive} Albinism in Humans
   c) \textbf{Sex Influenced} Male Pattern Baldness in Humans
   d) \textbf{X-linked recessive} White Eyes in \textit{Drosophila}

3. (4) Only ONE of the following is a Quantitative Genetic Trait. CIRCLE the quantitative genetic trait.
   a) Your height.
   b) The score in the football game last Saturday.
   c) Your instructor’s ego.
   d) Your eye color.
   e) How tired you are right now.
4. (4) The following is a diagram showing the two Meiotic divisions. **Complete the diagrams** by drawing the chromosomes to demonstrate first division primary nondisjunction.

5. (4) The following are some of the ratios we have discussed in class. Fill in the number of the ratio **best described** by each name. Each number is used at most once.

- 1) 9:7
- 2) 15:1
- 3) 9:3:4
- 4) 9:6:1
- 5) 12:3:1
- 6) 9:3:3:1

<table>
<thead>
<tr>
<th></th>
<th>Duplicate Dominant Epistasis</th>
<th>Duplicate Recessive Epistasis</th>
<th>Single Dominant Epistasis</th>
<th>Single Recessive Epistasis</th>
</tr>
</thead>
</table>
6. (13) The following is a pedigree for a **Simple Recessive Trait**.

```
I  aa  Aa
   \-----\-----
   |      |      |
   |      |      |
   |      |      |
   \-----\-----
 II  aa  Aa
     \-----\-----
      |      |      |
      |      |      |
      \-----\-----
 III \----/ \----/
      |      |      |
      \-----\-----
 IV  \----/ \----/
      |      |      |
      \-----\-----

a) Write the genotypes for all individuals in Generations I - III. Give probabilities for the genotypes when you can, and a dash (-) when you cannot.

b) The probability the indicated individual in Generation IV will have the characteristic is \( \frac{1}{28} \).

7. (16) We are studying various physical characteristics of pinto beans. We have discovered a variety with **purple flowers** (vs. the normal **blue**) and **Long Stems** (vs. the normal **short**). We feel they are Simple Mendelian Traits. To test this, we do a dihybrid cross. The following are the results.

<table>
<thead>
<tr>
<th>Phenotype</th>
<th>Observations</th>
<th>Expected</th>
<th>Chi-Square</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purple Long</td>
<td>21</td>
<td>13.9375</td>
<td>3.5788</td>
</tr>
<tr>
<td>Purple Short</td>
<td>33</td>
<td>41.8125</td>
<td>1.8573</td>
</tr>
<tr>
<td>Blue Long</td>
<td>49</td>
<td>41.8125</td>
<td>1.2355</td>
</tr>
<tr>
<td>Blue Short</td>
<td>120</td>
<td>125.4375</td>
<td>0.2357</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>223</strong></td>
<td><strong>223</strong></td>
<td><strong>6.9073</strong></td>
</tr>
</tbody>
</table>

a) Complete the Table.

b) State the hypothesis for this experiment.

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Flower color + Stem length are *Simple Mendelian* Traits.

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c) What are the **degrees of freedom** for this experiment? 3

d) The statistical conclusion is (circle one) **Reject the Hypothesis** or **Fail to Reject the Hypothesis**

e) State your conclusion of this test in terms of the genetics involved for this experiment. Be careful how you word your conclusion.

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The data are consistent with flower color + stem length as *Simple Mendelian* Traits.
8. (12) Your instructor’s fascination with the squirrels on campus has led him to a behavioral study of the squirrels in the Quad. He was able to isolate a Camouflage gene and an Aggression gene. These two traits are on different chromosomes. The Camouflage allele is dominant (vs. Noncamouflage). The Aggression allele is recessive (vs. Docile), and is only expressed when the squirrel is camouflaged. The usual dihybrid cross is done. What are the expected frequencies of these traits among the F₂?

<table>
<thead>
<tr>
<th>Camouflaged &amp; Aggressive</th>
<th>Camouflaged and Docile</th>
<th>Noncamouflaged and Aggressive</th>
<th>Noncamouflaged and Docile</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/16</td>
<td>9/16</td>
<td>0</td>
<td>9/16 = 1/4</td>
</tr>
</tbody>
</table>

9. (9) In his youth, your instructor was a swallow (the bird) breeder for the Monty Python troupe. They were interested in increasing the terminal velocity of the bird. The breed used had a mean velocity of 53 mph, with a standard deviation of 0.75 mph. The estimated heritabilities were 0.85 and 0.35 for heritability in the broad and narrow sense, respectively. In order to increase the terminal velocity, they kept the fastest 10% in a standard mass selection scheme.

- Proportion Selected (p) = 0.5
- Selection Intensity (I) = 0.8
- Standardized Selection Point (Z) = 0.67

Include relevant units for all answers.

a) What is the selection response for this experiment?
   \[ SR = (\sigma I) I \]
   \[ = (0.75 \text{ mph})(1.76)(0.35) \]
   \[ = 0.462 \text{ mph} \]

b) What is the expected mean velocity among the offspring of the selected individuals?
   \[ M + SR \]
   \[ 53 \text{ mph} + 0.462 \text{ mph} = 53.462 \text{ mph} \]

c) What is the expected mean of the group of birds that your instructor selected as the parents?
   \[ M + SD = M + \sigma I \]
   \[ = 53 \text{ mph} + (0.75 \text{ mph})(1.76) \]
   \[ = 54.375 \text{ mph} \]
10. (10) A man has blood type AB and a woman has blood type O. Answer the following questions concerning this couple.
   a) Give the antigens present in the blood of each. Man \( A^B \) Woman \( \text{None} \)
   b) Give the antibodies present in the blood of each. Man \( \text{None} \) Woman \( A^A, B^B \)
   c) What are the expected frequency of blood types among their offspring?
      \[
      A \quad B \quad AB \quad O \quad O
      \]
   d) What are the possible blood types (considering only the ABO locus) of the parents of the Man? (Write Yes or No in the blanks provided).
      \[
      A \quad \text{Yes} \quad B \quad \text{Yes} \quad AB \quad \text{Yes} \quad O \quad \text{No}
      \]
   e) What are the possible blood types (considering only the ABO locus) of the parents of the Woman? (Write Yes or No in the blanks provided).
      \[
      A \quad \text{Yes} \quad B \quad \text{Yes} \quad AB \quad \text{No} \quad O \quad \text{Yes}
      \]

11. (8) Consider the following pedigrees. For each pedigree, circle if that pedigree gives evidence that excludes X-Linked Recessive inheritance.
    X-Linked Can be Excluded \( \quad \) Cannot be Excluded
    \[
    \begin{array}{c}
    \text{Excluded} \\
    A^Y \quad a^a \\
    a^b \\
    A^x \quad A^x
    \end{array}
    \quad \begin{array}{c}
    \text{X-Linked Can be Excluded} \\
    A^x \\
    a^Y \\
    a^b \quad a^a \\
    \end{array}
    \quad \begin{array}{c}
    \text{X-Linked Can be Excluded} \\
    A^x \\
    a^Y \\
    A^x \quad A^Y \\
    a^Y \quad a^x \quad a^x \quad a^Y
    \end{array}
    \quad \begin{array}{c}
    \text{X-Linked Can be Excluded} \\
    A^Y \\
    a^x \quad a^x \quad A^Y
    \end{array}
    \]