A homozygous line of parakeets with **blue feathers** and **banded wings** was crossed to a homozygous line of parakeets with **green feathers** and **unbanded wings**. The F1 progeny from this cross had **green feathers** and **banded wings**. Brother to sister matings were conducted among the F1 animals and the following F2 progeny were recovered:

Green feathers and banded wings	121
Green feathers and unbanded wings	29
Blue feathers and banded wings	33
Blue feathers and unbanded wings	2
Total	185

a. If the genes that produced these phenotypes were unlinked, what would be the expected numbers of F2 cross progeny in each of the phenotypic classes?

b. Use a chi-squared test to determine if these genes are linked. The Equation for Chi Squared is below, and the Chi Squared table is on the last page of the exam.

$$X^2 = \sum \frac{(Observed - Expected)^2}{Expected}$$

c. State in a single complete sentence: what is your interpretation of this Chi Squared result?

Ans

a) Make a cross between parents PPSS(green and unbanded) x ppss(blue and banded)

F1 generation all are heterozygous (**PpSs X PpSs**).

following table shows a dihybrid cross between two heterozygous parents (**PpSs X PpSs**). The four gametes of each parent are shown along the top and left sides of the table.

Gametes	**PS**	**Ps**	**pS**	**ps**

PS	**PPSS**	**PPSs**	**PpSS**	**PpSs**
Ps	**PPSs**	**PPss**	**PpSs**	**Ppss**
pS	**PpSS**	**PpSs**	**ppSS**	**ppSs**
ps	**PpSs**	**Ppss**	**ppSs**	**ppss**

This table shows four different phenotypes with the following fractional ratios:
9/16 : green and unbanded

3/16: green and banded

3/16: blue and banded

1/16: blue and banded

b) This cross is produced by a dihybrid cross (**PpSs X PpSs**). involving two pairs of heterozygous genes resulting in a theoretical (expected) ratio of 9:3:3:1.

We can test our hypothesis using **chi square**.

1. For the observed number (Column 2), enter the number of each phenotype

2. To calculate the observed ratio (Column 3), divide the number of each phenotype by 2 (the lowest number)

3. For the expected ratio (Column 4), use 9:3:3:1, the theoretical ratio for a dihybrid cross. The fractional ratios for these four phenotypes are 9/16, 3/16, 3/16 and 1/16.

4. To calculate the expected number (Column 5), multiply the number of each phenotype by the expected fractional ratio for that grain phenotype.

5. In the last column (Column 6), for each grain phenotype take the observed number of phenotype (Column 2) and subtract the expected number (Column 5), square this difference, and then divide by the expected number (Column 5). Round off to three decimal places.

6. To calculate the chi square value, add up the four decimal values in the last column (Column 6).

Phenotype (Column 1)	**Observed Number** (Column 2)	**Observed Ratio** (Column 3)	**Expected Ratio** (Column 4)	**Expected Number** (Column 5)	**[Obs No. - Exp No.]^2 ÷ Expected No.** (Column 6)
Green feathers and banded wings	121	60.5	**9**	**185x 9/16 =104**	**289/104 = 2.77**
Green feathers and unbanded wings	29	14.5	**3**	**185 x 3/16 = 34.6**	**31.3/34.6 = 0.906**
Blue feathers and banded wings	33	16.5	**3**	**185 x 3/16 =34.6**	**2.56/34.6 = 0.073**
Blue feathers and unbanded wings	2	1	**1**	**185 x 1/16 =11.5**	**1/11.5= 0.086**
Total Number:	**185**	----------	----------	**Chi Square Value:**	**3.835**

7. **Degrees Of Freedom:** Number of phenotypes - 1. In this problem the number of phenotypes is four; therefore, the degrees of freedom (df) is three (4 - 1 = 3). In the given Table locate the number in row three that is nearest to your chi square value of 3.83.

c) **Probability Value:** In the following Table , find the number in row three that is closest to your chi square value of 3.83. In this case the probability value that lines up with 3.83 is .50. This number means that the probability that your hypothesis is correct is 0.50 or 50 percent. The probability that your hypothesis is incorrect is 0.50 or 50 percent