BIOLOGY
SECTION II
Time—1 hour and 30 minutes

Directions: Answer all questions.

Answers must be in essay form. Outline form is not acceptable. Labeled diagrams may be used to supplement discussion, but in no case will a diagram alone suffice. It is important that you read each question completely before you begin to write. Write all your answers on the pages following the questions in the pink booklet.

1. In fruit flies, the phenotype for eye color is determined by a certain locus. ***E*** indicates the dominant allele and ***e*** indicates the recessive allele. The cross between a male wild-type fruit fly and a female white-eyed fruit fly produced the following offspring.

	Wild-type Male	Wild-type Female	White-eyed Male	White-eyed Female	Brown-eyed Female
F1	0	45	55	0	1

The wild-type and white-eyed individuals from the F1 generation were then crossed to produce the following offspring.

F2	23	31	22	24	0

(a) Determine the genotypes of the original parents (P generation) and explain your reasoning. You may use Punnett squares to enhance your description, but the results from the Punnett squares must be discussed in your answer.

(b) Use a Chi-squared test on the F2 generation data to analyze your prediction of the parental genotypes. Show all your work and explain the importance of your final answer.

(c) The brown-eyed female in the F1 generation resulted from a mutational change. Explain what a mutation is, and discuss two types of mutations that might have produced the brown-eyed female in the F1 generation.

Question 1 (continued)

(a) Maximum 4 points

1 pt Genotypes of the parents (words or symbols) X^EY (or X^+Y) and X^eX^e
1 pt Discuss/show how these resulted in this F1 (may be annotated Punnett)
1 pt Explain that it is a sex-linked (X-linked) gene (not just the word)
1 pt How you know which type is dominant
1 pt F2 results (may be annotated Punnett square)

(b) Maximum 4 points

1 pt Correct F2 hypothesis (1:1:1:1; or 25/genotype)
1 pt Show work (components): o e o-e $(o-e)^2$ $(o-e)^2/e$
(or correct numbers (4/25 + 36/25 + 1/ 25 + 9/25 = 50/25 = 2; or at least the last term)
1 pt Sum: correct chi-square result ~ 2.0 or 1.85
1 pt degrees of freedom = 3 (critical value is 7.82)
1 pt correct interpretation of chi-square in terms of p
p = probability that the difference between the observed and the expected value is due to chance alone.
This p value shows we accept our hypothesis.
The null hypothesis is supported in this case.
(alternative: 2 X^2 tests of white *vs.* red males and white *vs.* red females)

(c) Maximum 4 points

1 pt Explain what a mutation is: (heritable) change in the DNA (code)
1-2 pts Discuss 2 types of mutations
May be: Point mutation, frameshift (deletion/duplication), insertion, transposition, break, inversion within gene, base substitution, nonsense/stop, missense)
May NOT be: chromosomal aberration, nondisjunction, silent/neutral, transcription or translation or processing error
1 pt Molecular or biochemical elaboration beyond the explanation required