BIO 201 Mendelian Genetics Practice Problems

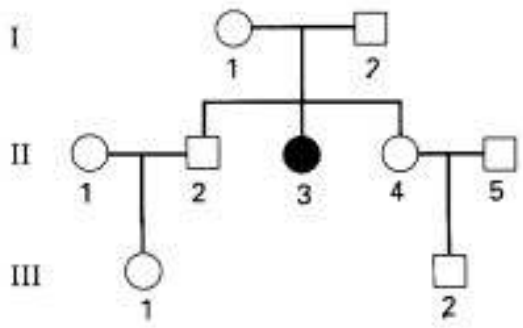
1. In a certain species of plants, purple flowers are dominant to white. When a particular purple-flowered plant is self-fertilized, the progeny are 28 purple-flowered and 11-white flowered. (a) What is the genotype of the plant that was selfed? (b) What proportion of the purple-flowered progeny is expected to be true-breeding (pure-breeding, also called "breed true")? (c) What proportion of the white-flowered progeny will breed true?

2. Suppose that in a plant species, spiny pods (S) are dominant to smooth (s). Additionally, Purple flowers (P) are dominant to white flowers (p). Consider pod shape and flower color together. What mix of phenotypes would you expect in each of the following crosses? State your assumption(s).

   a. *PP ss* x *pp SS*
   b. *Pp SS* x *pp ss*
   c. *Pp Ss* x *Pp SS*
   d. *Pp Ss x Pp ss*
   e. *Pp Ss* x *Pp Ss*
   f. *Pp Ss* x *pp ss*

3. Consider the plant species mentioned in question (2). Suppose that a pure breeding Spiny, purple plant is crossed with a pure breeding smooth, white plant. (a) What will be the phenotype of F1 and F2? (b) What will be the phenotypes of the progeny from a cross between the F1 and the Purple, spiny parent? (c) What will be the phenotypes of the progeny from a cross between the F1 and the smooth, white parent? (d) In the F2 generation, what proportion of the progeny will be homozygous for dominant alleles at both loci?
4. Continuing with the plants mentioned in question (2), a spiny purple plant is bred with a spiny white plant. Among the progeny, we find 29 spiny-purple, 32 spiny-white, 10 smooth-purple and 11 smooth-white. Deduce the genotypes of the parents.
5. Again, continuing with the plants mentioned in uestion (2), two spiny-purple plants are crossed and they produce a large number of seeds which are all collected and stored. Just two seeds are planted. One grows into a spiny-white plant and the other grows into a smooth-purple plant. If all the seeds were planted, what would be the expected phenotypes and their ratios?

6. Phenyloketonuria is a caused by a recessive autosomal allele. In the pedigree below, the female (dark circle) in the pedigree is affected with phenylketonuria. If person III-1 and III-2 were to marry (they are first cousins), what is the probability that their child will be affected? Assume that II-1 and II-5 are dominant homozygotes.



7. Mendel used several characters for his crosses. Consider three of these- Purple flower dominant to white; Round seeds dominant to wrinkled; Yellow seed dominant to green. A pure breeding purple-wrinkled-yellow plant is crossed with a pure breeding white-round-green plant. (a) Write the genotypes of the parents (b) Write the genotype and phenotype of the F1 (c) How many different types of gametes can the F1 produce? (d) What proportion of the F2 progeny will be heterozygous at all loci? (e) What proportion of the F2 progeny will be Purple-Round-Green? (f) What assumption(s) did you make in answering these questions?

For the next questions, you should use the Chi-Square tables given below. You CANNOT use ANY OTHER Chi-square table. Answer the following questions-

8. Fill in the blanks in the table below

Degrees of Freedom (df)	Alpha (α)	Chi-Square (critical) Value
1	0.05	
5		12.833
14	0.1	
19	0.975	

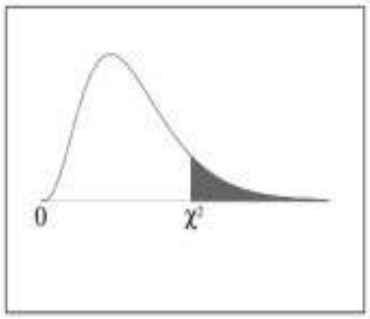
9. In the garden pea, yellow cotyledon color is dominant to green, and inflated pod shape is dominant to the constricted form. In a cross of pure breeding Yellow-Inflated to a pure breeding green-constricted, the F2 progeny were as follows-

193 green, inflated
184 yellow constricted
556 yellow, inflated
61 green, constricted

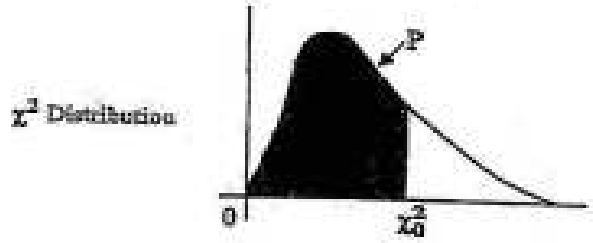
Do these two genes assort independently? Support your answer using Chi-square test for goodness of fit. Show all the steps for doing a Chi-square test ie., state the null hypothesis, Alpha, df, Critical Chi-square value, calculated chi-square value and the final conclusion.

10. Three scientists, Erich von Tschermak-Seysenegg, Carl Correns and Hugo De Vries rediscovered the work of Mendel in late 1890s. Two of them, Tschermak and Correns, repeated some of the classic crosses of Mendel. Both of them crossed plants having yellow pods with plants having green pods. The F1 were all yellow. The F1 were selfed to yield F2. Tschermak, in his experiments, observed 3580 yellow and 1190 green progeny in the F2. Correns found 1394 yellow and 453 green F2 progeny in his experiments. Use teh Chi-squared test for goodness of fit to test if the results (ie., phenotypic distribution in F2) obtained by these two scientists are in agreement with the expectations based on Mendel's experiment.

Chi Square Tables



df	$\chi^2_{.995}$	$\chi^2_{.990}$	$\chi^2_{.975}$	$\chi^2_{.950}$	$\chi^2_{.900}$	$\chi^2_{.100}$	$\chi^2_{.050}$	$\chi^2_{.025}$	$\chi^2_{.010}$	$\chi^2_{.005}$
1	0.000	0.000	0.001	0.004	0.016	2.706	3.841	5.024	6.635	7.879
2	0.010	0.020	0.051	0.103	0.211	4.605	5.991	7.378	9.210	10.597
3	0.072	0.115	0.216	0.352	0.584	6.251	7.815	9.348	11.345	12.838
4	0.207	0.297	0.484	0.711	1.064	7.779	9.488	11.143	13.277	14.860
5	0.412	0.554	0.831	1.145	1.610	9.236	11.070	12.833	15.086	16.750
6	0.676	0.872	1.237	1.635	2.204	10.645	12.592	14.449	16.812	18.548
7	0.989	1.239	1.690	2.167	2.833	12.017	14.067	16.013	18.475	20.278
8	1.344	1.646	2.180	2.733	3.490	13.362	15.507	17.535	20.090	21.955
9	1.735	2.088	2.700	3.325	4.168	14.684	16.919	19.023	21.666	23.589



Degrees of Freedom	Values of P									
	0.005	0.010	0.025	0.050	0.100	0.900	0.950	0.975	0.990	0.995
11	2.603	3.053	3.816	4.575	5.578	17.275	19.675	21.920	24.725	26.757
12	3.074	3.571	4.404	5.226	6.304	18.549	21.026	23.337	26.217	28.300
13	3.565	4.107	5.009	5.892	7.042	19.812	22.362	24.736	27.688	29.819
14	4.075	4.660	5.629	6.571	7.790	21.064	23.685	26.119	29.141	31.319
15	4.601	5.229	6.262	7.261	8.547	22.307	24.996	27.488	30.578	32.801
16	5.142	5.812	6.908	7.962	9.312	23.542	26.296	28.845	32.000	34.267
17	5.697	6.408	7.564	8.672	10.085	24.769	27.587	30.191	33.409	35.718
18	6.265	7.015	8.231	9.390	10.865	25.989	28.869	31.526	34.805	37.156
19	6.844	7.633	6.907	10.117	11.651	27.204	30.144	32.852	36.191	38.582
20	7.434	8.260	9.591	10.851	12.443	28.412	31.410	34.170	37.566	39.997