Genetics 320 Problem Set Two
Solutions

1 (1 point): A pure-breeding red flower line is crossed with a pure-breeding white flower line. All the F1 individuals are green, while the F2 shows red, white, and green flowered-individuals. Crossing red and green individuals gives equal numbers of red and green-flowered offspring. Crossing white and green individuals gives equal numbers of white and green-flowered offspring. What genetic model accounts for these observations (i.e., give the genotypes and their corresponding phenotypes)?

RR = red, RW = green, WW = white

2 (1 point): U of A scientists studying life on mars found that there are three sexes, with each contributing one allele at random to its offspring. The genotype **sss** gives the dreaded *sundevil* phenotype. If the three parents are **SSs**, **sSS**, and **Sss**:

(a) What is the probability an offspring shows the *sundevil* phenotype?

(1/3)(1/3)(2/3) = 2/27

(b) What is the probability an **SSS** offspring? ***(2/3)(2/3)(1/3) = 4/27***

(c) What is the probability an **SSs** offspring?

Pr(s from P1) + Pr(s from P2) + pr (s from P3) = (1/3)(2/3)(1/3) + (2/3)(1/3)(1/3) + (2/3)(2/3)(2/3)

3 (1 point): Consider the offspring in a cross of two **AaBbCcDdEe** parents. Compute the probabilities for the following offspring:

(a) **AAbbCCee** ***answer: (1/4)(1/4)(1/4)(1/4)***

(b) **aabbccddee** ***answer: (1/4)(1/4)(1/4)(1/4)(1/4)***

(c) **aABbccDDee** ***answer: (1/2)(1/2)(1/4)(1/4)(1/4)***

(d) **A-B-ccddE-** (where **A-** = **AA** or **Aa**) ***answer: (3/4)(3/4)(1/4)(1/4)(3/4)***

4 (2 points): Consider nose hair color. Individuals have a single locus with two alleles (**H** for hair, and **N** for no hair). If present, nose hair is either red or green, with color controlled by a single locus with two alleles (**R** for red hair, **G** for green hair). Both loci assort independently. Given the following crosses, determine which alleles are dominant (**H** or **N** , **R** or **G**) and also determine the genotypes (as far as possible) of the parents in these crosses. *Hint:* The best way to examine problems of this sort is to consider the loci separately.

		Number of offspring		
	Cross	Green Hairs	Red hairs	no hair
(a)	Green X Red (***HHGG x HHRR***)	0	100	0
(b)	Green X Red (***HHGG x HHGR***)	51	53	0
(c)	Red X Red (***HHGR x HHGR***)	25	76	0
(d)	Green X No Hair (***HHGG x NN - -***)	0	0	103
(e)	Green X No Hair (***HHGG x HNGR***)	50	53	100
(f)	Green X No Hair (***HHGG x HNGG***)	98	0	102

5 (1 point): Several questions of **A**, **B**, **O** blood groups

(a) What offspring are expected in a cross between **O** and **AB** parents? Give the proportions of both blood group phenotypes and genotypes.

ii x AB gives 1/2 iA = A, 1/2 iB = B

(b) In a cross between **A** and **B** parents; **A**, **B**, **AB**, and **O** offspring were produced. What are the possible parental genotypes?

Parents are Ai and Bi, giving AB, Ai = A, Bi = B, and ii = O

(c) In a cross between **A** and **B** parents, **A** and **AB** offspring were produced. What are the possible parental genotypes?

Since all offspring have A, the A parent is AA, while the B parent is Bi

6 (2 points): Consider the following genetic model for coat color. **A-B-** individuals have agouti coat color, **A-bb** have cinnamon, **aaB-** have black, and **aabb** brown. Likewise, **D-** individuals have full color, **dd** have dilute color. Assume all three (**A/a**, **B/b**, **D/d**) loci are unlinked and consider a cross of **AABBDD** X **aabbdd**. What are the phenotypes and genotypes and their relative proportions in the F1? In the F2? Note that you don't have to write out ALL genotypes, but (where appropriate) can use **A-** instead of **AA**, **Aa**, etc.

F1 is all AaBbDd = (AaBb)(Dd) = full color agouti.

F2: Since All loci segregate independently, 3/4 are D- = full color, 1/4 are dd = dilute color. Likewise, (ignoring, for now the dilute locus) $(3/4)^2 = 9/16$ ***are A-B- = agouti, (3/4)(1/4) = 9/14 are A-bb = cinnamon, (1/4)(3/4) = aaB- = black, and*** $(1/4)^2 = 1/16$ ***are brown. Hence (9/16)(3/4) = 27/64 are agouti, (9/16)(1/4) = 9/64 are dilute agouti, etc***

7 (2 points): Suppose two loci (alleles **A/a** and **B/b**) interact to determine the number of nose hairs the following fashion: Each capital letter allele (**A**, **B**) that an individual carries adds 10 noses hairs, with **aabb** = zero nose hairs, **AABB** = 40 nose hairs, **AaBB** = **AABb** = 30 nose hairs, etc.

(a) Is there dominance here? Epistasis? Explain (simply saying yes or no is NOT sufficient).

No Dominance or epistasis, as alleles at a locus are additive and different loci are also additive

(b) In a cross of **AABB** x **aabb**, what are the proportions of the different genotypes and phenotypes in the F1? In the F2?

In the F1, all are AaBb = 20 nose hairs.

In the F2,

Genotypes	*Phenotype*	*Frequency*
AABB	*40 nose hairs*	$(1/4)^2 = 1/16$
AABb, AaBB	*30 nose hairs*	$(1/4)(1/2) + (1/2)(1/4) = 1/4$
AAbb, AaBb, aaBB	*20 nose hairs*	$(1/4)^2 + (1/2)^2 + (1/4)^2 = 3/8$
Aabb, aaBb	*10 nose hairs*	$(1/4)(1/2) + (1/2)(1/4) = 1/4$
aabb	*no nose hairs*	$(1/4)^2 = 1/16$