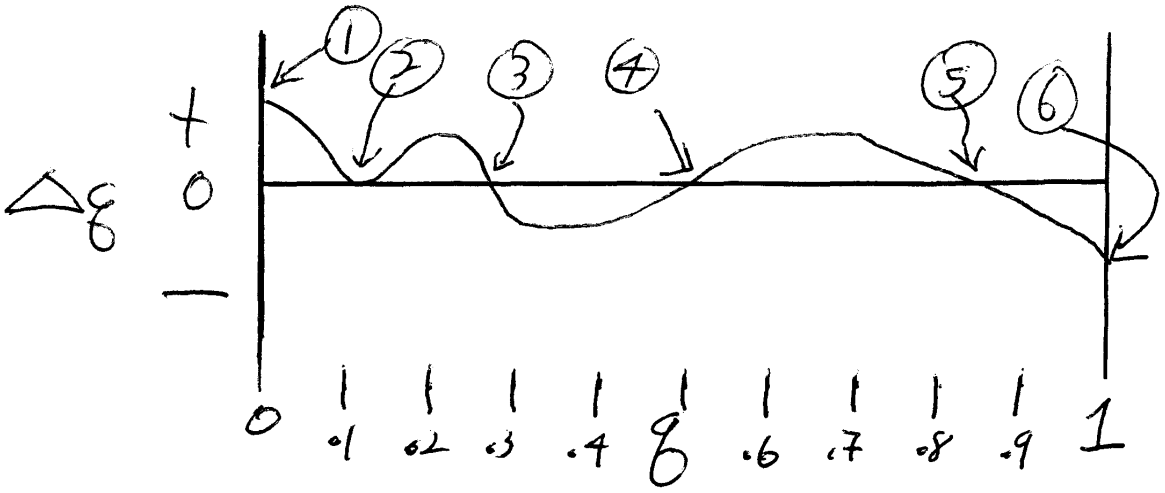
NAME: _____***KEY***_____

Notes:

1. Make sure you have your name on the test.
2. Make sure you have the correct number of pages — check now!
3. Be sure to show ALL your work on problems — credit is given for correct steps in solving the problem. The correct answer without a clear showing of the derivation of the answer will receive little or no credit.
4. Maintain silence throughout the test.
5. For multiple choice questions, put the letter of the correct answer in the blank to the left of the question number.
6. DO NOT GET UP — if you have a question, raise your hand and the instructor will come to you.
7. Read the questions carefully — misreading is a primary cause of point loss. Also be sure to answer the question that was asked.

1a. (12) Interpret the following Δq graph, by filling out the chart for each indicated point:

Point #	Equilibrium? Yes (Y) or No (N)	IF equilibrium, Trivial (T) or Interesting (I)?	IF equilibrium, Stable (S), Metastable (M) or Unstable (U)?	IF stable equilibrium, Globally stable (G) or Locally stable (L)?
1	**N**	-----	-----	-----
2	**Y**	**I**	**M**	-----
3	**Y**	**I**	**S**	**L**
4	**Y**	**I**	**U**	-----
5	**Y**	**I**	**S**	**L**
6	**N**	-----	-----	-----



__c___1b. (3) If the population whose Δq graph is shown in problem 1 started out at q = 0.2, what proportion of **hetero**zygotes would be in the population after a long time? (Choose the closest from among the following) a. 0.06 b. 0.26 c. 0.40 d. 0.66 e. 0.86

2. (14) A population consists of 100 A_1A_1, 100 A_1A_2 and 75 A_2A_2 individuals.

a. Test this population for Hardy-Weinberg genotype frequencies.

b. Use 3.84 as the critical value for your test.

100 + 100 + 75=275=N $p = \frac{100+\frac{100}{2}}{275} = 0.5455$ q=1-p=.4545

$p^2N=(.5455)^2x275=81.83$
$2pqN=2x\ 0.5455x\ 0.4545x275= 136.36$
$q^2N=.4545^2x275=56.81$

	A_1A_1	A_1A_2	A_2A_2
observed	100	100	75
expected	81.83	136.36	56.81
$\frac{(o-e)^2}{e}$	4.04	9.7	5.82

$$\chi^2 = 4.04 + 9.7 + 5.82 = 19.5541$$

(with 3-2=1 d. f.) Critical value = 3.84.χ^2 >critical value (19.6>>3.84), so NOT in H-W

3. (15) Derive and solve the recurrence equation for selection against a recessive lethal.

A_1A_1	A_1A_2	A_2A_2	genotypes
p^2	$2pq$	q^2	H-W proportions
1	1	0	fitnesses

$$q_1 = \frac{pq}{p^2+2pq} = \frac{pq}{p(p+2q)} = \frac{q}{p+q+q} = \frac{q}{1+q}$$

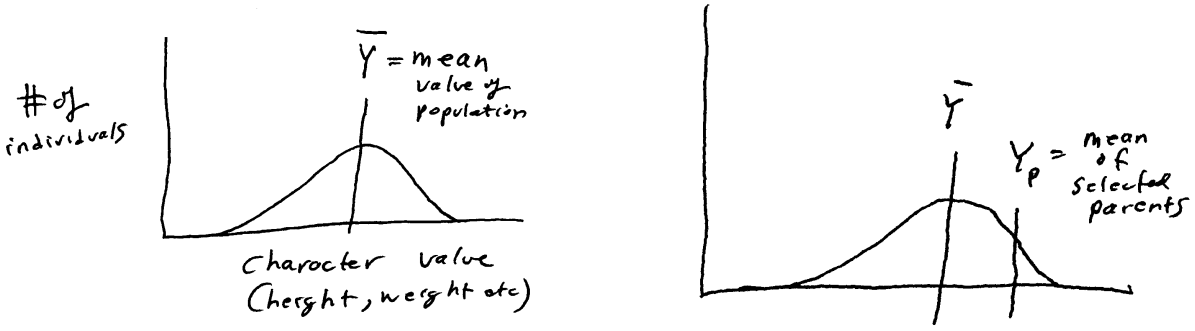
$$q_2 = \frac{q_1}{1+q_1} = \frac{\frac{q_0}{1+q_0}}{1+\frac{q_0}{1+q_0}} = \frac{\frac{q_0}{1+q_0}}{\frac{1+q_0}{1+q_0}+\frac{q_0}{1+q_0}} = \frac{\frac{q_0}{1+q_0}}{\frac{1+2q_0}{1+q_0}} = \frac{q_0}{1+2q_0}$$

$$q_3 = \frac{q_2}{1+q_2} = \frac{\frac{q_0}{1+2q_0}}{1+\frac{q_0}{1+2q_0}} = \frac{\frac{q_0}{1+2q_0}}{\frac{1+2q_0}{1+2q_0}+\frac{q_0}{1+2q_0}} = \frac{\frac{q_0}{1+2q_0}}{\frac{1+3q_0}{1+2q_0}} = \frac{q_0}{1+3q_0}$$

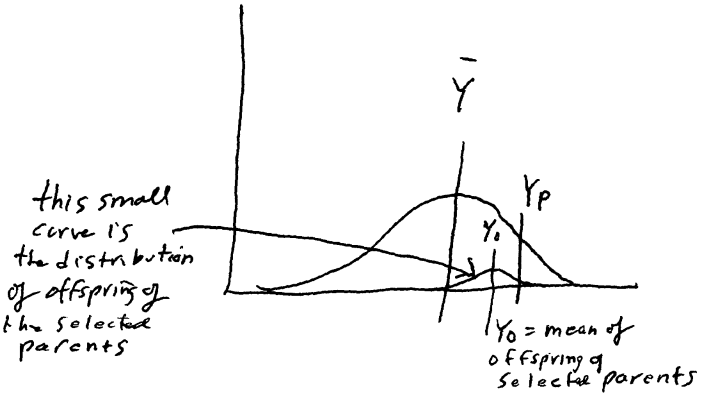
therefore, by mathematical induction,

$$q_n = \frac{q_0}{1+nq_0}$$

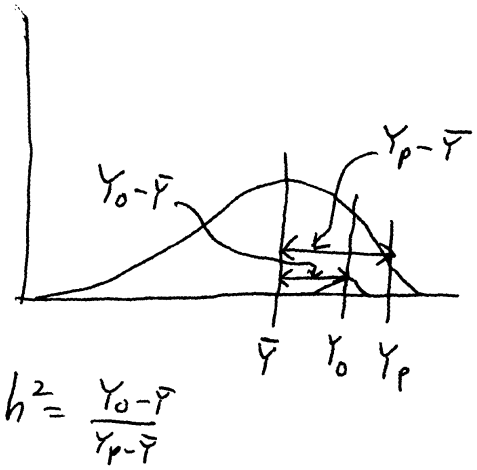
4. (14) Graphically derive the equation for heritability.



In the graph above left, the distribution of some character trait is shown for some population. The mean value of the population is denoted by $\bar{Y}$. We select parents who have a higher than average value for the trait; the mean value of the trait for these selected parents is called Y_p. Now we breed the parents together, and look at their offspring. The offspring will vary among themselves, of course, but their mean value we denote Y_O. This is shown below:



Heritability is the proportionate distance that the mean of the offspring is from the population mean to the mean of the selected parents.



___b___ 5. [Ch. 4.4] If, for many generations, individuals who are taller than average in a population survive and reproduce better than individuals at or below average, and height is heritable, we would have: a. stabilizing selection for height in this population b. directional selection for height in this population c. disruptive selection for height in this population d. selection for a trivial stable equilibrium in this population e. heterosis

__c___ 6. [Ch 4.6] The reproductive success of individuals in a population: a. is all the same b. is the same among the vast majority of the population c. varies among members of the population d. is normalized to 1 in recurrence equation calculations e. is only used in deriving the solution to a recurrence equation

___sickle cell anemia____7. [Ch 5.10] On the preceding line, give an example of a human polymorphism maintained by heterozygous advantage.

__c___8. [Ch. 5] Which of the following is **NOT** one of the forces which can cause evolutionary genetic change: a. natural selection b. mutation c. crossing over d. genetic drift e. migration

___d___9. [Ch. 9.5] The evolutionary response of a character to selection is measured by which of the following? a. quantitative variation b. degree of polymorphism c. pleiotropy d. heritability e. additive genetic epistasis

__a___ 10. [Ch. 9.8] The amount of genetic variability in a population is reduced by which of the following: a. stabilizing selection b. dispersive selection c. normalizing selection d. heritabilizing selection e. none of the preceding

__b___11. [Ch. 10.3] Gene families may originate by gene duplication by: a. normal crossing over b. unequal crossing over c. plesiosynapsis d. mitosis e. translocational concerted mutation

__b___ 12. [Ch. 10.8] Much of the nuclear genome of organisms consists of various classes of non coding DNA of which of the following types: a. Z-DNA b. repetitive DNA c. mitochondrial DNA d. chxDNA e. both a and c

__a___13. [Ch 11.4] Provided that the rate of (favorable) mutation is high enough, which of the following will happen? a. sexual populations will evolve faster than asexual populations b. sexual populations will evolve at the same rate as asexual populations c. sexual populations will evolve more slowly than asexual populations d. one cannot tell anything about the comparative rate of evolution in sexual and asexual populations e. none of the preceding

__b___14. [Ch. 11.5] The taxonomic distribution of asexual reproduction suggests which of the following: a. sexual populations have a higher rate of speciation than asexual populations b. sexual populations have a lower rate of extinction than asexual populations c. sexual populations are found primarily in animals, rather than plants d. sexual populations have a lower rate of speciation than asexual populations e. sexual populations have a higher rate of extinction than asexual populations

__b__15. [Ch. 12.8] Group selection is thought to be a generally: a. strong force in evolution b. weak force in evolution c. strong force in plants, but a weak force in animals d. strong force in animals, but weak force in plants e. none of the preceding

__d__16. [Ch. 12.11] Why do adaptations evolve? a. because they increase the fitness of organisms b. because they increase the fitness of the species or population c. because the increase the reproduction of kin groups d. because they increase the reproduction of genes e. none of the preceding

__a___ 17. [Ch. 13.2] Which of the following causes adaptation: a. natural selection b. migration c. genetic drift d. mutation e. meiotic drive

__d___ 18. [Ch. 13.7] Natural selection takes time to operate. Thus, organisms may be adapted to past, rather than present, environments. This phenomenon is called a: a. vestigal adaptation b. imperfect selective advantage c. coadaptive constraint d. time lag e. non-random imperfection