Sampe Exam 1 Solution

1) Selective breeding to reduce the frequency of an undesirable rare recessive trait in domestic species is very difficult unless:

a) The chromosomal location of the gene has been identified.
b) Heterozygotes can be identified.
c) Phenotypic evidence of the trait can be surgically removed.
d) Artificial insemination is widespread.

The correct answer is b). We mentioned this a couple of times in class: as an allele becomes rarer, proportionally more copies of it are found in heterozygotes. Therefore, for recessive traits, once they are rare it is hard to reduce their frequency much further unless heterozygotes can somehow be identified. Even if you don't remember this, answers a), c) and d) are clearly wrong. It's not clear how knowing the chromosomal location would help, surgical removal sounds positively Lamarckian, and selective breeding has worked for centuries for many species without artificial insemination.

2) The oldest known eukaryote fossils occur in the:

a) Cambrian
b) Cenozoic
c) Paleozoic
d) Mesozoic
e) Precambrian

The correct answer is e). Straightforward memory but you'd have to have zoned on most of the relevant lecture to not get this. A lot was happening by the end of the Precambrian so there were most certainly eukaryotes. The biggest danger is perhaps in confusing Cambrian and Precambrian even though you 'know' the correct answer. So check, double check and re-check your answers. Decide on a strategy for finding your mistakes and stick with it.

3) An adaptive radiation produces:

a) sterile hybrids.
b) unfilled ecological niches.
c) a group of closely related but distinct evolutionary lineages.
d) unoccupied habitats.
e) a reduction in the rate of evolutionary change.

The correct answer is c). We never defined adaptive radiation in exactly these terms but if you understood the concept this is simply a rephrasing of what I illustrated using the Drosophila example etc. In addition note that the alternate answers are often the opposite of what we might expect – adaptive radiation is likely to fill niches, occupy habitats and increase the rate of evolutionary change.

4) If an isolated human population is at Hardy Weinberg equilibrium and 10% **OF MALES** are color-blind (a sex-linked recessive trait found on the X chromosome in humans), what proportion of the population **AS A WHOLE** would you expect to be color-blind? (Assume a 50:50 sex ratio).

a) 1 %
b) 5 %
c) 5.5 %
d) 7.5 %
e) 10 %

The correct answer is c). This is a hard question. I have used it on exams in the past and have decided to retire it. Some students have complained that this question requires more logic than genetics but I'd argue it requires both. Anyway, remember that the frequency of a recessive trait in the female population (at H-W eqbm) is q^2, but in the male population is q. So if 10% of males are colorblind (q=0.1) we would expect, at H-W eqbm., only 1% of females (q^2=0.1x0.1=0.01) to be affected. Assuming a 50:50 sex ration then this would be 50 females and 50 males in a population of 100 and 5 of the males and 0.5 of the females would be affected. That's 5.5 affected individuals out of 100 or 5.5%

5) If a gene is described as polymorphic, how many alleles does it have?

a) One
b) Two
c) Three
d) Two or more

The correct answer is d). One way to become familiar with terminology (polymorphic, heterozygous, allopatric) is to use it. It can be tricky (but not impossible) in everyday conversation but when you ask questions in section or office hours, try to use the correct terminology. It will become more familiar and will save having to learn it the night before the exam. I try to reduce the terminology I give you, that which is left is important and I expect you to know.

6) A true story: A female hummingbird normally lays exactly two eggs each time she nests. Occasionally, a nest with three eggs is found, but the usual result is the loss of all three nestlings because the nest, built for two, breaks apart as they grow larger. Of course females that lay only one egg, which also occurs from time to time, raise only one young. Assuming egg number is inherited, this pattern is an example of:

a) directional selection
b) disruptive selection
c) stabilizing selection

The correct answer c). Thanks to Glenys Thomson for this one. Hummingbirds are cool. Test your powers of observation by looking for hummingbird nests. They are usually incredibly well camouflaged. Anyway, this sounds like a pretty standard example of stabilizing selection.

7) Which of the following populations is in Hardy Weinberg equilibrium?

I	25% AA	50%Aa	25%aa
II	64%AA	32%Aa	4%aa
III	81%AA	18%Aa	1%aa

a) I only
b) II only
c) III only
d) I and II only
e) I, II and III

Correct answer is e). This type of question (with I, II and III) is useful for phrasing certain types of question and helps avoid confusion. The question itself is quite straightforward although how quickly you can do it probably depends on your ability with mental arithmetic. In the midterms you will have 80 minutes to do 50 questions. Assuming some time for staring into space and filling in the tiny bubbles, this is a little over 1 minute per question. This should be plenty of time but be aware of the time. If you are slow on math problems you might want to leave them all until the end and then divide the remaining time equally between them Or better still, practice until they become more familiar. To answer the question, you need to set q^2 *= aa frequency and then solve for q, calculate p from 1-q and check to see if the other two frequencies correspond to* p^2 *and 2pq. In the first case* q^2 *=0.25 so q=0.5. Therefore p =0.5, so* p^2 *should be 0.25 and 2pq should be 0.5 – which they are. In the second case* q^2 *=0.04 so q=0.2. Therefore p =0.8, so* p^2 *should be 0.64 and 2pq should be 0.32– which they are. In the third case* q^2 *=0.01 so q=0.1. Therefore p =0.9 so* p^2 *should be 0.81 and 2pq should be 0.18– which they are.*

8) Because of differences in breeding times, two species of frog do not mate at the same time and so do not produce interspecific hybrids. The isolating mechanism is:

a) behavioral
b) mechanical
c) temporal
d) hybrid breakdown

Correct answer is c). We can't actually rule out the others but the mechanism that is specifically mentioned (twice!) in the question is temporal isolation. There are no 'trick' questions; the obvious answer is usually the correct answer.

Use the following information to answer questions 9)-10). An X-linked recessive gene produces a red-green color-blindness in humans. A woman with normal vision whose father was color-blind has children with a color-blind man.

9) What is the probability that the first child from this mating will be a color-blind boy?

a) 0
b) 0.25
c) 0.5
d) 0.75
e) 1

The correct answer is b). Set out what you know. The woman has normal vision, so she must be XX or Xx. But her father was color blind (ie xY) so he must have passed on an x to her (if he passed on the Y she would have been a man). So she must be Xx. Her partner is color blind so must be xY. That's what we know. What are we asked for? The probability that the first child from this mating will be a color-blind boy. Well we can get that from a simple mendellian cross:

		x	*Y*
x	|	*xx*	*xY*
X	|	*xX*	*XY*

So the probability of a color blind boy (xY) is ¼ or 0.25.

10) Of the girls produced by these parents, what percentage can be expected to be color-blind?

a) 0%
b) 25%
c) 50%
d) 75%
e) 100%

The correct answer is c). See the previous comments and read the question carefully. It is asking what proportion of the GIRLS produced are color blind (xx)? In a cross of a carrier woman and a colorblind man this will be half the girls.