

1) Hamilton's rule says:

- a) $rc > b$ *b) $rb > c$ c) $c > rb$ d) $b > rc$ e) $rc = b$

2) If a phenotype has a large number of genetic components, the distribution of phenotypes is likely to be:

- a) poisson b) negative exponential c) uniform *d) normal e) chi-square

3) When constructing phylogenies, the only informative characters are:

- a) shared, ancestral ones
b) unique, ancestral ones
*c) shared, derived ones
d) unique, derived ones
e) convergences

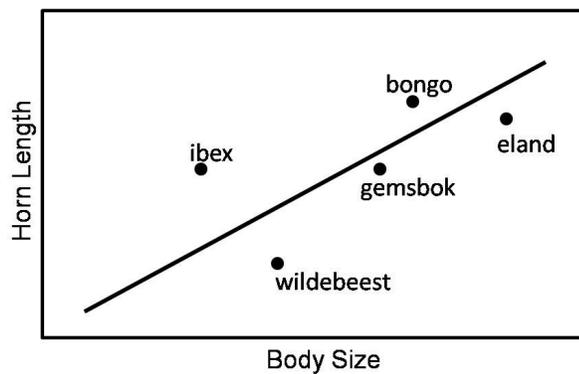
4) Sexual selection occurs when:

- a) sex is involved
b) when meiosis is costly
c) when the conditions of Hardy-Weinberg equilibrium are not met
*d) when not all individuals have equal chance of mating
e) none of the above

5) Which of the following statements about adaptation is false?

- a) adaptation may constrain evolution
b) adaptation is a hypothesis
c) adaptations lead to higher fitness
d) adaptations are the result of natural selection
*e) adaptations are differences among populations

6) You are studying the relationship between the intensity of sexual selection and horn length in antelope. If your hypothesis that sexual selection has favored longer horns is correct, which of the five species in the figure below should have experienced the greatest sexual selection?



- a) bongo
b) eland
c) gemsbok
*d) ibex
e) wildebeest

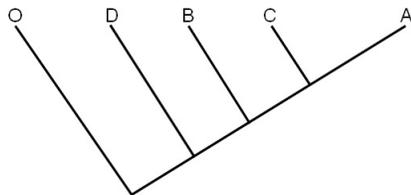
7) You are studying long-winged swallows. One of the characters that you have measured, and found to be of interest, in the study is the wing length. From a large set of data, you have determined that the phenotypic variance in wing length is 0.5. By cross-fostering eggs, you have also determined that the phenotypic covariance between the mid-parent and its offspring is 0.1. You have also been able to determine from other laboratory experiments that there is no dominance component—the only genetic effects are additive and that because everyone in the population mixes thoroughly, that there is no genetic-environmental covariance. What is the heritability of wing length?

- a) 0.5 b) 0.1 c) 0.4 *d) 0.2 e) none of the above

8) Both male and female bowerbirds are drably colored. Males and females interact only during courtship; males provide no parental care and females raise the young by themselves. Males build a horseshoe-shaped structure of sticks, the bower, which they then decorate with brightly colored objects. In particular, females prefer bowers decorated with blue objects (e.g., flowers, feathers). Females may visit the bowers of multiple males before accepting one as a mate. If female choice results from sexual selection for indirect benefits, then

- a) females should prefer a male whose bower has many non-blue objects as much as they prefer a male whose bower has only a few blue objects
 b) males whose bowers have blue ornaments should have higher mating success than males whose bowers lack blue ornaments
 c) males whose bowers have with many non-blue ornaments should have mating success that is similar to males whose bowers have only blue ornaments
 d) both sexes of bowerbirds should prefer to eat blue fruits over other colors
 *e) blue objects should be relatively rare in the environment

9) Use the table of traits and phylogeny shown below to answer the question. Group O is the outgroup. In which trait do you observe a reversal?



O	A	B	C	D
Median Ocellus	No Median Ocellus	Median Ocellus	No Median Ocellus	Median Ocellus
Rough Sculpturing	Smooth Sculpturing	Smooth Sculpturing	Smooth Sculpturing	Smooth Sculpturing
Pterygote	Pterygote	Pterygote	Pterygote	Pterygote
Tibia with spurs	Tibia without spurs	Tibia with spurs	Tibia with spurs	Tibia with spurs
Dorsal Spine	Dorsal Spine	Dorsal Spine	Medial Spine	Dorsal Spine
Respiratory Pits	Respiratory Pits	Respiratory Grooves	Respiratory Pits	Respiratory Grooves
Forked Cercus	Unbranched cercus	Unbranched cercus	Forked Cercus	Forked Cercus

- a) lack of a median ocellus in A and C
 b) respiratory pits in A and C

- *c) forked cercus in C
 d) median ocellus present in B
 e) dorsal spine in B

10) You are studying the rose-spotted numbat, which lives for one year. In this species there are two types of helpers. Type I helpers repel predators, bring food to the young and defend the territory. Having one of these helpers increases the reproductive output of the breeders by 0.5 offspring. Type I helpers are related to the young of the breeding pair by $r = 0.4$, on average. Additionally, the Type I helpers can occasionally breed and produce, on average, 0.5 offspring per year. Type II helpers do not breed, however, they are much more effective in providing help to the breeders. Their help, which is also given exclusively to the breeders (to whose young they are also related by $r = 0.4$) results in an increase of 1.5 offspring. Which of the following statements is true?

- a) Type II helpers have greater direct fitness than Type I helpers
- *b) Type II helpers have greater inclusive fitness than Type I helpers
- c) Breeders with Type I helpers have higher fitness than breeders with Type II helpers
- d) Type I helpers have greater indirect fitness than Type II helpers
- e) Type I helpers do not increase the fitness of the breeders they help