I. Matching (20%): Choose a term that best describes the explanation or examples (2 % each)

1. The phylogenetic principle which specifies the hypothesis that with simplest explanation or requiring the fewest evolutionary events is the best.
2. One clade that includes all the named descendants of a particular common ancestor.
3. The evolutionary changes in the timing of development.
4. The geographic distribution of a species is limited and restricted to a particular region.
5. The set of phenotypes that genotype is capable of expressing under different environmental conditions.
6. The evolution of novel functions from pre-existing genes and developmental pathways.
7. Developmental pathways prevent certain evolutionary trajectories from occurring because the genetic variation enabling those trajectories is not present.
8. Morphological or ecological divergence in response to competition between species.
9. The activity that enhances the fitness of other individuals but lower the fitness of the actor.
10. A strategy such that, if all the members of a population adopt it, then no mutant strategy could invade under the influence of natural selection.

Suggested items:

Altruism	Breeding strategy	Conflicts	Co-option	Developmental constraint
Developmental plasticity	Ecological character displacement	Endemic	Evolutionary stable strategy	Heterochrony
Heterotopy	Maximum likelihood	Maximum parsimony	Monophyletic group	Mutualism
Norm of reaction	Polyphyletic group			

II. Short Answers (70%): Please provide your answer in no more than 150 words.

1. Dispersal and vicariance are both important processes to determine species distribution and even cause speciation. For example, we would like to know whether one deer species common to both Taiwan and China are previously introduced to Taiwan or anciently distributed at both sides across the Taiwan Strait. Provide your opinions on how to distinguish between these two processes. (10%)
2. How can we test whether the appearance of one population individuals in certain habitat is the result of local adaptation? (5%) How do you think the geographic and altitudinal ranges of high altitude plants in Taiwan will be affected when global warming arrive? (5%)
3. When comparing speciation rates in closely related clades of flowering plants show that flower shape with bilateral symmetry is correlated with higher rate of forming new species than those with radial symmetry. Provide your explanation of why (5%).
4. The homeotic gene sequences (homeoboxes), which help to direct body development, are common to flies and mice and even plants. Given this similarity, explain why these animals are so different (5%).

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5. In the peppered moth, black individuals may be either homozygous (A_1A_1) or heterozygous (A_1A_2), whereas pale gray moths are only homozygous (A_2A_2). Suppose that in a sample of 250 moths from one locality, 108 are black and 142 are gray. Which allele is dominant? Assume that the locus is in Hardy-Weinberg equilibrium, what are the allele frequencies? Under this assumption, what proportion of the sample is heterozygous? What is the number of heterozygous? (10%)

6. In one field trip to a rain forest, you have collected two groups of tree frogs. The two groups of tree frogs are similar in morphology. Based on your previous collections and readings, you suspected that they are two different species. Propose a research project to test your hypothesis. (consider more than one species concepts) (10%)

7. Epigenetic inheritance is a growing field in recent years. Given what you have learned from population genetics, do you think epigenetic changes might contribute long-term evolution? Explain your answer. (5%)

8. Explain stabilizing selection and why is birth weight a common example of stabilizing selection. (5%)

9. The classic example of Waddington's was the use of a high-temperature "heat-shock" in *Drosophila*, which resulted in some flies having lost their wing cross-veins. Waddington demonstrated that the cross-veinless phenotype could be selected upon, suggesting considerable hidden (cryptic) genetic variation for this trait. Is Waddington's experiment an example of inheritance of acquired characteristics? Explain your results. (5%)

10. Coyne and Orr (1997) observed that sexual isolation is more pronounced between sympatric populations than allopatric populations of the same apparent age, and take this finding as evidence for reinforcement of sexual selection. Explain Coyne and Orr's idea. (2%)
It might be argued, though, that any pairs of sympatric populations that were not strongly isolated would have merged, and so would have been unavailable for study. Thus the degree of sexual isolation in sympatric compared with allopatric populations might be biased. How would you rule out this possible bias? (3%)

III. True or False (10%)

1-5 Consider the first copy of an allele for insecticide resistance that arises by mutation in a population of insects exposed to an insecticide.

1. Is this mutation an adaptation? (T/F)

2. If, after several generations, we find that most of the population is resistant, is the resistance an adaptation? (T/F)

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3. If we discover genetic variation for insecticide resistance in a population that has had no experience of insecticides, is that variation an adaptation? (T/F)

4. If an insect population is polymorphic for two alleles, each of which confers resistance against two different insecticides that are alternately applied, is the polymorphism an adaptation? (T/F)

5. Or if each of the two resistance traits an adaptation? (T/F)

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