Please answer all questions below. In most cases you should be able to answer them with 1-2 sentences. In some cases diagrams will be appropriate. Total points: 50.

1. Recall Julian Huxley's studies of courtship signals in Great-Crested Grebes, as depicted in the film "Signs and Signals."
   a. According to the concept of "ritualization," what is the origin of the behavior patterns that grebes use as courtship signals? (2 pts.)
   **Such behavior patterns arose from non-communicative behaviors such as preening or drinking**
   b. Which of Tinbergen's "Four Questions" most closely applies to the concept of ritualization (2 pts.)
   **Phylogeny**

2. The image on the screen shows crab spiders, which make their living by hiding on flowers and eating insects that come to the flower for nectar or pollen. The body color of crab spider matches that of the flower petals, making it very hard to see, at least for human observers. However, the graph at right is from a recent study showing that honey bees are more likely to land on flowers with crab spiders than on ones without them. This certainly benefits the spiders but not the bees.

   This raises some interesting questions; I would like you to offer hypotheses that would help explain this phenomenon.
   a. What is the sensory basis of the bees' ability to tell the difference between flowers with crab spiders and flowers without crab spiders?
   **Possible answers: vision (color, e.g., UV), vision (spatial pattern), olfaction; also, perhaps some other cue associated with flower quality attracts both spiders and bees.**
   b. Given that honey bees risk being eaten in an encounter with a crab spider, then it is surprising that they should be attracted to flowers with crab spiders rather than repelled by them. Explain how either of your hypotheses accounts for the bees' attraction to flowers with spiders. (3 pts.)
   **The correct answer, based on the study cited, is that the spiders show up in the UV, and this makes the flower a more conspicuous target. I accepted other answers if they were reasonable.**

3. The book describes a study in which the size of a particular brain area in men is correlated with sexual orientation. Specifically, this brain area is bigger in heterosexual than in homosexual men. What does this observation reveal about whether there is "genetic" basis for sexual orientation (5 pts.)
   **Nothing. The difference could be associated with genetic differences, or with differences in environment during childhood development or resulting from behavior in adulthood.**
4. Neural mechanisms: *briefly* define the following
   a. Receptive field (for example of a retinal ganglion cell) (2 pts.)
      The region of space, or of sensory tissue (e.g., retina) where the stimulus must occur to produce activity in the cell.
   b. Spike (2 pts.)
      Action potential
   c. Tonic response (2 pts.)
      Cell is active for as long as the stimulus is present
   d. Tuning curve (2 pts.)
      A curve (often hump-shaped) describing a cell's response to variation in a particular type of stimulus (e.g., wavelength of light)

4. Methods in behavioral research. You observe a group of large birds (Canada geese) heading south in a flock shaped like the letter V. List two distinct questions about this behavioral trait (the V shape of the flock). Then pick one of the questions and state at least two different hypotheses to answer it. Note: I’ll be grading you not on whether the questions and hypotheses are correct, but on whether you understand the difference between a question and a hypothesis.

   a. Two questions (4 pts.):
      (i) I accepted lots of possible answers: the key thing is that you needed clearly to offer questions (not hypotheses) AND the questions had to be different from another
      (ii)
   b. Two hypotheses about ONE of your questions (say which one you are addressing) (4 pts.):
      (i) Again, I accepted lots of possible answers, provided the answers were stated as hypotheses, pertained to the same question, and were different from each other.
      (ii)

5. Genes and behavior. List two different methods by which researchers can *quantify* the heritability of traits? (In other words, I am asking you to tell me which methods can measure the strength of genetic influence on traits, not just whether there is a genetic influence.)

   a. (2pts.) Artificial selection
   b. (2 pts.) Comparing relatives
6. Name one major contribution that each of the following scientists made to the study of behavior. (Emphasize how they contributed new concepts or new methodological approaches, not their findings with specific organisms.)

   a. Konrad Lorenz (2 pts.) **Examples of acceptable answers:** Imprinting as a constrained learning process; sensitive periods in learning; fixed action patterns as innate features of behavioral repertoire
   
   b. Niko Tinbergen (2 pts.) **Examples:** developed experimental approaches to behavior; use of physical models; the concept of the sign stimulus; the "four questions"

   c. Karl von Frisch (2 pts.) **Examples:** experimental approaches to behavior; provided experimental evidence for Umwelt concept; broadened appreciation for intelligence of simple animals

   d. Charles Darwin (2 pts.) **Theory of natural selection; considered behavior as part of evolved phenotype on par with morphohology**

7. Classical conditioning (as typified by Pavlov’s dog) versus conditioned taste aversion

   a. In what way are these two learning phenomena similar? (3 pts.)
   
   Both are forms of associative learning, and obey several of the same principles, namely that initially neutral stimulus must precede presentation of intrinsically meaningful stimulus, and can later acquire ability to trigger behavior.

   b. What is one way in which they are different? (3 pts.)
   
   Here are three ways: lag between E1 and E2 can be very long in conditioned taste aversion (CTA), CTA is much faster, and CTA is longer lasting

**Don'tWrite Below This Line**
6. As explained in the book and in lecture, meadow voles show sex differences in brain and behavior--males range more widely than females, have better spatial memory, and have a bigger hippocampus (a brain structure involved in spatial memory). In prairie voles (a different species), there are no sex differences in any of these traits. Consider these patterns in the framework of Tinbergen's "Four Questions." Specifically, give me one question for each of Tinbergen's Four Questions (2 pts. Each)

a. Physiological causation

b. Ontogeny

c. Phylogeny

d. Function