Examples of My Lecture Exam Questions & Expectations for Answers

1) Define the following terms, in one or two sentences
   Note: There will always be a set of terms to define in each exam, and these questions range from 5-15% of the total value of the exam.

   Examples of terms I have put on previous exams:
   prognathous
   scape
   proximal
   tagma (plural = tagmata)
   Neoptera
   elytra

   Example Answers for elytra
   A-range:
   Elytra are the sclerotized pair of fore wings on Coleoptera. They are modified to protect the hind wings and body.
   B-range:
   Fore wings of Coleoptera.
   C-range:
   Fore wings of certain insects **OR** modified wings
   D-range:
   Wings **OR** found in beetles

2) What is the difference between homology and serial homology? (8 points)

3) If I point to a spot on the back of the head, what two landmarks would you use to determine if it is the occiput or the postocciput? Explain. (10 points)

4) Describe variation in the morphology of the labium in insects (illustrate as needed). (15 points)
   Note: I could ask the same question about any of the mouthparts; I would expect a detailed comparison of the different forms of the labium found in the major insects groups that I covered in lecture. For example, grasshopper vs. flies and Hemiptera vs. butterfly vs bee would very adequately cover the range of variation.

5) Describe the morphological differences between the pronotum and metanotum of either a grasshopper or a cricket and tell me why they differ. (10 points)

6) Draw a cross-section of the beak of a mosquito/stinkbug labeling all the mouthparts and indicating the position of the food canal and the salivary canal. (12 points)

7) What types of evidence do Snodgrass and Rempel use to support their views regarding the segmentation of the head? (10 points)

8) How does the structure of the integument differ in a soft-bodied cricket and a hard-bodied beetle? (10 points)

9) What does an abductor muscle do? Give a specific example in insects. What are the functions of the tentorium? (8 points)

10) Label all the parts in the following diagram: (10 points)
Example Diagram 1 - A wing with Costa, Subcosta, 3 branches of a Radius, 2 branches of a Media, a Cubitus and 2 Anal veins.
Example Diagram 2 - A head with arrows pointing to 10 features ranging in difficulty from the compound eye to the subgenal sulcus [e.g. labrum, clypeus, frons, gena, vertex, epistomal sulcus, pedicel].
Note: Questions of this nature are graded in a straightforward manner, usually with one point for each item correctly identified, or slightly weighted (with 1.5 points for more difficult features).

11) In the head of which insects would you expect to find adductors and abductors modified as protractors and retractors and why? (15 points)

12) What parts of a crustacean (Subphylum Crustacea) and an arachnid (Subphylum Chelicerata) are homologous to the mandible, the maxilla, and the labium of an insect? You may choose any arachnid you like. (15 points)

Example Answers
A range:
The mandible is the appendage of the second post-oral segment in both Crustacea and insects (the appendage of the first is lost in Atelocerata and represented by the second antenna of crustaceans). The mandibles of crustaceans and insects are thus homologous based on position relative to head segmentation. The second post-oral segment of arachnids, such as scorpions, bears the pedipalp. One could argue, then, that the pedipalp is thus homologous to the mandible. The appendages of the third and fourth post-oral segments of crustaceans are the generally referred to as the first and second maxillae. They are homologous to the insect maxilla and labium, respectively. In scorpions, as in other arachnids, the appendages of the third and fourth postoral segments are not mouthparts but rather legs. In scorpions, these function as walking legs though in some other arachnids, the appendage of the third postoral segment functions more like an antenna than a walking leg. There are other interpretations of the homologies of head appendages across arthropod subphyla, but the one I've presented here certainly has enjoyed it's share of support over the years.
B range:
The mandible and first two maxillae of the crustacean are homologous, respectively, with the mandible, maxilla, and labium of the insect. The mandible is the second post-oral segment in both Crustacea and insects. The second post-oral segment of arachnids such as spiders is the pedipalp. The third and fourth are not mouthparts.
C range:
The mandible and first two maxillae of the crustacean are homologous, respectively, with the mandible, maxilla, and labium of the insect. Arachnids, such as spiders, do not have mandibles.
D-F range:
Crustaceans have a mandible like insects but arachnids do not. Arachnids don't have a labium, either. [no factual errors, but no substance.}
F range:
Spiders have their antennae homologous to the maxillae and labium as walking legs. Crustaceans have two antennae. [factual errors and no substance.]

13) Compare the cibarium and the mouthparts of a butterfly with that of a cricket (in addition to your thoughts on the cibarium, explain in detail the types of mouthparts in each type of insect, how they differ, and any similarities they might have). (15 points)

Example Answers

A range:

Crickets have generalized, biting, chewing mouthpart. These consist of robust mandibles used for chewing, separate maxillae with galea and lacinia used for cutting into smaller pieces and (together with the well-developed labium) tasting and manipulating the food. There is also a flap-like labrum closing the front of the oral cavity as well as a tongue-like hypopharynx on the roof of the cavity. Muscles in the clypeus contract to work the cibarial pump and pull the mascerated food and salivary juices up the food canal into the mouth. The butterfly has haustellate mouthparts using for siphoning up food in the form of nectar. Mandibles are absent, the labium is usually represented only by palps, and the proboscis consists of the paired galea of the maxillae (the only prominent mouthparts). I would expect the cibarial pump to be much stronger since the liquid food must be pulled up through the long proboscis.

B range:

Butterflies have a coiled proboscis used for siphoning food, which is pumped up the proboscis by action of the cibarial pump. They do not have chewing mouthparts: the mandibles, for example, are absent and the labium is represented only by palps. Crickets have the generalized biting, chewing mouthparts consisting of robust mandibles, separate maxillae with galea and lacinia, a well-developed labium and flap-like labrum as well as a tongue-like hypopharynx. The cibarium is smaller.

C range:

The cricket has chewing type mouthparts with generalized labium, maxillae, mandibles, and labrum; the mouthparts of the butterfly consist of a single coiled unit in which the cibarium is an important feature because it pumps the food up from the tip of the proboscis. [some detail, but far too brief.]

D range:

The butterfly will have a more developed cibarium and longer mouthparts used to obtain nectar. The cricket will have shorter, chewing mouthparts. The butterfly will have mouthparts more adapted for sucking whereas the cricket will have mouthparts adapted for chewing. [no errors, but no substance.]

F range:

The cricket has generalized mouthparts. The butterfly has a more complex and different arrangement that does have some similarities with the cricket. They both have a mandible and a maxilla but in the butterfly they are modified more for sponging and lapping than for grinding and chewing. The labium helps keep food in the mouth and in the butterfly it is more elongate and in the cricket it is like grasshoppers. The cibarium in the cricket is between the frons and the clypeus and in the butterfly it is lower on the head. [contains several factual errors.]

14) What is the difference between sternum and sternite?