1. Define the following terms. Make your definitions brief and to the point, but use complete sentences. (5 pts each)

1a. polyphyly
Grouping of taxa based on analogies, or characters that convergently evolved to be similar. Group does not include the common ancestor of taxa.

1b. biramous
Appendages, found in Crustaceans, which consist of a single base and divided into two separate parts distally. Example: biramous antennae.

1c. tracheal system
Respiratory system found in insects. Air filled tubes extend in from body wall to inner structures.

1d. tagmosis
Fusion of individual segments to form body wall, found in some insects.

2. Describe four different functions that insect appendages serve (Hint: Think about the appendages on each body region. (8 pts) (28 pts on page)

- Feeding- mouthparts
- Sensory- antennae and some legs
- Locomotion- found in legs
- Reproduction- found in abdominal region

3. Briefly describe three cautions that should be used when interpreting the fossil record (6 pts)

Fossils do not necessarily represent more primitive forms than living species.
The oldest fossil does not necessarily represent the earliest appearance of a taxon.
Fossil taxa are not necessarily ancestors of living ones

4. Discuss a major similarity between the fossil record documenting the appearance of multicellular animals and the record documenting the evolution of hexapods. (6 pts).

In both cases, the group seems to suddenly appear, relatively fully formed. Arthropods are found in the Burgess Shale, the earliest deposit of multicellular animals. Insects also appear suddenly in the fossil record.

5. Briefly review the general structure of the insect circulatory system and relate it to its major function. (8 pts).

Insects have an open circulatory system with a few vessels and chambers into which blood flows. A dorsal aorta (heart) pumps blood to the anterior from the abdomen. Blood flows around towards the ventral side and dorsally towards the heart. The system functions to distribute nutrients and to suppress parasitism.
6a. List the five mouth parts of a generalized insect and describe the function of two of these (12 pts).

<table>
<thead>
<tr>
<th>Name</th>
<th>Function (choose 2 mouthparts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Labrum</td>
<td></td>
</tr>
<tr>
<td>2) Hypopharynx</td>
<td></td>
</tr>
<tr>
<td>3) Mandibles</td>
<td></td>
</tr>
<tr>
<td>4) Maxillae</td>
<td></td>
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<tr>
<td>5) Labium</td>
<td>(32 pts on page)</td>
</tr>
</tbody>
</table>

7. You have watched the evolution of the imaginary group the Archeopods, which started as a marine, wingless species with simple eyes, which later split into four daughter species according to the phylogeny shown here. You have traced the evolution of three characters in this group.
7a. Name a character that has convergently evolved to be similar in two taxa, and name the two taxa that share the similar derived state of this convergently evolved character. (6 pts).

Compound eyes evolved in species 1 and species 4.

7b. Name two species that belong to a monophyletic group. (6 pts).

Species 1 and species 2

7c. If you were to group species 1, 2, 3 together based on their being terrestrial, what kind of character would terrestriality be? (4 pts).

Derived homology

(16 pts on page)

8. Discuss the relationship between the morphology of an insect gut and its diet. (6 pts).

Insects that consume solid food have a short straight gut with surfaces to protect against abrasion. Insects with a liquid diet tend to have longer, coiled guts to maximize absorption.

10. List the three main regions of the insect gut and briefly describe their function. (12 pts).

<table>
<thead>
<tr>
<th>Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Foregut</td>
<td>Involved in physical processing (grinding of food) and storage.</td>
</tr>
<tr>
<td>2. Midgut</td>
<td>Involved in digestion and absorption of nutrients.</td>
</tr>
<tr>
<td>3. Hindgut</td>
<td>Sorts out waste products from nutrients, water and salts.</td>
</tr>
</tbody>
</table>

12. Rank the body regions of an insect with respect to their degree of tagmosis. (6 pts).

Highest Tagmosis  Head
Intermediate  Thorax
Lowest Tagmosis  Abdomen