1. Under what condition, Lamarckism is reasonable?
2. What is the impact to biology and taxonomy after Darwin published “Origin of Species”?
3. Which categories do binomial nomenclature involved in ICZN?
4. Please explain the differences between classification and identification.
5. Please describe the contribution of systematics to biology according to your knowledge.
6. Please define the term “taxon” and explain what is “taxa”?
7. Please state the development of species concepts.
8. How does species concept affect the establishment of a new species?
9. What are the differences among sympatric, allopatric, and parapatric speciation?
10. Please state the process how a phenon is assigned to a species.
11. What are infraspecific categories? Please describe them according to your understanding.
12. How to distinguish subspecies, population, and meta-population?
13. What are the differences among cladistics, evolutionary taxonomy, and phenetics?
14. What is the new taxonomy?
15. How to distinguish homologous from analogous character?
16. What are the essential elements for describing a new species?
17. What is the type method?
18. Please explain holotype, paratype, lectotype, and neotype.
19. Please state the process of phenetic analysis.
20. Why DNA barcoding is necessary in contemporary taxonomy?

I. Please pick up one of the terms in the boxes to answer each of the following questions. (10%)

| A. typological species concept | H. genetic drift |
| B. phenetic species             | I. autapomorphy |
| C. biological species           | J. synapomorphy |
| D. ecological species           | K. symplesiomorphy |
| E. pre-mating isolating mechanism | L. monophyletic group |
| F. post-mating isolating mechanism | M. paraphyletic group |
| G. adaptive radiation           | N. polyphyletic group |
1. _________ Species are groups of interbreeding natural populations that are reproductively isolated from other such groups.

2. _________ Species are the smallest groups that are consistently and persistently distinct and distinguishable by ordinary means which is operationary and nonexplanatory based only on the observable facts of similarity and discontinuity.

3. _________ Zygote produces an F1 hybrid of reduced viability (hybrid inviability).

4. _________ Potential mates meet but do not mate (ethological isolation).

5. _________ Random changes in gene frequency in small isolated populations which is not subject to natural selection.

6. _________ Evolutionary process in which species descended from a common ancestor multiply and diverge to occupy different ecological niches.

7. _________ The common possession of a derived homologous character or shared derived character.

8. _________ The common possession of an ancestral character.

9. _________ A group of taxa descended from a single ancestral taxon.

10. _________ A group of taxa derived from two or more distinct ancestral taxa.

II. True or false : (5%)

1. _________ Scientific name refers to any Latinized formal taxonomic terms. Therefore, Homo sapiens, Insecta, and Diptera are all belong to scientific name.

2. _________ Species name means generic name and the specific name. Species name is also a kind of scientific name.

3. _________ Both generic name and specific name need to be in upper cases.

4. _________ The generic name and specific name need gender agreement.

5. _________ All the specimens used in establishing a new species are types. Among these, the holotype could include multiple specimens and must be male.

III. Essay questions

1. There are many species concepts reported. According to the historical development, four groups of species concept can be defined. Please state them. (8%)
2. What is speciation? What are the differences between sympatric and allopatric speciation? (8%)

3. What are the differences among cladistics, evolutionary taxonomy, and phenetics? (7%)

4. Do you think systematics is different from taxonomy? Why? (5%)

5. How would molecular work improve the study of systematics? (7%)

1. Do you think is taxonomy matter to your entomological study? Why and How? (15%)

2. Now a day, molecular biology is very helpful in many scientific studies, would you like to state the impact of some other techniques to Taxonomy. You may show me the example of some insects from your point of view or based on your experience. (15%)

3. According to your knowledge, what is the biogeography and what is the relationship in between phylogeny and geographic distribution? (10%)

4. What is Darwin 200? Does any relationship in between Darwin and Insect Taxonomy you would like to share us. (10%)

I. Please explain and compare the following pairs of terms: (10%)
   1. taxon vs. category
   2. variety vs. subspecies
   3. sympatric vs. allopatric
   4. catalog vs. fauna
   5. monophyly vs. polyphyly

II. Essay questions (40%)
1. Many species definitions have been proposed. The “Biological Species Concept” is the widely accepted one. However, in some circumstances, there are difficulties in applying it. Please explain what the possible difficulties are. (8%)

2. There are three major schools of macrotaxonomy, namely evolutionary taxonomy, phenetics, and cladistics. Among them, phenetics and cladistics have very different basic ideas, please explain each of these two schools and compare them. (8%)

3. What is ICZN? Please explain the “type method” and distinguish between
“holotype” and “paratype”. (8%)

4. Traditionally, morphological characters are used for identifying organisms. Recently, more and more applications have been developed using molecular techniques and people often refer to the method as “rapid identification”. Please explain why it could be considered “rapid” and further compare the advantages and drawbacks between the traditional and modern methods. (8%)

5. If you are a physiologist or an ecologist, but not a systematist, please discuss how systematics would be relevant, or even applied, to your field of study. (8%)

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1. Taxonomy is the science and practice of discovering, describing, classifying and naming species. Is taxonomy matter to Entomological study? Please providing some cases from your study or historical review and describing why and how the taxonomy effective in that cases? (15%)

2. The systematic collection is very important to taxonomists and other biologist in general beyond question. What is type method and what is holotype? Please also providing some other types that you knew before and let me know why the type series is so important to taxonomy? (15%)

3. According to your knowledge, what is the biological species concept? You should mention about the speciation, isolating mechanism and population thinking. You may compare with evolutionary species concept or some other ones as well. (15%)

4. What is the relationship and difference in between Charles Darwin (12 February 1809 – 19 April 1882), Alfred R. Wallace (8 January 1823 - 7 November 1913) and Ernst Mayr (1904-)? They are definitely the very person that affects the theory of evolution in different aspects in different time period. You may talk about the background, the critical journey and the achievement in their life. (20%)

5. What is the relationship in between following terms: biogeography, evolution and taxonomy? You could answer the question by describing a case or several cases together. (15%)

6. Please give the scientific name (Latin name) of their order, and vernacular name (both in English and in local language of your home country)) to the following insect taxa of designated (a-e) and the other five ones(f-j) proposed by yourself. 
   a. Blattaria; b. Lampyrudae; c. Gryllidae; d. Tephretidae; e. Apidae. (20%)

8/02 Ⅱ
I. Please explain and compare the following pairs of terms: (24%)
1. microtaxonomy vs. macrotaxonomy
2. phenon vs. species
3. monograph vs. revision
4. holotype vs. paratype
5. parapatric vs. peripatric
6. character vs. character state
7. convergence vs. parallelism
8. synapomorphy vs. autapomorphy

II. Essay questions (26%)
1. Please name at least three types of characters and explain the merits and the drawbacks in applying these characters in systematics. (8%)
2. Please identify the following two trees (Fig. 1 and 2) and interpret why one is belonging to phenogram and the other a cladogram. Then, please explain how phenetics and cladistics differ from each other. (10%)

Fig. 1

Fig. 2

3. When you read a paper on insect taxonomy, what are the major components included in the species description? What other extra information should be provided if it is a new species? (8%)

II

1. What is the similarity and dissimilarity in between insects, spider, mites and earthworm? Based on your knowledge, please make a key or give a table as tools for identification. 15%
2. If you are a taxonomist, what is the working procedure while you do taxonomy and identification? Can you tell me what the difference in between taxonomy and identification? 15%
3. Why taxonomy matter in the global biodiversity and sustainability issues? Please give some case studies for support. 10%
4. Does your study need any hypothesis or knowledge about biological species concept? Based on your knowledge, how many theories of species concept? And what about the relationship that related to taxonomic work? 10%
1. Taxonomy is the science and practice of discovering, describing, classifying and naming species. Would you please providing some cases to prove the taxonomic study is importance according to your own research subjects or historical review and describing why and how the taxonomy affect the applied study? (10%)

2. What is the similarity and dissimilarity in between insects, spider, mites and earthworm? Based on your knowledge, please make a key or give a table as tools for identification. (10%)

3. The systematic collection is very important to taxonomists and other biologist in general beyond question. What is type method and what is holotype? Please also providing some other types that you knew before and let me know why the type series is so important to taxonomy? (10%)

4. Please give the scientific name (Latin name) of their order, and vernacular name (both in English and in local language of your home country)) to the following insect taxa of designated ones (a-e) a. Blattaria; b. Lampyridae; c. Aphidae; d. Tephretidae; e. Apidae and the other five taxa (f-j)which you have to propose yourself. (10%)

5. If you are a taxonomist, what is the working procedure while you do taxonomy and identification? Can you tell me what the difference in between taxonomy and identification? 10%

I. Please explain and compare the following terms: (14%)
1. holotyp, neotype, and lectotype
2. synapomorphy vs. symplesiomorphy
3. classification vs. identification
4. population vs. metapopulation

II. Essay questions (36%)
1. For any named animal, it should belong to specific categories. What are the seven mandatory categories for any given named animals? What is ICZN and which categories are confined by ICZN? (10%)
2. What is DNA barcoding? Will DNA barcoding or molecular information be a replacement for traditional morphological taxonomy? Why? (8%)
3. Do the following trees represent same relationships among taxa A, B, C, D, E, and F? Why does a phenogram (Fig. 1) with a distance scale on the side while a cladogram marked characters on branches? You may explain these by the way how the trees were constructed and the different concepts between phenetics and cladistics. (10%)
4. Many species concepts have been proposed. Which species concept will you apply for defining a species? Are there other plausible ones? Why? (8%)

1. How to apply DNA characters in insect identification? Is there any criterion?

2. How sympatric and allopatric speciation make population structure different in phylogeographical distribution?

3. How to identify homologuous from analogous characters in studies of molecular phylogeny?

4. Define the following terms; species complex, species group, haplotype, haplogroup, metapopulation.

5. Commonly, insect could distribute all over Taiwan. However, it is possible to find two or more subspecies of the same insect species in Taiwan. Why?

1. Constructing phylogenetic trees will provide us the information on the relationships among the taxa analyzed. In fact, there should be only one fact in their evolutionary history. However, the result of cladistic analysis often finds more than one tree, while phenetic analysis will provide only one tree. Does it mean that the result from phenetics will reflect the evolutionary fact better? What
1. “There is already too much literature on the ‘species problem’. It has been discussed, argued over, and symposiaumed to death for years. And it is clear that there is still no final consensus as to what a species is, or even whether species exist.” The above statement is from the book “Describing species” written by Winston (1999). What is your opinion on the statement and the concept of species? And, how would species concept affect the establishment of a new species? (12%)

2. What are the differences among the three schools of systematics, namely, cladistics, evolutionary taxonomy and phenetics? Which school(s) do you favor? Why? (10%)

3. Relationship between two taxa is indicated by the existence of homologous characters. Why does homology matter? What are the
criteria available for us to determine the homologous characters? (10%)

4. Nomenclature is the system of scientific names applies to taxa and also the application of these names. In zoology, we follow the regulation ICZN. There are some important properties of scientific names, such as uniqueness, universality, stability, and priority. Please explain what is ICZN and how it related to these properties. (10%)

5. Recently our department held an insect exhibition based on the specimens donated by a retired Japanese Professor Hatta and there were other similar cases. Why would one donate his private life-long collection to an insect museum? Why is systematic collections important? (8%)

1. Define the following terms; subspecies, neotype, haplogroup, coalescent time. (20%)

2. Vicariance and dispersal are the important causes in speciation and population differentiation. Depict the possible processes in allopatric speciation through vicaricance and/or dispersal? (10%)

3. Commonly, insect could distribute all over Taiwan. However, it is possible to find two or more subspecies of the same insect species in Taiwan. Why? (10%)

4. How to apply DNA barcode in insect systematics? (10%)

1. Biological species concept has been widely accepted and applied to the solitary sexually reproducing organisms. Please explain what biological species concept is and why the isolating mechanisms are important under this concept. (10%)

2. The Binominal system developed by Linnaeus has been universally accepted and used for more than 250 years. What is the binominal system? What is the Linnaean hierarchy? Please also explain the reason for the persistence of use. (10%)
3. How are the three schools of systematics, i.e. cladistics, evolutionary taxonomy, and phenetics, differ from each other? (10%)

4. There are many insect museums in the world. What is the value of collections? How would a graduate student use museum collections for his/her research? (10%)

5. Besides morphology, what others could be applied as taxonomic characters? Are there good characters and bad characters? Why? (10%)

1. Define the following terms; species complex, coalescent time, haplogroup, metapopulation, neotype. (10%)

2. Many insect subspecies, which is related to the other subspecies distributing in neighbor areas, are endemic to Taiwan. However, two or more subspecies of the same insect species have been described in Taiwan. Why? (10%)

3. How could DNA characteristics improve the study of systematics? (10%)

4. Vicariance and dispersal are important factors in population differentiation. How sympatric and allopatric speciation mechanisms make population structure different in phylogeographical distribution? (10%)

5. Why systematic work is the essential element for biodiversity research. (10%)

1. 分類學著作(taxonomic publication)發表新種(new species)的文章應具備哪些要件? (5%) 請列出昆蟲分類學相關的國內及國際期刊共五份(5%)。10%

2. 昆蟲分類的系統經常有學者提出異動，請舉一例說明分類系統會異動(5%)。動物學家 E.Mayr 曾說「分類學的歷史，是特徵的爭
辯史」，請問此話怎麼解釋？(5%)10%

3. 分子生物學的特徵與傳統昆蟲分類及鑑定工作之關係如何？試舉實例敘述之。10%

4. 昆蟲在生態系中的功能角色多樣性很高，請就其營養方式各列舉5個科的昆蟲，列出示( order)及科( family)之中文名(Chinese name)及科學名(scientific name)與其營養階層(1)食葉性；(2)潛葉性；(3)蛀果性；(4)造癭性；(5)吸樹汁；(6)吸血性；(7)食動物毛髮皮屑；(8)腐肉分解。10%

5. 有一種昆蟲發表時為 Mitius splendens (Shiraki,1930) n. comb. 請回答下列問題。10%

1). 種名包括哪部分才是完整？
2). 屬名是什麼？
3). 種之名(或 epithet) 是什麼？
4). authorship 是指什麼？