

Test Bank for Qualification Examination

Ph.D. Qualified Examination Taxonomy and Systematics

10601

1. Please explain holotype, paratype, lectotype, and neotype. And tell me the timing of each type method to apply? (10%)
2. Now a day, molecular biology is very helpful in many scientific studies, would you like to state what is the impact to Taxonomy. Why DNA barcoding is necessary in contemporary taxonomy? Why barcoding projects apply COI ? Please full spelling COI(20%)
3. According to your knowledge, what is the species concept for and how many different species concepts do you know in the systematics? (10%)
4. Which categories do binominal nomenclature involved in ICZN(2000)? What are infraspecific categories accept in ICZN(2000) (10%)
5. Define the following terms; population, coalescent time, integrated species concept, preadaptation. (16%)
6. The fate of hybrid zones over time (10%)
7. How to recognize the speciation events were caused by punctuated equilibrium or phyletic gradualism? (10%)
8. There are five factors affect the dynamics of allele frequency in microevolution. What factors would be vital involving in macroevolution? (14%)

10502

9. Define the following terms; Punctuated equilibrium, Phyletic gradualism, integrated taxonomy, Punctuated gradualism. (18%)
10. In general, insect species could be found across an island. However, it is possible to find two or more subspecies of the same insect species in Taiwan. Why? (15%)
11. Phylogeographical history could be inferred based on the phylogenetic relationship and the associated distribution of organism. How founder and vicariance effect possibly lead to a different phylogeographical pattern? (15%)
12. If you use both molecular and morphological characters to construct phylogeny for clarifying the relationship among species within an insect family, please explain the following questions. (12%)
 - (1) When multiple genes are used, what and why you choose them?

- (2) How would you analyze these data from multiple genes and morphology?
13. If you are interested in the relationship of a host-specific group of insects and come up with some scenarios for their evolution, how would systematics help you to understand their evolution and test your hypotheses? (10%)
14. Please explain what are monophyletic group, paraphyletic group, and polyphyletic group. Would all the three types of groups are eligible to recognize as a taxon? Are there different schools in systematics providing different ideas? (8%)
15. Suppose during your long observation and rearing of a group of insects, you found one colony from an isolated area perform very differently from other colony. You realize that it should be a different species although morphological similar. Please propose how you would do to clarify the species status and what would be species concept(s) you apply. (10%)
16. Please choose three of the following scientists, explain their contribution in systematics and evolution. (12%)
- A. Carlous Linnaeus
 - B. Theodosius Dobzhansky
 - C. Willi Hennig
 - D. Ernst Mayr
 - E. Edward O. Wilson
 - F. Your own choice

10402

1. 農業害蟲及益蟲調查也是建立農業生產資訊的重要資料庫，同時也是農業生態系生物多樣性監測的重要資料。朱耀沂、吳文哲(1992)曾發表，農業害蟲種的學名常有錯誤；農業昆蟲研究，無論是害蟲或益蟲的鑑定及確認，都需要存證標本和已發表的報告同時保存在標本館，以供日後的查證及再查證。荔枝上的可可細蛾的鑑定錯誤，如果當時能保存標本供比對，則往日的研究材料，可以再比對而得到確認(楊正澤，1997)。如此其研究成果只要再鑑定，改用正確的學名，錯誤鑑定(misidentification)的名字只要列入異名表中，此篇論文依然具一定的重要性及學術價值，而不致遭到一筆抹煞，浪費已投入的研究能量。你能就上述例子加以說明嗎？
2. 這樣將生物多樣性調查結果，建立資料庫保存原始數據之外，調查的生物標本，保存起來，不但是累積標本館蒐藏量，同時更是保存證據，為

學術研究成果保值，這是一種保險制度，利用存證標本，供未來再鑑定再求證的依據。建立以存證標本(voucher)為中心之系統蒐藏，將是分類學家的新任務。請問除了上述舉的例子，或許你有其他例子，請舉例說明為何存證標本蒐藏是學術研究保值與保險的策略(10%)。

3. 請說明 1970 年代新系統分類學的特徵有哪幾類?(5%) 後來加入分子生物學特徵，分子生物特徵的特色及其發展過程，請加以說明(15%)。分子生物學特徵的應用使傳統分類系統架構產生變化，例如蚜蟲由同翅目(Homoptera)變動為半翅目(Hemiptera)，更多的例子，正在討論中。請你就所知舉兩例說明(10%)。
 4. If there is a new species included in the specimens you collected, how would you decide that it is a new species? If you plan to publish it, what information should be included in the description of the new species? Please also explain the necessary treatment and concern to have the name become valid according to the latest regulation of ICZN. (12%)
 5. How would a species diverge into different species? What kind of speciation mechanisms could be involved relating to geographic distribution? (10%)
 6. Constructing phylogenetic trees will provide us the information on the relationships among the taxa analyzed. If you have acquire both morphological and molecular characters for constructing phylogeny to clarify the relationship among many species within a genus. What kind of analysis will you conduct? How and why you do so? (12%)
 7. What is your opinion on the role a natural history museum? As many universities also hold good insect collections, should they play the same role? (8%)
 8. Please choose two of the following terms, then (1) explain the term itself and (2) interpret its relationship to Systematics. (8%)
 - A. Biodiversity
 - B. Phylogeography
 - C. DNA barcoding
 - D. Digital archiving of specimens
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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?

98/01 I

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%)

98/01 II

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%)

98/02 I

- 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, phonetics, and cladistics. Among them, phonetics 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%)

98/02 II

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%)

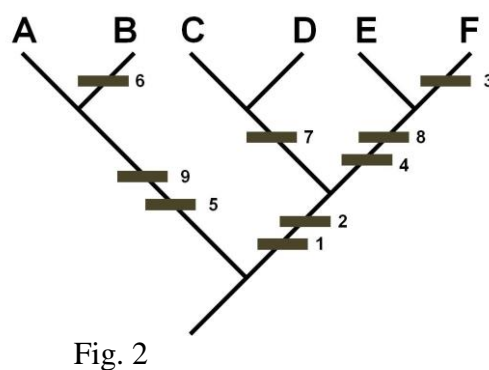
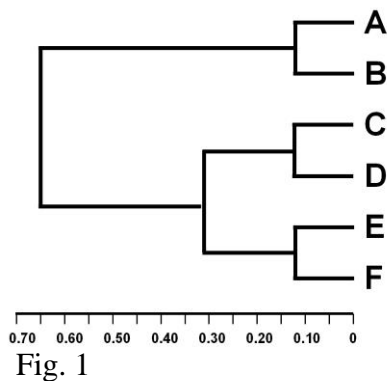
99/01 I

- 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%)



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%)

99/01 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%

99/02 I

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%

99/02 II

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%)

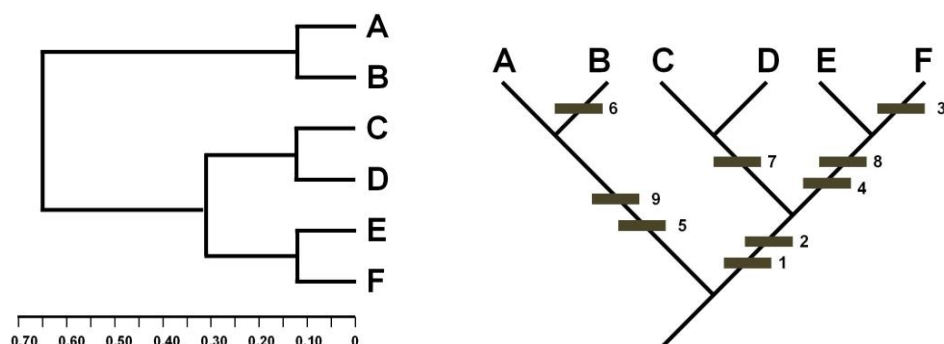


Fig. 1. A phenogram.

Fig. 2. A cladogram.

4. Many species concepts have been proposed. Which species concept will you apply for defining a species? Are there other plausible ones? Why? (8%)

100/02 I

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 homologous 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?

100/02 II

17. 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 are the differences between phenetics and cladistics? How would you do when there are multiple trees found in cladistics analysis? (12%)
18. If you find a new species in your group and plan to publish it, what will be the procedures in describing the new species? Please also explain the necessary treatment and/or concern to have the name become valid according to the latest regulation of ICZN. (10%)
19. What are homology and homoplasy? What are their effects in systematics? (10%)

20. How would new species originated? Please state at least three speciation mechanisms. Besides, what is a “species complex” and why would this happen? (10%)
21. Systematics is an area with fast development nowadays. Please choose four of the following terms and explain them. (8%)
- A. Cyber taxonomy/ cyber systematics
 - B. Phylogenomics
 - C. Phylogeography
 - D. DNA barcoding
 - E. New systematics
 - F. New taxonomy

101/01 I

1. “There is already too much literature on the ‘species problem’. It has been discussed, argued over, and symposiumed 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%)

101/01 II

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 vicariance 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%)

101/02 I

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 Binomial system developed by Linnaeus has been universally accepted and used for more than 250 years. What is the binomial 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%)

101/02 II

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%)

102/02 I

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，列出目(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)造瘿性；(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?

102/02 II

1. Wallace's zoogeographic regions have been updated by Holt et al. (2013, Science). What is new proposed by Holt et al. (2013) . (10%)
2. How to apply DNA barcode in species and subspecies delineation? (10%)
3. Phylogeographical history could be inferred based on the phylogeny and the associated distribution of organism. How founder and vicariance effect possibly lead to a different phylogeographical distribution? (20%)
4. How systematic works in insects could be applied into biodiversity research? (10%)

103/02 I

1. Define the following terms; population, paraphyletic group, adaptive radiation, coalescent time, peripatric speciation. (10%)
2. How could DNA sequences apply in study of insect phylogeny? (10%)
3. For researcher in biodiversity, insect identification is always a hard

- work. How to apply the identified data either in order, family, genus, or species to elucidate the insect fauna of the likely survey area? (10%)
4. In general, the insect species in Taiwan is in a homogeneous pattern, however, two subspecies belonging to the same species occasionally could be found. Why or what the mechanism it is? (10%)
 5. How to identify homologous character from analogous character based on the resolution of molecular phylogeny? (10%)

103/02 II

1. What is a species? Do you consider species is an objective reality and natural grouping which could be recognized by inspection? How about other higher categories, such as genus and family, are they also natural? Would the recognition differ among three different schools in systematics? (12%)
2. Some phylogenetic analysis may find more than one tree. However, there should be only one fact in their evolutionary history. What approaches could be taken when there are multiple trees found in the analysis? (10%)
3. Coding characters is an important procedure in phylogenetic analysis. However, sometimes the samples on hand may have difficulties in coding. What may cause missing values? What would be the effects of having missing values? (8%)
4. How can trees help us solve problems beyond systematics? Please provide at least three aspects of their applications. (10%)
5. Many museums spent lots of efforts in collecting and keeping specimens. Why would it worth to do so? Please explain the role of insect collections and their importance. (10%)

104/02 I

1. 農業害蟲及益蟲調查也是建立農業生產資訊的重要資料庫，同時也是農業生態系生物多樣性監測的重要資料。朱耀沂、吳文哲(1992)曾發表，農業害蟲種的學名常有錯誤；農業昆蟲研究，無論是害蟲或益蟲的鑑定及確認，都需要存證標本和已發表的報告同時保存在標本館，以供日後的查證及再查證。荔枝上的可可細蛾的鑑

定錯誤，如果當時能保存標本供比對，則往日的研究材料，可以再比對而得到確認(楊正澤，1997)。如此其研究成果只要再鑑定，改用正確的學名，錯誤鑑定(misidentification)的名字只要列入異名表中，此篇論文依然具一定的重要性及學術價值，而不致遭到一筆抹煞，浪費已投入的研究能量。你能就上述例子加以說明嗎?(10%)

這樣將生物多樣性調查結果，建立資料庫保存原始數據之外，調查的生物標本，保存起來，不但是累積標本館蒐藏量，同時更是保存證據，為學術研究成果保值，這是一種保險制度，利用存證標本，供未來再鑑定再求證的依據。建立以存證標本(voucher)為中心之系統蒐藏，將是分類學家的新任務。請問除了上述舉的例子，或許你有其他例子，請舉例說明為何存證標本蒐藏是學術研究保值與保險的策略(10%)。(20%)

2. 請說明 1970 年代新系統分類學的特徵有哪幾類?(5%) 後來加入分子生物學特徵，分子生物特徵的特色及其發展過程，請加以說明(15%)。分子生物學特徵的應用使傳統分類系統架構產生變化，例如蚜蟲由同翅目(Homoptera)變動為半翅目(Hemiptera)，更多的例子，正在討論中。請你就所知舉兩例說明(10%)。(30%)

104/02 II

1. If there is a new species included in the specimens you collected, how would you decide that it is a new species? If you plan to publish it, what information should be included in the description of the new species? Please also explain the necessary treatment and concern to have the name become valid according to the latest regulation of ICZN. (12%)
2. How would a species diverge into different species? What kind of speciation mechanisms could be involved relating to geographic distribution? (10%)
3. Constructing phylogenetic trees will provide us the information on the relationships among the taxa analyzed. If you have acquire both morphological and molecular characters for constructing phylogeny to clarify the relationship among many species within a genus. What kind of analysis will you conduct? How and why you do so? (12%)
4. What is your opinion on the role a natural history museum? As many universities

also hold good insect collections, should they play the same role? (8%)

5. Please choose two of the following terms, then (1) explain the term itself and (2) interpret its relationship to Systematics. (8%)

A. Biodiversity

B. Phylogeography

C. DNA barcoding

D. Digital archiving of specimens

105/02 I

1. If you use both molecular and morphological characters to construct phylogeny for clarifying the relationship among species within an insect family, please explain the following questions. (12%)

(1) When multiple genes are used, what and why you choose them?

(2) How would you analyze these data from multiple genes and morphology?

2. If you are interested in the relationship of a host-specific group of insects and come up with some scenarios for their evolution, how would systematics help you to understand their evolution and test your hypotheses? (10%)

3. Please explain what are monophyletic group, paraphyletic group, and polyphyletic group. Would all the three types of groups are eligible to recognize as a taxon? Are there different schools in systematics providing different ideas? (8%)

4. Suppose during your long observation and rearing of a group of insects, you found one colony from an isolated area perform very differently from other colony. You realize that it should be a different species although morphological similar. Please propose how you would do to clarify the species status and what would be species concept(s) you apply. (10%)

5. Please choose three of the following scientists, explain their contribution in systematics and evolution. (12%)

A. Carlous Linnaeus

B. Theodosius Dobzhansky

C. Willi Hennig

D. Ernst Mayr

E. Edward O. Wilson

F. Your own choice

105/02 II

1. Define the following terms; Punctuated equilibrium, Phyletic gradualism, integrated taxonomy, Punctuated gradualism. (18%)
2. In general, insect species could be found across an island. However, it is possible to find two or more subspecies of the same insect species in Taiwan. Why? (15%)
3. Phylogeographical history could be inferred based on the phylogenetic relationship and the associated distribution of organism. How founder and vicariance effect possibly lead to a different phylogeographical pattern? (15%)