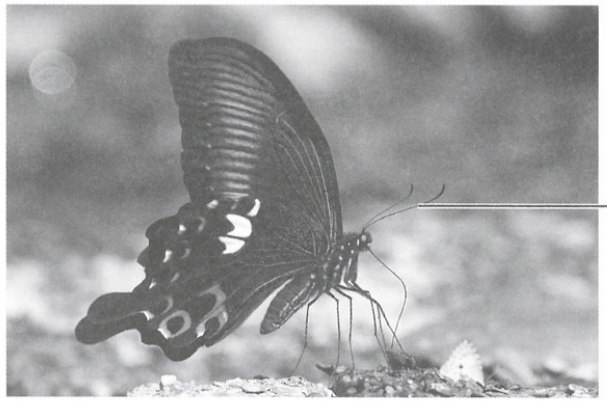
10. *Habenaria* is a genus of orchids with dull-coloured and scented flowers, which attract moths for pollination at night. In the group, *H. rhodocheila* is an exceptional species with reddish flowers which lack a detectable scent. It was found that no insects visited the flowers of *H. rhodocheila* at night for pollination while insect species A consumed nectar from the flowers in the daytime.

(a) The following dichotomous key can be used to identify the group to which insect species A belongs:

1a	with wings	.....	2
1b	without wings	.....	Group P
2a	antennae longer than head	.....	3
2b	antennae shorter than head	.....	Group Q
3a	wings rest at their sides	.....	Group R
3b	wings rest together upright	.....	Group S

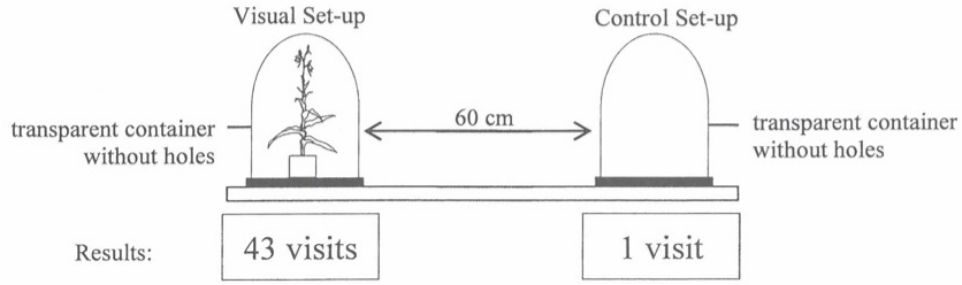
The photograph below shows the appearance of species A at rest. Using the above key, write down the sequence which leads to the identification. (1 mark)



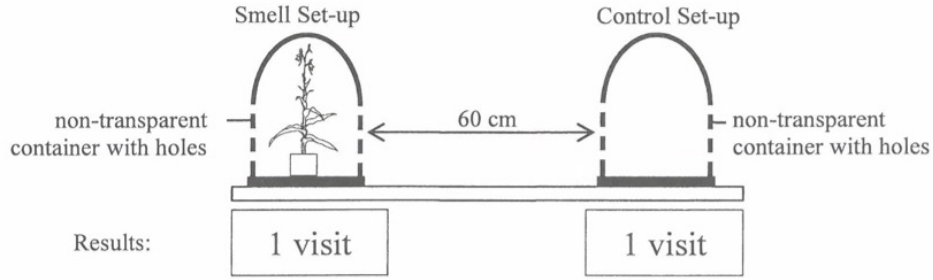
(b) In this case, *H. rhodocheila* was evolved from other *Habenaria* species. Suggest how the speciation of *H. rhodocheila* could be facilitated by different insect pollinators. (3 marks)

(c) To determine if insect species A is attracted to the flowers of *H. rhodocheila* by its appearance or its smell (if any), researchers designed an investigation as shown in the diagrams below:

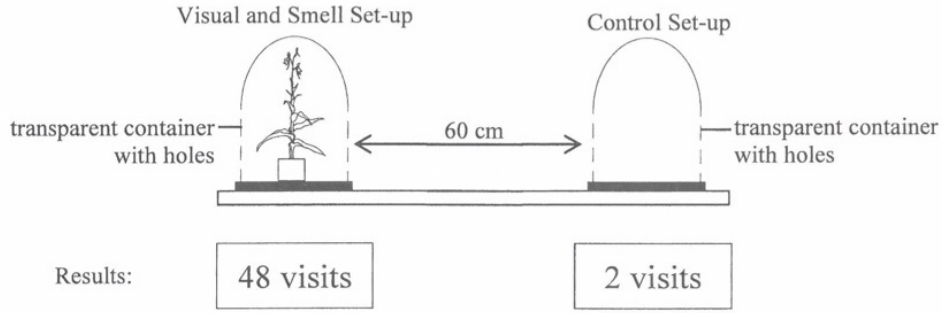
Treatment 1:



Treatment 2:



Treatment 3:



In each treatment, two set-ups were placed in an open area at a distance of 60 cm from each other for one hour. After that, the position of the two set-ups was exchanged for another hour. During the two-hour period, if an individual of species A approached any set-up to a distance of less than 10 cm, it was counted as one visit. The number of visits to each set-up is shown in the boxes in the above diagrams.

(i) To ensure that the investigation was a fair test, exchanging the positions of the two set-ups was a necessary step. Explain why. (1 mark)

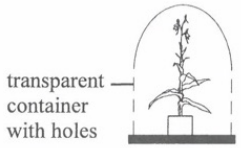
(ii) With reference to the aim of the investigation, what conclusions can you draw from the results of Treatment 1 and Treatment 2 respectively? (4 marks)

(iii) When Ann and Ken compared the results of the three treatments, they had different interpretations. Ann thought that the larger number of visits in Treatment 3 might reflect a synergistic effect of visual and smell attractions while Ken thought that it might be simply due to random variations. To verify Ann's idea, they decided to conduct a further investigation with two more treatments for comparison.

The diagrams below show the Visual and Smell Set-up. In each treatment, complete the corresponding Control Set-up by putting a '✓' in the appropriate boxes to show the conditions that should be adopted. (2 marks)

Treatment 4:

Visual and Smell Set-up



Conditions for the corresponding Control Set-up:

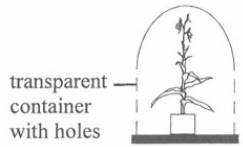
☐ with plant ☐ without plant

☐ transparent container ☐ non-transparent container

☐ container with holes ☐ container without holes

Treatment 5:

Visual and Smell Set-up



Conditions for the corresponding Control Set-up:

☐ with plant ☐ without plant

☐ transparent container ☐ non-transparent container

☐ container with holes ☐ container without holes

DSE M.C. Questions - Biodiversity
(sort by difficulty)

Challenging

2014 Q.15 (35%)

Which of the organisms below belong to the domain Eukarya?

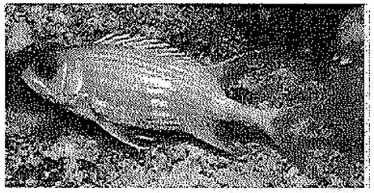
(1) Yeast
(2) Amoeba
(3) Mouse

A. (1) and (2) only B. (1) and (3) only C. (2) and (3) only D. (1), (2) and (3)

2014 Q.18 (31%)

Directions: Questions 17 and 18 refer to the following photographs of two different fish:

Fish X ***Fish Y***



Which of the following allow further study of the phylogenetic relationship between the two fish?

(1) Compare the amino acid sequences of their functional proteins
(2) Compare their internal body structure
(3) Compare their living habitats and behaviours

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

Average

2013 Q.21 (54%)

Which of the following combinations shows the correct information about Eubacteria and Protista?

	Eubacteria	***Protista***
A.	bigger in size	smaller in size
B.	absence of cell wall	presence of cell wall
C.	presence of true nucleus	absence of true nucleus
D.	absence of mitochondria	presence of mitochondria

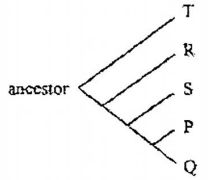
Directions: Questions 14 and 15 refer to the information below. Five new species of eubacteria were discovered in Antarctic ice core samples. The nucleotide sequences of the gene that codes for an essential protein of these new species were compared. The table below shows the number of nucleotide differences between the species:

2016 Q.14 (68%)

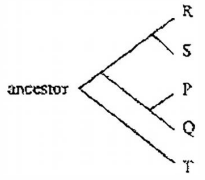
	Number of nucleotide differences				
Species	P	Q	R	S	T
P	-	4	12	11	22
Q		-	12	11	19
R			-	4	22
S				-	22
T					-

Which of the following evolutionary trees best illustrates the phylogenetic relationship of the five species?

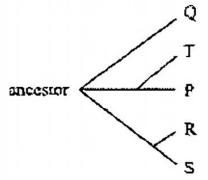
A.



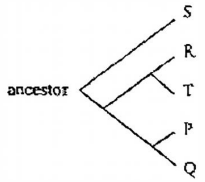
B.



C.



D.



Average

2016 Q.15 (51%)

Which of the following cell components can be found in these species?

A. nucleus
B. cell wall
C. chloroplast
D. mitochondrion

2018 Q.9 (41%)

Which of the following statements provides the best reason for classifying unicellular organisms into domain Bacteria and Archaea?

A. Archaea are more ancient than bacteria
B. Archaea are smaller than bacteria
C. The DNA sequences of archaea are distinct from those of bacteria
D. The compositions of the cell wall and cell membrane of archaea are different from those of bacteria

2018 Q.32 (64%)

Organisms P and Q are found in the same local habitat. Their population sizes have continued to grow in the last few years. Which of the following statements best describes organisms P and Q?

A. They are heterotrophs.
B. They are top predators.
C. They have different niches.
D. They have different predators.

Easy

2014 Q.17 (81%)

Directions: Questions 17 and 18 refer to the following photographs of two different fish:

Fish X

Fish Y

Using the dichotomous key below to identify the fish:

1a Both eyes on the top of the head..... 2
1b One eye on each side of the head..... 3

2a Has long whip-like tail..... *Aetobatus narinari*
2b Has short, blunt tail ..... *Bothus mancus*

3a Has spots on its surface..... 4
3b Does not have spots on its body surface..... 5

4a Has chin whiskers..... *Pseudupeneus maculatus*
4b Does not have chin whiskers..... *Sphoerosides spengleri*

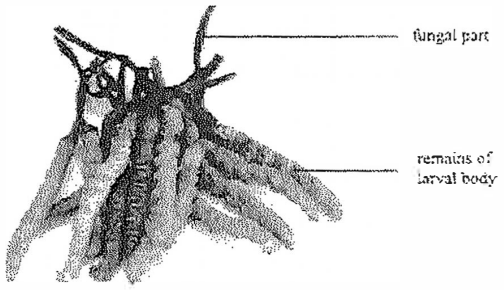
5a Has stripes on its body surface ..... *Holocentrus rufus*
5b Does not have stripes on its body surface..... *Parapriacanthus guentheri*

	Fish X	***Fish Y***
A.	*Bothus mancus*	*Pseudupeneus maculatus*
B.	*Bothus mancus*	*Holocentrus rufus*
C.	*Aetobatus narinari*	*Parapriacanthus guentheri*
D.	*Aetobatus narinari*	*Sphoerosides spengleri*

Easy

2018 Q.14 (91%)

Caterpillar fungus is kind of Chinese herbal medicine. When the spores of this fungus land on the larvae of moths, the spores will germinate inside the body of the larvae and grow out of their heads, as shown in the photograph below:



Which of the following best describes the role of this fungus?

A. Parasite
B. Predator
C. Producer
D. Consumer

Answers

Challenging

2014
15 [D]
18 [A]

Average

2013	2016	2018
21 [D]	14 [B]	9 [C]
	15 [B]	32 [C]

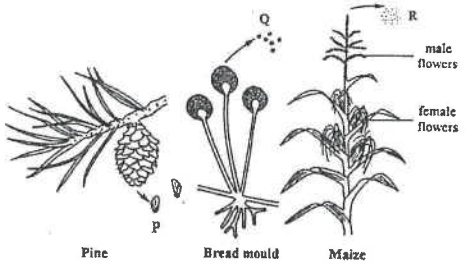
Easy

2014	2018
17 [B]	14 [A]

Past papers - Biodiversity

CE - 1996

1. (a) The diagrams below show three kinds of plants :



(i) Pine and bread mould belong to the same major plant group and maize belongs to another group.

(1) State one feature that distinguishes these two major plant groups. (1)

(2) Bread mould belongs to the sub-group fungi. Name the sub-group to which pine belongs. (1)

(ii) State the role of the following structures in the reproduction of the plants :

(1) P (1)

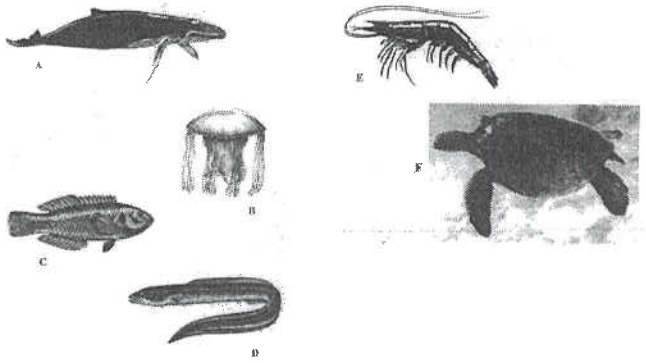
(2) R (2)

(iii) State one feature that is common to structures Q and R which enables them to be carried by wing. (1)

(iv) Referring to the diagram, explain how bread mould is adapted for obtaining nutrients. (4)

CE - 1998

1. (a) In a marine museum, living marine animals are kept in different exhibition areas according to their animal group. Some of the animals in the museum are shown in the diagrams below :



(i) Using letters provided, state all the animal(s) that should be placed in the exhibition area for reptiles. (1)

(ii) B and E are kept in the same exhibition area. Name the animal group to which they belong. (1)

(iii) State two structural differences between A and C which explain why they are kept in different exhibition areas. (2)

(iv) The amount of daily food intake per unit mass of A is much greater than that of C. Suggest an explanation for this. (4)

(v) The population of F in Nature has decreased continuously in recent years. Suggest two ways of preventing the extinction of F. (2)

CE - 2002

3. (b) In an ecosystem, there are various types of bats. One type of bats, A, is shown in photograph 1 below. When a sample of its faeces was examined, pieces of legs and wings of a certain group of animals were found as shown in photograph 2.

Photograph 1 (magnification $\times\frac{1}{5}$)

Photograph 2 (magnification x4)

(i) (1) To which group of vertebrates do bats belong? (1)

(2) Referring to photograph 1, state one external features of bat A through which it is classified into the group you stated in (1). (1)

(ii) With reference to photograph 2, suggest the group of animals that bat A feed on.(1)

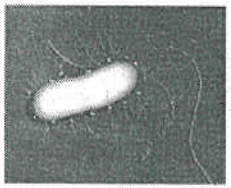
(iii) The faeces of another type of bats, B, are found to contain some seeds. Suggest an explanation for the presence of intact seeds in the faeces of bat B. (2)

(iv) A third type of bat, C, feeds on the blood of large animals. Assuming that bats B and C have the same amount of daily food intake, compare the daily amount of faeces they produce. Explain your answer. (2)

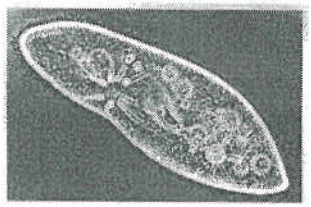
(v) Having different types of bats is advantageous to the survival of bats in an ecosystem. Suggest an explanation for this using the information about bats A, B and C given above. (2)

CE - 2005

1. The following pictures show four different organisms:



P (x 12 000)



Q (x 1500)

R (x 4)

S (x 1)

(a) Organisms can be classified into five kingdoms. Name the kingdom that P and Q each belongs to. (2)

(b) State two cell structures that can be found in Q, R and S, but not in P. (2)

(c) Explain the role of S in the cycling of materials in nature. (2)

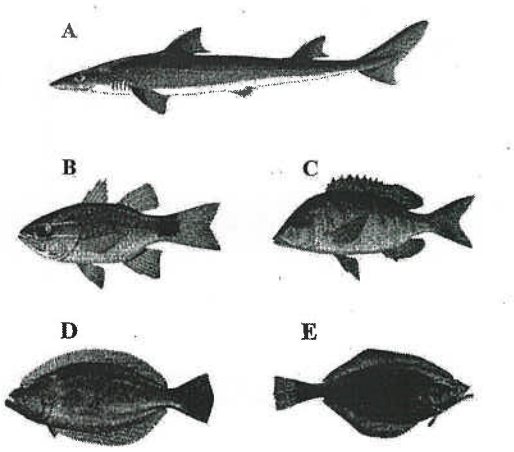
(d) A number of human diseases such as influenza and SARS are caused by viruses. Some scientists consider viruses as organisms, but some do not. Give one reason for each of these views. (2)

AL - 2002 IA

4. The following key is constructed for identifying the fishes A-E shown below.

1a	Both eyes on the same side of the head ----------	2
1b	One eye on each side of the head ----------	3
2a	Both eyes on the right side of the head ----------	Paralichthys olivaceus
2b	Both eyes on the left side of the head ----------	Cleisthenes herzensteini
3a	Caudal fin asymmetrical ----------	Squalus mitsukurii
3b	Caudal fin symmetrical ----------	4
4a	Two dorsal fins ----------	Apogon fleurieu
4b	One dorsal fin ----------	Lethrinus haematopterus

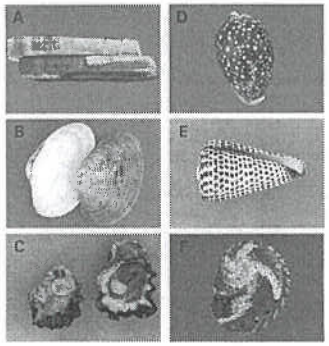
Using this key, identify each of the fishes A, C and D, and state the key sequence you went through in making the identification (5)



Source: 中國科學院海洋研究所，《中國海洋魚類原色圖集（1）》，上海：上海科學技術出版社，1992。

AL -2005 1A

1. The key below is constructed for identifying animals A to F, the shell(s) of which are shown below:



1a	The animal has only one piece of shell.....	2
1b	The animal has two pieces of shell.....	4
2a	The shell is flat.....	Haliotis ovina
2b	The shell is not flat.....	3
3a	The shell becomes narrower toward one end.....	Conus littertus
3b	The shell becomes narrower toward both ends.....	Cypraea vitellus
4a	The two pieces of shell are equal in size.....	5
4b	The two pieces of shell are unequal in size.....	Ostrea nigromarginata
5a	The shell is elongated in shape.....	Solen grandis
5b	The shell is oval in shape.....	Paphia euglypta

Using this key, identify animals B, C and D. Write down the full scientific name of each and the key sequence taken for making the identification. (5)

Animal	Scientific name	Key sequence for identification
B		
C		
D		

DSE-2012 1B

4. The following key can be used for identifying organisms under the same phylum:

1a	Absence of eyes ----------	2
1b	A pair of eyes ----------	3
2a	Six legs ----------	Class A
2b	More than six legs ----------	Class B
3a	Six legs ----------	Class C
3b	More than six legs ----------	Class D

(a) Using the above key, identify which class organism X shown in the photograph below belongs to. (1 mark)

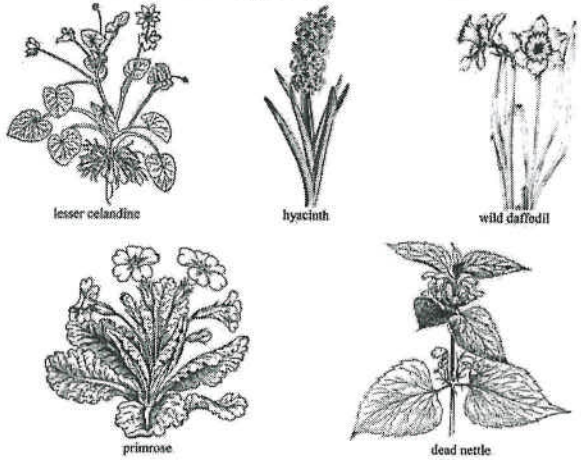
(b) Suggest a characteristic of the habitat of organism X. Explain your answer. (2 marks)

(c) A newly found organism Y has a pair of eyes and fewer than six legs. Although it is believed that this organism belongs to this phylum, it cannot be identified by using the above key. Explain why this problem occurs. (1 mark)

(d) Suggest ***one*** way to collect more information which can be used for deciding whether organism Y belongs to this phylum. (2 marks)

DSE – 2016 1B

4. The following diagrams show the appearance of five flowering plants:



(a) In the following table, put a '√' in the appropriate boxes to show the features of each flowering plant. (2 marks)

	Leaves with parallel veins	Leaves with network veins	Single flower	Cluster of flowers	Other features
lesser celandine					heart-shaped leaves
hyacinth					funnel-like flowers
wild daffodil					trumpet-like flowers
primrose					club-shaped leaves
dead nettle					two-lipped flowers

(b) Using the information from the table in (a), complete the following dichotomous key: (3 marks)

1a The plant has leaves with parallel veins 2
1b The plant has leaves with network veins 3

2a [ ] ..... hyacinth
2b [ ] ..... wild daffodil

3a The plant has two-lipped flowers ..... [ ]
3b The plant does not have two-lipped flowers ..... [ ]

4a [ ] ..... lesser celandine
4b [ ] ..... primrose

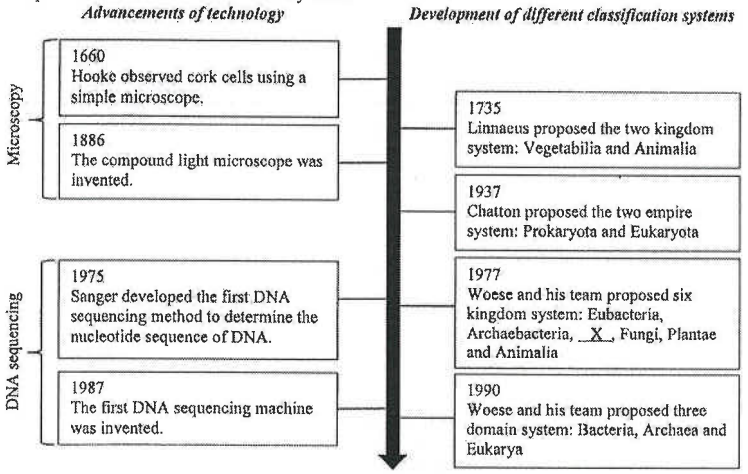
(c) Study the following statement:

The dichotomous key shows that the lesser celandine and primrose have a closer evolutionary relationship.

Do you agree? Explain your answer. (2 marks)

HKDSE - 2017 1B

6. The chart below shows the timeline of some major advancements of technology and the development of different classification systems:



a. Name kingdom X in the six kingdom system proposed by Woese and his team in 1977. (1 mark)

b. How did the following technological advancements contribute to the development of different classification systems? (4 marks)

Microscopy:

DNA sequencing:

Past papers Marking Scheme – Biodiversity

CE - 1996 Q. 1 (a)

(i) (1) The major plant group to which maize belongs produces flowers / fruits, while the other group does not 1
(2) *gymnosperm 1

(ii) (1) To form a new plant / to protect the embryo / for dispersal of the plant 1
(2) To carry the male gamete 1
to the female gamete for fertilization 1

(iii) dry, small, light (any one) 1

(iv) Bread mould has branching rhizoids / root-like structures 1
to provide a large surface area 1
for secreting digestive enzymes / enzymes to digest the organic food 1
and then absorb the digested products 1

Effective communication (c) 1

CE - 1998 Q.1 (a)

(i) F 1

(ii) invertebrate 1

(iii)

A	C		
has mammary glands	no mammary glands	)	
no scales	has slimy scales	)any two	1,1
no lateral line	has lateral line	)	
breathes by lungs	breathes by gills	)	

(iv) A has a higher body temperature than C 1
This enables A to achieve a higher metabolic rate 1
Thus A needs more food for respiration to release more energy 1
to compensate for the faster heat loss to the surrounding 1

Effective communication (c) 1

(v) Prohibit the overhunting of F
Prohibit the trading of F
Protect the breeding grounds of F
Establish a reserve area to protect F
Educate people to protect the animals any two 1,1

CE - 2002 Q.3 (b)

(i) (1) mammal 1
(2) body covered with hair 1

(ii) insects / invertebrates 1

(iii) Bat B feeds on fruits 1
Some seeds escape the chewing action of the teeth / the seed coat protects the seeds from being digested in the alimentary canal 1
Thus intact seeds are egested in the faeces

(iv) Bat B produces a larger amount of faeces per day than bat C 1
because bat B feeds on plants which contains more indigestible material / bat C feeds on blood which contains less indigestible material 1

(v) Different types of bats have different diets 1
thus the competition for food among the bats would less / more resources would be available to the bats / the risk of extinction of bats due to the disappearance of a certain food source would be smaller 1

CE - 2005 Q.1

(a) P : Prokaryotes 1
Q: Protoctists 1
(b) nucleus, mitochondria 1,1
(c) S breaks down organic matter 1
into inorganic matter which can be used by plants for growth 1
(d) Support virus as organisms : because it can reproduce in a cell / it has genetic materials to control its life processes 1
Against virus as organisms : because it is non-cellular / has no cytoplasm / cannot replicate by itself / has no metabolism unless it is within a host cell 1

AL- 2005 1A

1.

	Scientific name	Key sequence for identification	5
Animal B:	Paphia euglypta (½)	1b → 4a → 5b (1)	
Animal C:	Ostrea nigromarginata (½)	1b → 4b (1)	
Animal D:	Cypraea vitellus (½)	1a → 2b → 3b (1)	

½ mark for underlining the scientific names of all animal specimens.

DSE-2012 1B

4. (a) • Class A (1) (1)

(b) • the light intensity of the habitat is very low / the habitat is completely dark (1) (1)
• as organism X does not have eyes to survive in the habitat (1) (1)

(c) • the key is constructed based on the morphological characteristics of exisiting organism found (1) / not all the morphological characteristics of the phylum are listed in the key (1)

(d) • carry out a comparative study about the amino acid sequence of similar proteins / base sequence of DNA template / mRNA of similar proteins found in organism Y and other organisms in this phylum (1) (✓ accept comparison of developmental process / cellular structure / chemical composition) (1)
• to establish the phylogenetic relationship between them (1) (1)

6 marks

DSE – 2016 1B

4. (a)

	Leaves with parallel veins	Leaves with network veins	a single flower	a cluster of flowers	Other features
lesser celandine		✓	✓		heart-shaped leaves
hyacinth	✓			✓	funnel-like flowers
wild daffordil	✓		✓		trumpet-like flowers
primrose		✓	✓		club-shaped leaves
dead nettle		✓		✓	two-lipped flowers

(each correct pair of characteristics 1) [mark on the bottom left and bottom right comers respectively; accept '/' but not 'O' or "X" or other symbols] 2

(b) 2a The plant has a cluster of / funnel-like flowers
2b The plant has a single / trumpet-like flower } (1)
[accept negative statement, e.g. The plant does not have a cluster of flowers]
3a dead nettle
3b 4 } (1)
4a The plant has heart-shaped leaves
4b The plant has club-shaped leaves } (1)
[accept negative statement, e.g. The plant does not have heart -shaped leaves]
Remarks: These three sets of answers should be marked separately 3

(c) this is incorrect (1)

because a dichotomous key is used to identify organisms from a group based on the observable / morphological features which may not be related to their evolutionary / phylogenetic relationship (1)
[accept: not all observable / morphological can reflect their evolutionary relationship]
[accept: a dichotomous key is purely for identifying organisms, not for phylogenetic classification]
[accept: observable / morphological features which may not be related to their evolutionary / phylogenetic relationship]
[accept: similarities in observable / morphological features can be resulted from adapting the similar environment / convergent evolution]
[NOT accept: observable I morphological cannot reflect their evolutionary relationship]
[NOT accept: only genetic/sequence similarities can reflect their evolutionary relationship]
Remarks: if the points are contradictory, no mark will be given 2

HKDSE – 2017 1B

6. (a) • X:Protista* (1) (1)

(b) Microscopy:
• microscopy allows the observation of cellular structures [accept membrane-bound organelles; NOT accept cell wall or cell membrane](1)
• this distinguishes prokaryotic cells from eukaryotic cells (1), giving rise to the basis of the two empiresystem proposed

DNA sequencing: (4)
• DNA sequencing determines the nucleotide sequence of the DNA of different organisms/ allows the comparison of their genetic makeups(1) [accept RNA sequence]
• so that the scientists can work out the phylogenetic relationship (1), giving rise to the basis of the 3 domains system