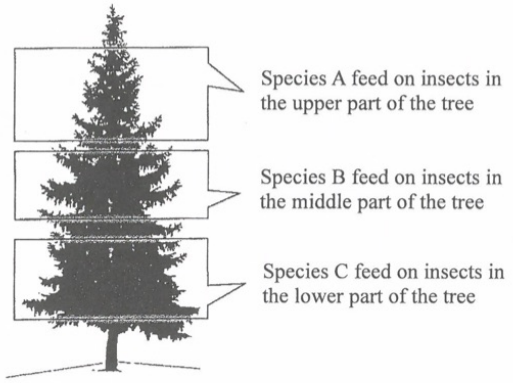
8. Decomposers can speed up the process of ecological succession because they

A. break down rocks into soil particles.
B. remove dead organic matter from the soil.
C. release carbon back into the atmosphere in the form of carbon dioxide.
D. release nitrogen back into the soil in the form of ammonium compounds.

9. Three bird species are living on the same tree species for years. They feed on the insects found at different regions of the tree as shown in the diagram below:

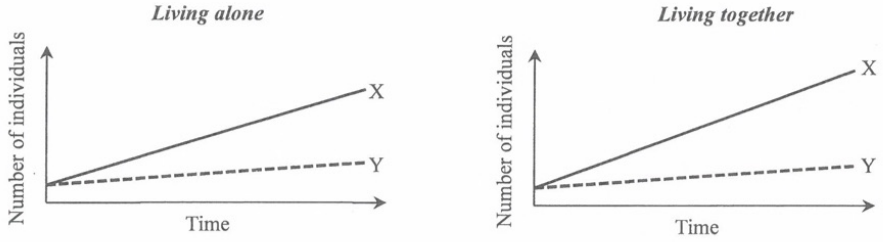


Which of the following can be deduced from the above phenomenon?

(1) The insects are evenly distributed on the tree.
(2) Birds species A, B and C have different ecological niches.
(3) There is less interspecific competition among bird species A, B and C.

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

10. The graphs below show the changes in the population sizes of organisms X and Y over a period of time when they are living alone or living together.



Which of the following correctly describes the ecological relationship of X and Y?

A. predation
B. mutualism
C. competition
D. commensalism

DSE M.C. Questions - Ecosystems

(sort by difficulty)

Challenging

2018 Q.5 (37%)

The diagrams below show the pyramids of numbers and biomass of a food chain:

Which of the following is most likely to be the producer in this food chain?

A. Rice
B. Trees
C. Grass
D. Phytoplankton

Average

2014 Q.3● (69%)

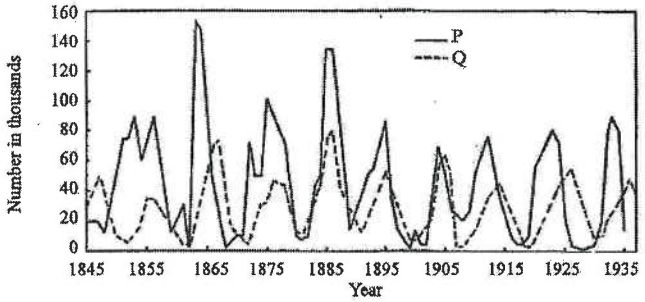
Some environmental protection groups claim that the vegetarian diet is good for our environment. This is probably because

A. vegetables grow faster than animals.
B. it protects endangered species as less animals are killed for food.
C. growing vegetables can produce oxygen but rearing animals only consumes oxygen.
D. it reduces the emission of carbon dioxide associated with rearing animals for food.

Average

2014 Q.31 (51%)

The graph below shows the changes in the populations of two organisms that exhibit a predator-prey relationship in a habitat:



Which of the following statements about the identity of the organism is correct?

A. P is the predator because its number fluctuates more than that of Q.
B. P is the predator because its lowest number is lower than that of Q.
C. Q is the predator because its number fluctuates less than that of P.
D. Q is the predator because its highest number is lower than that of P.

2014 Q.33 (45%)

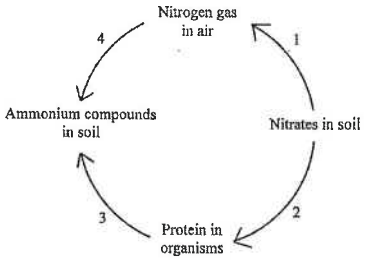
Which of the following processes releases nitrogen-containing compounds from organisms back into the environment?

A. Nitrification
B. Decomposition
C. Denitrification
D. Nitrogen fixation

Average

2015 Q.31 (58%)

Directions: Questions 30 and 31 refer to the diagram below, which shows the conversion of some nitrogen-containing substances in nature:

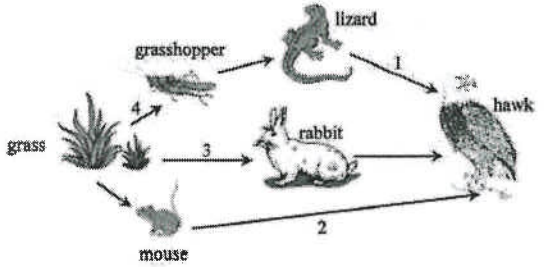


Which of the following processes does ***not*** require the action of bacteria?

A. 1
B. 2
C. 3
D. 4

2016 Q.30 (61%)

The following is a food web found in grassland:



If the energy input for each food chain is the same, the transfer of energy between two trophic levels is the smallest in

A. 1 B. 2 C. 3 D. 4

Average

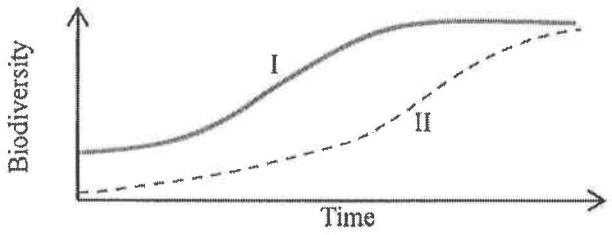
2016 Q.34 (47%)

Symbiotic bacteria found in the root nodules of bean plants are able to convert

A. nitrite ions to nitrate ions.
B. nitrogen gas to nitrate ions.
C. organic nitrogenous compounds to nitrate ions.
D. nitrogen gas to ammonium ions.

2017 Q.12 (71%)

The following graph shows the predicted change in biodiversity during the processes of primary and secondary succession in an ecosystem:

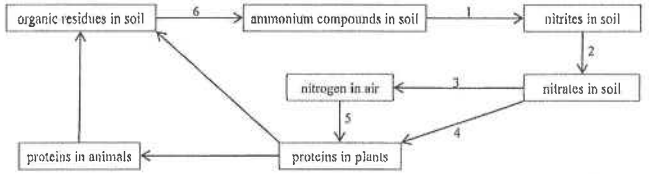


Which of the following combinations is correct?

	Type of succession	*Explanation*
A.	I is primary succession.	A climax community is reached in I.
B.	I is secondary succession.	I has a higher biodiversity than II at the beginning.
C.	II is primary succession.	Pioneer community is involved in II.
D.	II is secondary succession.	II shows a slow increase in biodiversity.

Average

Directions: Questions 32-33 refer to the diagram below, which shows some processes in the nitrogen in nature:



2017 Q.32 (56%)

Which of the following combinations correctly matches the microorganisms involved in processes 3 and 6?

	3	*6*
A.	denitrifying bacteria	nitrogen-fixing bacteria
B.	nitrogen-fixing bacteria	fungi
C.	fungi	denitrifying bacteria
D.	denitrifying bacteria	fungi

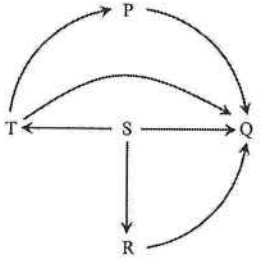
2017 Q.33 (62%)

Which of the following processes ***does not*** require the action of bacteria?

A. 1 B. 2 C. 4 D. 5

Average

Directions: Questions 34 and 35 refer to the diagram below, which shows the flow of energy among organisms found in a grassland:



2017 Q.34 (62%)

Which of the following statements correctly describe(s) the above organisms?

(1) S is a heterotroph.
(2) P is the secondary consumer.
(3) Q has the largest total biomass

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

2017 Q.35 (56%)

If there is a decomposer in this group of organisms, it is most likely to be

A. Q B. R C. S D. T

2019 Q.29 (68%)

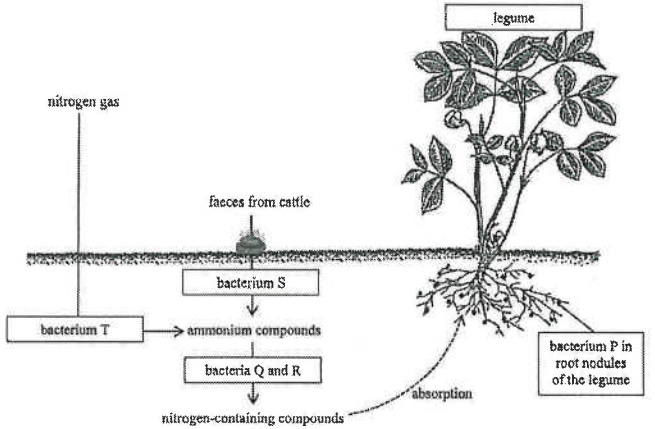
If a student wants to find out whether the distribution of plant species is affected by the slope of a hillside, which of the following sampling methods should be used?

A. Set up a line transect along the hillside and record the plant species that touch the line.
B. Set up a line transect around the hillside and record the plant species that touch the line.
C. Randomly place quadrats along the hillside and record the plant species within the quadrat.
D. Randomly place quadrats around the hillside and record the plant species within the quadrat.

Average

2019 Q.33 (70%)

Directions: Questions 33 and 34 refer to the diagram below, which shows some processes of the nitrogen cycle:

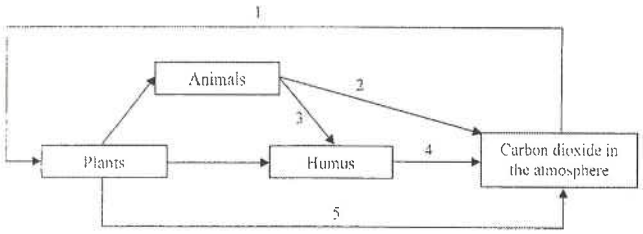


Which of the following statements about the bacteria shown in the diagram is correct?

A. P belongs to parasitic bacteria.
B. Q belongs to nitrifying bacteria
C. R belongs to nitrogen-fixing bacteria.
D. S belongs to denitrifying bacteria.

Easy

Directions: Questions 16 and 17 refer to the following diagram, which shows the flow of carbon in an ecosystem:



2012 Q.16 (78%)

Which of the following combinations correctly shows the process indicated by labels 1,4 and 5?

	1	*4*	*5*
A.	respiration	photosynthesis	decomposition
B.	photosynthesis	respiration	decomposition
C.	photosynthesis	decomposition	respiration
D.	decomposition	photosynthesis	respiration

2012 Q.17 (80%)

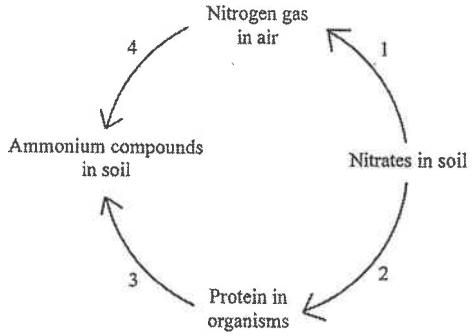
Saprophytes are involved in process

A. 1. B. 2. C. 3. D. 5.

Easy

2015 Q.30 (79%)

Directions: Questions 30 and 31 refer to the diagram below, which shows the conversion of some nitrogen-containing substances in nature:



Process 3 is

A. nitrification.
B. denitrification.
C. decomposition.
D. nitrogen fixation.

2018 Q.6 (89%)

Protecting sharks in the wild is important for maintaining the ecological balance of the marine ecosystem because

A. Sharks are an endangered species
B. Shark fin is a popular dish for banquets
C. The dead bodies of sharks are an important food source for decomposers
D. Sharks are top predators that regulate the population sizes of other consumers

Easy

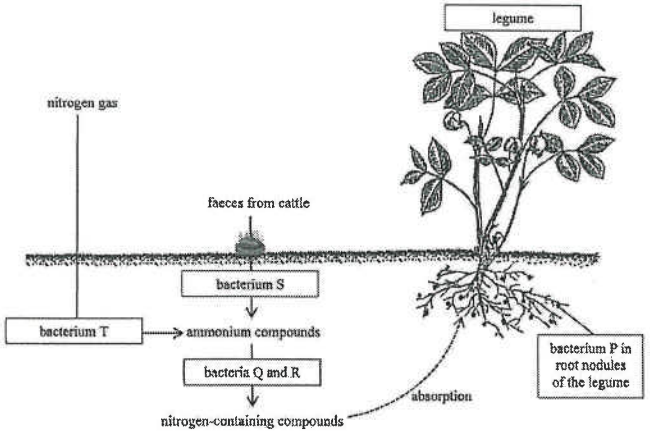
2018 Q.33 (77%)

Which of the following statements about primary succession and secondary succession is correct?

A. Primary succession is always followed by secondary succession.
B. Primary succession always starts with a barren area while secondary succession does not.
C. Secondary succession always ends with a climax community while primary succession does not.
D. Secondary succession always ends with a climax

2019 Q.34 (81%)

Directions: Questions 33 and 34 refer to the diagram below, which shows some processes of the nitrogen cycle:



Which of the following bacteria has a similar role to fungi in the cycling of materials?

A. Q.
B. R.
C. S.
D. T.

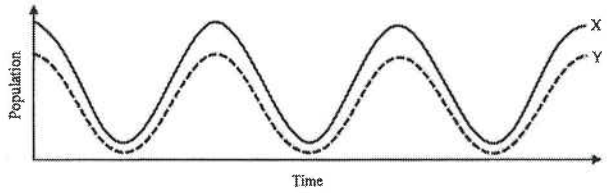
2020 Q.16

16. Australia has some plant and animal species which cannot be found elsewhere in the world. Which of the following is likely to be the key factor that led to the occurrence of these unique plant and animal species in Australia?

A. isolation
B. mutation
C. competition
D. environmental stress

2020 Q.32

32. The following graph shows the change in the populations of organisms X and Y living in the same habitat:

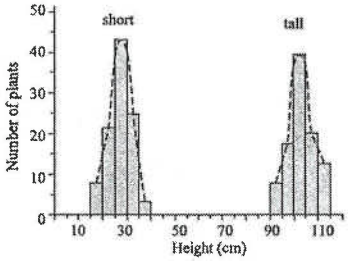


Which of the following is the most likely ecological relationship between organisms X and Y?

A. predation
B. mutualism
C. competition
D. commensalism

2020 Q.33

Directions: Questions 33 and 34 refer to the following graph, which shows the variations in the height of a certain type of plant:



33. Which of the following conclusions can be drawn from the above graph?

A. The short and tall plants are of two different species.
B. The two traits, short and tall, are controlled by a pair of alleles.
C. More samples should be taken to cover the full range of heights.
D. The height of the plants displays the properties of continuous and discontinuous variations.

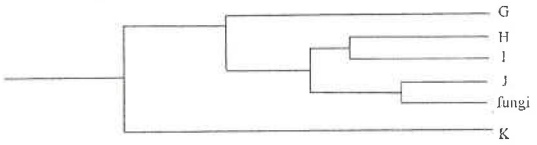
2020 Q.34

34. Which of the following factors contributes *least* to the variations shown?

A. the height of the parental plants
B. the light intensity in the environment
C. the independent assortment of chromosomes
D. the oxygen concentration in the environment

2021 Q.28,29,32,33,34,35,36

Directions: Questions 28 and 29 refer to the diagram below, which shows an evolutionary tree demonstrating the phylogenetic relationship of the six kingdoms:



28. Which of the following combinations correctly shows the kingdoms represented by G, J and K in the evolutionary tree?

	G	*J*	*K*
A.	Archaebacteria	Animalia	Eubacteria
B.	Archaebacteria	Plantae	Eubacteria
C.	Eubacteria	Plantae	Protista
D.	Eubacteria	Animalia	Protista

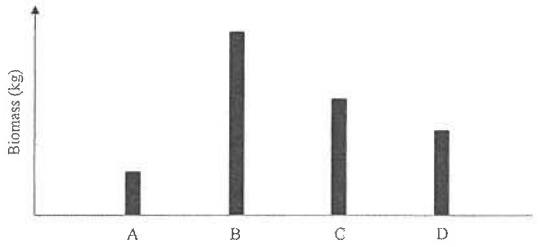
29. Which of the following pairs of organisms belongs to the same domain?

A. G and K
B. G and H
C. H and J
D. J and K

32. During primary succession in a terrestrial habitat, which of the following descriptions about the ecosystem is *incorrect*?

A. The nutrient level of the soil decreases.
B. The complexity of the food web increases.
C. The abundance of non-vascular plants decreases.
D. The energy available to the community increases.

Directions: Questions 33 and 34 refer to the following graph, which shows the biomasses of four populations forming a food chain in a terrestrial habitat:



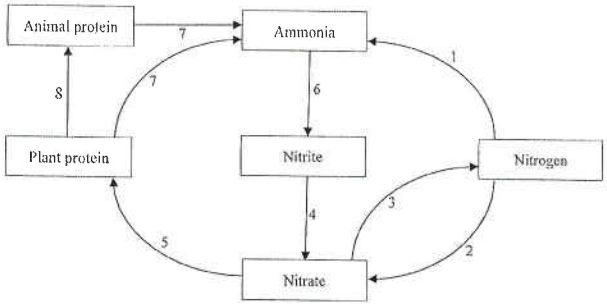
33. Which population is most likely the autotrophs in this habitat?

A. A
B. B
C. C
D. D

34. What would you expect to happen if the number of individuals in population D decreased?

A. The number of individuals in population A would increase.
B. The number of individuals in population C would decrease.
C. The amount of energy passed to population A would decrease.
D. The amount of energy passed to population C would increase.

Directions: Questions 35 and 36 refers to the diagram below, which shows some natural processes involved in the nitrogen cycle:



35. Process 2 refers to

A. lightning.
B. nitrification.
C. denitrification.
D. nitrogen fixation.

36. Which of the following pairs of processes involves the action of bacteria?

A. 1 and 5
B. 2 and 6
C. 3 and 7
D. 4 and 8

Answers

Challenging

2018
5 [C]

Average

2014	2015	2016	2017	2019
30 [D]	31 [B]	30 [A]	12 [B]	29 [A]
31 [D]		34 [D]	32 [D]	33 [B]
33 [B]			33 [C]	
			34 [B]	
			35 [A]	

Easy

2012	2015	2018	2019
16 [C]	30 [C]	6 [D]	34 [C]
17 [C]		33 [B]	

2020
16[A]
32[B]
33[D]
34[D]

Past papers – Ecosystems

CE - 2003

1. (c) The photographs below show a Hong Kong newt and a lizard which can be found in Tai Mo Shan Country Park.

Hong Kong newt

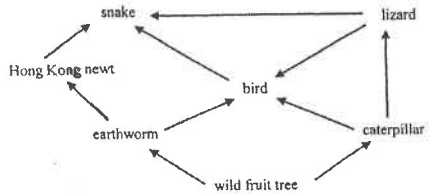
Lizard

(i) The two animals above belong in different vertebrate groups. Based on the photograph, state one external feature of the newt that is characteristic of its group (1)

(ii) Name the vertebrate group to which the Hong Kong newt belongs. (1)

(iii) Only a small number of Hong Kong newts exist today and it is listed as a protected species. Suggest two reasons to account for its small population. (2)

(iv) The diagram below shows a simplified food web in Tai Mo Shan Country Park:



(1) With reference to the given food web, draw a food chain that consists of five trophic levels. (1)

(2) Construct a pyramid of numbers for this food chain. (2)

(3) Explain the shape of this pyramid of numbers. (4)

CE - 2005

5. Every year, people in Hong Kong consume a lot of big marine fish such as humphead wrasse (蘇眉). This fish takes five years to reach maturity. Because of the strong market demand, young fish are often caught together with the mature ones, and as a result, the population of this fish has decreased greatly in the past ten years.

(b) Suggest two ecological consequences of the overfishing of humphead wrasse. (2)

(c) Some people propose that the catching of young humphead wrasse should be prohibited. Explain why this may maintain the population of this fish. (3)

CE - 2005

8. (b) The picture below shows a school garden with some tomato plants:

(i) Explain why continuous harvesting of tomatoes may lead to the depletion of nitrate in the garden soil. (2)

(ii) Which organism in the soil turns some of the nitrate into atmospheric nitrogen? (1)

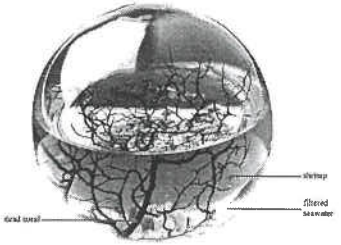
(iii) Suggest two ways to restore the nitrate content of the soil. (2)

(iv) A student flooded the soil with water. As a result, the air content of the soil became very low. Explain why this condition may lead to poor plant growth. (3)

CE - 2007

9. (a) The photograph below shows an ecosphere:

The ecosphere is a self-sustaining ecosystem sealed in glass container. It contains bacteria, microscopic algae, shrimps and branches of dead coral in filtered seawater.



(i) Why is it essential to put the algae into the ecosphere to make it self-sustaining? (4)

(ii) How can the activity of the bacteria contribute to the growth of algae? (2)

(iii) This ecosphere can only support two trophic levels. Suggest a possible explanation for this. (2)

CE - 2008

8. (a) In order to increase the yield of crops, farmers may add inorganic fertilizers and fungicides to the field. Fungicides can kill fungi which may infect crop plants. The table below shows the effect of applying these chemicals to a wheat field.

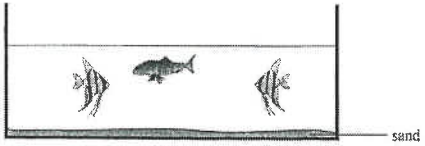
Mass of inorganic fertilizers added (kg)	Yield of wheat (arbitrary unit)	
	With the addition of fungicides	Without the addition of fungicides
0	33	33
80	54	52
160	64	60
240	68	61
320	70	58

(i) Plot a graph to show the yield of wheat when different amounts of inorganic fertilizers are added in the presence and in the absence of fungicides. (3)

(ii) With the reference to the graph plotted, describe the effect of fungicides and inorganic fertilizers on the yield of wheat. (3)

CE - 2009

10. (a) The following diagram shows the freshwater aquarium set up by Cindy.



All the fish died after one week. She learnt from the internet that a high level of ammonia in water is harmful to the fish. She suspected that this caused their death.

(i) Account for the presence of ammonia in the aquarium. (2 marks)

(ii) After searching on the internet, she found that the ammonia concentration in water can be lowered by installing a biological filter seeded with bacteria. To set up the aquarium again, she purchased a biological filter and noted to following instructions:

I. Leave the tap water in the aquarium for at least one night before installing the filter.

II. Allow the filter to operate for four weeks before putting fish in the aquarium.

(1) What kind of bacteria is seeded in the biological filter? Explain how this kind of bacteria can lower the ammonia concentration in the aquarium. (2 marks)

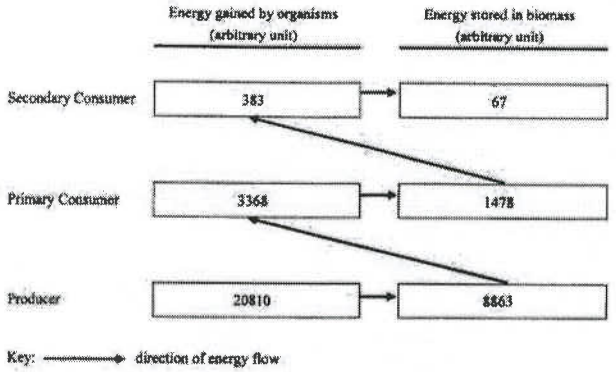
(2) With reference to the process of water treatment in Hong Kong, explain why instruction I is necessary. (2 marks)

(3) Why is it necessary to leave the filter operating for four weeks before putting fish in the aquarium? (1 mark)

(iii) Cindy is advised to grow some water plants in the aquarium. What is the role of the water plants in the cycling of materials in the aquarium?(2 marks)

CE - 2010

7. The diagram below shows the energy flow in a food chain.



(a) Explain the difference between the energy stored in biomass and the energy gained at each trophic level. (2)

(b) Suggest *two* reasons to explain why in each trophic level the energy gained is always less than the energy that can be provided by the previous trophic level. (2)

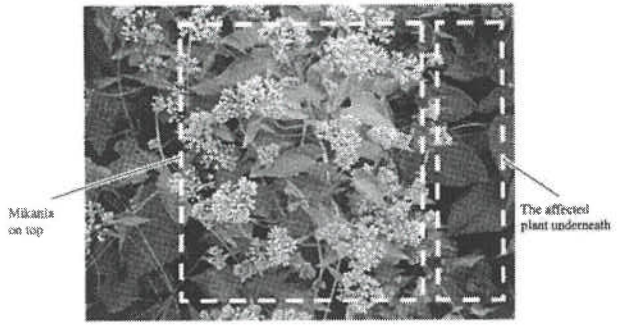
(c) Below is the comparison of the average mass of individual organisms in a food chain:

	Average mass of individual organisms (arbitrary unit)
Producer	100000
Primary consumer	1
Secondary consumer	100

Sketch a pyramid of numbers relating the three trophic levels. (3)

CE- 2010

9. (b) Mikania is a climber plant which originates in South America. It climbs up other plants to reach for better sunlight. Its leaves grow extensively and cover the affected plants, eventually leading to the death of the plants. The photograph below shows Mikania and the affected plant.



(i) With reference to the photograph, identify the plant group to which Mikania belongs. (1)

(ii) State the relationship between Mikania and the affected plant. Suggest how Mikania can lead to the death of the affected plant. (3)

(iii) A researcher wanted to find a way to control the spread of Mikania. He discovered that a native parasitic plant, dodder(菟絲子), coils around the Mikania and absorbs nutrients form them. He then conducted a study by growing dodder in Mikania-affected areas A and B on an island. The results are shown in the table below:

	% coverage of Mikania on the affected plant	
	with dodder coiled	without dodder coiled
Area A	20	98
Area B	75	99

(1) State ***one*** limitation of using dodder for controlling the spread of Mikania. Give supporting evidence from the above results. (2)

(2) Apart from dodder, an invertebrate from another country can also control the spread of Mikania by feeding on them. From the ecological point of view, suggest three reasons why this invertebrate should not be introduced to Hong Kong to control Mikania. (3)

AL - 2006 1A

2. Each of the following figures shows the changes in population density of two interacting species:

Figure 1

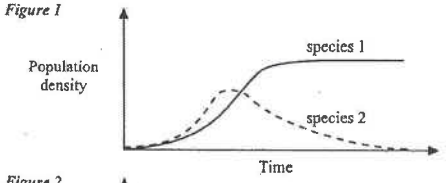
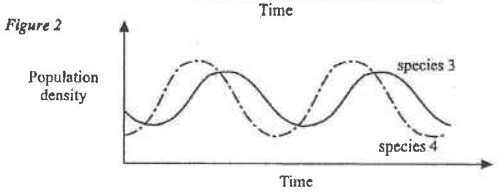


Figure 2



Name the type of interaction between the species in each case. (2)

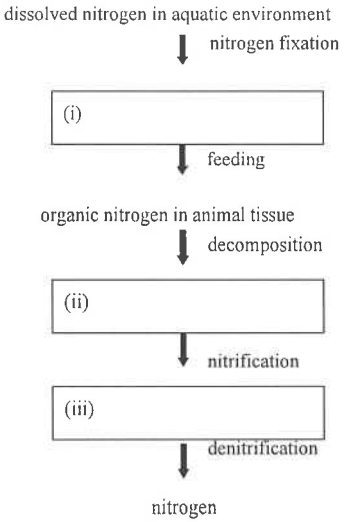
Figure 1 : ..... Figure 2 :.....

AL - 2007 1A

1. The following flowchart shows part of the nitrogen cycle in the aquatic ecosystem.

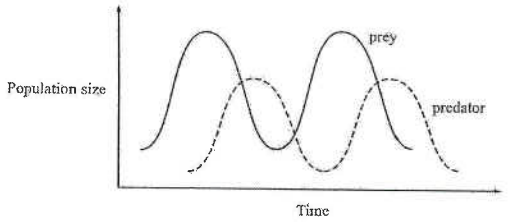
(a) In each of the boxes below, state a compound which contains nitrogen. (3 marks)

(b) In the flowchart, circle the process that incorporates inorganic nitrogen into the living system. (1 mark)



AL - 2007 1A

2. The graph below shows the change in the population size of a prey species and its predator species in the natural environment over a period of time:



(a) Explain why the predator and prey populations fluctuate as shown in the graph. (4)

(b) Explain why the prey population does not drop to zero. (1)

AL - 2009 1A

3. Line transect is a kind of sampling method used in ecological studies.

(a) What is the criterion for choosing a location to place the transect line in a habitat? (2)

(b) State two limitations of this sampling method. (2)

AL - 2010 1A

4. The following flowchart shows the amount of energy incorporated into the biomass at each trophic level when energy flows through a food chain (all energy values are given in arbitraryunits):

(a) Using the above data, complete the following table to show the energy transfer efficiency in this food chain. (1)

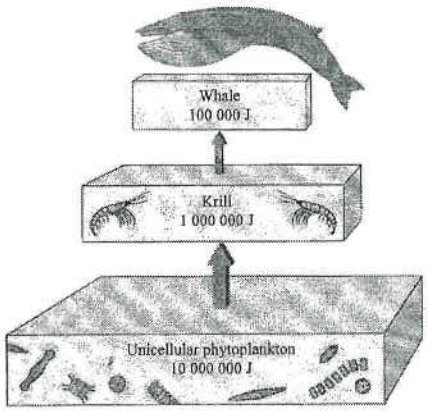
	Energy transfer efficiency (%)
From producers to primary consumers	10
From primary consumers to secondary consumers	
From secondary consumers to tertiary consumers	20

(b) Explain the low energy transfer efficiency from producers to primary consumers. (3)

(c) The tertiary consumers of this food chain are ectotherms. If these tertiary consumers were endotherms, what would the change be in the energy transfer efficiency from secondary consumers to tertiary consumers? Give an explanation for your answer. (2)

DSE-2012 1B

6. The diagram below shows a food chain in an ocean. The energy content of each trophic level is shown in the boxes:



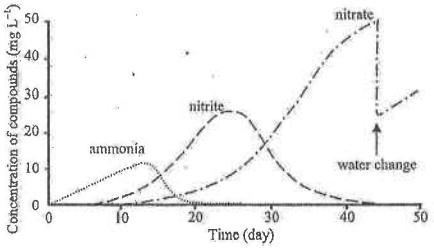
(a) In the space below, calculate the percentage decrease in energy content from unicellular phytoplankton to krill. (2 marks)

(b) Give two reasons why there is a decrease in energy content from a lower trophic level to a higher one. (2 marks)

(c) In another food chain, the producer is tree and the primary consumer is caterpillar. Would the percentage decrease in energy content be greater or smaller than the value found in (a)? Explain your answer. (2 marks)

HKDSE - 2013 1B

5. Knowing that the nitrogen cycle is important to the healthy growth of fish, Tom purchased testing kits to monitor the levels of ammonia, nitrite and nitrate in his aquarium. He kept the aquarium aerated with an air pump. The graph below shows the changes in the concentrations of the three compounds over 50 days:



(a) Name the process that led to the changes shown in the graph. (1 mark)

(b) After three weeks, Tom observed a high concentration of nitrite in the water and the fish were showing symptoms of nitrite poisoning. Therefore, Tom added a suspension of a bacterial culture to the water to lower the nitrite concentration. Suggest the type of bacteria he added and explain how it lowered the nitrite concentration. (2 marks)

(c) To prevent the accumulation of nitrate, Tom regularly replaced some water in the aquarium with fresh water. What else could Tom do to lower the nitrate concentration?(2 marks)

HKDSE - 2013 1B

8. A study was carried out to investigate the distribution and abundance of animal species A and B on a rocky shore. The table below shows the results obtained from the back of the shore to the waterfront:

Distance from the back of the shore (m)	Abundance (number of individuals m^{-2})	
	Species A	Species B
1	10	0
2	25	2
3	40	8
4	38	10
5	20	20
6	18	35
7	15	33
8 (waterfront)	11	28

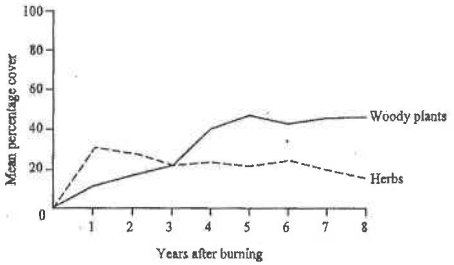
(a) Plot a graph to show the results. (5 marks)

(b) Based on the information in the graph, suggest which species would have a higher tolerance to desiccation. Explain your answer. (4 marks)

(c) Briefly describe the sampling procedure used to obtain the above data. (3 marks)

HKDSE - 2014 1B

5. In a study, a plot of land was burnt by fire. After this, the vegetation on this land, classified into herbs and woody plants, was monitored for 8 years. The percentage cover of each type of vegetation is shown in the graph below:



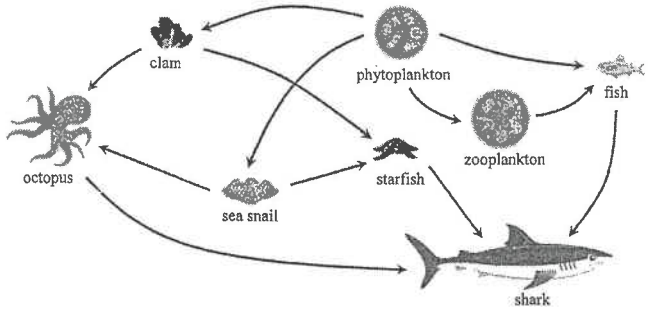
(a) Which type of succession is shown in the above case? Explain your answer. (2 marks)

(b) (i) Describe briefly how the dominant community of vegetation changes with time after the fire. (2 marks)

(ii) Explain the changes in the dominant described in (i). (4 marks)

HKDSE – 2015 1B

3. The diagram below shows the feeding relationships among some organisms in a marine ecosystem:



(a) Write down the shortest food chain found in the diagram. (1 mark)

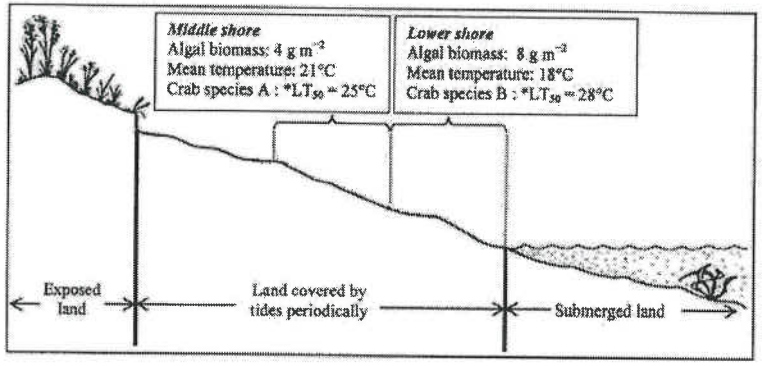
(b) In the space provided below, draw the pyramid of numbers for the food chain in (a). (2 marks)

(c) Explain the shape of the pyramid of numbers drawn in (b). (3 marks)

(d) Suggest *two* practical methods that allow you to confirm the feeding relationships among various organisms in this ecosystem. (2 marks)

HKDSE – 2016 1B

5. The diagram below shows some biotic and abiotic factors of a rocky shore, the distribution of two crab species and their temperature tolerance:



* Median lethal temperature (LT_{50}): When a species is exposed to that temperature for 24 hours, half of the individuals die.

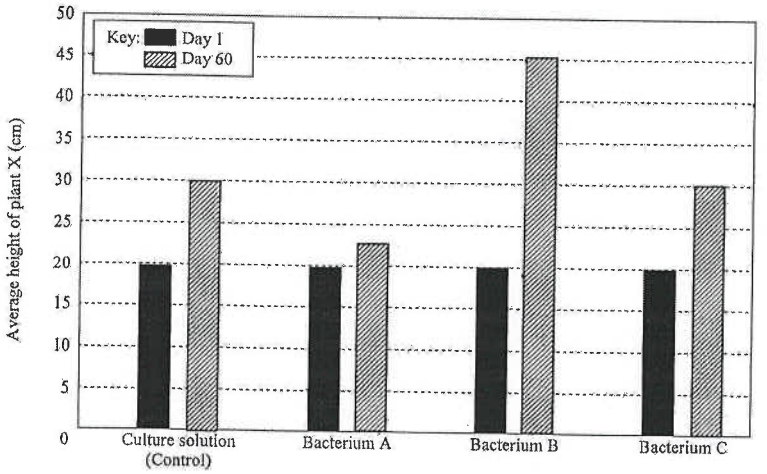
(a) The two species coexist on a rocky shore and feed on the same species of alga. When the two crab species are kept in a simulated habitat with the algal species, they will fight against each other. According to the information given in the diagram, deduce which crab species, A or B, would be a stronger competitor. (3 marks)

(b) Deduce whether temperature tolerance is a determining factor for the distribution of these crab species. (4 marks)

(c) Explain why quadrats are unsuitable for studying the abundance of crabs on the rocky shore. (2 marks)

HKDSE - 2017 1B

8. In an investigation about the effect of soil bacteria on the growth of plant X, three types of soil bacteria (A, B and C) were grown separately in one type of culture solution. After this, each bacterial culture was added to the soil of separate pots of plant X. A control was prepared by adding the culture solution only. The average height of plant X was recorded at day 1 and day 60 of the experiment. The results are shown in the chart below:



a. With reference to the above results, state the effect of each type of bacterium on the growth of plant X. (3 marks)

Bacterium A :

Bacterium B :

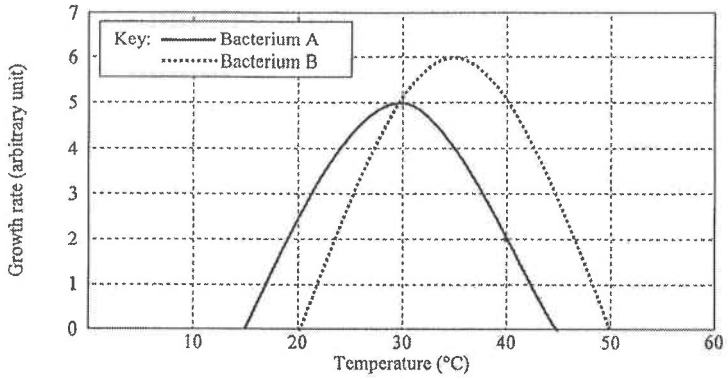
Bacterium C:

b. It is known that both bacteria A and B are able to colonise the root of plant X and obtain nutrients from the root for growth. Suggest the possible ecological relationships between each type of bacterium and plant X. (2 marks)

Bacterium A:

Bacterium B:

c. In a subsequent experiment, the effect of temperature on the growth of bacteria A and B was tested and the results are shown in the graph below:



i. Indicate the optimum temperature for the growth of bacteria A and B respectively. (1 mark)

Bacterium A:

Bacterium B:

ii. Normal soil temperature in Hong Kong is around 30°C in summer. Global warming has led to an increase in soil temperature within 2°C. With reference to the above graph, predict the changes in the population sizes of bacteria A and B in soil in summer. (2 marks)

d. Plant X is a foreign species that is more competitive than the native plant species in Hong Kong. With reference to your answers in (a) and (c)(ii), suggest a possible impact of global warming on the native plant community. Explain your answer. (2 marks)

HKDSE - 2019 1B

7. The table below shows the changes in soil nitrogen content and the number of species of herbaceous plants and woody plants before and after a landslide on a hillside:

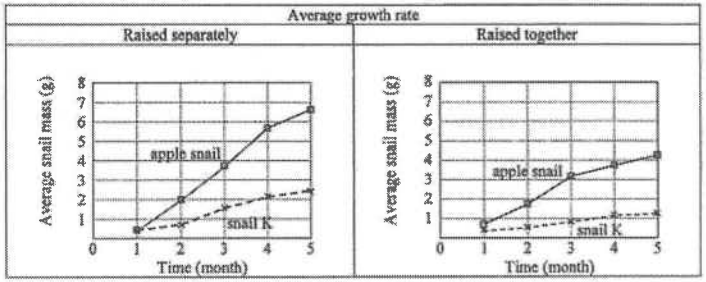
	Soil nitrogen content ($mg\ g^{-1}$)	Number of plant species	
		Herbaceous plants (e.g. grass)	Woody plants (e.g. shrubs and trees)
Before landslide	6	10	15
2 years after landslide	1	17	2
20 years after landslide	3	14	9

(a) What type of ecological succession occurred on the hillside after the landslide? Explain your answer. (2 marks)

(b) (i) Explain the change in the soil nitrogen content shown in the above table. (3 marks)

(ii) With reference to the change in soil nitrogen content, explain the change in the plant composition after the landslide in terms of the number of species of herbaceous and woody plants. (3 marks)

9. The apple snail originates from South Africa. It was first imported to Asian countries for human consumption. However, it escaped to the local wetland habitat. Below are data regarding the average growth rates of apple snail and a local species K when they were raised separately and raised together:



(a) With reference to the above data, what would happen to the population of snail K in the wetland habitat once the apple snails have escaped to this habitat? Support your answer with data from the graphs above. (4 marks)

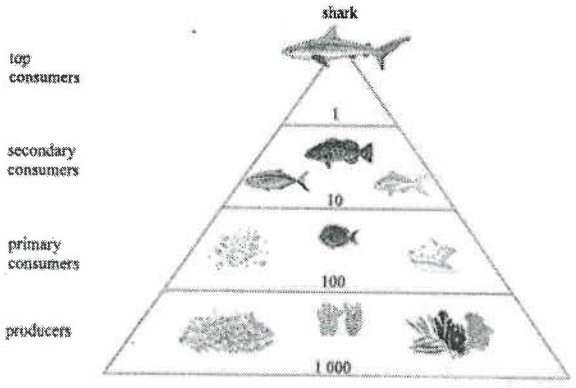
(b) It has been noted that apple snails consume wetland plants at a high rate, especially buds and young leaves. Suggest why the feeding habitats of apple snails may have an adverse effect on the community of local wetland habitats. (3 marks)

(c) Apart from the above, suggest another biotic factor which may explain why an imported species would turn into an invasive or dominant species. (1 mark)

(d) Suggest one human activity which might lead to an invasion of imported species in Hong Kong. (1 mark)

HKDSE - 2020 1B

2. The diagram below shows the total biomass (arbitrary unit) at each trophic level in a marine ecosystem:



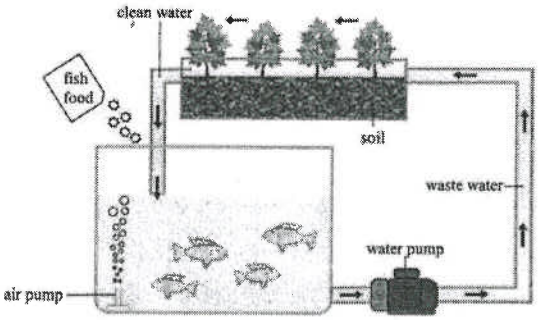
(a) As the trophic level becomes higher, the total biomass of each level decreases. Give *two* reasons for this phenomenon. (2marks)

Reason 1:

Reason 2:

(b) Sharks, being the top consumers in the ocean, play an important role in keeping the populations of other marine organisms under control. It is predicted that the extinction of sharks would result in overpopulation of producers. Explain how this would happen. (3 marks)

6. The diagram below shows a mini-ecosystem in which waste water from a fish tank is used as a source of nutrients for plant growth by making use of the interaction among fish, microorganisms and plants. Adding fertilisers and periodic change of water are not necessary. This is an eco-friendly way to grow vegetables and raise fish for human consumption.



(a) Ammonia, a toxic substance, is the major waste product excreted by fish. Ammonia in waste water from the fish tank can be converted to nitrate, which is required by plants for growth.

(i) Name the bacteria involved in the conversion. (1 mark)

(ii) Describe how plants can obtain nitrate from waste water and make use of it for protein synthesis in their leaves. (3 marks)

(b) The air pump performs some important functions in this system. Describe these functions. (2 marks)

(c) If double the amount of fish food is added accidentally, some fish will die a few days later. Based on your knowledge of the cycling of materials, suggest an explanation for this phenomenon. (4 marks)

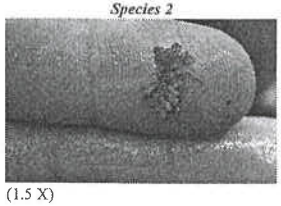
HKDSE - 2020 1B

9. The photographs below show the appearances of two species of free-floating, freshwater plants, Species 1 and Species 2:

Species 1

(0.58 X)

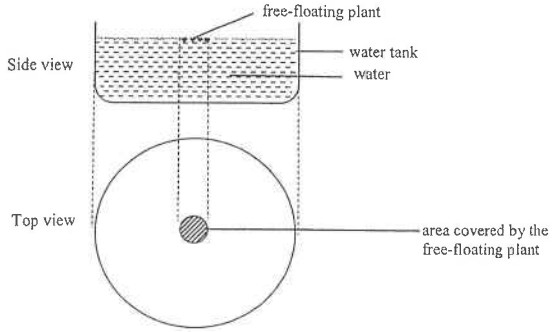
Species 2



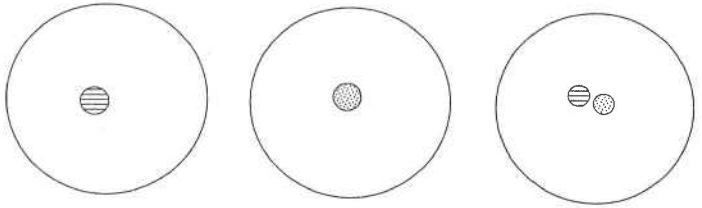
(1.5 X)

To study the interaction between these two plant species, each species was grown either alone or together with another species in a water tank for 50 days. Each species covered 10% of the area of water surface at the beginning of the experiment. The experimental set-up and design are shown in the following diagrams:

Experimental set-up:

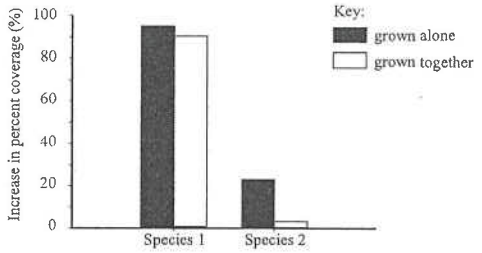


Experimental design (top view):



Species 1 grown alone | Species 2 grown alone | Species 1 and 2 grown together

The percent coverage of each plant species was measured at the beginning and at the end of the experiment. The increases in the percent coverage are shown below:



(a) With reference to the aim of the experiment, what conclusions can be drawn about the interaction between Species 1 and 2? Explain your answer. (4 marks)

Conclusion 1:

Conclusion 2:

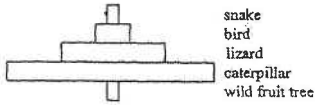
(b) With reference to the photographs of Species 1 and 2, suggest an explanation for the difference in the percent coverage of the two plant species when they were grown together. (2 marks)

Past papers Marking Scheme – Ecosystems

CE - 2003 Q.1 (c)

(i) naked skin 1
(ii) Amphibia / Amphibian 1
(iii) Destruction / lack of habitats for the Hong Kong newt
The newt may have low reproductive potential
Poor ability to find food / insufficient food supply
Poor defensive mechanism against natural enemies
Hunted by humans any two 1,1

(iv) (1) wild fruit tree → caterpillar → lizard → bird → snake 1
(2) Drawing of the pyramid : upright inverted bottom 1,1



(3) Energy is lost along the food chain 1
due to respiration / excretion / incomplete ingestion and digestion of food / death 1
thus the number of organisms in each trophic level decreases from caterpillar to snake 1
However, the biomass/energy/size of the fruit tree is much greater than that of a caterpillar, so a fruit tree can support many caterpillars 1

CE - 2005 Q.5

(b) Because it leads to extinction of the species / decrease in bioversity 1
and an increase in the population of its prey 1
(c) It allows the young fish to reach sexual maturity 1
so that they can carry out reproduction 1
As a result, the production of offspring can compensate for the loss of fish 1

CE - 2005 Q.8 (b)

(i) The nitrate in the soil is absorbed by the tomato plant for growth 1
When tomatoes are harvested, the nitrogen in the tomatoes is not recycled to the soil 1
(ii) denitrifying bacteria 1

(iii) add chemical fertilizer
bury leaves / organic matter into the soil
grow leguminous plants any two 1,1

(iv) When the soil became poorly aerated, plant roots would not have oxygen for respiration 1
Thus they cannot absorb mineral salts from the soil 1
by active transport 1
resulting in poor plant growth

CE - 2007 Q.9

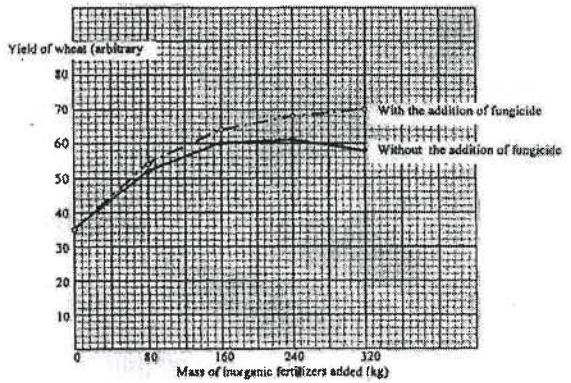
(a) (i) It converts light energy to chemical energy 1
which is passed along the food chain to support other organisms 1
It also maintains a steady air composition 1
by releasing oxygen and absorbing carbon dioxide 1
(ii) Bacteria break down the organic matter to inorganic matter 1
which is then absorbed and used by algae for growth 1
(iii) The biomass of algae is limited in the ecosphere 1
Energy is lost along food chain 1
and cannot support more trophic levels

CE - 2008 Q.8

(a) (i) Title (T) 1
Correct plotting and joining of points (P) 1 1/2
Correct labelling of curves (G) 1/2

Other alternative for the title:
Effect of different amount of fertilizers on the yield of wheat in the presence and in the absence of fungicide
The yield of wheat when different amounts of fertilizers are added in the presence and in the absence of fungicide
The effect of fertilizers and fungicides ont the yield of wheat

e.g. Title: Effect of the use of fungicide on the yield of wheat when different amount of fertilizers were added



(ii) Any three of the following: 1, 1, 1
In the presence of fungicide, the yield of wheat increases with the increase in the amount of fertilizer added (from 0 kg to 320 kg)
In the absence of fungicide, the yield of wheat increases with the increase in the amount of fertilizers added till 240 kg, and decreases when fertilizers added is higher than 240 kg
The yield of wheat is higher in the presence of fungicide than in the absence of fungicide
The difference in the yield of wheat between the presence and the absence of fungicide increases when the use of fertilizers increases

1st and 2nd points can be written as:
The yield of wheat increases with the increase in the amount of fertilizer added in both cases until 240 kg of fertilizers added
Beyond 240 kg fertilizers added, the yield of wheat increases in the presence of fungicides but decreases in the absence of fungicides

(iii) Leaching of fertilizers to the aquatic habitat nearby, e.g. rivers, ... 1
will lead to the rapid growth of algae / algal bloom 1

Any one of the following: 1
Other organisms in the habitat will suffocate due to oxygen depletion atnight
The algae may block the gills of the fish and suffocate it
The algae may produce toxins which kills other aquatic organisms
Abundant of suspended algae prevents light from reaching the aquatic plants below

CE - 2009 Q.10 (a)

(a) (i) Nitrogenous wastes released by the fish 1
is decomposed to ammonia by bacteria 1

(ii) (1) Nitrifying bacteria 1
They convert ammonia into nitrate 1
(2) The residual chlorine in the tal water may kill the bacteria 1
Leaving the tap water for at least one night allows time for chlorine gas to escape 1
(3) To allow the multiplication of bacteria to a sufficient population 1

(iii) Water plants can absorb the nitrates in the aquarium
The nitrates are sued for synthesis of proteins

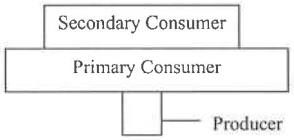
Water plants can carry out photosynthesis
to provide oxygen for other organisms / to lower the carbon dioxide concentration in water
} 1, 1 any one set

CE - 2010 Q.7

7. (a) The amount of energy stored in biomass is always less than the amount of energy gained at each trophic level (1)
because energy is lost as heat during respiration/ only part of the energy gained is used for growth/ energy is lost in form of metabolic wastes (1)

(b) Energy is lost/ trapped in the undigested/ unabsorbed parts of organisms of the previous level
Energy is lost in the uneaten parts of organisms of the previous level (2)
Energy trapped in the dead bodies of organism is not available to the organisms of next higher trophic level/ is redirected to the decomposers
any two

(c)



Shape.....(2 or 0)
Label..... (1)

CE - 2010 Q.9b

9. (b) (i) Flowering plant/ dicotyledons (1)

(ii) competition (1)
Mikania covers the affected plant so the underlying plant cannot get sufficient amount of light (1)
for photosynthesis to make enough food (1)

(iii) (1) The effectiveness of using dodder for controlling the spread of Mikania varies greatly in different areas (1)
because the reduction in % coverage of Mikania caused by the dodder in area B is much lower than those in area A. (1)

OR
The use of dodder is not a perfect / ideal solution for complete elimination of Mikania (1)
as the % coverage of Mikania in both areas A and B does not drop to zero even when dodder is introduced (1)

(2) (A) Because there is no predators/ parasites/ natural enemies for this introduced invertebrate in HK
(B) They may feed on other local organisms/ disturb the local food chains or webs
(C) They may carry pathogens that do not exist in HK before
(D) They may upset the existing ecological equilibrium
} any three(3)

AL -2006 1A

2. • Figure 1: *competition (1) 2
• Figure 2: *predation (1)

AL - 2007 1A

1. (a) i. proteins (1) / amino acids
ii. ammonia (1) / ammonium compounds
iii. nitrate (1) / nitrite
(b) circle - nitrogen fixation 1

AL - 2007 1A

2. (a) • when the predation pressure / predator population is low, the prey population can increase rapidly (1)
• a greater population of prey can support rapid growth of / increase in the predator population (1) / reproduction of the predator, thus the predator population increases subsequently
• the prey population will drop due to increased predation (1)
• when the food supply (prey) becomes less, predator population will drop subsequently (1) and the cycle repeats (1)
(b) • when the prey population becomes extremely low, it is very hard for the predator to locate the remaining prey (1) / predator is forced to feed on other prey

AL - 2009 1A

3. (a) Any **ONE** of the following:
- place the transect line across a selected site where there is zonation of plants and animals (1) along with physical factors (1)
- place the transect line across a selected site where is sucessional change (1) along with physical factors (1)
- changes in physical factors (1) that are suspected to affect plants and animals distribution (1)

(2)

(b) any **TWO** of the following:
- only organisms that touch the line transect are recorded (1)
- the population / density / abundance of the organisms are not estimated (1)
- applicable to sessile organisms only (1)

(2)

AL - 2010 1A

4. (a) · 20 (1)

(b) · plants contain a high proportion of cellulose and sometimes lignin (1)
· which are relatively indigestible (1)
· and therefore unavailable as energy sources for most herbivores (1) (3)

(c) · the energy transfer efficiency would be lower (1)/ less energy would be incorporated
· endotherms spend more energy in maintaining a constant body temperature (2)

DSE-2012 1B

6. (a) (10 000 000 – 1 000 000) / 10 000 000 x 100% = 90% (Remark: accept -90%)
Method / equation 1 mark
Correct answer 1 mark (1,1)

(b) • some energy is not obtained by the organisms of higher trophic level as part of the body of prey is not consumed (1) / part of the food is not digestible or is egested (1) (1)
• some energy is lost by the organisms at the higher trophic level through excretion (1) / respiration (1) / in the form of heat (1) (1)
Remarks:
- Any two of the above.
- The words "higher trophic level" are not required. However, if the wrong trophic level is mentioned, the mark will not be awarded.
- some individuals escape from predation is not accepted.

(c) • the percentage decrease in energy content is greater (1) (1)
• as caterpillars mainly feed on leaves of trees, leaving most of the part of the biomass of tress unconsumed (1) / lignin is not consumed (1)

6 marks

HKDSE - 2013 1B

5. (a) nitrification * (1) (1)

(b) • nitrifying bacteria (1).
• which convert nitrite to nitrate (1) and help lower the nitrite level (2)

(c) • adding aquatic plants to the aquarium (1)
• the plants would assimilate / absorb / convert nitrate into their biomass (1). (2)

HKDSE - 2013 1B

8. (a) • correct title (1)
– concept: distribution of species, defined location, e.g.
> The distribution and abundance of animal species A and B on a rocky shore
> Abundance of animal species from the back of a shore to the waterfront
• choice of axes (1)
• with labels and units (1)
– X: distance from the back of the shore (m); Y: abundance (number of individuals m^{-2} or m^{-2})
• correct plotting and joining of line showing the distribution of species A and B (1,1) (5)

(b) • species A is found to be more abundant at the back of the shore than species B (1)
• the back of the shore has a lower chance / less period of time to be covered by water (1)
• thus, organisms found at this region is more likely to face the problem of desiccation (1)
• therefore, it can be deduced that species A has a higher tolerance of desiccation (1) (4)

(c) • place a transect line from the back of the shore to the waterfront (1)
• place a quadrat along the transact line at regular intervals (1)
• count the number of Species A and B in the quadrat (1) and record the results (3)

HKDSE - 2014 1B

5. (a) • secondary succession (1)
• because it involves the restoration of the community after a major disturbance, i.e. fire (1) (2)

(b) (i) • from year 0 to 3, herbs is the dominant vegetation (1)
• from year 3 to 8, woody plant is the dominant vegetation (1) (2)

(i • the underground sprouting organs and seeds were not damaged in the fire (1),
)
• herbs generally germinate and grow faster than woody plants (1)
• hence the percentage cover of herbs increased rapidly at first (1) and become the dominant vegetation in the first three years
• as woody plants continue to grow and over-shadow the herbs, thus out-compete the herbs for light (1), they replace herbs as the dominant vegetation (4)

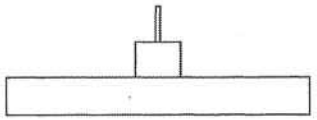
HKDSE – 2015 1B

3. (a) phytoplankton → fish → shark (1) 1
(Text description is not accepted)

(b) Shark:

Fish: 2

Phytoplankton:



correct shape (1)
lables (1) 2

(c) Not all energy in the lower tropic level is transferred to the next higher level (1) / energy is lost along the food chain due to respiration
and the organisms at lower levels are smaller in size / biomass of individual (1)
(Not accept biomass of the whole trophic level)
therefore, a larger number of individuals at a lower trophic level is required to support those at upper levels (1) 3

(d) Any two of the following:
- by dissecting the gut of the predators to find out what prey items are inside (1)
- field observation of the feeding relationship (1)
(direct observation is not accept)
- laboratory study by offering different preys to a predator (1) 2

HKDSE – 2016 1B

5. (a) species B (1)
the lower shore has higher algal biomass which indicates that it is a more favourable area (1)
a stronger competitor normally occupies a more favourable habitat (1) 3

(b) mean temperature at the lower shore is lower than that at the middle shore / vice versa (1)
if temperature tolerance is a determining factor, middle shore should be unfavourable to species A / lower shore should be more favourable to species A (1)
however, species A occupied middle shore instead of lower shore (1)
therefore, there are other factors determining the distribution / temperature tolerance is not the determining factor (1) 4

(c) quadrat sampling relies on counting organisms in a confined area (1)
so it is only useful for studying plants or very slow moving organisms / crabs may move away from the quadrat (1) 2

HKDSE – 2017 1B

8. (a) Bacterium A: inhibits/hinders/slows down/prevents/decreases/has negative effect on (do NOT accept "stops") (the growth of plant X) (1)
(all symbols like + are not accepted)
Bacterium B: promotes/increases/has positive effect on (the growth of plant X) (1)
Bacterium C: has no obvious effect on /a neutral effect on / does not change (the growth of plant X) (1) (3)

(b) Bacterium A: parasitic (1) / pathogenic
Bacterium B: mutualistic (1) (do NOT accept symbiotic) (2)

(c) (i) Bacterium A: 30(°C) /30/29/31
Bacterium B: 35(°C) /35/34/36 } (1) (1)

(ii)
- population size of bacterium A decreases (1) while
- population size of bacterium B increases (1) (2)

(d)
- native plant community decreases in size/diversity (due to the threat of plant X) (1) (do NOT accept: "native plant community may die" or "plant X becomes dominant")
- because inhibition on the growth of plant X decreases as the population size of bacterium A decreases /the growth of plant X increases as the population size of bacterium B increases (1) (2)

10 marks

HKDSE – 2019 1B

7. (a)
- secondary succession(1)
- because succession occurred in pre-existing soil / pre-existing plants (1) (2)

(b) (i)
- after the landslide, the original vegetation / top soil was removed, so the soil nitrogen content fell / after the landslide, rapid growth of herbaceous plant absorbed nitrogen from the soil, so the soil nitrogen content fell (1)
- some plant species have symbiotic nitrogen fixing bacteria in their root nodules, which enrich the soil nitrogen content by fixing atmosphere nitrogen (1)
- as time went by, the dead mass of the new vegetation was decomposed by soil bacteria (1)
- hence releasing nitrogen compounds back into the soil (1), and so soil nitrogen content increased with time (max. 3)

(ii)
- in the early stage / 2 years after the landslide, there were many more herbaceous plant species than woody plant species (1)
- since the nutrient requirements of herbaceous plant species are lower than those of woody plant species (1), low soil nitrogen content favours the growth of herbaceous plants / does not favour the growth of woody plants
- subsequently, the number of woody plants species increased as the soil nitrogen content continued to increase (1) (3)

8 marks

HKDSE – 2019 1B

9. (a)
- both apple snails and snail K showed a lower growth rate when they were raised together (1)
- this shows that there was competition between apple snails and snail K for habitat and / or food (1)
- the growth rate of snail K would be slower and some of them would fail to reach maturity for reproduction / death rate of snail K would be higher (1)
- so the population of snail K would fall / decline (1)

OR

- apple snails had a higher growth rate when raised separately from snail K (1),
- the growth rate of snail K fell significantly when raised together with apple snails (1)
- this shows that apple snails were more competitive than snail K (1)
- hence the population of snail K would fall / decline (1)

(4)

(b)
- in the long term, plants would fail to reach maturity for reproduction (1)
- it reduces the size of the plant community in the habitat (1),
- this would reduce food availability / shelter for other animals (1)

OR

- in the short term, plants would grow more slowly (1)
- the biomass of producers would decrease (1)
- this would reduce food availability for other herbivores / animals (1)

(3)

(c)
- lack of natural predators in the local habitat / a high rate of reproduction (1)

(1)

(d) any reasonable answers such as:
- release of imported pets to the natural environment once owners cannot / do not want to keep them anymore (1)
- release of imported organisms to the natural environment for religious purposes (1)
- bringing in non-local seeds / plants which the reproduce and spread to the wild habitat through seed dispersal (1)

(1)

9 marks