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Ecology revision questions and answers

- The number of trophic levels in a food chain is mainly determined by the
 - Deficiency of energy transfer between levels
 - Biomass of the producer
 - Net productivity of ecosystem
 - Species diversity of the ecosystem

A

Comment: The number of trophic levels in a food chain is limited by the amount of energy loss from one trophic level to another; other factors are space and availability of food

- Which one of the following characteristics of a parasite is not a means of ensuring continuity of species of the parasite?
 - Degeneration of redundant body structures
 - Protection against host enzymes
 - Means of penetrating other organisms
 - Means of dispersing offspring

A

Comment

Degeneration of redundant body structures is an adaptation of a parasite to its mode of life but does not directly ensure continuity of its species

Remember that: some of the adaptations of a parasite that ensure continuity of the parasite species include

- Possession of penetrating devices for gaining entry into the host*
- Possession of protective devices which prevent the parasite from being harmed by host's defense mechanisms. For example, gut parasites secrete inhibitor substances which inactivate the hosts' digestive enzymes.*
- Having means of dispersing its offspring, for example, employing a secondary host, for example tape worm employ a cow or a pig.*
- Having a resistant stage that can survive unfavorable conditions.*
- Producing a big number of offspring to increase the chances of survival*

- The biomass of consumer is always less than that of producers because
 - Producers have to support consumers
 - Consumers have a low productive rate
 - Energy is lost through body process of consumer
 - Consumers are small in size

C

Comment

The producers have highest energy in a food chain and more energy is lost from producer to primary consumer through respiration, excretion and undigestible parts.

4. In estimating the population of tilapia in a fish pond, 60 fish were captured, marked and released. After 2 days, 50 were captured and out of which 10 were marked. The population of tilapia in the pond was
- A. 300
 - B. 400
 - C. 200
 - D. 100

Comment

10 marked animals are found in 50 animals

Therefore, 60 marked animals are found in $\frac{50 \times 60}{10} = 300$ total

5. A good pesticide is one which
- A. Kills a wide range of organism
 - B. Persist for a long time after its application
 - C. Kills pests at different trophic levels
 - D. Easily transforms to non-toxic forms D

Qualities of a good pesticide

- It must be specific to intended organism
- Should easily transform to nontoxic substance after killing the intended organism
- Cheap
- Easily available

6. Which one of the following is not used to describe a population of organism?
- A. Density
 - B. Biodiversity
 - C. Size
 - D. Distribution B

Comments

A population is a group organism of the same species in a given area or community.

- *A population density is the number of organisms in a given group in a given area*
- *A population size is the number of individual in a given group*
- *Population distribution is the pattern of spreading of organism in a given area*

NB. Biodiversity is the variety of species on the earth and does not describe a population

7. Mosses growing on the bark of a tree form an association with the tree is called
- A. mutualism
 - B. parasitism
 - C. commensalism
 - D. predator C

Comments

- **Commensalism** is an association between two organisms in which one organism (commensal) benefits while the other animal (host) does not benefit. Here the moss gains support and shelter from a tree that gains nothing

- **Mutualism** is an association between two organisms in which both parties benefit for example in lichen, the fungi absorbs water from the atmosphere for the algae to photosynthesize for both organisms.
 - In **parasitism**, one organism (parasite) lives on or in another (host) from which it derives food or nutrients and causing harm.
 - **Predation**, an organism (predator) kills and feeds on the another (host).
8. Which one of the following equation shows the correct relationship between gross primary productivity (GPP) and net productivity (NPP) in plants?
- GPP = NPP – photosynthesis
 - NPP = GPP – photosynthesis
 - GPP = NPP – plant respiration
 - NPP = GPP – plant respiration**

Comments

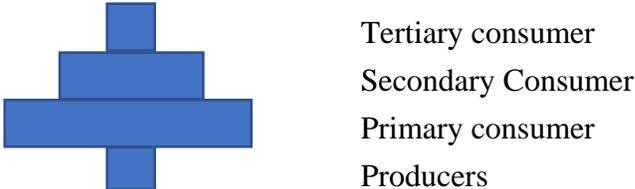
- **Productivity of a plant** is the rate at which energy is stored in plant in form of organic substances for photosynthesis
 - **Gross productivity (GPP)** is the rate at which chemical energy derived from photosynthesis is stored by the plant.
 - **Net productivity (NPP)** is the net gains of organic materials in photosynthesis allowing for the losses due to respiration.
Thus, NPP = GPP – losses due to respiration
9. Which one of the following activities does not contribute to the greenhouse effect?
- Deforestation
 - Use of SFCs
 - Burning of fossil fuel
 - Emission of gases from industries B
- Comments**
- **Greenhouse effect** is caused by accumulation of carbon dioxide which prevent escape of heat from the earth's surface leading global warming.
 - **Deforestation** contributes to the accumulation of carbon dioxide, by reducing on the trees that would reduce carbon dioxide by photosynthesis
 - **Burning of fossil fuel and emission of gases from industries** add carbon dioxide to atmosphere
 - **Chlorofluorocarbons (CFCs)** cause depletion of ozone layer and increase sun rays that reach the earth. This causes direct global warming but not through greenhouse effect.
10. Which one of the following is correct about organism in an ecosystem?
- Some organisms exist in isolation
 - Every organism can be independent
 - Each organism has a different source of food
 - All organism interacts with each other D
11. Which one of the following methods of estimating population has the highest chances of error?
- Removal method
 - Quadrat method

- C. Capture-recapture method
- D. Direct count method

Comments

The capture-recapture method is based on a small representative sample of organisms and therefore higher chances of error.

12. The figure shows a pyramid of numbers for a food chain



The most likely mode of nutrition relationship between producer and primary consumers is

- A. Mutualistic
- B. Symbiotic
- C. Parasitic
- D. Autotrophic

C

Comment

Here the producer is a big organism that can support numerous small parasites

13. Which one of the following environmental factors has direct effect on all organisms?

- A. Light
- B. Humidity
- C. Temperature
- D. Rainfall

Comments: temperature affects all organisms by altering the rate of enzyme catalysed reaction.

14. Which one of the following factors reduces interspecific competition in a community?

- A. Resource partitioning
- B. High intraspecific competition
- C. Large number of species
- D. Similar producer-prey strategies among the species.

A

Comments

Interspecific competition is competition which occurs among organisms of different species. Resource partitioning, is the allocation of particular resources to particular species. This reduces interspecific competition since each species use different resources.

15. Which one of the following is **not** exhibited by well adapted parasite?

- A. Inflicting moderate harm to its host
- B. Employing an intermediate host
- C. Killing the host
- D. Using more than one host

Comments

A well-adapted parasite never kills the host. However, it may,

- *Inflict moderate harm to its host*
- *Employ a intermediate host*
- *Use more than one host*

16. Depletion of the ozone layer is caused by
- Greenhouse effect
 - Release of carbon dioxide in the atmosphere
 - Penetration of ultraviolet light
 - Release of the chlorofluorocarbon in atmosphere

Comments

Chlorofluorocarbons are chemicals that react and destroy ozone layer

17. The type of succession where recolonization of an area results into a different community from the original one is known as
- Primary
 - Dominant
 - Deflected
 - Secondary

C

Comments

When an established community is destroyed and then allowed to regenerate, sometimes recolonization of the habitat leads to establishment of a climax community different from the original climax community. This new community is referred to as a plagioclimax and occurs by a succession termed deflected succession.

18. Radioactive rays are particularly dangerous in nature because they
- cannot be absorbed by plant so they only affect animals
 - accumulate in animals and return to the soil animals die
 - cause extremely high temperatures in the environment
 - accumulate in high concentrations at high trophic levels

C

Comments

Radioactive radiation produce a lot of heat when encounter an obstacle in environment

19. Determining the commonest plant species in a large habitat within a short time can be best carried out using the
- line transect
 - quadrat
 - direct count
 - aerial view

A

Comments

Line transect involves the use of a tape of string along the ground in a straight line between two designated points. Sampling is rigorously confined to species actually touching the line. This gives a quick method of identifying the commonest plant species in a large habitat.

20. Excessive use of pesticides in the long term affect mostly
- carnivore
 - parasites
 - producers
 - herbivores
- Comment

A

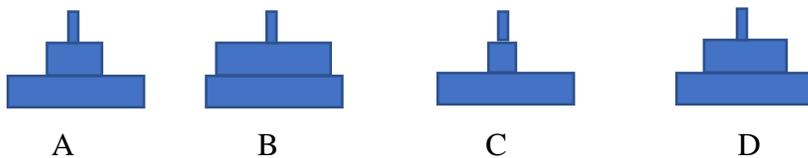
Pesticides have a property of bioaccumulation, i.e. they keep on increasing in concentration in higher trophic levels. As a result, carnivores are the most affected.

21. Which one of the following is true about the environment of a forest floor under a thick canopy?

- A. Has wide temperature fluctuations
- B. Receives far red light**
- C. Develop dense plant growth
- D. Has heavy soil erosion

➤ *The presence of thick canopy, ordinary light cannot penetrate to reach the plants under the canopy. But far red light has more energy and penetrating power to reach the floor of the forest.*

22. In which pyramid does the primary consumer make efficient use of the producer



B

The energy pyramids, bars are drawn proportional to the total energy utilised at each trophic level. Those shown indicate three trophic level, producer, primary consumer and secondary consumer. A larger bar indicates has more energy. Hence in B the primary consumer is able to derive more energy.

23. Which one of the following factors has the greatest limiting influence on the population of algae at the bottom of a pond?

- A. Light
- B. Carbon dioxide
- C. Mineral salts
- D. Oxygen

A

➤ *Algae are photosynthetic organisms are thus limited by light reaching the bottom of the pond since light may be obstructed by lower plants on the water surface.*

24. Which one of the following factors does not affect the distribution and abundance of organism?

- A. Mimicry
- B. Predation
- C. Human species
- D. Speciation

D

➤ *Speciation is the formation of a new species from preexisting one and thus has no effect on species distribution.*

25. Which one of the following would be an effect of decreasing competition on a stable population?

- A. Increasing the environmental resistance thereby increasing the population
- B. Lowering the environmental resistance thereby increasing the population
- C. Lowering the environmental resistance thereby decreasing the population
- D. Increasing the environmental resistance thereby decreasing the population

B

➤ *Competition is one of the factors that constitute environmental resistance. Other include, predation, diseases, e.t.c. therefore, reduction in competition reduces environmental resistance and thus encourages population growth.*

26. Algae have much smaller biomass compared to a large producer such as trees but may have the same productivity because
- A. A lot of material and energy are locked up in the dead xylem tissue of the tree.
 - B. The algae have a very high turn-over
 - C. Algae have a high rate of reproduction
 - D. The rate of growth and death in algae is high
- B

27. Predators in top trophic levels in food chain are most severely affected by persistent pesticides because
- A. Their systems are highly sensitive to chemicals
 - B. They have high reproductive rates
 - C. They cannot store pesticides in their tissues
 - D. The pesticides become concentrated in their prey
- D

28. Nitrifying bacteria convert ammonia into nitrites and nitrites into nitrates in order to
- A. Enrich the soil
 - B. Generate energy for synthesis of organic compounds
 - C. Maintain the nitrogen cycle
 - D. Reduce the amount of nitrogen in the atmosphere
- B
- *Nitrifying bacteria are chemosynthetic bacteria. They obtain energy for synthesizing material from oxidizing ammonia to nitrites and nitrates. They include nitrosomonas and nitrococcus.*

29. Three counts of 103, 46 and 20 of plant species, were made using a quadrat of 25cm². The density of plant per m² is
- A. 169 B.56.3 C. 22520 D.676
- C

Method

Average for number in 25cm² = (103+46+20)/3 = 56.3

1m² = 100 x 100 cm²

= 10000cm²

But 25 cm² contain 56.3 of plant species

Therefore, 10000cm² contain $\frac{56.3 \times 10000}{25} = 22,520$ species per m²

30. Which one of the following ecological pyramid may be used to determine the productivity in an ecosystem?
- A. Pyramid of energy
 - B. Pyramid of biomass
 - C. Pyramid of numbers
 - D. Pyramid of productivity
- A

➤ *Productivity of an ecosystem is the measure of the net energy output at each trophic level. This can only be illustrated by the pyramid of energy.*

31. Which one of the following forms of environmental hazards is attributed to application of CFCs?

- A. Greenhouse effect
- B. Acid rain
- C. Ozone layer depletion
- D. Eutrophication.

Comments

Chlorofluorocarbons (CFCs) attack and destroy the ozone layer, leading to its depletion.

NB:

- Greenhouse effect is caused by accumulation of CO₂ in atmosphere.
- Acid rain is caused by accumulation of acidic gases, e.g. CO₂ and SO₂ in atmosphere
- Eutrophication is caused by disposal of nitrates-rich waste into water bodies.

32. Which one of the following processes does not affect the biochemical oxygen demand?

- A. Ammonification
- B. Nitrogen fixation
- C. Nitrification
- D. Denitrification

D

- *Bacteria that are involved in nitrogen fixation, nitrification and ammonification are aerobic and so require oxygen and therefore increase demand for oxygen, (BOD) in aquatic habitat. Denitrifying bacteria are anaerobic, their activities do not require oxygen, and thus do not increase biomedical demand.*

33. Which one of the following constitutes the most energy transfer?

- A. Praying mantis feeding on flies
- B. Aphids feeding on plant sap
- C. Cat feeding on small mammals
- D. Beetle larvae feeding on dung

B

- *Aphid is a primary consumer and therefore receives more energy than other consumers.*

34. Which one of the following has the greatest biomass in an ecosystem?

- A. Tertiary consumer
- B. Primary producer
- C. Secondary consumer
- D. Primary consumer

- Producers actually produce the biomass

35. Which one of the following is not a problem that endoparasite face in their transmission?

- A. Leaving the host
- B. Entering the host
- C. Living away from the host
- D. Identifying the host

A

- Leaving a host is effortless

36. Which one of the following statement is correct about the exponential phase in the population growth?

- A. Death rate and birth rate are equal
- B. Number of individuals and rate of growth increase

- C. The number outstrip the supply of factors for support
 D. Slow growth of the population B
 ➤ *During exponential phase of population growth, there rapid increase in the number of organisms in a population. Birth rate is higher than death rate.*
37. The number of organisms in each trophic level reduces as one moves up a food chain because
 A. Energy is lost in moving from one trophic level to another
 B. Energy is lost from the top levels
 C. Organism in higher trophic levels are less productive
 D. Of high level of predation at the top trophic levels A
38. Which of the following activities does not contribute to global warming?
 A. Use of pesticide
 B. Deforestation
 C. Burning fossil fuel
 D. Use of CFCs A
39. During which energy transfer is most energy lost in an ecosystem?
 A. Producer → Primary consumer
 B. Primary consumer → secondary consumer
 C. Secondary consumers → tertiary consumer
 D. Tertiary consumer → decomposer A
40. The bacteria which convert nitrates to nitrites during the nitrogen cycle are example of
 A. Nitrogen fixing bacteria
 B. Nitrifying bacteria
 C. Decomposing bacteria
 D. Denitrifying bacteria A

Comments

Conversion of nitrates to nitrites reduces the nitrogen content of the soil and is called denitrification done by denitrifying bacteria.

- Nitrogen fixing bacteria fix nitrogen from atmosphere to nitrates
- Nitrifying bacteria convert nitrites to nitrates
- Decomposing bacteria cause rotting of organic materials

41. A climax community is one in which
 A. Succession
 B. A carrying capacity has been reached
 C. Succession has ceased
 D. Death rate of organism is at its lowest C
42. Good drainage and ploughing of soil reduces the process of
 A. Nitrification
 B. Decomposition

- C. Denitrification
- D. Nitrogen fixation C
 - *Good drainage and ploughing improves soil aeration and oxygen content of the soil which reduce the activity of anaerobic denitrifying bacteria*

43. In any ecosystem, a continued input of energy is required because
- A. Matter is continually used in metabolism
 - B. Biological succession occurs very slowly
 - C. Of the continued increase in population in ecosystem
 - D. Energy is lost each time it is transferred between organisms D

44. Which of the following would contribute to greenhouse effect?
- A. Use of nuclear power
 - B. Use of fossil fuels
 - C. Excessive use of fertilizers
 - D. Accumulation of sewage in water bodies B
 - *Use of fossil fuel adds carbon dioxide to atmosphere leading to global warming*

45. In the energy transfer in an ecosystem, the greatest loss in energy is between
- A. Primary producer and primary consumer
 - B. Primary consumers and secondary consumers
 - C. Secondary consumer and tertiary consumer
 - D. Tertiary consumers and decomposers A

46. From a bush, 120 beetles were collected and, marked and released back into the bush. A few days later 120 beetles were collected from the same place, and 30 of them carried the mark. The estimated number of beetles in the bush is
- A. 240
 - B. 360
 - C. 480
 - D. 560 C

Calculation

30 marked beetles are contained in 120 beetles in second sample

$$\therefore 120 \text{ marked beetles are distributed in } \frac{120 \times 120}{30} = 480$$

47. Energy flow in an ecosystem refers to the energy
- A. Consumed in total, by all organisms
 - B. Consumed by the organism at each energy level
 - C. Converted from light to chemical energy by the primary producer
 - D. Transferred from the primary producer through the various consumers D
48. Which one of the following parasites is unicellular?

- A. Taenia
- B. Plasmodium
- C. Ascaris
- D. Trypanosome B

49. Which of the following ecological effects may not be caused by deforestation?

- A. Species extinction
- B. Reduction in soil fertility
- C. Acid rain
- D. Flooding and land slides A

Comments

Deforestation may cause species extinction due to lack of shelter and food, reduction of soil fertility due to increased leaching and high decomposition of humus as a result of increased soil temperature of flooding due to removal of plant cover.

Acid rain is caused by acid gases such as Sulphur dioxide and nitrogen dioxide usually from industrial emissions

50. Which of the following characteristics of a parasite would increase its chance of survival?

- A. Being highly specific
- B. Inflicting severe effects on host
- C. Parasitizing more than one type of host
- D. Employing no vector C

51. Which one of the following would be a characteristic of a poorly adapted parasite?

- A. Employing vectors
- B. Inflicting mild harm to the host
- C. Having a dormant stage during the life cycle
- D. Inflicting severe harm to the host D

➤ *When a parasite inflicts too much pain to the host, the host will fight back to remove the parasite or when the host dies, the parasite will have nowhere to feed from*

52. Which of the following methods of controlling malaria would cause least damage to the environment?

- A. Draining swamps
- B. Spraying swamps and ponds
- C. Spraying oil over stagnant water
- D. Introducing fish into the swamp and ponds D

Comments

Fish eat mosquito larvae reducing the population of mosquito without causing harm to the environment

- *Draining swamps lead to death of other aquatic organisms.*
- *Spraying swamps and pond lead to indiscriminate killing of organisms not intended to die.*
- *Spraying oil causes suffocation of all organisms in water*

53. The mycorrhiza on some plants serve to

- A. Fix nitrogen from atmosphere
- B. Absorb mineral salts from the soil
- C. Break down humus
- D. Synthesize carbohydrates
 - Mycorrhiza is a mutual association between fungi and plant roots; the fungi helps the plant in the following ways
 - Breaks down humus to release nitrated,
 - Increases absorptive surface
 - Synthesis proteins and carbohydrates for those plants that lack chlorophyll.

54. In which of the following situations would population growth occur?

When the number of

- A. Birth equals the number of deaths
- B. Birth plus the number of immigrations is less than the number of deaths plus the number of emigration.
- C. Birth plus the number of immigrations is greater than the number of deaths plus the number of emigration.
- D. Deaths plus the number of emigration is greater than the number of births plus the number of immigration. D

55. Which of the following features are most useful to amphibians in living in aquatic habitat?

- A. Moist skin, membrane around eggs, and gills
- B. Membrane around eggs, gills and webbed feet**
- C. Long hind limbs, short fore limbs and gills
- D. Webbed feet, moist skin and gills B

Comments

- *Membrane around the eggs protects the eggs from aquatic predators.*
- *Gills are used for gaseous exchange in tadpole*
- *Webbed feet increase surface area and repulsive forces during swimming*

56. Which one of the following is an intracellular parasite?

- A. Trypanosome
 - B. Plasmodium
 - C. Schistosome
 - D. Hook worm B
- Plasmodium is a parasite that cause malaria is intracellular in the liver.

57. There is a limited biomass at each trophic level in a food chain because at each level, there is

- A. Reduction in the number of organisms
- B. Loss of energy
- C. Reduction in size of organisms
- D. Reduction in amount of food. B

58. How many reproductive stages does malarial parasite undergo to complete the life cycle?

- A. 1

- B. 2
- C. 3
- D. 4

➤ The *Plasmodium falciparum* life cycle has **three main stages**: the **exoerythrocytic (liver)** stage, the **erythrocytic (blood)** stage, and the **sporogonic (mosquito)** stage, which involve both human and mosquito hosts.

59. Which one of the following describes greenhouse effect?

- A. Depletion of the ozone layer increases atmospheric temperature.
- B. The earth retains the heat gained from the sun
- C. Increasing atmospheric carbon dioxide prevents heat loss from earth surface
- D. The earth gives out carbon dioxide which prevents light rays from the sun reaching the earth.

60. The asexual reproductive stage of plasmodium in the liver is represented by the

- A. Zygote
- B. Gametocyte
- C. Merozoite
- D. Sporozoite

C

➤ Asexual reproduction of plasmodium involves the formation of merozoites in the liver (exo-erythrocytic schizogony) and the blood (erythrocytic schizogony). The sexual reproduction stage of *Plasmodium* species, the parasites that cause malaria, takes place exclusively inside the mosquito vector. This process, known as **sporogony**, begins when a female *Anopheles* mosquito feeds on an infected human and ingests male and female gametocytes along with the blood meal.

61. Plant roots in association with symbiotic bacteria is an indication that

- A. the plant is unhealthy
- B. the roots have been attacked
- C. soil around roots lacks nitrogen
- D. soil around roots lack humus

C

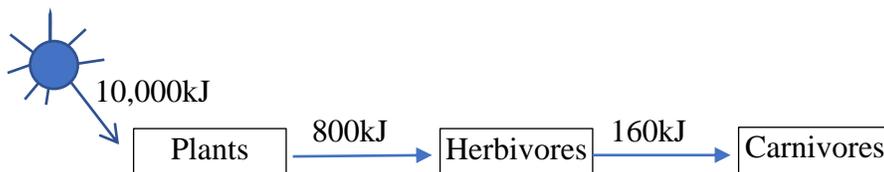
62. Which one of the following is not a component of environmental stress?

- A. Lack of light
- B. Lack of shelter
- C. Topography
- D. Diseases

C

Structured questions

1. (a) What is parasitism? (1mark)
Parasitism is a close association between two organisms of different species in which one organism (the parasite) benefits while the other (host) is harmed.
- (b) State **three physiological** adaptations of endo parasites. (3marks)
- (i) *Ability to respire anaerobically*
 - (ii) *Production of digestive enzymes that aid penetration into the host*
 - (iii) *Chemo sensitivity in order to reach the optimum location in the host's body*
 - (iv) *Production of anticoagulants in blood feeder*
 - (v) *Production of chemicals that switch of host's defense mechanisms*
- (c) Give **three** advantages of a parasitic mode of life to the parasite (3marks)
- (i) nutrients are always readily available and so no loss of energy in searching for food.
 - (ii) They live in a homeostatically regulated environment, and so there is no need for osmoregulation
 - (iii) They are usually provided with already digested food nutrient and there is no need for a digestive system
 - (iv) They are usually provided with shelter and protection from predators.
- (d) Describe **three** ways of a parasite-host relationship which ensures the success of a parasite. (3marks)
- inflicting mild harm to the parasite
 - Inhabiting more than one host
 - Using a vector for transmission form one host to another
2. The figure shows energy flow in a food chain



- (a) (Assuming 10% of the energy received by herbivores is lost, calculate the energy retained. (03marks)

Energy received by herbivores = 800kJ

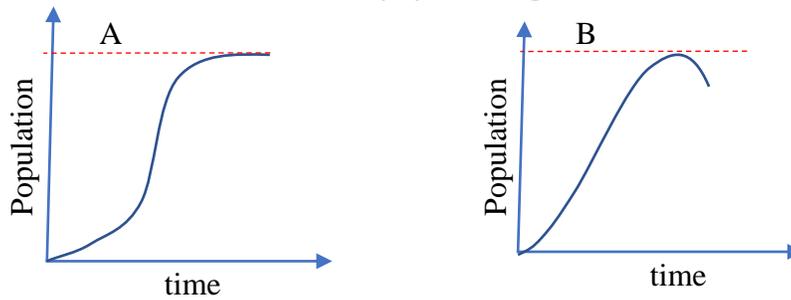
Percentage loss in energy = 10%

Percentage energy retained $100 - 10 = 90\%$

Energy retained = $\frac{90 \times 800}{100} = 720 \text{ kJ}$

- (b) Explain why
- (i) Energy transfer from herbivores to carnivores is more efficient than that from producers to herbivores. (3marks)
Producers plants contain a high proportional of indigestible cellulose (unavailable energy) to many primary consumers while herbivore (animal) tissues are highly digestible providing more nutrients to carnivore. As a result a larger percentage of energy is transferred from the herbivores to the carnivores than from producers to herbivores.
- (ii) The efficiency of energy transfer from herbivores to carnivores is less than 100%. (02marks)
- *Some energy is lost in respiration*
 - *Some energy is lost in excreta*
 - *Some structures like teeth and bones cannot be digested to obtain energy*
- (c) State the factors which limit the number of trophic levels in a food chain. (02marks)
- *Amount of energy received by the producer*
 - *Energy retained at each trophic level*

3. The below show the two forms of population growth curves of animals



- (a) Indicate by drawing on curve the carrying capacity of the environment (01mark)
 ----- Carrying capacity
- (b) Compare the pattern of population changes in curve A and curve B (2marks)
- Similarities*
- *In both curves, population of animals increase gradually initially, then rapidly approaching an exponential growth rate and then decline to the maximum growth rate*
 - *Both population begin at zero*
- Differences*
- *In A, the population attains a maximum and maintains it over the time of*

study while in B, after attaining a maximum growth, the population decline.

(c) Suggest an explanation for the population changes in curve B. (4marks)

- Initially, the growth rate is slow because:
 - (i) A few animals have reached reproductive maturity
 - (ii) The animals are not yet adapted to the conditions of environment
- Then, the growth rate increased due to
 - (i) The animals are now well adapted to the environment
 - (ii) There are many reproducing individuals
- The declining growth rate occurs as a result of environment stress such as
 - (i) Competition for available resources such as food and shelter
 - (ii) Accumulation of waste products
 - (iii) Reproduction failure
 - (iv) predation
- the decline after a maximum growth rate is due to declining resources in environment

(d) Suggest three biotic factors which can result into a change in carrying capacity, in an environment. (03marks)

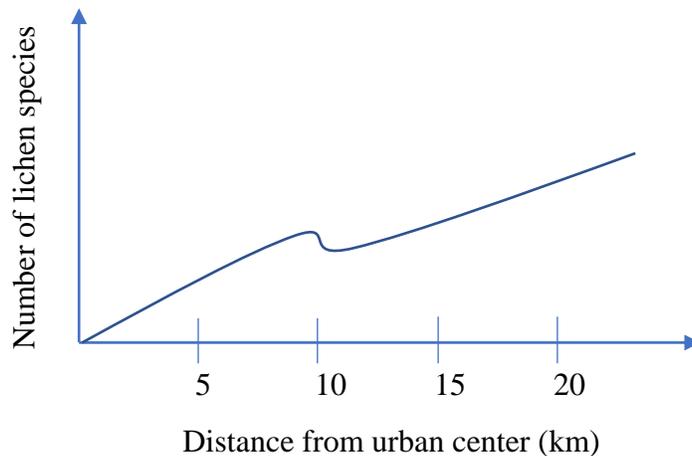
- Predation
- Competition
- Parasitism
- Available resources

4. (a) State three ecological problems which arise from accumulation of domestic waste in urban communities (03marks)

- Untreated sewage may end up in water bodies, causing eutrophication.
- Destruction of habitats where they pile
- Bad smell/air pollution
- Leads deadly communicable diseases
- Decay of wastes in absence of oxygen produce methane, a greenhouse gas.
- Nonbiodegradable wastes lead to poor drainage

(b) Give two ways of reducing domestic waste (2marks)

- Recycling of non-biodegradable materials in domestic waste
 - Burying biodegradable rubbish
 - Burning rubbish or treating with chemicals to reduce bulk.
 - Use of organic wastes to generate power/electricity
 - Use of organic waste to generate fuel
- (c) The figure below shows lichen species growing along a 20km transect from an urban Centre.



- (i) Explain the trend in the lichen species with distance from urban centre (3marks)

The number of lichen species generally increase with distance from urban center.

Reason

The level of pollution from urban industries reduces with increasing distance from the urban center. This leads to reduced levels of Sulphur dioxide promoting lichen growth.

- (ii) Suggest an explanation for the observed number of lichen species at a distance of 10km from urban center (2marks)

There is a reduction in the number of lichen species at a distance of 10km from the urban center probably due to presence of isolated factory, dumping ground for wastes or bush burning.

5. (a) How can predation be beneficial to the prey? (02marks)

Predator regulates the population of the prey reducing intraspecific competition for available resource.

- (b) Give factors that may affect the predator prey balance in nature (4marks)

- *Insufficient food supply for the prey*
- *Insufficient water supply for the predator and prey*
- *Diseases to predators and prey*
- *Presence of parasites for predator and prey*

- *Lack of shelter for predators and prey*
 - *Accumulation of toxic wastes for the predator and prey*
 - *Overharvesting by man of predator and/or prey*
 - *Adverse climatic conditions*
- (c) Outline ways by which humans affected the predator-prey balance resulting into harmful consequences (04marks)
- *Deforestation that reduce shelter for predator and prey.*
 - *Hunting of the predators or prey*
 - *Water pollution may kill the predators or prey*
 - *Encroachment on the forests removing shelter for predators or prey.*
6. (a) (i) Describe how a quadrat method can be used to determine species density. (2marks)
- *A square frame of metal or wood of xm is placed randomly in an area on the ground(quadrat) containing species to be identified and counted*
 - *The number of species in the enclosed area is counted and recorded.*
 - *The procedure is repeated a number of times to obtain an average, N.*
 - *Species density = $\frac{N}{x^2}$*
- (iii) State the advantages and disadvantages of the method. (2marks)
- Advantages**
- *it is accurate*
 - *it marks out a small area within which determination of number of species present is easy*
 - *it gives a good sample size of immobile species*
- Disadvantages**
- *it is time consuming*
 - *cannot be used to estimate the density of rapidly moving animals*
 - *tiresome*
- (b) (i) why is it important to estimate population size?
- *To understand the existing food relationship with a habitat*
 - *To monitor population changes over a period of time.*
 - *To know the population of the pest in order to determine the control method*
 - *To estimate the rates of increase in population and carrying capacity of a habitat for different population so as to maintain ecological balance*
 - *To be able to value wildlife reserves and design/alter boundaries of various conservation areas.*
 - *To construct food chains, food webs and pyramid of numbers*
 - *To be able to determine the resource that can support a given population.*
 - *To manage national parks and game reserve, and forests.*
- (ii) In estimating the number of fish in a small lake, 625 fish were caught, marked and released. After one week, 920 fish were caught and of these,

150 had been marked. What was the estimated size of fish population (2 marks)

150 marked fish are contained in 920 fish caught

$\therefore 625 \text{ fish marked would be found in } \frac{625 \times 920}{150} = \mathbf{3,833 \text{ fish}}$

- (iii) In using the method in b(ii) estimate the population size of fish, state two assumptions that were made (2marks)
- *The organism mix randomly within the population.*
 - *Organism disperse randomly within the geographical area of the population.*
 - *Changes in the population size due to immigration, emigration, birth and death within the time of the experiment are negligible.*

7 The table shows the amount of DDT measured in parts per million(ppm) Found in a variety of organisms associated with a fresh water lake

Where the DDT level was measured	Amount of DDT/ppm
Water	0.0003
Phytoplankton	0.006
Zooplankton	0.004
Herbivorous fish	0.39
Carnivorous fish	1.8
Fish-eating birds	14.3

- (a) (i) Calculate how many times the DDT is more concentrated in carnivorous fish compared with its concentration in water (2marks)

$$\begin{aligned} \text{Concentration index} &= \frac{[\text{DDT}]_{\text{carnivorous fish}}}{[\text{DDT}]_{\text{fresh water}}} \\ &= \frac{1.8}{0.003} = 6000 \text{ times} \end{aligned}$$

- (iii) What does the results show?

DDT accumulates in the tissues of organisms along the food chain

- (b) Explain why concentration of DDT changes from water to carnivorous fish. (03marks)

DDT is non-biodegradable but very soluble in fats, in animals it becomes accumulated in fats along the food chain.

- (c) State two effect of DDT to organism (02marks)

- *it interferes with conduction of impulses in nervous system*
- *in birds it interferes with formation of egg shell*
- *reduces sperm count in animals*
- *DDT has a possible mutagenic effect especially on pests and lead to flourishing of pests on prolonged use.*

(d) Explain how a pest sprayed with a pesticide may flourish afterwards? (3marks)

- the pests may mutate and breed pesticide resistant offspring, these flourishes since they are no longer affected by the pesticide.
- Pesticide may kill pests' predators leaving the pests to flourish

8. (a) State two human activities that increase the levels of carbon dioxide in the atmosphere. (2marks)

- Bush burning
- Burning fossil fuel
- deforestation

(b) What is the effect of high levels of each of the following gases in atmosphere? (7marks)

(i) Carbon dioxide

- Global warming
- Ocean acidification
- Extreme weather

(ii) Sulphur dioxide

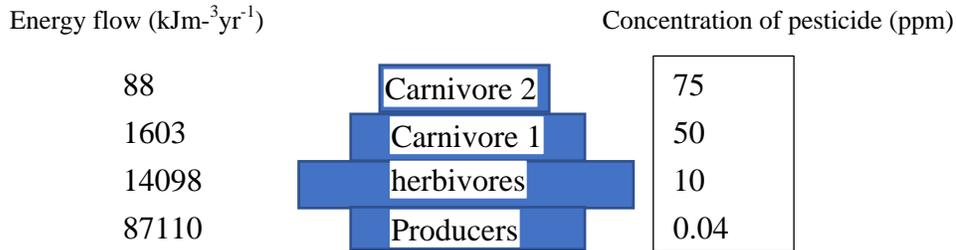
- Breathing discomfort
- Acid rain
- **Mercury Accumulation:** *SO₂* deposition can increase the accumulation of mercury in water and soil, potentially leading to higher mercury levels in the food chain.
- **Haze and Climate:** *SO₂* can also form fine aerosol particles, contributing to haze and influencing climate patterns.

(c) State one indicator in the environment where there is prevalence of high level of sulphur dioxide in the environment. (1mark)

- Disappearance of lichen

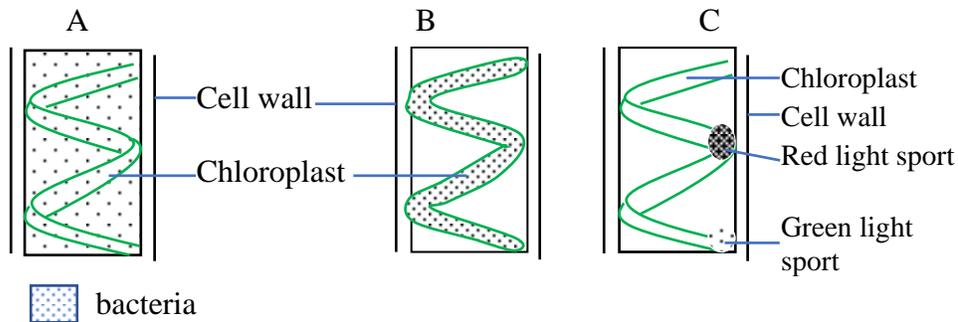
9. (a) State the importance of the following elements in plant metabolism
- (i) Calcium (1mark)
- *Activates enzymes*
 - *Constitutes cell walls (calcium pectate)*
 - *It facilitates lipid metabolism*
 - *Required during cell division and cell enlargement*
 - *It helps in translocation of carbohydrates*
- (ii) Magnesium (1mark)
- *Activates enzymes involved in DNA and RNA synthesis*
 - *Constituent of chlorophyll*
 - *Used for the binding of components of ribosome.*
- (b) How does water logging of the soil affect its nitrate content? (3marks)
- *It decreases the concentration of nitrates in the soil through:*
 - *Dissolution and dilution*
 - *Leaching of dissolved nitrates*
 - *Decrease in the concentration of oxygen promoting denitrifying bacteria.*
- (c) Describe three special ways of obtaining essential elements by some plants growing in soil deficient on those elements. (5marks)
- *Symbiotic relationships with organisms that can fix nitrates such rhizobium bacteria in root nodules nitrogen for leguminous plants.*
 - *Carnivorous plants such as Venus trap fly digest small animals to obtain nitrates*
 - *Parasitic plants such as mistletoes feed on other plants to obtain nitrates*

- 10 (a) In an aquatic ecosystem which was affected by an insecticide, analysis of energy flow and concentration of the pesticide at each level in a food chain was made. The results are shown on the pyramid of biomass of the ecosystem, in figure below.



- (a) What does the width of each bar of the pyramid represent? (1mark)
 Total number of organisms at each trophic level per unit volume
 Total mass of organisms at each trophic level per unit area or volume.
- (b) Explain why, from producer to secondary consumer,
 (i) The level of pesticide increase (2marks)
 Persistent pesticides are not readily broken down; they accumulate in animal's tissues without being metabolized.
- (ii) The flow of energy decrease? (2marks)
 From one trophic level to energy is lost through excretion, respiration, death and decay.
- (c) From the biomass, explain how the producer can sustain the herbivores (2marks)
 By having a higher turn over than the herbivores so that productivity of the producers is higher than that of herbivores.
- (d) Give three ecological problems that may arise through the use of pesticides. (3marks)
- They kill useful organisms such as pollinators for which they are not intended
 - A few pests may develop resistance leading to resurgence
 - The killed pest may be the only source of food to some organism which may also die in absence of the pest.
 - May kill natural predators to the pest that we become defendant to the pesticide.

- 11 One strand of spirogyra was placed on each of three microscope slides A, B and C. The spirogyra was in water contained aerobic, free-moving bacteria. The three slides were placed under conditions shown in figure below. After one hour of incubation, the results are shown below.



- (a) Describe the distribution of bacteria on the three slides A, B, C. (3marks)

Slide A: bacteria are evenly distributed all over the slide

Slide B: bacteria are only distributed along the chloroplast

Slide C: bacteria distributed around a chloroplast portion illuminated with light but more concentrated at red light spot than at green light spot.

- (b) Explain the distribution of bacteria on each slide (7marks)

Slide A: in the darkness spirogyra do not produce oxygen by photosynthesis, leading to uniform distribution of oxygen and aerobic bacteria.

Slide B: in light spirogyra produce oxygen by photosynthesis which concentrated along the spirogyra strand. This causes the aerobic bacteria to be attracted to the spirogyra.

Slide C: Oxygen is produced by photosynthesis at illuminated spot at the spirogyra attracting the aerobic bacteria to illuminated spots. Red light being more effective than green light for photosynthesis, lead to production of more oxygen and attracted more aerobic bacteria than green light. Part of the spirogyra left in the darkness did not photosynthesis to produce oxygen and thus did not attract aerobic bacteria.

- 12 The table shows the concentration of organism chloride in different organism inhabiting a pond. Study the table and answer the question that follow.

organism	Planktons	Large fish	Fish eagle	Small fish
Concentration of organic chloride (ppm)	0.04	0.5	25	40

- (a) Comment on the data given in table above

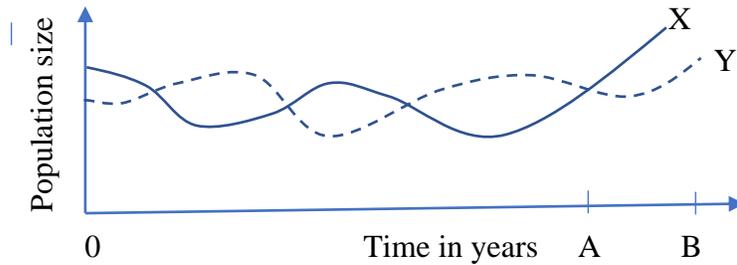
The concentration of the organic chloride increases up the trophic levels from planktons to fish eagle but is highest in small fish.

- (b) Using the information given in the table, construct a possible food chain in the pond.

Plankton → small fish → large fish → fish eagle
↓
Fish eagle

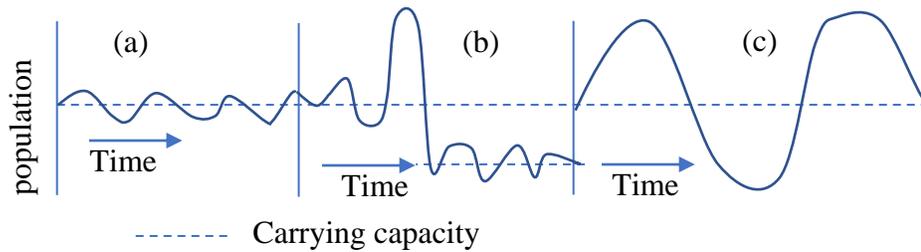
- (c) Explain the high concentration of chlorine in the fish eagle
Being at the highest level in food chain, it receives a very high level of organic chloride which has persisted in both small and large fish on which it feeds.
- (d) Suggest the properties you would recommend for a suitable chemical to use in water purification
- specific to intended organism
 - biodegradable
 - less toxic to aquatic organism and human life
 - unable to change the taste, color or smell of water

- 13 The figure shows changes in the size of a population of a producer and the consumer in a lake over time.



- (a) State which curve represents the
- Producer **X** (½ mark)
 - Consumer **Y** (½ mark)
- (b) Explain the interaction between the two population before point A (5marks)
- *The population of consumer and producer fluctuates because consumer depends on the producer for food.*
 - *When the population of consumer is high, they feed on producer at a rate higher than the producers can reproduce. The population of the consumer increase that of the producer decline.*
 - *When the population of the producer falls, that of the consumer also falls due to death of some consumers from starvation. This allows the population of the producer to recover and the cycle continues.*
- (c) Suggest how human activities could result in the interactions of the population between points A and B (4marks)
- Between A and B, the population of both organisms increase. This may be due to increased nutrient content to support big population from;
- Excessive use of fertilizers near the lake shore
 - Dumping of untreated sewage into the lake
 - Deposition of detergents into the lake

- 14 The figure shows population growth curves partten (a), (b) and (c) that occur naturally



Describe and suggest reasons for thr observed pattern of each population growth curve

(a) (3marks)

Show small rapid cyclic variation of population about the carrying capacity

Reason

Rapid changes in environmental resistance occur in the population in either direction. A positive change is rapidly cancelled by an equal negative population change leading to equilibrium maintenance of population about the carrying capacity.

(b) (4marks)

Shows cyclic variation at first followed by a very high population rise and big drop to a new lower carrying capacity.

Reason

In an equilibrium population, there appear factors such as emergence of food resource that caused a rapid rise in population density. The large numbers of the population depletes the resource available to such a low level that it can support fewer numbers than before.

(c) (3marks)

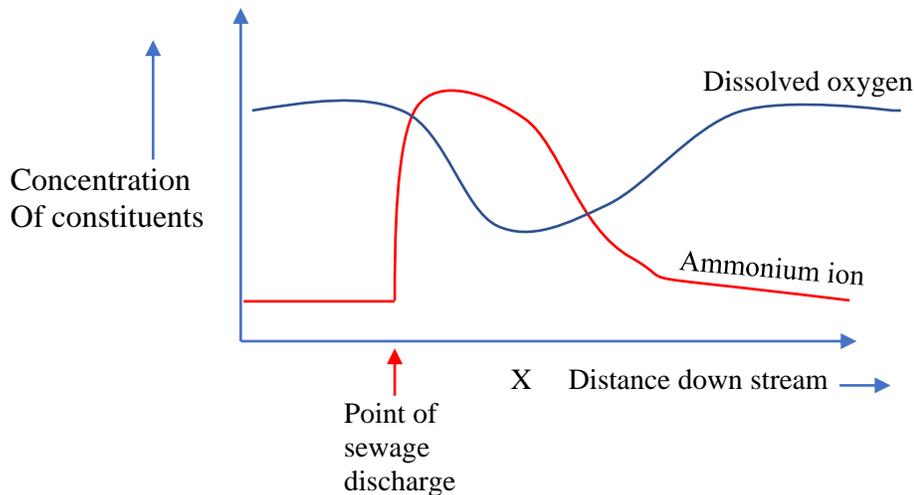
Show cyclic variation of population, of large amplitude, about the carrying capacity.

Reason

The population is controlled by presence or absence of another organism acting as a predator or prey. Increase in either causes reduction in the population of the other or vice versa over a long period of time,

- 15 (a) What is meant by **eutrophication**? (2marks)
Eutrophication is the heavy nutrient enrichment and low oxygen content of a water body because of excessive discharge of nitrogen and phosphate fertilizers into the water body. It is the presence of higher than normal amounts of nitrates and phosphate in water body coupled with a low oxygen concentration.
- (b) State two human activities that may encourage eutrophication (2marks)
- *Excessive use of fertilizers on agricultural land*
 - *Untreated sewage (rich in phosphorus and nitrates)*
- (c) What are the effects of eutrophication? (4marks)
- *Species diversity decrease and dominant biota change*
 - *Plant, algae and animal biomass increase*
 - *Turbidity of water increase*
 - *Rate of sedimentation increase, shortening life span of the lake*
 - *Anoxic condition may develop*
- (d) Effects of eutrophication are more severe in water bodies where thermal pollution occurs. Explain. (2marks)
- *Warm water has lower solubility for oxygen*
 - *High respiration of organism at high temperature reduce oxygen content of water.*
- 16 (a) What do you understand by **biological control**? (2marks)
Use of a living organism (predator/parasite) to control a population of host
- (b) What considerations must be made before application of a biological pest control method? (2marks)
- *Whether the control agent is specific to intended pest*
 - *Rate of reproduction of both pest and control organism*
 - *Whether a biological control agent is available or not*
- (c) (i) state **two** ways in which chemical pest control method can upset ecosystem (2marks)
- (ii) Suggest **two** reasons why pests eventually flourish after a period of pesticide application. (2marks)
- *Resistant strain to the pesticide may evolve*
 - *Pesticide may kill the predators of the pest such that the pest increases in absence of the predator*
- (d) Suggest three characteristics of a good pesticide (3marks)
- *Should be highly specific to the pest.*
 - *Should be biodegradable*
 - *Low toxicity to other organisms*
 - *Cheap*
 - *Readily available*

- 17 The graph below shows the effect of sewage discharge on some chemical constituents of a river at increasing distance down stream from the point of sewage discharge



- (a) Give explanation for the variation in concentration of ammonium ions and dissolved oxygen, down stream from the point of sewage discharge
- (i) Ammonium ion (3marks)
Ammonium ions levels in the streams increase rapidly at the point of sewage discharge gradually and exponentially decrease to a low almost constant level
Reason
- Sewage contains ammonium ions from decomposition of dead organic matter which are added to the stream at the point of discharge
 - At farther distance down stream concentration of ammonium ions decrease due to dilution and nitrifying bacteria that convert it progressively into nitrates.
- (ii) dissolved oxygen (3marks)
Oxygen in solution/dissolved oxygen decrease rapidly at first just after the discharge of sewage into the stream, then gradually to a low level and later increases gradually further down stream to normal value
Reasons
Sewage contains aerobic bacteria that deplete oxygen for their activity. Farther down stream photosynthetic algae add oxygen so that its concentration returns to normal.
- (b) Describe the effect of sewage on the ecosystem at distance X down stream.(4marks)
- Proliferation of algae, fungi and other aquatic animals due to availability of nutrients
 - Less light penetration
 - Low oxygen concentration leading to death of fish and other animals
 - Decomposition of organism by decomposers leading to further decreased oxygen concentration.

- 18 Table 1 gives information on the frequency (5) of plant along a grassland/wood land transect.

Plant type	Distance along transect /m					
	0	4	8	12	16	20
Grass A	95	85	90	5	0	0
Grass B	10	8	5	10	5	5
Herb G	0	0	0	5	10	15

Open glassland
←
→
 Woodland

List the structural and pheological adaptations that enable grass, e.g. grass A, to survive in it habitat

- High reproductive rate
 - Rolling of leaves during hot condition to prevent excessive water los
 - Possession of shortfirm stem to withstand pressure of wind
 - High photosynthetic rate
 - Possession of hairy leaves to reduce water loss
 - Reduction in number of stomata to prevent excessive water loss
 - Possess of rhizomes to survive unfavorable conditions
- (a) Give **two** structural adaptations you would expect to find in Herbs that would enable them survive in the woodland.
- Possession of climbing stems with tendrils
 - Being parasitice to big trees
- (b) How would you describe the distribution of grass B
- Has fairly even distribution in both glass land and woolland environment but it is slightly in high proportions in open grassland

- 19 (a) What is ecological impact of each of the following human activities?
- (i) Use of pesticide (6marks)
- They are nonspecific and may kill other unintended organisms. This reduces the biodiversity of the ecosystem.
 - Most pesticides are persistent. They accumulate along the food chain and may eventually kill/damage other unintended organisms at higher trophic levels including man.
 - Predator of the organism targeted by the pesticide may be deprived of their only source of food and therefore upset the food chain.
 - Use of broad-spectrum pesticide can lead to pest resurgence after the period of treatment because some pests become resistant yet the pesticide kills the pest and predator.
 - Pesticides pollute air, water and soil.
- (ii) Use of artificial fertilizers (4marks)
- Fertilizers applied to crop plants are lost in surface run-off water and pollute soil and water resources.
 - Increase crop yield
 - Increase nutrient content of the soil
 - Decrease in the number of microorganisms in the soil such as saprophytic bacteria.
 - Nitrogen and phosphate-based fertilizers leach into groundwater and increase its toxicity leading to water pollution.
 - They change the chemical composition of the soil.
- (iii) Over fishing (5marks)
- Extinction of some species
 - Reduction of the population of adult reproductive fish, leaving a population of mainly young individuals because fish are caught as soon as they reach catchable size
 - It may lead to a rapid increase in the number of fish prey.
 - May lead to reduction or even extinction of some aquatic fish predators
 - Disruption of aquatic

- 20 (a) Outline the causes of nutrient deficiency in soil (4marks)
- Soil exhaustion due to over cropping without intervals of resting of the soil
 - Leaching nutrients to deeper soil
 - Excessive use of fertilizers
 - Water logging
 - Soil pollution
 - Burning causes loss of non-metallic nutrients such as carbon
 - Monoculture
- (b) Explain how plants have overcome the problem of nitrogen and phosphorous deficiencies in soils they grow in. (16marks)
- Living in symbiotic relationship with organism that are capable of producing such minerals. For example, symbiotic bacteria in the root nodules of leguminous plants fix nitrogen from the atmosphere to nitrates that can be used by the plant.
 - Some plants live association with the fungi such as mycorrhiza association whereby the fungi digest organic matter, absorb the nutrients and pass them to the plant.
 - Adopting parasitic mode of feed, to obtain nutrients from another plant that can easily obtain nutrients from deeper soil
 - Developing long roots that can absorb nutrients that are leached into deeper soil Adopting carnivorous behavior in order to obtain mineral from digested animals such Venus fly trap

Assay questions

1. (a) What is a food chain? (2marks)
A food chain is a series of organism in an ecosystem which organic molecules initially produced by green plants or other photosynthetic organism are transferred.
- (b) Explain how energy flows through an ecosystem? (08marks)
 - Solar energy is absorbed by autotrophs (producers) such as green plants and fixed into energy containing organic molecules in the process of photosynthesis.
 - This energy incorporated into the organic molecules is called gross primary production (GPP). Some of the energy is lost as heat in respiration of the producer so that the amount of energy, called net primary production (NPP) becomes available to the primary consumer
 - This energy is then transferred in from organic molecules, to primary consumer, then secondary and tertiary consumer through feeding in various food chains and food webs in an ecosystem.
 - At each trophic level energy is lost as heat in respiration, through death or decaying of organic matter or undigested waste materials.
 - Energy transferred is therefore reduce from producers through to tertiary consumers.
 - However, the energy lost from organism through death and decay and through waste materials (egesta and excreta) is not last from the ecosystem. This energy is transferred to decomposers and detrivores when they feed on dead or decaying organic matter or on the waste materials.
 - The energy then flows in the decomposer and detritus food chains, some of which is recycled to some tertiary consumer which feed on decomposers/detritus feeder.
 - The rest of the energy is completely lost from ecosystem as heat in respiration of decomposers and detrivores.
- (c) How does temperature influence the distribution of organism? (8marks)
 - Different animal species require different optimum temperatures for their reproductive stages (breeding). Thus, temperatures impose a restriction on the distribution of species-based

reproduction preference.

- Animals like camel that are tolerant to high temperature can survive in deserts while others cannot, so live in cooler places
- Endotherms such as mammals and birds that maintain their body temperatures, have wide distribution in different environmental conditions compared to ectotherms such as reptiles that cannot regulate their body temperature.
- Temperature also influences the geographical distribution of animals through its effect on plants as primary producers in a food chain. The ecological range of most animal species, except insects, birds and mammals which are able to migrate, is determined by the local availability of food.
- Temperate plants are distributed in cool regions whose temperature does not usually exceed 25°C while plants such as xerophytes that can withstand higher temperatures are more abundant in the tropics and deserts where temperatures are usually above 25°C.
- C₄ plants have a wide distribution range in hot climatic regions because they are more efficient at fixing carbon dioxide at high temperatures. On the other hand, C₃ plants, which fix carbon dioxide more efficiently at lower temperatures, are more abundant in cooler climatic regions.
- Some aquatic plants can withstand very high temperatures and can thrive in hot springs while those that can withstand very low temperatures thrive in snow. The biggest percentage of plants survive in moderate temperatures which support their metabolic activities.

3. (a) What is the ecological impact of each of the following human activities?

(i) Use of pesticide (6 marks)

- *They are nonspecific and may kill other unintended organisms. This reduces the biodiversity of the ecosystem.*
- *Most pesticides are persistent. They accumulate along the food chain and may eventually kill/damage other unintended organisms at higher trophic levels including man.*
- *Predators of the organism targeted by the pesticide may be deprived of their only source of food and therefore upset the food chain.*
- *Use of broad-spectrum pesticides can lead to pest resurgence after the period of treatment because some pests become resistant yet the pesticide kills the pest and predator.*
- *Pesticides pollute air, water and soil.*

(ii) Use of artificial fertilizers (4 marks)

- *Fertilizers applied to crop plants are lost in surface run-off water*

and pollute soil and water resource.

- *Increase crop yield*
- *Increase nutrient content of the soil*
- *Decrease in the number of microorganisms in the soil such as saprophytic bacteria.*
- *Nitrogen and phosphate-base fertilizers leach into ground water and increase its toxicity leading to water pollution.*
- *They change the chemical composition of the soil.*

(iii) Over fishing (5marks)

- *Extinction of some species*
- *Reduction of the population of adult reproductive fish, leaving a population of mainly young individuals because fish caught as soon as they reach catchable size*
- *It may lead to rapid increase in the number of fish prey.*
- *May lead to reduction or even extinction of some aquatic fish predators*
- *Disruption of aquatic ecosystem*

(b) Describe advantages of biological pest control over pesticides in an ecosystem. (5marks)

- *It is highly specific and affects the organism intended*
- *It nontoxicity*
- *Does not cause environment pollution*
- *Organisms used are biodegradable and are not persistent in the environment for long.*
- *It is cheap in terms of time and cost*

4. (a) Describe the relationship between organisms in the lichen. (06marks)

- *Lichen is an association between a fungus and green algae.*
- *The fungus forms the outer covering that protects the algae in the interior of the lichen*
- *The fungus provides the algae with protection, water, mineral salts and anchorage.*
- *The algae photosynthesize and provide the fungus with organic materials and oxygen.*

(b) Compare mutualism and parasitism. (7marks)

Similarities

- *Both are close relationship between different organisms of different species*
- *In both one organism is smaller and lives in or on a big organism*
- *In both the smaller organism may be aerobic or anaerobic*

Differences

Mutualism

- (i) Both organisms benefit*
- (ii) No organism is harmed*
- (iii) Produce nutrients important to other organism in nature*
- (iv) Important in nutrient recycling in nature*

Parasitic

- (i) Only one organism (parasite) benefit*
- (ii) The host suffer harm from the parasite*
- (iii) Does not produce any useful nutrient in environment*
- (iv) Not important in nutrient recycling*

- (c) Explain how termite are able to feed on wood. (07marks)

Termites breakup the wood into tiny pieces using their sharp and strong mandible which they swallow easily. On reaching the crop, protozoa and bacteria in the crop ingest the swallowed food by phagocytosis. They secrete cellulase into their food vacuole, thereby digesting the cellulose in the termite diet.

The product of digestion mainly glucose diffuse out of the protozoa and are absorbed by termites.

5. (a) Explain how ferns are better adapted for terrestrial life than mosses (08marks)

Ferns are better adapted to terrestrial life than mosses because

- (i) Ferns have rhizomes (horizontal ground stems) which act as organs for food storage and survival of unfavorable climatic conditions unlike mosses.
 - (ii) Saprophyte ferns have true root for anchorage, absorption of water and mineral salts unlike mosses which have false roots (rhizoids).
 - (iii) Ferns produce more spores than mosses. This increases the chances of colonization of habitats.
 - (iv) Ferns have well developed vascular system which supply the plant with water, mineral salts and food.
 - (v) The lignified xylem offers support.
 - (vi) Ferns have broader leaves that provide large surface area for photosynthesis.
 - (vii) The sporophyte generation of fern is nutritionally independent while that of moss depend on gametophyte
 - (viii) Leaves have waxy cuticle to reduce water loss.
- (b) How does temperature influence the following process in plant?
- (i) Plant growth (07marks)
 - *Temperature acts as a limiting factor in plant growth and development by influencing the rate of cell division, cell metabolism,*

photosynthesis, respiration, and excretion which directly impact on growth.

- *It affects the rate of enzyme reaction reactions which are responsible for growth, doubling the rate for every 10⁰C rise within the enzyme working range. Thus, when maintained within the enzyme working range, temperature will promote growth.*
 - *Above or below the enzyme working range, enzymes are denatured or inactive respectively. In either case, the reaction ceases, leading to delayed/limited growth.*
 - *Low temperature stimulates flowering and germination in plants.*
- (ii) Plant distribution (05marks)
- *Temperate plants are distributed in cool regions whose temperatures do not usually exceed 25⁰C while plants that can withstand higher temperatures are more abundant in tropics or desert where temperature are usually above 25⁰C.*
 - *C4 plants are more abundant in hot climatic temperature because they are more efficient at fixing carbon dioxide at high temperature. On the other hand, C3 plants are more abundant in color environment because they fix carbon dioxide better at lower temperature.*

Some aquatic plants can with stand very high temperatures and can thrive in hot springs while some that can withstand cold temperatures thrive in snow. The biggest percentage thrive in moderate temperatures which can support their metabolic activities

6. (c) Outline the causes of nutrient deficiency in soil (4marks)
- *Soil exhaustion due to over cropping without intervals of resting of the soil*
 - *Leaching nutrients to deeper soil*
 - *Excessive use of fertilizers*
 - *Water logging*
 - *Soil pollution*
 - *Burning causes loss of non-metallic nutrients such as carbon*
 - *Monoculture*
- (d) Explain how plants have overcome the problem of nitrogen and phosphorous deficiencies in soils they grow in. (16marks)
- Plants living in soil deficient in nitrogen and phosphorus overcome this problem by any of the following means:*
- *Living in symbiotic relationship with organism that are capable of producing such minerals. For example, symbiotic bacteria in the root nodules of leguminous plants fix nitrogen from the atmosphere to nitrates that can be used by the plant.*
 - *Some plants live association with the fungi such as mycorrhiza association whereby the fungi digest organic matter, absorb the nutrients and pass them to the plant.*

- *Adopting parasitic mode of feed, to obtain nutrients from another plant that can easily obtain nutrients from deeper soil*
 - *Developing long roots that can absorb nutrients that are leached into deeper soil*
 - *Adopting carnivorous behavior in order to obtain mineral from digested animals such Venus flytrap.*
7. (a) What is meant by
- (i) Biotic potential? (3marks)
A biotic potential is the maximum rate of natural increase in population that can occurs under ideal circumstances. It varies according to the age structure of a population and it's influenced by female and male ratio.
 - (ii) Primary productivity? (2marks)
Primary productivity is the rate at which energy trapped by autotrophic plants in an ecosystem is stored by them in form of organic substances which can be used as food material by other organism.
- (b) Discuss the factors which influence the size of the population in ecosystem (12marks)
- *Natality or birth rate; this is the rate at which new members are added to the population by reproduction. Birth of younger ones increases the population size.*
 - *Mortality or death rate; the rate at which individual die, the higher the death rate, the higher the rate of decrease in the population.*
 - *Immigration rate; organisms moving into the population increase its size*
 - *Emigration rate; organisms moving out of the population decreases its size.*
 - *Environmental factors; changes in environment factors affect population size. These can be biotic or abiotic.*
Abiotic factors that affect population size includes
 - *Weather, this include daily duration of the sun and its intensity, rainfall, humidity and temperature. Most organisms adapt to live in specific whether conditions. Their population increase when favorable conditions prevail and decrease when unfavorable conditions prevail.*
 - *Natural calamities such as feminine, flood, drought, fire, earthquake cause large scale down of the population*
 - *Availability of food and space are limiting factors to the population. When food, water and space are available the population increase in size. Otherwise the population decreases in size*
The biotic factors include
 - *Predator prey relationship: availability of the prey, the population of predators increase while increase in the*

population predator reduces the population of the prey.

- *Disease reduce the population organism*
- *Parasites only exist where there is the hosts*
- *Inter and intraspecific competition; increase in competition of organisms for resources reduce the population of the organism.*

(c) Suggest reasons why human populations are not naturally regulated by negative feedback mechanisms (3marks)

- ✓ *Humans easily adapt (find solution) to whichever environmental resistance appear/cause threat to population*
- ✓ *Humans have isolated themselves into protected areas where there is no direct predators.*
- ✓ *Humans have sophisticated ways of fighting predator*
- ✓ *They have superior influence on every organism*
- ✓ *They are the only animals that have sex for pressure increasing the chances of reproduction*

8. Figure 1, 2, 3 shows the immigration and extinction of species on different categories of virgin islands.

Figure 1 shows the rate of immigration of new species on an island nearby the shore and one that is far from the shore.

Figure 2 shows the rate of extinction of species on a large island and on small island

Figure 3 shows the rate of immigration and extinction of species on the island.

Study the information and use it to answer the questions that follow.

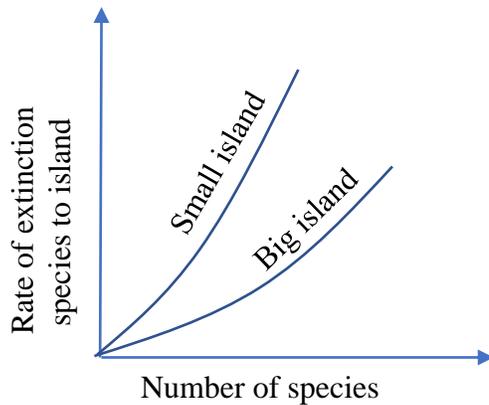
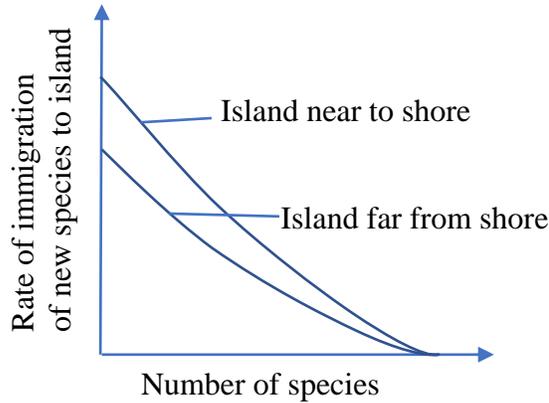


Figure 2

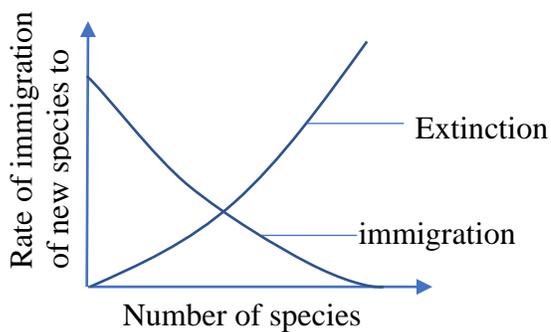


Figure 3

(a) Explain the rate of

- (i) Immigration of new species on an island that is near to the shore and one that is far from the shore (figure 1) (10marks)

The rate of immigration is higher for the island near the shore than that far from the shore. However, the rate of immigration decreases exponentially on both islands as the number of species on the islands increase. This occurs at a faster rate on the island far from the shore.

Explanation

- *The rate of immigration is higher for near than far islands because the island nearer the shore is more accessible to organisms than that far from the shore. More species of organism especially from the main land move and occupy the island near the shore. On the other hand, only species capable of swimming or flying are able to access the island far from the shore. These are fewer than the rest of all the other organisms.*
- *The rate of immigration decreases as the number of species on both islands increase because*
 - *Competition for resource such as food, mates and shelter increases. Only the better adapted species survive while the less adapted ones either die or escape from the island. Therefore, a few less adapted species immigrate to this island where there is stiff competition.*
 - *Resource eventually get exhausted and this discourages more species from immigrating to the island*
 - *The number of predators increases and feed on the prey on the island. As a result, few prey organisms immigrate to such island and the population of the prey decrease.*
 - *Disease outbreak associated with high population on the island discourages immigration to such island.*

- (ii) Extinction of species on a small island and on a large island (figure 2) (09marks)

The rate of extinction of organism from small and large islands increase exponentially with increase in the number of species on the island. However, this occurs at a higher rate on small island.

Explanation

- Environmental; resistance in form of diseases, competition for shelter and food reduce the number of organism on island greatly. Since the number of organisms accommodated by Small Island is less than that on big island, the intensity of resistance on Small Island is stiffer than that of the bigger island.

- The reproducing population on the small island is so small that chances of successful reproduction in animals are small. This makes many of the organisms to die before they have had a chance to pass on their genes, leading to extinction.
- The number of predator increases with increase in the number of the prey. The predator feed on the prey and cause extinction. A large island provides more hiding spaces for the prey to escape and may explain why extinction from large island is a slower rate.
- Competition for resources such as food, shelter and mates increase as the population increases. The better adapted species survive while the less adapted die. A smaller island has fewer resource overall and so has a higher rate of extinction.

(iii) Immigration and extinction of species on an island (figure 3
(7marks)

Rate of immigration on the island decrease with increase with the number of species on the island.

Explanation

- *As the number of species on the island increase*
 - *competition for resources such as food, mates and shelter increases. Only the better adapted species survive while the less adapted ones either die or escape from the island. therefore, few of such less adapted species immigrate to this island where competition is stiff.*
 - *Resources eventually get exhausted and this discourages more species immigrating to the island.*
 - *The number of predators increase and feed on the prey on the islands as a result fewer prey immigrate to the island, thus the population of the prey reduce which discourages predators for immigration.*
- *Diseases outbreaks associated with high population on the Island discourages immigration of organisms to the Island*
- *Natural calamities such as earthquake, fire, floods may also discourage immigration of organism to the Island.*

The rate of extinction of organism on Islands increase exponentially with increase with the number of species on the island.

- *Environment resistance in form of diseases reduces the number of organisms on the island.*
- *The producing population on the island may be so small that the chances of finding a mate is very low. This makes the organism to dies before producing young ones leading to extinction.*
- *The number of predators increase on the island eat the prey to extinction.*
- *Natural calamities such as flood may cause massive death of*

organism leading to their extinction.

- *Competition for resources such as food, shelter and mates increase as the population increases. The better adapted species survive while the less adapted die or escape from the island and eventually become extinct.*

(b) From figure 1, 2, 3 what conclusions can you draw about what determines the number of species on an island? (05marks)

- *Size of the island*
- *Distance of the island from the shore*
- *Number of species on the island*
- *Rate of immigration to the island*
- *Rate of extinction of organism from the island*

(c) Describe how factors other than those depicted in information provided, may affect the immigration of new species on an island. (4marks)

- *Resource availability; if an island has a large resource base; more species are attracted to it. However, the number of immigrants eventually reduces the resource on the island leading to extinction of species.*
- *Predation: presence of predators on the island discourage immigration of the prey organism, presence of the prey encourages immigration of the predator.*
- *Species mobility; species that can fly or swim are able to migrate to a far island or run away from predators and can easily search for food.*
- *Environmental conditions on the island: favorable conditions on the island encourage immigration of large number of species.*
- *Accidental introduction of new species to island,*

(d) Suggest the factors that would cause immigration of new species to a virgin land. (5marks)

- *Availability of food*
- *Availability of shelter*
- *Absence of predator*
- *Favorable environmental conditions such as good temperature, adequate rain fall, etc.*
- *Distance from the shore*
- *Fleeing from over population in the cradle land*
- *Accidental movement of organisms to the island.*

9 (a) What is biological pest control (2marks)

Is the control of the population of the pest using its natural enemy such as predator, parasite or pathogen.

(b) Explain the precautions to be taken in application of biological pest control (06marks)

- *Climatic conditions should favor the predator not the pest*

- The biological control agent should be specific to the pest
 - The predator should be introduced when there enough numbers of the prey (food) to prevent it being wiped out prematurely.
- (c) Describe the ecological qualities of a good pesticides
- Persistence: the pesticide should not remain in the environment including within the organisms without being broken down
 - The pesticide should be specific to targeted organism
 - Pesticide should not be poisonous the plant it protects.
- 10 (a) Describe the trend of succession that would take place on a bare rock. (10marks)
- Succession on bare rock is called primary succession and occurs in three stages.
- Pioneer stage**
- Bare rock breaks down physically and chemically during the process of weathering
 - Rain water assists in weathering because it is acidic. It dissolves some minerals leading to rock disintegration
 - These conditions are not favorable for most plants but lichens are the first to inhabit the rock, they are called pioneer organisms.
 - Invasion of lichens on bare rock cause further weathering, and their death and decomposition lead to formation of humus. This makes it possible for invasion of mosses. Mosses form a dense mat which trap tiny particles of rock, some organic debris and water.
- Spruce stage**
- Death of the mosses add to the nutrient content of the mat so that eventually the mat support germination of seed of colonizing angiosperm whose bodies also contribute to the growing layer of soil.
- Climax stage**
- Soon large woody shrubs begin to grow in the newly formed soil
 - Lichens and mosses may be covered by decaying leaves causing their death.
 - Eventually thicker layer of soil develops, leading to growth of big trees
 - Animal species immigrate into the forming fauna and the size of animals that invade increase as the size of the vegetation increase.
 - After a long time, the mature forest community grows. This is called climax community.
- (b) Outline the flow of energy in the climax community described in (a) (10marks)
- Energy in form of light from the sun is used for photosynthesis to produce organic molecules.
 - The initial amount of energy fixed by ecosystem is called gross primary production (GPP); part of this energy is used by the producers (plant) for respiration the remainder in form of organic matter is called the Net Primary production (NPP)
 - The energy flow in the climax community from one trophic level to another in

unidirectional.

- The energy is transferred in form of organic matter following feeding relationship among organisms that constitute food chain and food webs in a community
- At each feeding level, there is considerable loss of energy in various ways such as respiration, death and decay and through excreta.

Thus the energy flow in decreasing quantities from producer (plant) to primary consumer (herbivores) and finally to decomposer.

- 11 Describe the influence of biotic factors, excluding man, on the distribution of organisms in nature. (20marks)

Biotic factors, such as **competition, predation, food availability, and disease**, profoundly influence organism distribution by directly impacting survival and reproduction, shaping population sizes, and altering habitat suitability through complex interspecies relationships. These living interactions determine where species can successfully live, thrive, and spread within an ecosystem.

(i) Competition: Organisms vie for limited resources like food, water, space, and mates. **Intraspecific competition** (within the same species) can limit population size and density. While **Interspecific competition** (between different species) can lead to competitive exclusion, where one species outcompetes another, resulting in population decline or local extinction for the less dominant species.

(ii) Predation: The relationship between predators and their prey directly affects population numbers. Increased predator numbers can decimate prey populations, while a decline in prey reduces food for predators, creating a cyclical pattern. New predators unfamiliar to prey can cause rapid population declines.

(iii) Food Availability: The presence and abundance of food sources are critical for survival and reproduction. Areas with abundant food, like rainforests, support more species than resource-scarce deserts. Changes in food sources disrupt entire food chains, leading to population declines.

(iv) Disease and Parasitism: Pathogens and parasites can cause widespread illness and death. The introduction of a new pathogen or parasite into a population lacking resistance can cause severe population reductions or even wipeouts. Outbreaks, such as the chytrid fungus affecting frogs, demonstrate how diseases can devastate populations and alter ecosystems.

(v) Facilitation/Mutualism: Some biotic interactions benefit the organisms involved. Symbiotic relationships, like a clownfish living in a sea anemone, provide shelter

and protection, allowing organisms to thrive where they otherwise couldn't.

(vi) Grazing: Both insufficient and excessive grazing pressure impact plant communities, affecting biodiversity. Too little grazing allows dominant plants to outcompete others, while too much reduces overall plant numbers.

- 12 (a)(i) Describe how plants absorb nitrates from the soil.
- plants absorb nitrates through the root hair by diffusion which is a passive process or by active transport that require energy. The absorption of minerals by active transport is selective.
 - The nitrates cross the cortex of the root through apoplast, Symplast and vacuolar pathways into the xylem vessels of the root.
 - root pressure and transpiration pull translocate the nitrates up the plant in solution with water
 - from the xylem, the nitrates are conveyed to the cells of plant tissue by diffusion and active transport.
- (ii) Give three ways in which plants use nitrates they have absorbed.
- Synthesis of chlorophyll
 - Synthesis of nucleic acid (DNA and RNA)
 - Synthesis of proteins/enzymes
 - They are determinant of cation-anion balance in the plant.
 - They are determinant of osmotic pressure of the cells
- (c) Describe ecological effects of drainage of nitrate fertilizers into rivers and streams.
- Accumulation of nitrates in the stream (eutrophication) encourages proliferation of protist and algae on the surface of water.
 - Respiration of the Protoctista at night may deplete water of oxygen leading to death of other organisms.
 - Death of algae and other organisms, lead to accumulation of aerobic bacteria decomposer, these lead to further death of organism.
 - Light penetration decreases due to algae proliferation. Aquatic animals fail to photosynthesize and die due to lack of food.
 - Eventually there is increases water viscosity,
- 13 (a)(i) outline the importance of population size of different organisms in a given area to an ecologist
- The knowledge of population size helps ecologist to
- assess **population health and status**,
 - understand **species interactions** like competition and predation,
 - evaluate **conservation needs**,
 - determine **environmental carrying capacity**,
 - analyze **genetic diversity**,
 - predict **ecosystem changes**.
- (iii) Differentiate between sample count and total count.

Sample count involves counting a *subset* of a population to estimate the total, while **total count** (or census) involves counting *every single member* of the entire population.

- (b) Give five factors to be considered before carrying out counting exercise
- (i) **Species characteristics:** The physical size, mobility, and behavior of the target species significantly influence the counting approach. **Large, slow-moving animals** like elephants may be counted directly through aerial photography or visual censuses. **Mobile or evasive animals** that move frequently or are camouflaged are difficult to count directly and may require indirect estimation methods, like mark-recapture. **Sessile organisms** (those that are fixed in one place), like plants, are often counted using quadrat sampling.
 - (ii) **Population distribution:** The spatial arrangement of individuals within the habitat (clumped, uniform, or random) is critical for selecting a representative sampling strategy. An incorrect assumption about the distribution can lead to a significant sampling error, resulting in an inaccurate population estimate.
 - (iii) **Biotic and abiotic factors:** The living (biotic) and non-living (abiotic) components of the ecosystem affect the population's density and distribution. **Abiotic factors** such as temperature, rainfall, or food availability can cause populations to fluctuate or migrate. **Biotic factors** like predator-prey dynamics, disease, and competition also affect population numbers and must be understood before the count.
 - (iv) **Life cycle and reproduction:** The species' breeding cycle can impact population size at different times of the year and may require adjusting the timing of the counting exercise.
- (c) Describe a suitable method you would use to estimate the population of
- (i) Fish e.g. tilapia
The mark-recapture method, using the Lincoln-Petersen index, is the most suitable technique for estimating the population of mobile organisms like tilapia. A total count is impractical because the fish are hidden and constantly moving, making a direct census impossible. This method provides a statistically sound estimate based on sampling and proportions.
 - (ii) Flying insects in a woodland.
The most suitable method for estimating the population of flying insects in a woodland is the **capture-mark-recapture method**, using traps rather than nets for the initial capture. This technique is effective for mobile,

flying organisms because it accounts for the fact that a complete census is impossible.

Give reasons for your choice

- 14 (a) Describe the physiological and structural factors of the water hyacinth which enabled it to spread and persist on Lake Victoria.

Structural factors

- (i) **Aerenchyma tissue:** The plant's spongy, bulb-like leaf stalks (petioles) contain large air-filled cavities called aerenchyma. This tissue provides the exceptional buoyancy needed to keep the water hyacinth afloat on the water's surface.
- (ii) **Broad, waxy leaves:** The large, glossy, and curved leaves are able to capture sunlight for photosynthesis effectively. Their broad shape also allows them to form a dense, interwoven canopy on the water's surface.
- (iii) **Fibrous root system:** A dense mass of fine, dark, feathery roots hangs freely in the water. These roots are highly efficient at absorbing nutrients directly from the surrounding water.
- (iv) **Stolons (runners):** Water hyacinth reproduces asexually through stolons, which are runners that grow from the main plant to produce daughter plants. This allows for extremely rapid vegetative propagation and the formation of large, connected mats.

Physiological factors

- (i) **Rapid growth rate:** Under ideal conditions, water hyacinth is one of the fastest-growing plants in the world. Its population can double in size in as little as one to two weeks, allowing it to quickly cover large expanses of water.
- (ii) **Efficient nutrient absorption:** The plant has a high capacity for taking up nutrients, particularly nitrogen and phosphorus. The increasing nutrient-rich water in Lake Victoria (eutrophication), caused by industrial and agricultural runoff, created a highly favorable environment for explosive growth.
- (iii) **High reproductive output:** In addition to asexual reproduction, water hyacinth produces flowers that create thousands of seeds. These seeds are extremely resilient and can remain viable in the lake's bottom mud for up to 30 years. This long-term seed viability ensures the plant's persistence, even after physical or biological controls have been temporarily successful.

- (iv) **Competitive advantage:** The ability to form dense floating mats shades out and outcompetes native, submerged aquatic plants for sunlight. This, along with the depletion of oxygen, suppresses the growth of other organisms and gives the water hyacinth a dominant ecological position.
- (v) **Mobility via winds and currents:** The floating mats of water hyacinth can be moved across the lake by winds and currents. This allows the plant to be dispersed to new areas, where it can re-establish and colonize further shorelines.

(b) Outline the ecological dangers of this weed on the water

- (i) **Oxygen depletion (hypoxia)** due to reduced gaseous exchange resulting from dense, interlocking mats of water hyacinth and aerobic decay causes death of fish and other aquatic organisms.
- (ii) **(ii) Loss of biodiversity** water hyacinth out competes other organisms for space and nutrients. It also alters habitat making survival of other organisms impossible.
- (iii) **(iii) Water quality degradation** due to toxins and bad odor from decomposition of dead organic matter hyacinth and other organisms
- (iv) **Nutrient cycling interference:** By absorbing large amounts of nutrients like nitrogen and phosphorus, the plants remove them from the water. However, when the plants die and decay, these nutrients are released back, contributing to eutrophication and subsequent algae blooms.
- (v) **Hydrological disruption** of the natural flow of water in rivers, canals, and other waterways. This blockage can increase the risk of flooding in some areas while reducing water flow in others.
- (vi) **Increased water loss:** Water hyacinth has a high rate of evapotranspiration, meaning it draws water from the lake and releases it into the atmosphere. Studies have shown this can significantly increase water loss compared to a clear water surface.
- (vii) **Interference with infrastructure:** The weed clogs intake pipes for water treatment plants, irrigation systems, and hydroelectric power generation

facilities, impacting essential services.

- (c) Suggest three control methods of the water weed, and for each method point out one weakness.
- (i) Mechanical/Manual Removal but the sheer volume and rapid multiplication of water hyacinth make this method costly and tedious.
 - (ii) Chemical Control (Herbicides) but causes mass death of the plant such its decomposition leads depletion of water of oxygen resulting in mass scale death of fish. Also chemical may put human health at risk.
 - (iii) Biological control: using water hyacinth predator like weevils is a very slow process.
- 15 (a) Explain how plants living under the canopy of forest trees are able to survive (15marks)
These plants have the following adaptation
- Maximizing light capture**
- (i) **Large, broad leaves:** Many understory plants have large, wide leaves to increase the surface area available for capturing sunlight.
 - (ii) **High chlorophyll concentration:** These leaves are often a darker green because they contain more chlorophyll, which increases their capacity to absorb the limited light that penetrates the canopy.
 - (iii) **Leaf arrangement:** Plants arrange their leaves in a broad, flattened layer with minimal overlap, known as a monolayer, to prevent self-shading and expose as much surface area as possible to incoming light.
 - (iv) **Leaf movement:** Some species can adjust the angle of their leaves throughout the day to follow the path of the sun as it filters through gaps in the canopy.
- Using limited light effectively**
- (i) **Exploiting sunflecks:** The forest floor receives fleeting bursts of light called sunflecks when wind rustles the canopy leaves. Understory plants are adapted to rapidly ramp up photosynthesis during these short, intense periods to maximize energy gain.
 - (ii) **Low light compensation point:** Shade-adapted plants have a low light compensation point, meaning they can **photosynthesize** efficiently even at low light intensities. This is also achieved by reducing their respiration rates,

so they can still achieve a net energy gain.

- (iii) **Use of specialized pigments:** Some plants, particularly in tropical rainforests, have accessory pigments like anthocyanin. This reddish pigment on the underside of their leaves reflects certain light wavelengths, potentially recycling light back to the chlorophyll-rich mesophyll layer to increase photosynthetic efficiency.

Taking advantage of seasonal changes

- (i) **Spring ephemerals:** In temperate deciduous forests, many understory plants grow and complete their life cycle during early spring. They take advantage of the period after the last snow melts but before the forest canopy grows leaves, ensuring they have access to sunlight without competition from the trees.

Other adaptations

- (ii) **Nutrient cycling:** The forest understory is a nutrient-rich environment due to the constant decay of leaves and debris from the canopy. This provides a steady supply of nutrients for the undergrowth plants.
- (iii) **Moderated environment:** The canopy creates a more humid and temperature-stable environment below. This reduces the risk of water loss through transpiration and protects plants from temperature extremes, making survival easier.

(b) Describe how herbaceous plants are supported of the ground (05marks)

- (i) Absorb water osmosis making their cells turgid to provide support
- (ii) Some have supporting tissues like collenchyma and sclerenchyma
- (iii) Others obtain support by climbing other plants
- (iv) By growing clusters

- 16 Graphs A, B and c shows results of three experiments that were carried out to study the relationship between a predator, *Didinium* and a prey Paramecium under three set of conditions.

In the first experiment, Paramecium was introduced into a culture at point **P** and Didinium at point **D** as shown in figure1

In the second experiment, Paramecium and Didinium was introduced to ether at point **P + D** at different population densities. This is shown in graph **B** of figure 1

In the third experiment, Paramecium and Didinium were introduced together at point

P + D at different densities. And after every three days as shown by the arrow in the graph in graph C of figure 1.

Study the graphs and answer the questions that follow.

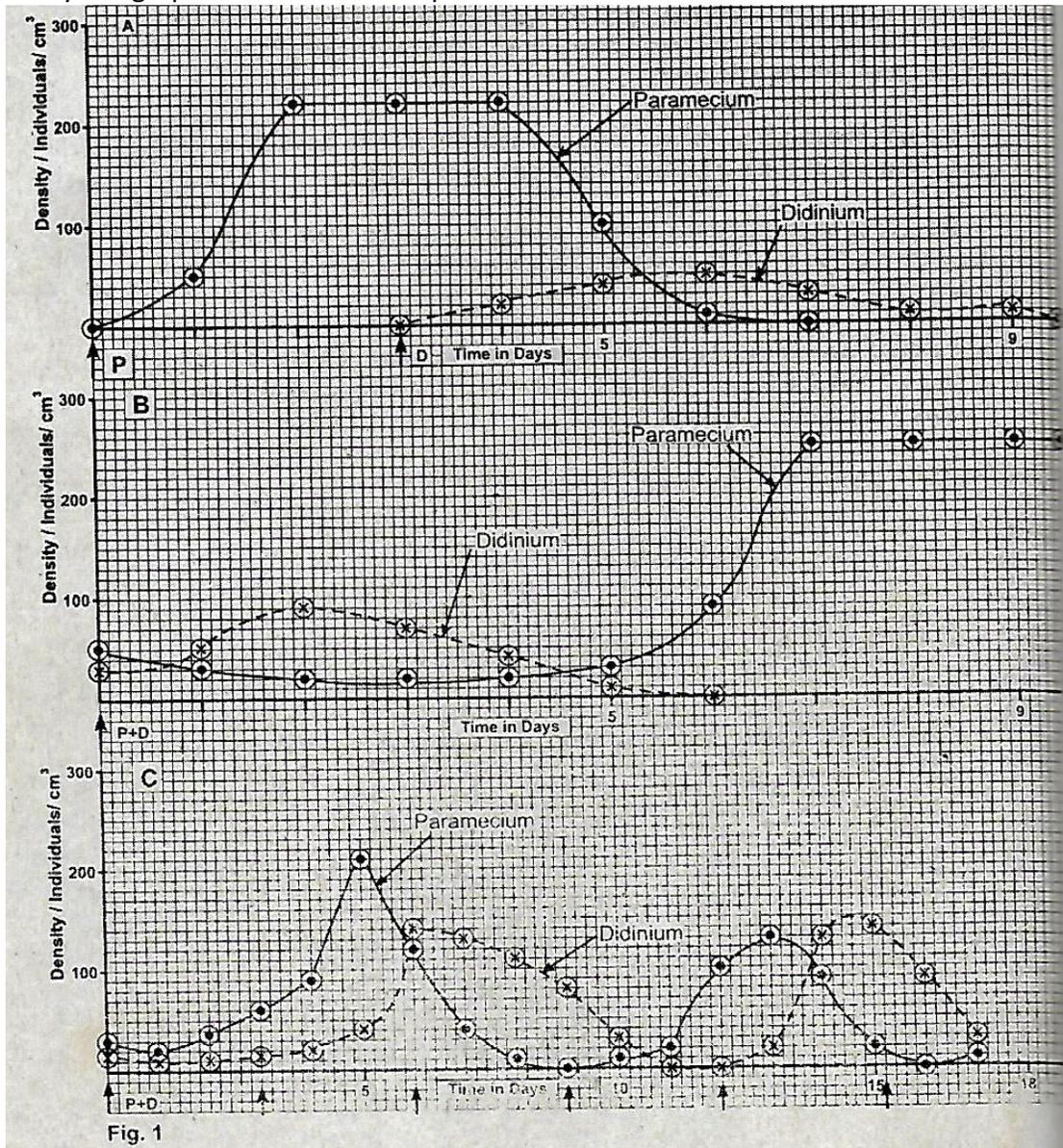


Fig. 1

- (a) Describe the trend of the population growth of Paramecium and Didinium in graph.
- (i) A (04marks)
- The population of paramecium increases gradually on the first day then steeply to the maximum on the 2nd day. It becomes constant between the 2nd and 4th day and then decrease to very low level by the 6th day.
 - The population of Didinium increased gradually to 2 ½ day to reach a maximum

and remains constant up to the 3rd day. It declines gradually by the 5th day, remained constant up to the 6th day before finally reducing to zero by the 9 ½ day.

(ii) B (03marks)

- The population of paramecium declines gradually up to the 3rd day, increases gradually up to the 5th day and then increases steeply up to a maximum by the 6th day. It then remains constant up to the 10th day.
- The population of Didinium increases gradually between 1st and 2nd day. It then declines gradually up to the 5th day before declining to zero by the 6th day.

(iii) C (04marks)

- The population of paramecium declines slightly in the first. It increases gradually up to the 4th day, then steeply up to a maximum by the 5th day before declining sharply by the 7th day. It decreases to zero by the 9th day followed by a gradual increase up to 11th day. It sharply to the 2nd maximum on the 13th day before reducing gradually to zero by the 16th day then increases slightly by the 17th day.
- The population of Didinium decreases in the first day, then remain constant up to the 2nd day. It then increases up to the 5th day and reaches a peak on the 6th day. It then declines gradually to zero by the 11th day and then remain constant up to the 12th day, it then increases gradually by the 13th day and then sharply increases to a 2nd maximum value by the 17th day.

(b) Explain the interaction of the two species of organism in graph

(i) A (06marks)

- When introduced into the paramecium culture, Didinium feeds on the paramecium and reduces its population. Didinium te increase in number and reaches a maximum.
- The increased number od Didinium feeds on paramecium to extinction
- Due to lack of food, competition for space and accumulation of wastes in the culture, Didinium starves to extinction

(ii) B (06marks)

- Didinium feed on paramecium, multiplies and increase in number. This reduces the population of paramecium to a level that can not support Didinium population. Some Didinium die due to starvation, reducing their population
- This reduces pressure on paramecium which increase in population up to the carrying capacity and remain constant.

(c) Compare the trend of the population growth of the two species in graph B and C.

(05marks)

Similarity

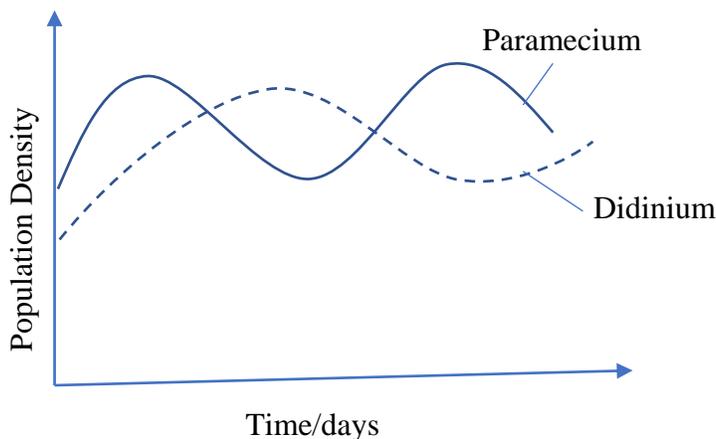
- In both, Didinium population increases gradually to a peak and then declines.
- The population of Didinium declines to zero at a certain point during the experiment
- In both, the population of paramecium decrease gradually in the 1st day.
- The peaks of paramecium is higher than those od Didinium
- Paramecium introduced in large number than Didinium.

Differences

	Graph B	Graph C
a	Population of paramecium raised to the maximum and remain constant	The population of paramecium reached a maximum and declined
b	The population of Didinium reached a maximum and then dropped to zero on the 6 th day There no cyclic fluctuation of population in either	Population of Didinium keeps fluctuating, reaching a maximum and reducing with time
c	organism	The population of both species fluctuates cyclically.

- (d) Supposing Paramecium and Didinium were introduced at the same time under natural environmental conditions, sketch curves to show the expected trend of population with time (5marks)

A graph to show the relationship between population of paramecium (prey) and Didinium (predator) under nature environmental conditions



- (e) Explain the trend of the population curves of Paramecium you have drawn in (d) (5marks)

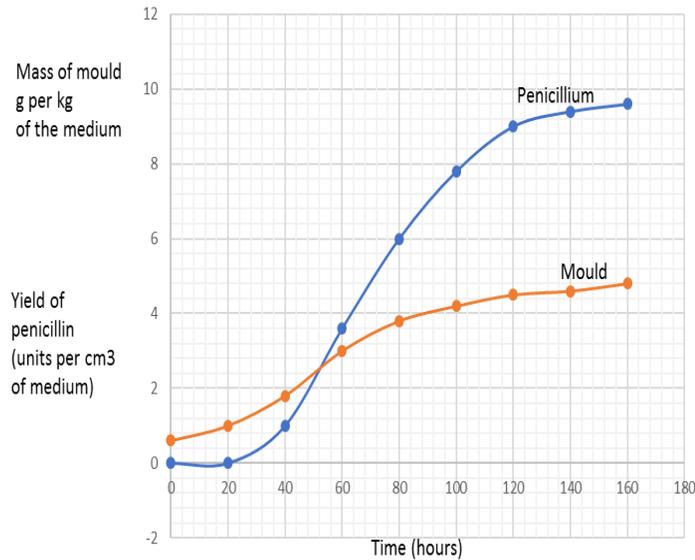
- The reproductive rate of paramecium is higher than that of Didinium and so the population of paramecium increases faster.
- Predator (Didinium) feed on paramecium, reducing their number. As the number of paramecium reduces, the population of Didinium also starts to decrease as a result of reduced food reserve.
- Eventually, the population of Didinium reduces to the extent that their predatory pressure on paramecium reduces. Paramecium multiplies and increase in number. This in turn provides food for the remaining predator causing their multiplication

and the cycle continues.

- 17 How are vertebrates adapted to terrestrial life? (20 marks)
- (i) The vertebral column and limbs provide support and aid movement
 - (ii) They have bones, joints and muscles to effect movements
 - (iii) They have well developed osmoregulatory organ to maintain body fluid concentrations
 - (iv) They possess lungs for gaseous exchange
 - (v) They have impermeable cuticles to reduce water loss
 - (vi) Have long loop of Henle to increase reabsorption of water from urine or to conserve water.
 - (vii) They have well developed metabolic and behavioral mechanism for maintaining body temperature.
 - (viii) Internal fertilization reduces wastage of sperms
 - (ix) Streamline shape to reduce resistance to movement
 - (x) In addition, viviparity, most produce encapsulated eggs
- 18 Growth of two microorganisms in culture media and yield of their products was analyzed. The table shows the growth of the yeast and yield of its product ethanol.

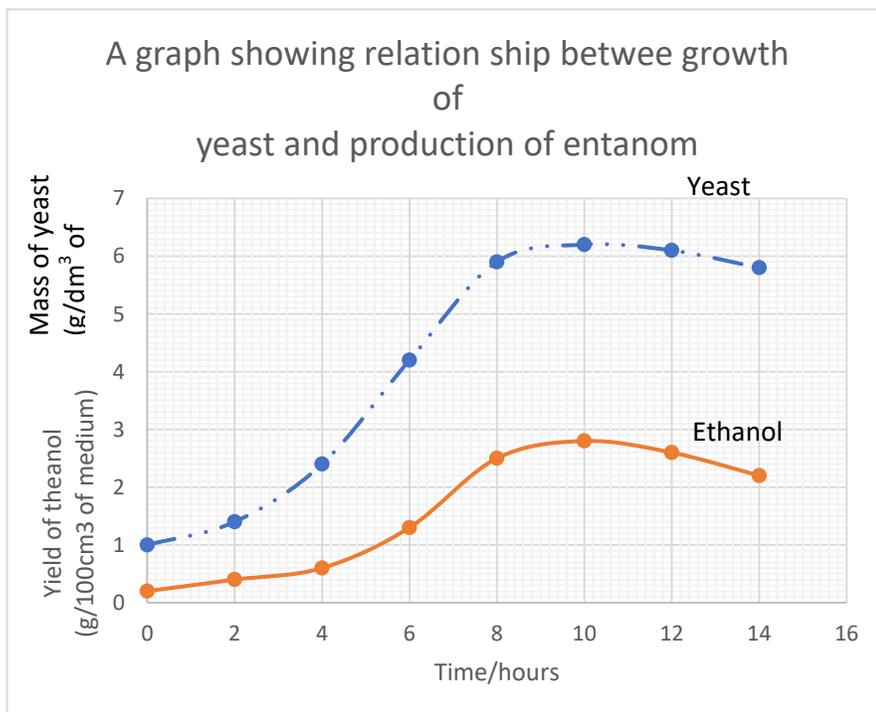
Time (hrs)	Mass of yeast (g per dm ⁻³ of the medium)	Yield of ethanol (g per 100cm of the medium)
0	1.0	0.2
2	1.4	0.4
4	2.4	0.6
6	4.2	1.3
8	5.9	2.5
10	6.2	2.8
12	6.1	2.6
14	5.8	2.2

Graph 1 shows the growth of the ascomycete mould *Penicillium* and the yield of its products penicillin. Use the data to answer the questions that follow



Graph 1

- (a) Represent the information in the table graphically (6marks)
Use your graph and graph1, to answer question (b) –(f)



(b) Describe the patterns of growth of the mould and yeast (6marks)

Mould

- *Growth begins slowly up to 20 hours and then continues more rapidly up to 80hours, then much slowly after 100hours.*

Yeast

- *Growth begins slowly for the first 4 hours, then rapidly from 4 to 8hours. It declines gradually up to 10 hours and then rapidly up to 14 hours.*

(c) Give two differences in the growth pattern of the mould and yeast. (4marks)

- *Yeast grows faster than the mould such that within less than 2 hours, there is noticeable increase whereas in mould, the increase is only noticeable after 10hours.*
- *The growth of yeast begins to drop after 10 hours whereas growth of the mould continues throughout the period of experiment.*

(d) Explain what is happening in the growth of yeast population during each of the following:

(i) 0 - 2 hours

- *There mainly cell growth and synthesis of enzymes. There is little increase in number of cells (lag phase)*

(ii) 4 - 6 hours

- *There is maximum growth because there a large number of reproductive individuals and low limiting factors. (log phase)*

(iii) 8 - 10 hours

- *Slow grow because nutrients are used up and there is accumulation of ethanol that reduce cell growth.*

(iv) 12 – 14 hours

(8marks)

- *Cells begin to die due to the toxicity of ethanol and insufficient nutrients, there is accumulation of wastes.*

(e) Describe the relationship between the

(i) Growth of mould and yield of penicillin

- *Growth of mould does not directly correlate with production of penicillin.*
- *At the beginning when the mould is growing, no penicillin is produced until after 16hours. Then the rate of accumulation of penicillin occurs more rapidly than the growth of the mould.*

(ii) Growth of yeast and production of ethanol (4marks)

- *There is a direct relationship between growth of yeast and production of ethanol*
- *Production of ethanol increases as the number of yeast cell increases. The number of yeast cell drops when the concentration of ethanol is very high.*

(f) State three ways in which the pattern of accumulation of penicillin in graph 1 differs from the pattern of accumulation of ethanol on your graph.

(6marks)

- *Penicillin is not produced until 20 hours whereas ethanol is produced with 1 hour.*
- *Production of penicillin goes on and even attains a maximum stationary phase at 160hours whereas production of ethanol reaches a maximum in 10 hours and then decline.*
- *Exponential phase of penicillin production is steeper than that in ethanol production,*

(g) Ethanol is a direct product of metabolic process essential for the life of the organism. Penicillin is a product of metabolic process which is not essential to keep the organism alive.

Suggest how the differences in the pattern of accumulation of these two products may be related to their differing roles in the metabolism of the producer organisms. (2marks)

- *Ethanol is a direct product of respiration in anaerobic conditions and its production rate is directly proportion to the number of yeast cells present.*
- *Penicillin is a secretion. Its production is not directly proportional to the metabolic rate. It accumulates with time independent of the number of organism producing it.*

(h) State the economic importance of saccharomyces and penicillium (4marks)

- *Yeast is used in fermentation*
- *Yeast is used in backing of bread*
- *Mould decomposes organic matter and may lead to rotting of food and fruits.*
- *Mould is used to produce antibiotics like penicillin.*

18 The distribution of the stomata and other leaf modification in plants are indicative of their habitats. Discuss. (20marks)

- **Hydrophytes**, plants that live in fresh water
 - (i) have numerous stomata on the upper surface of the leaves and few or none on the lower surface to increase water loss
 - (ii) They have broad and spongy leaves to enable them loss excess water and float on water e.g. water li
 - (iii) They have hydathodes to exudes excess water
- **Mesophytes**, plants that live in moist places on land,
 - (i) have more stomata on the lower surface and few on the upper surface to minimize water loss.
 - (ii) Have hairy leaves to reduce water loss through evaporation.
 - (iii) Some shed off their leaves in order to conserves water.
- **Halophytes**, plants living in areas of high salinity
 - (i) Have reduced number od stomata on both sides of the leaves to reduce water loos.
 - (ii) Have buoyant leaves to float on water
 - (iii) Have freshy leaves to store water
 - (iv) Have tolerant to water stress
- **Xerophytes**, plants found in dry areas

- (i) have reduced number of stomata to reduce water loss by evaporation
- (ii) some leaves are reduced to spine to reduce surface area for water loss
- (iii) they have sunken stomata to maintain high humidity around the stomata and reduce water loss
- (iv) impermeable cuticle
- (v) hairy leaves
- (vi) some have rolled/folded leaves to reduce surface area for water loss
- (vii) some have shiny leaf surface which reflect much light rays

20 (a) (i) outline the importance of population size in different organism in a given area to ecologist

- It enables construction of food chains and webs, pyramid of numbers, biomass and energy.
- Enable an ecologist to understand existing relationship within the habitat.
- To know the population of the pest in order to work out control method
- To estimate the rate of increase in population or carrying capacity of a habitat so as to maintain ecological balance.
- To find out population changes with time/season with changes in environmental factors.
- Provide information for conservation forest reserve and management of national parks.
- To be able to value wild life resources and design/alter boundaries of various conservational areas.

(ii) Differentiate between sample count and total count

	Total count	Sample count
1.	All organisms are counted	Only organisms in part of an area are counted
2.	The whole area is searched	Only part of an area is selected and searched
3.	It gives absolute number of organism in the whole area	The total number of organisms in part of the whole area is determined

(b) Give five factors to be considered before carrying out a counting exercise.

- (i) Natural vegetation
- (ii) Size of organisms to be counted\
- (iii) Behavior/social structure/activity of the organism to be counted
- (iv) Nature of the habitat: aquatic or terrestrial
- (v) Available resources e.g. apparatus, transport, camera, money.

(c) Describe a suitable method you would use to estimate the population of

(i) Fish e.g. tilapia in a lake

Capture-mark-release recapture/ Lincoln index method

Gill netting

Reason

*Because fish is large in size and can easily be identified and capture and counted.
Lincoln index method*

- N_0 fish are gill-netted and after their operculum tagged with an inconspicuous aluminium discs and then released back into the water without harming them.
- After some time N_1 fish is netted again, and N_2 fish found marked.
- The population of fish N in a lake is then estimated from

$$N = \frac{N_0 \times N_1}{N_2}$$

(ii) Flying insects in an open woodland.

Removal method

Reason

They are small and mobile

- Using a net, in form of a sweep net, the number of insect captured is recorded.
- This procedure is repeated a further three times and gradually reducing numbers are recorded.
- A graph of number of insects per sample against the previous cumulative number of insect is plotted
- By extra plotting the line of the graph to the point at which no further animals would be captured, the total population of insects is determined.

21 (a) How are the following organism adapted for their mode of life?

(i) *Schistosoma mansoni*

- *Large number of eggs are released into the intestine of bladder by rupture of blood vessel*
- *They have miracidia which use tissue as vector.*
- *They form sporocysts which produce numerous cercariae. i.e. have high reproduction rate.*
- *Cercariae have gland for piercing the skin.*
- *They have ventral structure and mouth.*
- *Are always found in pair (male and female) ensure a high reproductive rate*
- *They live in blood vessels associated with the intestine and urinary system where they obtain nourishment.*

(ii) *Ancylostoma duodenale*

- *They have strong for grasping the walls of the small intestines*
- *They occur in large numbers*
- *They have high reproductive rate*
- *They have protective devices*
- *Show internal organ degeneration*
- *Are resistant to digestion by body enzymes*

(iii) *Ascaris lumbricoides*

- *Has high reproductive rate.*
- *Occur in large number.*
- *They respire anaerobically which enables them live in low oxygen area.*

- They are resistant to digestive enzymes.

(b) Give a brief description of major types of interspecific association in nature.

✚ **Parasitism:** one of the organism (the parasite), live temporarily or permanently in or on the other (the host) and derives metabolic benefits from it and cause harm to it,

✚ **Mutualism:** an association which is mutually beneficial. Both organism benefit from the relationship.

✚ **Commensalism:** an association in which only one of the participants, the commensal benefits and the other neither gains or loses.