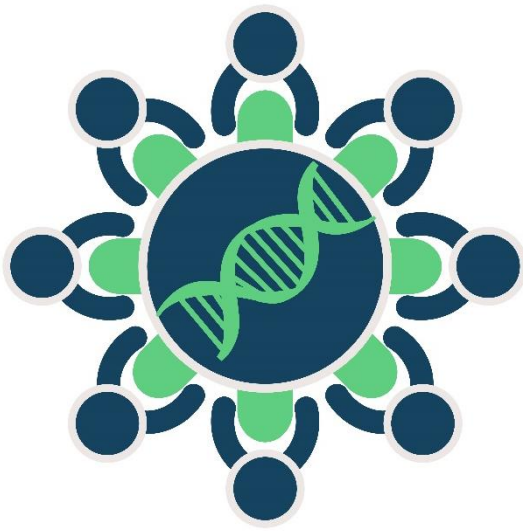


Bio League Competition 2023 Phase One answers

Biochemistry and Cell Biology

1) Which membrane-bound organelle is involved in the synthesis of lipids, detoxification of drugs, and metabolism of carbohydrates in a cell? (1point)

a) Peroxisome
b) Endoplasmic reticulum
c) Golgi apparatus
d) Vacuole

Ans: b

2) Which type of cell junction is responsible for forming a strong mechanical attachment between cells in epithelial tissues? (1point)

a) Desmosomes
b) Gap junctions
c) Tight junctions
d) Hemidesmosomes

Ans: a

3) Which of the following are found in the muscle cell:
(1point)

a) cell wall
b) axon
c) Sarcoplasmic reticulum
d) None

Ans: c

4) Imagine yourself operating a miniature vehicle within a liver cell. The first organelle you will come across while leaving the cell's nucleus is
(1point) ….

a) rER
b) sER
c) mitochondria
d) plasma membrane

Ans: a

5) Embryonic stem cells are known that they are:
(1point)

a) capable of developing into differentiated cells.
b) capable of giving rise to any cell type or a complete embryo.
c) having power to produce or influence several effects or results.
d) A & B

Ans: a

6) Which of them are dead cells (select all the correct) (1point)

a) Mature sclerenchyma cells
b) epidermis
c) enamel
d) external hoof wall

Ans: all of them

7) which cells organelles aren't involved in apoptosis (select all the correct) (1point)

a) Lysosome
b) ER
c) Golgi
d) Mitochondria

Ans: a, b, and c

8) Lysosomes are known as "suicidal bags" because (2points)

a) Parasitic activity
b) Presence of food vacuole
c) Catalytic activity
d) Hydrolytic activity

Ans: d

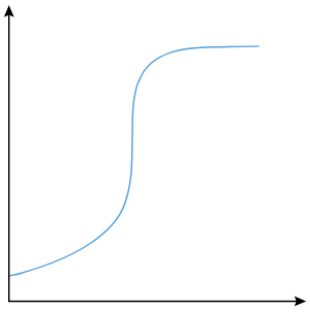
9) All of the following are right about the cell theory except: (1point)

a) Theodor Schwann, Matthias Schleiden, and Rudolf Virchow are the founders of it.
b) Cells are the basic unit of structure and function in living things.
c) All cells arise from pre-existing cells through cell division.
d) Cells contain hereditary information that is passed to daughter cells during cell division.
e) None

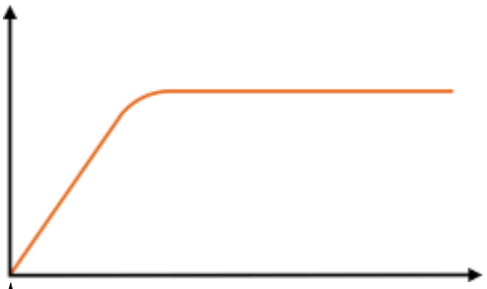
Ans: e

10) Which of the following graphs are the relation between enzyme activity and temperature? (2points)

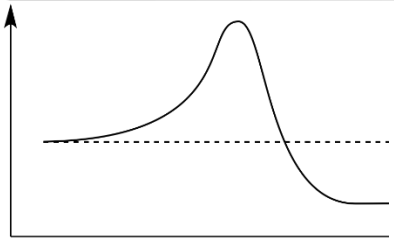
a)



b)



c)



d) None

Ans: d

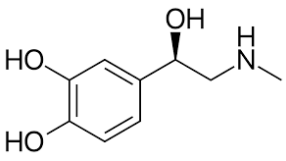
11) All of the following are the function of chaperone protein except. (1point)

a) Protein Folding Assistance
b) Protein Quality Control
c) Protein Transport and Assembly
d) Involvement in energy production or metabolism.

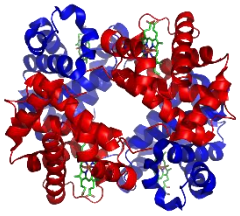
Ans: d

12) Which of the following proteins is responsible for transport oxygen from the lungs to tissues and carry carbon dioxide from tissues back to the lungs. (3points)

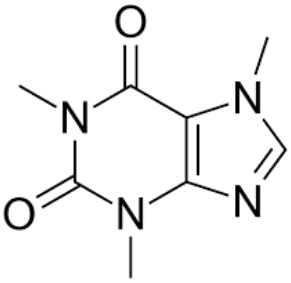
a)



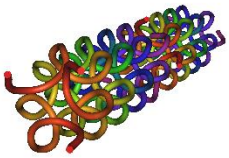
b)



c)



d)



Ans: b

13) The resting potential membrane is determined by (1 point)

a) Calcium-ion gradient
b) Sodium-ion gradient
c) Bicarbonate-ion gradient
d) None

Ans: d

14) A Which of the following statement is true? (select all the correct answers) (3points)

a) Lysozyme has an S-S linkage
b) Ribonuclease has S-S linkage
c) Heme group in cytochrome c is covalently linked to the protein on two sides
d) Ribonuclease has SH-SH linkage

Ans: a, b, and c

15) All of the following are enzymes that catalyzes the reversible conversion of 2-phosphoglycerate to phosphoenolpyruvate except what? (Select all the correct answers) (2points)

a) Trypsin
b) Enolase
c) Chymotrypsin
d) Hexokinase

Ans: a, b, and c

16) Which of the following enzymes is involved in catabolism of carbohydrates? (1point)

a) Lipase
b) Protease
c) Nuclease
d) None

Ans: d

17) The membrane around the vacuole is known as (1point)

a) Tonoplast
b) Elaioplast
c) Cytoplast
d) Amyloplast

Ans: a

18) What is correct about the ketogenesis pathway? (2points)

a) metabolic pathway that converts glucose into ketones in the cytoplasm of cells
b) metabolic pathway that converts ketones into acetyl-CoA in the mitochondria of cells
c) metabolic pathway that converts amino acids into urea in the liver during protein catabolism
d) metabolic pathway that converts acetyl-CoA into ketone bodies in the liver during prolonged fasting or starvation

Ans: d

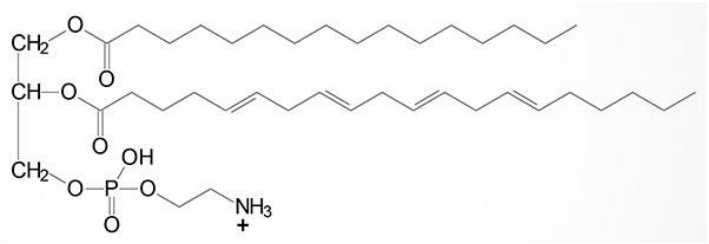
19) What is the name of the protein on the surface of a helper T cell that binds to the antigen-presenting cell and helps activate the B cell? (2points)

a) CD4
b) CD8
c) MHC I
d) MHC II

Ans: a

20) The picture below is: (2 points)

a) Carbohydrate
b) Amino acid
c) Protein
d) Lipid



Ans: d

21) Which of the following directly donates electrons to the electron transport chain in cellular respiration? (2points)

a) NADH
b) FADH2
c) Coenzyme Q
d) Cytochrome c

Ans: a

22) All of the following are important for white blood cell recognition except. (Select all the correct answers) (1point)

a) Glycoproteins
b) Glycosaminoglycans
c) Glycolipids
d) Proteoglycans

Ans: b, c, and d

23) A Which out of the following statements is false about the regulation of metabolic pathway? (select all the correct answers) (3 points)

a) Most of the metabolic pathways are regulated
b) Most of the metabolic pathways are not regulated
c) Regulation of metabolic pathways always involves changing the amount of enzymes
d) Metabolic regulation always depends on control by hormones

Ans: b, c, and d

24) What is the single-word term that describes the enzyme-catalyzed biochemical process by which a molecule is converted into a more complex form through the addition of a phosphate group? (2points)

Ans: Phosphorylation

Genetics and Evolution

1- Introns are:
(1point)
a) non-transcribed sequences (spacers) between two genes.
b) transcribed spacers between two genes.
c) located between the coding regions of a gene.
d) located between the coding regions of a mature mRNA.
Ans: c

2- The bacteria strains A and B and a certain bacteriophage which is infectious for both strains grow in one culture. After one day some bacteria which are equivalent to type A have originated, but show characteristics based on five alleles in B. Which processes might have caused this phenomenon?
I. transformation IV. sexduction
II. transposition V. mutation
III. transduction VI. Transfection
(2points)

a) I, II, III
b) I, III, IV
c) I, V, VI
d) II, IV, VI

Ans: b

3- Which of the following genotype frequencies of AA, Aa and aa, respectively, satisfy the Hardy-Weinberg principle?
(1point)
a) 0.25, 0.50, 0.25
b) 0.36, 0.55, 0.09
c) 0.64, 0.27, 0.09
d) 0.29, 0.42, 0.29

Ans: a

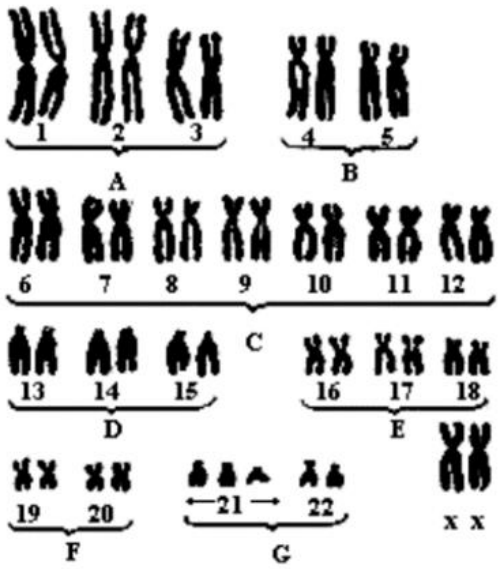
4- When the base composition of DNA from bacterium Mycobacterium tuberculosis was determined, 18 percent of the bases were found to be adenine. What is the [G] + [C] content?
(1point)
a) 18%
b) 32%
c) 36%
d) 64%
Ans: d

5- If (Rh+) blood is transfused into an (Rh-) woman who has not previously been transfused, then:
(2points)
a) anti-Rh antibodies will be produced in the organism of women.
b) the blood is incompatible so red cell agglutination and death may follow.
c) there is no immediate or long-term effect as 70% of the Rh population are heterozygous.
d) provided anti-D antibody is given before the next pregnancy no harm will be done.
Ans: a

6- Genetic material transmission from one bacterium to another one with the help of virus is called: (1point)
a) transposition
b) transformation
c) transversion
d) transduction.
Ans: d

7- The following diagram depicts the human caryogram with a hereditary disease. What is the syndrome called? Which of the below mentioned conditions is caused by the which deficiency?

I. Edwards syndrome
II. Down syndrome
III. Turner syndrome
IV. Slanted eyes, skeletal deformity (flattened back of the head), severe mental retardation, male or female.
V. Feminine constitution, rudimentary and functionless sexual organs, infantilism.
VI. Deformed fingers, heart conditions, high voices, lessened beard growth.
(2points)

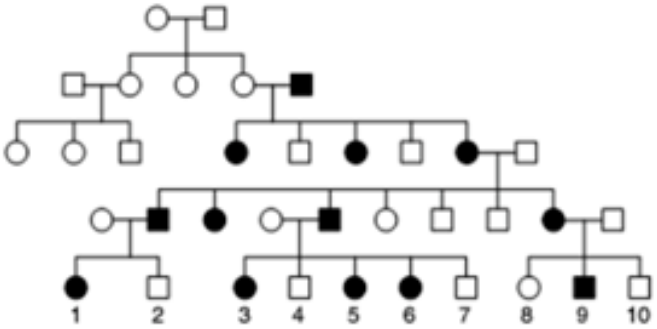


a) I and V
b) II and IV
c) II and IV
d) II and V
Ans: b

8- A rare genetic disease is characterized by immuno-deficiency, developmental and growth delay, and microcephaly. Suppose you extract DNA from a patient with this syndrome and find almost equal quantities of long and very short DNA strands, which enzyme is likely to be defective in this patient? (2points)
a) DNA ligase
b) Topoisomerase
c) DNA polymerase
d) Helicase
Ans: a

9) when white and black feather chicken mate, they produce gray feather chickens. Which term describes the relationship between the alleles of that trait? (1point)
a) incomplete dominance
b) codominance
c) complete dominance
d) mendelian
Ans: a

(10 and 11) A rare human disease afflicted a family as shown in the following pedigree.

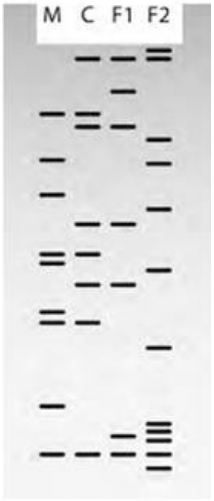


10) What is the most likely mode of inheritance of this disease? (1point)
a) Mode of inheritance is autosomal recessive.
b) Mode of inheritance is autosomal dominant.
c) Mode of inheritance is X-linked recessive.
d) Mode of inheritance is X-linked dominant
Ans: d

(11) What is the probability that the first child of the marriage between cousins, 1 x 4, is a boy with the disease? (2points)
a) 1/2
b) 1/4
c) 1/8
d) 1/16
Ans: b

12 - Which of the following RNA sequences would hybridize most effectively with the DNA sequence 5' - ATA CTT ACT CAT TTT – 3'? (1point)
a) 5' – ATA CTT ACT CAT TTT – 3'
b) 5' – UAU GAA UGA GUA AAA – 3'
c) 5' – AAA AUG AGU AAG UAU – 3'
d) 5' – AAA ATG AGT AAG TAT – 3'
Ans: c

13- In a paternity suit the ABO phenotypes of the mother, the child and the two possible fathers (F1 and F2) were determined, and a DNA profile was made for each person. Both the mother (M) and the child (C) are type A, Rh-negative. Father F1 is type B, Rh-negative and Father F2 is type O, Rh-negative. The DNA profiles are shown below. Which statement is true
(3points)



a) The mother has the genotype Rr for the Rh factor
b) The child has the genotype IAIo
c) F1 cannot be the father
d) All the above is wrong
Ans: b

14- Some genes in the genome of bacteria are organized in operons. Which statement about such operons is correct (2 points)

a) Genes of the operon are arranged in mosaic structures of introns and exons
b) Translation of all genes of one operon starts at the same initiation codon
c) All genes of the same operon are not expressed simultaneously
d) Proteins encoded in the genes of the same operon are translated from one common mRNA molecule

Ans: d

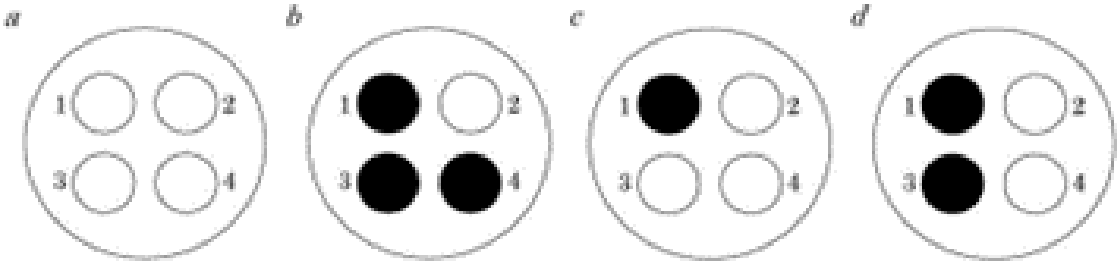
15) what relation between two individuals does a coefficient of relatedness of 0.7 indicate? (1point)

a) female child with his mother
b) female child with his full sister
c) female child with his full brother
d) female child with his father

Ans: b

16- Four mutant strains of bacteria (1~4) all require substance S to grow (each strain is blocked at one step in the S-biosynthesis pathway). Four plates were prepared with minimal medium and a trace of substance S, to allow a small amount of growth of mutant cells. On plate a, mutant cells of strain 1 were spread over entire surface of the agar to form a thin lawn of bacteria. On plate b, the lawn was composed of mutant cells of strain 2, and so on. On each plate, cells of each of the four mutant types were inoculated over the lawn, as indicated in the figure by the circles. Dark circles indicate excellent growth. A strain blocked at a later step in the S substance metabolic pathway accumulates intermediates that can „feed" a strain blocked at an earlier step.

What is the order of genes (1~4) in the metabolic pathway for synthesis of substance S? (3 points)



a) 2 → 4 → 3 → 1
b) 2 → 1 → 3 → 4
c) 1 → 3 → 4 → 2
d) 1 → 2 → 4 → 3
e) 3 → 4 → 2 → 1

Ans: c

17- In the enchanting land of Pikachu Island, geneticists are delving into the unique traits of the Pikachu population. These traits correspond to the "Electric Bolt" gene and are represented by three genotypes: "AA," "Aa," and "aa." The "AA" and "Aa" genotypes give Pikachu a high-voltage electric bolt ability, and "aa" leads to a low-voltage electric bolt ability. Upon thorough research, scientists have documented the following genotypes in the Pikachu population: 360 "AA," 480 "Aa," and 160 "aa" individuals.

Based on the provided genotype counts, what is the frequency of the "A" allele in the Pikachu population? (2 points)

a) 0.7
b) 0.6
c) 0.5
d) 0.4
Ans: b

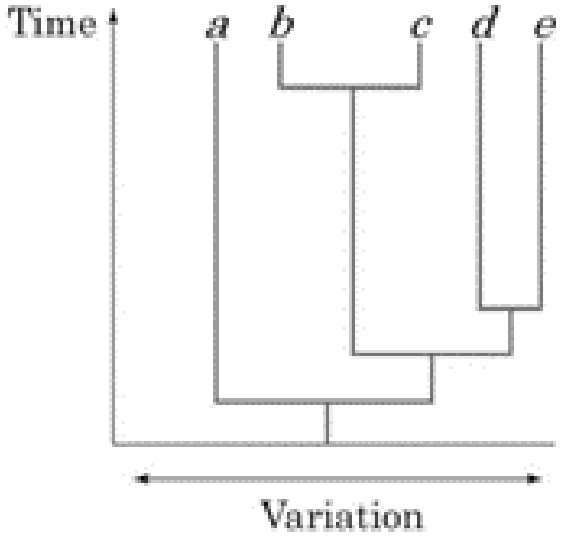
18- Parvovirus B19 is a single-stranded DNA virus that infects humans only and it may cause several symptoms such as fever, malaise, and headache. It may become NOT harmful if a mutation happens in which of the following enzymes? (SELECT ALL THAT APPLY) (2 points)
A) helicase.
B) DNA polymerase.
C) restriction enzymes.
D) reverse transcriptase.
Ans: b

(19) A, B, C, D are located on the same chromosome, the recombination frequencies are as follows :
B – A 18%
B – C 9%
C – D 21%
B – D 12%
what is the relative position of the four genes?
(1point)
a) CBDA
b) BCAD
c) DBCA
d) ACBD
Ans: c

(20) What is true for both genetic drift and natural selection?
I. They are mechanisms of evolution.
II. They are entirely random processes.
III. They result in adaptations.
IV. They affect the genetic make-up of the population.
(1point)
a) I and II
b) I and III
c) II and III
d) I and IV
Ans: d

21- The following figure shows a hypothetical evolutionary tree of species a~ e along with the variability between pairs of these species. Choose a statement that is correct. (2 points)

a) The speciation rate shows a linear relationship to evolutionary time.
b) The species pair a - b and the pair c- d shows sister group relationship.
c) The tree contains three monophyletic groups.
d) Species a can be used as an outgroup for the other four species.



Ans: d

22- Which of the following pairs does not show a monophyletic group - paraphyletic group relationship? (1point)
a) Monocots - Dicots
b) Tetra pods - Bony fishes
c) Echinoderms - Chordata
d) Birds – Reptiles
Ans: c

23- The Darwinian fitness of an individual is measured by: (1point)
a) the number of its offspring that survive to reproduce.
b) the number of mates it attracts.
c) its physical strength.
d) how long it lives.
Ans: a

24- two groups of butterflies were isolated for thousands of years. they were reunited and they could mate. moreover, their offspring have high fitness. which of the following is TRUE? (2points)
a) fusion occurred.
b) stability occurred
c) the two groups would extinct.
d) reinforcement occurs.
Ans: a

25- In a specific type of fish, individuals have either a left-mouthed or right-mouthed feeding specialization. When the left-mouthed individuals are more common in the population, they have a higher fitness because their feeding strategy is more effective against right-mouthed prey. However, as the frequency of left-mouthed individuals increases, the fitness advantage diminishes, and the right-mouthed individuals become more successful, resulting in fluctuating selection pressures based on the frequency of each phenotype. this is an example of (3points)

a) heterozygote advantage.
b) natural variation.
c) stabilizing selection.
d) frequency-dependent selection.
Ans: d

Anatomy and physiology

1- Which of the following is NOT a connective tissue? (1point)

a) Blood
b) Bone
c) Adipose tissue
d) Glia

Ans: d

2- The absorption of fructose by intestinal mucosa is (1point)

a) co-transport mechanism
b) simple diffusion
c) facilitated transport
d) active transport

Ans: c

3- Once upon a time, in the digestive system of a healthy individual, there was a team of enzymes that worked together to break down food and extract nutrients. These enzymes were produced by the pancreas and released into the small intestine to aid in digestion. However, there was some confusion about which enzymes were on this team. Which of the following options correctly lists the enzymes present in pancreatic juice? (1point)

a) Amylase, Trypsinogen, Peptidase, Rennin
b) Trypsinogen, Lipase, Amylase, Procarboxypeptidase
c) Peptidase, Pepsin, Amylase, Rennin
d) Maltase, Amylase, Trypsinogen, Pepsin

Ans: b

4- Of the following, which mechanisms are important in the death of erythrocytes in human blood? Is it (1point)

a) phagocytosis

b) hemolysis

c) mechanical damage

d) All of the above

Ans: d

5- After ovulation, the released cell from the ovary is: (1point)

a) A-Primary oocyte

b) B- Secondary oocyte

c) Primary germ cells

d) Polar body

Ans: b

6- “Yo, listen up, I got a story to tell,

'Bout an immune cell that's straight up swell,
I'm from the myeloid lineage, that's where I'm from,
And when it comes to histamine and heparin, I'm the one.
My name is ……, I'm here to say,
I'm commonly found in connective tissue, all day,
I'm like a superhero, protecting you from harm,
Releasing histamine and heparin, like an alarm.”
What is the name of this rapper?
(1point)

a) Neutrophil
b) Eosinophil
c) Mast Cell
d) Memory B cell
e) Megakaryocyte

Ans: c

7- Which term describes the location of the adrenal glands with reference to the kidneys? (1point)

a) proximal
b) distal
c) superior
d) inferior

Ans: c

8- In a mature female with a typical menstrual cycle of 28 days, if the menstruation phase started on the 10th day of October, when would ovulation most likely occur? (2 points)

a) 20th of October

b) 24th of October

c) 28th of October

d) 30th of October

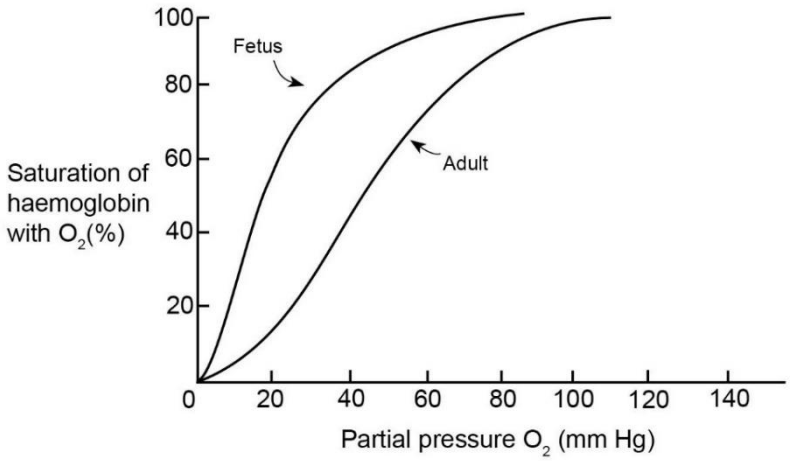
Ans: b

9- You are standing in the park on a cold winter day, which of the following processes does your body use to keep warm? (2 points)

a) Vasodilation
b) Vasoconstriction
c) Radiation
d) Convection
e) Perspiration

Ans: b

10- The graph shows the oxygen dissociation curves of hemoglobin from an adult sheep and a fetal sheep.



Which one of the following statements describes the difference in the behavior of the two types of hemoglobin?
(2 points)

a) Fetal hemoglobin has a higher oxygen affinity than adult hemoglobin.

b) Adult hemoglobin has a higher oxygen affinity than fetal hemoglobin.

c) Fetal hemoglobin cannot carry as much oxygen as adult hemoglobin.

d) Adult hemoglobin cannot carry as much oxygen as fetal hemoglobin.

Ans: a

11- The maximum amount of urea is present in (2 points)

a) Dorsal Aorta
b) Hepatic Vein
c) Renal Vein
d) Hepatic Portal Vein

Ans: b

12- Which of the given options is a structure that is present on the surface of intestinal epithelial cells? (2 points)

a) Zymogen granules
b) Pinocytic vesicles
c) Phagocytic vesicles
d) Microvilli

Ans: d

13- Dr. Kovvali, a neurologist, sees a patient that has muscle weakness, problems with coordination, fasciculations, and fatigue. When asked to talk, some speech is slurred as well. What condition/disease does his patient have? (2 points)

a) Multiple sclerosis
b) Macular degeneration
c) Amyotrophic lateral sclerosis
d) Duchenne muscular dystrophy
e) Primary lateral sclerosis

Ans: c

14- Unlike most bony fishes, sharks maintain body fluids that are isosmotic to sea water. They are therefore considered by many to be Osmo conformers because of the unusual way they maintain homeostasis. They Osmo regulate by
(2 points)

a) using their gills and kidneys to rid themselves of sea salts.

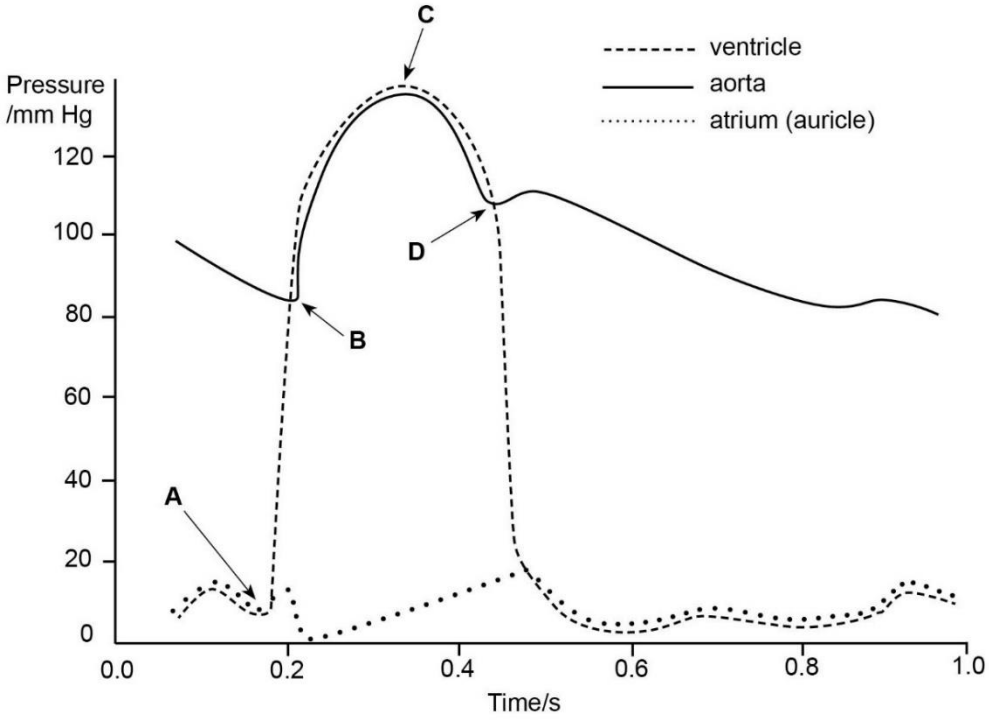
b) monitoring dehydration at the cellular level with special gated aquaporins.

c) tolerating high urea concentrations that balance internal salt concentrations to sea water osmolarity.

d) synthesizing trimethylamine oxide, a chemical that speeds salt removal from cells.

Ans: c

Questions 15 – 17 refer to the following diagram which shows blood pressures in the left atrium, left ventricle and aorta during the heartbeat cycle.



15-At which labelled point, **A**, **B**, **C** or **D** does the semi-lunar valve in the aorta open? (2 points)

a) A
b) B
c) C
d) D

Ans: c

16 - At which labelled point, **A**, **B**, **C** or **D** does the semi-lunar valve in the aorta close? (2 points)

a) A
b) B
c) C

d) D

Ans: d

17- At which labelled point, **A**, **B**, **C** or **D** does the bicuspid (mitral) valve close? (2 points)

a) A
b) B
c) C
d) D

Ans: a

18- Increasing the temperature of the human scrotum by 2°C (ie., near the normal body core temperature) and holding it there would (3 points)

a) Reduce the fertility of the man by impairing the production of gonadal steroid hormones.
b) Reduce the fertility of the man by impairing spermatogenesis.
c) Have no effect on male reproductive processes.
d) Increase the fertility of the affected man by enhancing the rate of steroidogenesis.

Ans: a

19- Consider the following processes:
I. Contraction of diaphragm
II. Relaxation of diaphragm
III. Lung volume increases
IV. Air flows into lungs

In what order do these processes occur when a person breathes air into the lungs? (3 points)
a) I → III → IV → II
b) IV → III → I → II
c) II → III → IV → I
d) II → IV → III → I
e) III → IV → II → I
Ans: a

20- Which of the following factors can cause harm to the intestinal lining? (3 points)
a) Non-steroidal anti-inflammatory drugs (NSAIDs)
b) Probiotics
c) Sugars
d) Steroids
Ans: a

21- John is a 60-year-old man who has been experiencing tremors and difficulty with movement for the past year. His symptoms have gradually worsened, and he is having trouble with everyday tasks such as buttoning his shirt and tying his shoes. He also feels stiff and has trouble initiating movement. John goes to see his doctor, who suspects he has a neurological disorder.

Based on the information provided, which disease or disorder is most likely affecting John? (3 points)

a) Multiple sclerosis
b) Lou Gehrig's disease
c) Parkinson's disease
d) Seizure disorder

Ans: c

22- Acetylcholine is a neurotransmitter that provides for communication between muscles and nerves. When there is a problem with the interaction between acetylcholine and the acetylcholine receptor sites on the muscles, which condition(s) can occur? (3 points)

a) Myasthenia gravis
b) Botulism
c) Multiple sclerosis
d) A and B

Ans: a

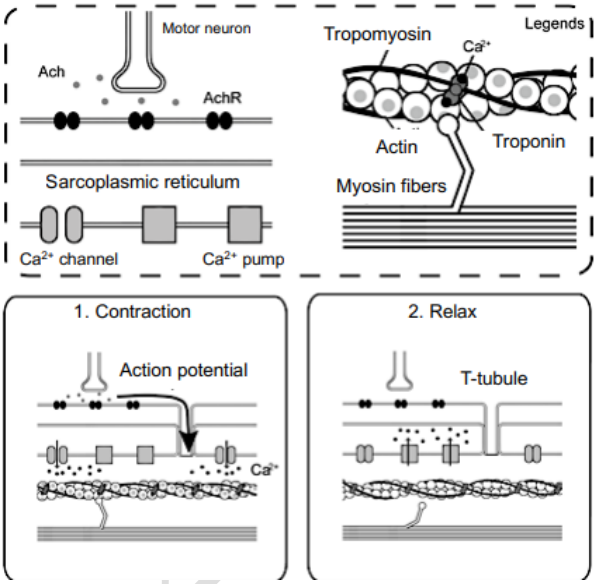
23- Certain metabolic diseases can affect the nervous system. For instance, people with diabetes can develop a nervous system problem called diabetic neuropathy. What are the symptoms of diabetic neuropathy? (3 points)

a) Constipation or diarrhea
b) Rapid heartbeat
c) Pain in feet
d) All of the above

Ans: d

24- The following figures illustrate the molecules in muscle fibers in two states: 1. Contraction, 2. Relaxation. The mutation or insufficient function of those molecules are associated with abnormal muscle functions. For example, a mutation in the Ca2+ channel or Acetylcholine receptor (AchR) may cause congenital myopathy. Note that the choices of muscle abnormality are:

(1) Myopathy (muscle weakness)
(2) Difficulties in arm extension
(3) Tetany (involuntary contraction of muscle)
(4) Hypercontractility (contraction occurs quickly, but relaxation occurs slowly)



Indicate the above symptoms that will occur in each type of muscle abnormality (A-D):
(4 points)

24 (A) Missense mutation in the Tropomyosin binding site of Actin that causes the muscle to be more sensitive for intracellular Ca2+ concentration.

a) 1
b) 2
c) 3
d) 4

Ans: d

24(B) Blocking the Ach release by Botulinum toxin treatment.

a) 1
b) 2
c) 3
d) 4

Ans: a

24 (c) Nonsense mutation in Ca2+ pump gene, which causes a deficiency in the removal of Ca2+ from cytosol.

a) 1
b) 2
c) 3
d) 4

Ans: b

24 (D) Low blood magnesium level, which results in frequent and uncontrolled depolarization.

a) 1
b) 2
c) 3
d) 4

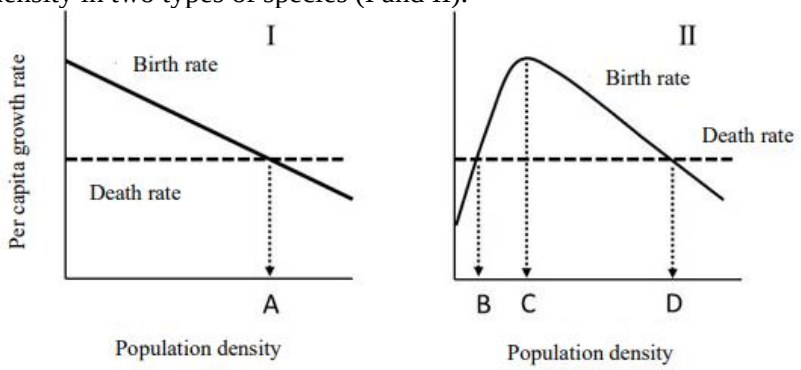
Ans: c

25-(4 points) You accidentally touch a hot stove; your hand will reflexively pull away from the heat source to prevent further injury. Describe the path in which the reflex travels (in cellular terms).

Ans: Sensory neuron → Dorsal root ganglion → Interneuron → Motor neuron → Response

Ecology and ethology

1- Density dependence is the fundamental process governing the population dynamics of organisms. The graph below describes per capita (per-individual) birth rate and death rate as a function of population density in two types of species (I and II).



Indicate whether each of the following statements is true or false.
(2 points)
a) Asexually reproducing species are more likely to be type I than sexually reproducing ones.
b) Population density is kept constant around all points of A, B, and D with a density-dependent manner.
c) The aggregation of individuals is advantageous, rather than detrimental, below the density threshold of C.
d) Type I species are more likely to go extinct when the population is severely decreased, than type II species.
Ans: a and c

2- A team of biologists conducted a study on the foraging behaviors of a group of nocturnal predators, known as "Lunaris owls" (Strix nocturna), in a densely forested region. The researchers aimed to understand the factors influencing the owls' hunting efficiency and prey selection. During their investigation, they noticed that Lunaris owls exhibited two distinct hunting strategies: "perch and pounce" from tree branches and "still-hover" flights near the forest floor.
Which of the following statements provides the most likely ecological explanation for the coexistence of these two hunting strategies in Lunaris owls? (3 points)

a) The "perch and pounce" strategy is employed by older, more experienced owls, while the "still-hover" strategy is used by younger, less experienced owls as they are still honing their hunting skills.
b) The "perch and pounce" strategy is more energy-efficient and is employed by Lunaris owls during periods of food scarcity, whereas the "still-hover" strategy is utilized when prey availability is abundant.
c) Lunaris owls exhibit distinct hunting strategies to reduce competition within the group, as each owl can specialize in a particular strategy based on its individual physical attributes and hunting preferences.
d) The two hunting strategies in Lunaris owls have evolved due to differences in the availability of preferred prey species, with the "perch and pounce" strategy targeting larger, slower-moving prey, and the "still-hover" strategy focusing on smaller, faster prey.

Ans: d

3- The table below presents data on the reproductive success of four different genotypes, A to D in a Hymenopteran insect. The sex determination of hymenopteran insects (bees and wasps) is haplodiploidy: males develop from unfertilized eggs and are therefore haploid, and females develop from normally fertilized eggs and are diploid. If a female mates with only one male, any two of her daughters will share, on average, 3/4 of their genes.

Females	Number of their own offspring	Number of siblings	Average number of offspring produced by each sibling
Genotype A	12	3	7
Genotype B	2	8	12
Genotype C	8	4	6
Genotype D	9	6	5

3 (A)- Provide the direct fitness of genotype A, assuming that all offspring are females and females with different genotypes do not compete. (1 point)

a) 1
b) 2
c) 3
d) 4
e) 5
f) 6

(1)	A>B>D>C
(2)	A>D>B>C
(3)	B>A>D>C
(4)	B>D>A>C
(5)	C>A>D>C
(6)	C>D>A>C

Ans: f

3 (B)- Rank genotypes A to D in descending order of inclusive fitness, assuming that all offspring are females. Choose the number from the table below. (1 point)

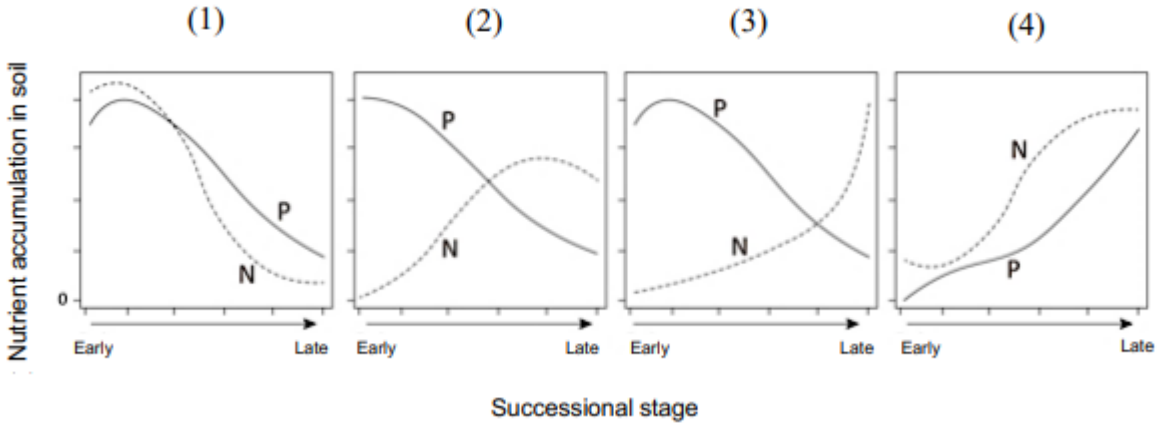
a) 1
b) 2
c) 3
d) 4
e) 5
f) 6

Ans: d

(1)	A>B>D>C
(2)	A>D>B>C
(3)	B>A>D>C
(4)	B>D>A>C
(5)	C>A>D>C
(6)	C>D>A>C

4- Primary succession can begin in a virtually lifeless area, characterized by early-seral plant species followed by the replacement of these species by other late-seral plant species. An example of this process can be seen in Alaska, where glaciers have retreated as a result of climatic warming during the Holocene. Through this succession, key soil properties such as nitrogen (N) and phosphorus (P) content also change. Nitrogen enters into the soil through the biological pathway of nitrogen fixation, the conversion of N2 to forms that can be used to synthesize organic nitrogen compounds. Phosphorus is added into the soil through the weathering of rocks. Plants in each successional stage use these nutrients for growth and survival. After the death of plants, the elements stored in the plants can reenter into the soil through the activities of microorganisms, which decompose and mineralize detritus. Soil nutrients can be absorbed and utilized by plants again over time, but some are lost through leaching out from ecosystems.

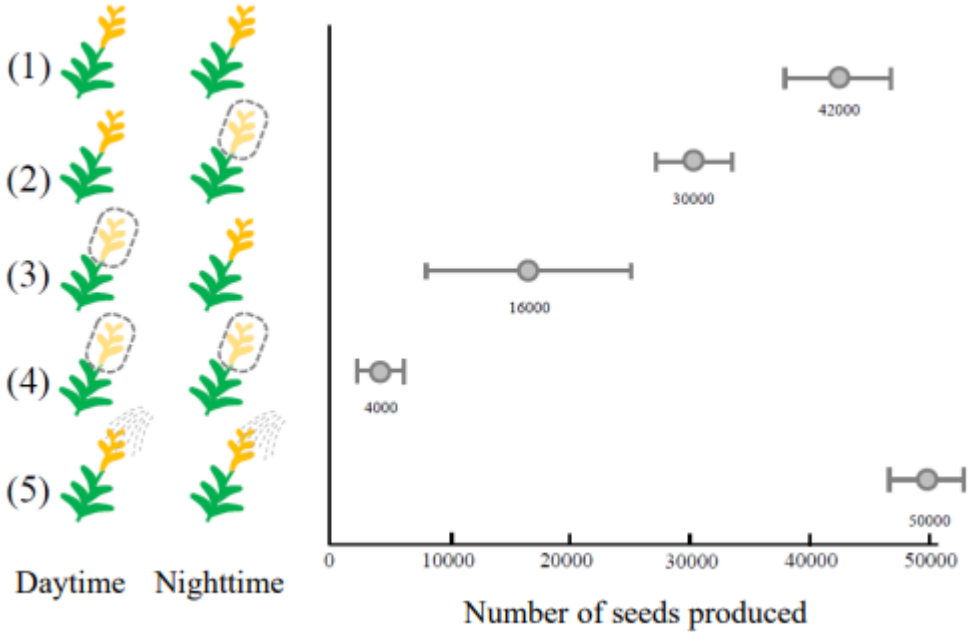
Choose a panel from (1) to (4) that represents temporal changes in nutrient accumulation in soil through primary succession after glacial retreat in Alaska. The climax stage is boreal forests. In the panels, N and P represent the total amount. (3 points)



a) 1
b) 2
c) 3
d) 4

Ans: b

5- An experiment was conducted to examine the relative effect of pollinators during the night and in the daytime on the reproductive success of golden rod flowers. Pollinators cannot visit the bagged flowers. The figure shows the number of viable seeds produced (mean ± standard deviation) by flowers that were not bagged (1), those bagged during the night (2), those bagged in the daytime (3), those bagged during both day and night (4), and those that underwent enforced pollination by an experimenter (5). (2 points)

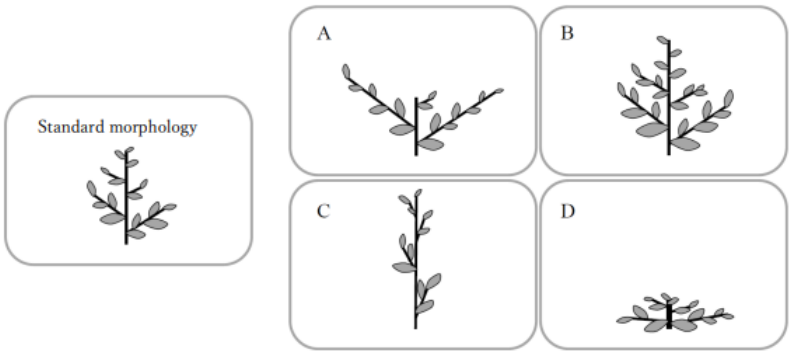


Indicate whether each of the following statements is true or false.

a) Nighttime pollinators contribute to about 60% of the total seed production.
b) The flowers may be capable of self-pollination.
c) The contribution of daytime pollinators has a greater variability than nighttime pollinators.
d) There are no limitations to pollination under natural conditions.

Ans: b

6- Plants show morphological plasticity and can change their morphology in response to different environmental conditions. The four figures below (A to D) show simplified diagrams of a plant's typical response to environmental conditions.



Match the following statements (a to d) with the corresponding diagrams (A to D) shown above and choose the appropriate number from the table below. (3 points)

	A	B	C	D
(1)	a	d	c	b
(2)	a	c	d	b
(3)	b	a	c	d
(4)	b	d	c	a
(5)	c	a	d	b
(6)	c	a	b	d

a) Response to soil fertilization.
b) Response to apical damage.
c) Response to shade condition.
d) Response to trampling pressure.

7- A blue jay (Cyanocitta cristata) utilizes which type of learning to avoid attacking monarch butterflies (Danaus Plexippus) and similar looking butterflies that cause the bird to vomit immediately after consuming them, linking the color with the foul taste? (2 points)

a) Classical conditioning
b) imprinting
c) habituation
d) operant conditioning
Ans: d

8- Without any competition in an ecological location, a species can reach which of following? (1 point)

a) Realized niche
b) Fundamental niche
c) Exploitation
d) Commensalism
Ans: b

9- When a harmless species is protected by its resemblance to a harmful species, which defensive adaptation is utilized? (1 point)

a) Batesian mimicry
b) Müllerian mimicry
c) Aposematic coloration
d) Cryptic coloration
Ans: a

10- Which type of forest is majority comprises lichens and mosses? (1 point)

a) Taiga forests
b) Tundra forests
c) Temperate mixed forests
d) Tropical ever-green forests
Ans: b

11- The X blood-type allele probably originated in Cairo and subsequently spread to New York and other regions of the world. This is an example of:
(1 point)
a) Artificial selection
b) Natural Selection
c) Genetic drift
d) Gene flow
e) Adaptive radiation
Ans: d

12- Which of the following causes populations to shift most quickly from exponential to logistic population growth? (2 points)

a) favorable climatic conditions
b) removal of predators
c) decreased death rate
d) competition for resources
Ans: c

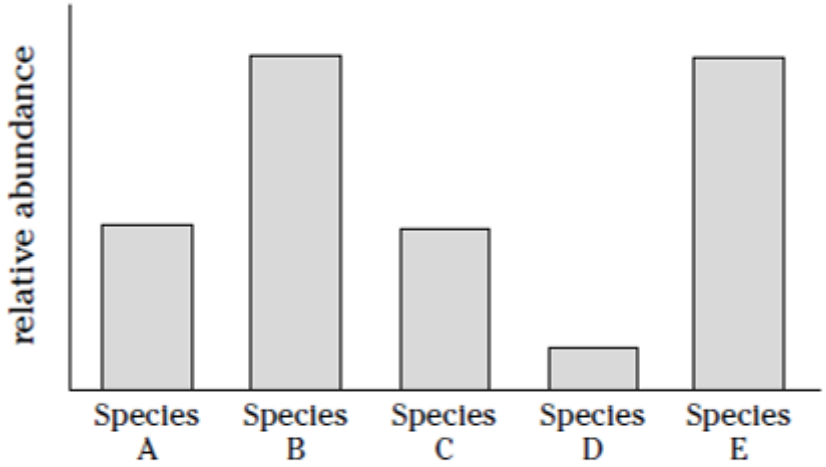
13- Which of the following statements are true?

I. Energy transmission between trophic levels is efficient

II. All primary producers are plants

III. Detritivores support primary producers
(2 points)
a) I only
b) II only
c) III only
d) I and II only
e) II and III only
Ans: c

14- The bar graph below represents the relative abundance of five species within the same community. (the symbol > means feed on)

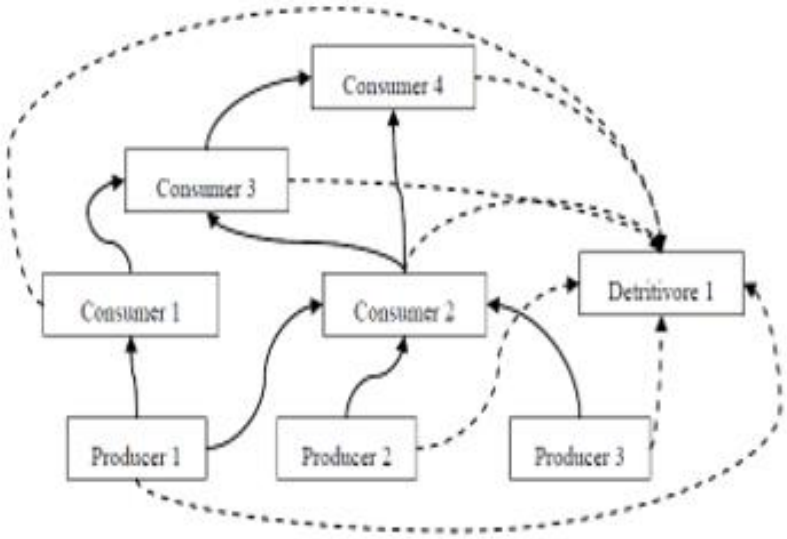


Which of the following is the most likely food chain that includes these species? (2 points)

a) E > B > D
b) B > A > D
c) D > C > B
d) D > E > A
e) A > E > D
Ans: b

15- Which of the following is most likely correct (3 points)
. The diagram below represents the relationships between organisms in a remote pond

ecosystem.



a) DDT present in the ecosystem would accumulate to the highest concentrations in the tissues of Detritivore 1.
b) The introduction of Consumer 4 individuals from an external population would lead to a temporary increase in numbers of Producer 2.
c) Disease in the Producer 1 population would lead to an increase in the Producer 3 population.
d) Extermination of Consumer 3 would cause a sustained increase in the population of Consumer 2.
e) Consumer 1 is more adaptable with regard to its food source than Consumer 3.
Ans: b

16- The cow Bos primigenius (which is bred for meat and milk) has a smaller brain and larger eyes than closely related wild species of ungulates. These traits most likely arose by: (2 points)

a) natural selection, because these traits evolved in the population over time
b) natural selection, because these traits were not consciously selected by humans
c) artificial selection, because changes in these traits co-occurred with human selection for high milk output and high muscle content
d) artificial selection, because these animals differ from their close relatives and common
Ans: c

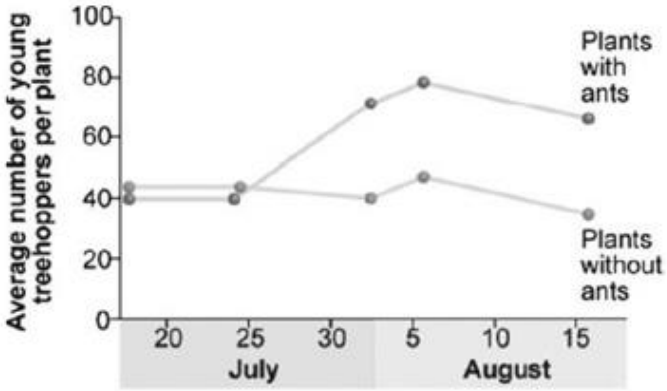
17- Which statements are correct?
1. Some autotrophic bacteria obtain energy oxidizing NH_4^+ to NO_2^- or NO_2^- to NO_3^-
2. Some autotrophic bacteria obtain energy reducing NO_2 or NO_3
3. Nitrogen-fixing cyanobacteria can utilize atmospheric nitrogen (N_2)
4. The ocean serves as a buffer, stabilizing the atmospheric CO_2 concentration
5. Coral reefs are very productive ecosystems, but they contain a minor portion of the global amount of assimilated C
(3 points)
a) 3, 4 and 5
b) 2, 3, 4 and 5
c) 1, 4 and 5
d) 1, 3, 4 and 5
e) Only 4 and 5
Ans: d

18- Which of the following is an example of commensalism? (1 point)

a) fungi residing in plant roots, such as endomycorrhiza
b) bacteria fixing nitrogen on the roots of some plants
c) rancher ants that protect aphids in exchange for sugar-rich honeydew
d) cattle egrets eating insects stirred up by grazing bison

Ans: d

19-



Treehoppers (a type of insect) produce honeydew, which ants use for food. Treehoppers have a major predator, the jumping spider. Researchers hypothesized that the ants would protect the treehoppers from the spiders. In an experiment, researchers followed study plots with ants removed from the system and compared them to a control plot. From the figure, what can you conclude?

A) Ants do somehow protect the treehoppers from spiders.
B) Ants eat the honeydew produced by treehoppers.
C) Ants reduce the numbers of treehoppers.
D) No specific conclusions can be drawn from this figure.

(3 points)

a) A
b) B
c) C
d) D

Ans: a