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ENVIRONMENT AND ECOLOGY

For UPSC Civil Services Prelims Exam 2025

FEATURES

- Chapter-Wise Segregation of Questions
- Detailed Explanations for all Questions
- Use of PW OnlyIAS Extra Edge for Additional Information
- Comprehensive Coverage of Important Topics

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1 Ecology and Ecological Concepts

Objective Questions for Practice

1. With reference to environment and ecology, which one of the following is the correct meaning of community?

(*a*) Number of organisms of the same species.

(*b*) The combination of populations of different species.

(*c*) Abiotic factors in surroundings.

(*d*) None of the above

Ans: (*b*)

An ecological community is defined as a group of species that are commonly found together. Ecological communities may be animal or plant assemblages with similar habitat requirements and contain species which may influence each other or rely on similar processes in their environment. A community's occurrence or presence is usually a result of underlying environmental conditions. For example, a particular group of plants adapted to extreme drought and high temperatures grow on shale barrens, while assemblages of plants and animals that are able to survive in periods of wet and dry live in vernal pool communities. Limestone stream communities are characterized by a high diversity of animal species that require calcium-rich groundwater. **Hence, option (*b*) is correct**.

2. With reference to environment and ecology, which one of the following is the correct meaning of habitat?

(*a*) The profession of organisms.

(*b*) The physical place where an organism lives.

(*c*) Abiotic factors in surroundings.

(*d*) None of the above.

Ans: (*b*)

Option (*b*) is correct:

About Habitat:

- The habitat of the organism is the physical place where an organism lives or the place where one would go to find the particular organism. In simple words, it is the address of the organism.
- The habitats of different plants and animals are different, however, at the same time, many plants and animals share the same habitat.
- It is a nutrient-providing area.
- **Examples:** Ponds, forests, grasslands, crop fields etc.

3. With reference to the Ecological Niche, consider the following statements:

1. It is the unique functional role or place of a species in an ecosystem.
2. Species may share the same habitat, but a niche is unique for a species.
3. Conservation efforts of species in their natural habitat require knowledge of the niche requirements of species.

How many of the above statements are correct?

(*a*) Only one (*b*) Only two

(*c*) All three (*d*) None

Ans: (c)

Statement 1 is correct: An Ecological Niche is the unique functional role or place of a species in an ecosystem. It is a description of all the biological, physical and chemical factors that a species needs to survive, stay healthy and reproduce.

Statement 2 is correct: A niche is unique for a species, which means no two species have exact identical niches. While different species may share the same habitat.

Statement 3 is correct: Effective conservation requires understanding a species' niche (e.g., habitat, food, and interaction needs) to ensure its survival in the natural environment.

4. With reference to a "Niche" in an ecosystem, consider the following statements:

1. It includes biological, physical and chemical factors that a species needs to survive.
2. Two or more species can have an exact and identical niche.
3. Physical niche is where the species lives.

How many of the statements given below are ***incorrect***?

(*a*) Only one (*b*) Only two

(*c*) All three (*d*) None

Ans: (*b*)

Statement 1 is correct: A niche is a description of all the biological, physical and chemical factors that a species needs to survive, stay healthy and reproduce.

Statement 2 is incorrect: A niche is unique for a species. Therefore, no two species can have exact identical niches. Niche plays an important role in conservation of organisms in their native habitat, if we have enough knowledge of the niche requirements of that species.

Statement 3 is incorrect: Habitat niche includes where the species lives. Whereas, reproductive niche includes how and when the species reproduces. Food niche includes what the species eats or decomposes and what other species it competes with for food. Physical and chemical niche includes temperature, land shape, land slope, humidity and other requirements of the species.

5. Consider the following statements regarding the Ecological Niche:

1. It describes the role an organism plays in a community.
2. Ecosystem stability has an inverse relation with Niche Diversity.
3. The ecological niche of dominant species is larger and more diverse than that of less dominant species.

How many of the statements given above are correct?

(*a*) Only one (*b*) Only two
(*c*) All three (*d*) None

Ans: (*b*)

Statement 1 is correct: In ecology, the term "niche" describes the role an organism plays in a community. A species' niche encompasses both the physical and environmental conditions it requires (like temperature or terrain) and the interactions it has with other species (like predation or competition).

Statement 2 is incorrect: Niche Diversity and Stability has a Direct Relation. The greater the niche diversity, the more is ecosystem stability because of the larger number of pathways for the flow of energy and less fluctuation of the species population.

Statement 3 is correct: Dominant species occupy an extensive and broader ecological niche in comparison to fewer dominant species.

PW Only IAS Extra Edge:

Ecotone

- An ecotone is a transition area between two biological communities, where two communities meet and integrate.
- It may be narrow or wide, and it may be local (the zone between a field and forest) or regional (the transition between forest and grassland ecosystems).

6. Consider the following statements:

1. Niche refers to the entire sequence of communities that successively change in a given area.
2. Sere refers to the defined tolerable conditions and distinct functional role of organisms in the ecological system.

Which of the statements given above is/are correct?

(*a*) 1 only (*b*) 2 only
(*c*) Both 1 and 2 (*d*) Neither 1 nor 2

Ans: (*d*)

Statement 1 is incorrect: The entire sequence of communities that successively change in a given area is called sere(s). The individual transitional communities are termed seral stages or seral communities. In the successive seral stages, there is a change in the diversity of species of organisms, an increase in the number of species and organisms, as well as an increase in the total biomass.

Statement 2 is incorrect: In ecology, the term "Niche" describes the role anorganismplays in a community. A species'nicheencompasses both the physical and environmental conditions it requires (like temperature or terrain) and theinteractionsit has with other species (like predation or competition). For example, the rare Kirtland's warbler (*Setophaga kirtlandii*), a small songbird of North America, has a very limited niche. It nests only among young jack pine trees (*Pinus banksiana*), which require periodicwildfiresfor their seeds togerminate.

7. Which of the following statements best describes Sere(s) in ecological succession?

(*a*) An individual community in ecological succession.
(*b*) The entire sequence of communities that successively change in a given area.
(*c*) The group of communities that dominate other species in a given area.
(*d*) A species that helps define an entire ecosystem.

Ans: (*b*)

The entire sequence of communities that successively change in a given area are called sere(s). The individual transitional communities are termed seral stages or seral communities. In the successive seral stages there is a change in the diversity of species of organisms, increase in the number of species and organisms as well as an increase in the total biomass. A keystone species is an organism that helps define an entire ecosystem. Without its keystone species, the ecosystem would be dramatically different or cease to exist altogether.

8. Which one of the following best describes the term "Realised Ecological Niche"?

(*a*) The niche that more than two other species shared when they coexist in a habitat.
(*b*) It is a set of conditions under which only an endemic species can survive and reproduce.
(*c*) It is the entire set of conditions under which an animal can survive and reproduce itself.
(*d*) It is the set of conditions actually used by given animal after interactions with other species have been taken into account.

Ans: (*d*)

Realized ecological niche is the set of conditions actually used by given animal (population, species), after interactions with other species (predation and especially competition) have been taken into account. It takes into account biotic interactions, such as competition and predation, which often narrow down a species' ecological range in nature. The realized niche is where a species is actually found in a given ecosystem, considering both abiotic and biotic factors.

> **PW Only IAS Extra Edge:**
> **Fundamental Ecological Niche:** A fundamental niche is a theoretical model of the ideal conditions under which a species can survive and reproduce without competition. It includes the biotic and abiotic conditions needed by an organism, such as food, water, shelter, and temperature.

9. Which one of the following best describes the term 'Carrying Capacity' of an environment?

(*a*) It refers to the number of births during a given period in the population that are added to the initial density.

(*b*) It is the maximum population size of a species that can be sustained by that environment.

(*c*) It refers to the situation when the populations evolve to maximise their reproductive fitness.

(*d*) It states that populations grow through births and immigration and decline through deaths and emigration.

Ans: (*b*)

The carrying capacity of an environment is the maximum population size of a biological species that can be sustained by that specific environment, given the food, habitat, water, and other resources available. The carrying capacity is determined by environmental factors such as adequate food and shelter. Growth is ultimately limited by the carrying capacity of the environment.

10. Consider the following statements with reference to Ecotones:

1. They consist of species only from the overlapping communities.
2. They are linear and show a progressive increase in the species composition of one incoming community
3. The edge effect refers to the greater occurrence of species and population density within the ecotone than in surrounding communities.

Which of the statements given above are correct?

(*a*) 1 and 2 only (*b*) 2 and 3 only

(*c*) 1 and 3 only (*d*) 1, 2 and 3

Ans: (*b*)

Statement 1 is incorrect: Ecotone is a transitional area of vegetation between two different plant communities, such as forest and grassland. It has some of the characteristics of each bordering biological community and often contains species not found in the overlapping communities.

Statement 2 is correct: Ecotones are linear and show a progressive increase in species composition of one incoming community and a simultaneous decrease in species of the other outgoing adjoining community.

- An ecotone may exist along a broad belt or in a small pocket, such as a forest clearing, where two local communities blend together.
- Some organisms need a transitional area for activities such as courtship, nesting, or foraging for food. Ecotones also appear where one body of water meets another (e.g., estuaries and lagoons) or at the boundary between the water and the land (e.g., marshes).
- Freshwater and marine ecotones are characterized by the presence of large plants that rise from roots attached to the submerged substrate, and thus they occur in areas where ample light is available at the bottom of the basin to permit growth.

Statement 3 is correct: Sometimes the number of species and the population density of some of the species is much greater in this zone than in either community. This is called the edge effect. The organisms which occur primarily or most abundantly in this zone are known as edge species. In terrestrial ecosystems edge effect is especially applicable to birds. For example, the density of songbirds is greater in the mixed habitat of the ecotone between the forest and the desert.

11. Which among the following statements is correct about Ecotone?

(*a*) Ecotone are a narrow transitional zone between different ecosystems unaffected by the abrupt changes in the environmental conditions.

(*b*) An ecotone generally do not possess unique species.

(*c*) Artificial ecotones are not possible with the present technology.

(*d*) Ecotones may serve as speciation centres, providing a variety of genetic stock for scientific research.

Ans: (*d*)

Ecotones are transitional zones or boundaries between different ecological communities or ecosystems. They represent areas where two or more distinct types of ecosystems meet and interact.

Point (*a*) is incorrect: Ecotones may be very narrow or quite wide. The width of an ecotone depends on various factors, including the specific ecosystems or habitat types it separates, the topography of the landscape, and the degree of gradual or abrupt change in environmental conditions.

Point (*b*) is incorrect: A well-developed ecotone contains some organisms that are entirely different from that of the adjoining communities. Some species are specially adapted to thrive in ecotone environments. These species are known as edge species or ecotone specialists and are well-suited to the intermediate conditions found in these transitional areas.

Point (*c*) is incorrect: Ecotones occur at multiple spatial scales and range from natural boundaries to human-generated ecotones. These artificial ecotones are designed to mimic natural transitional zones between ecosystems and can serve important ecological and environmental functions.

Point (*d*) is correct: Speciation (the process by which new species evolve from existing ones) is particularly active or where a high level of species diversity is observed. Recent evidence suggests that ecotones may also serve as speciation centres. Some researchers argue that ecotones deserve high conservation investment, potentially serving as speciation and biodiversity centers.

12. Consider the following statements regarding an ecotone:

1. It is the transitional zone between two or more diverse ecosystems.
2. It often contains species not found in its adjacent ecosystems.
3. It exhibits a unique phenomenon called edge effect.

How many of the above statements are ***incorrect***?

(*a*) Only one (*b*) Only two
(*c*) All three (*d*) None

Ans: (*d*)

Statement 1 is correct: Ecotone is a zone of transition between two or more diverse ecosystems. E.g. the mangrove forests represent an ecotone between marine and terrestrial ecosystems. Other examples are – grassland, estuary, and river banks.

Characteristics of Ecotone:

- It may be very narrow or quite wide.
- It has the conditions intermediate to the adjacent eco-systems. Hence it is a zone of tension.
- It is linear as it shows a progressive increase in species composition of one coming community and a simultaneous decrease in species of the other outgoing ad-joining community.

Statement 2 is correct: Well-developed ecotones contain some organisms that are entirely different from those of the adjoining communities. An ecotonal area often has a higher density of organisms of one species and a greater number of species than are found in either flanking community.

Statement 3 is correct: A few times, the number of species and the population density of some of the species is much greater in this zone than in either community. This is called the edge effect. The organisms which occur primarily or most abundantly in this zone are known as edge species. In terrestrial ecosystems edge effect is especially applicable to birds. For example, the density of birds is greater in the mixed habitat of the ecotone between the forest and the desert.

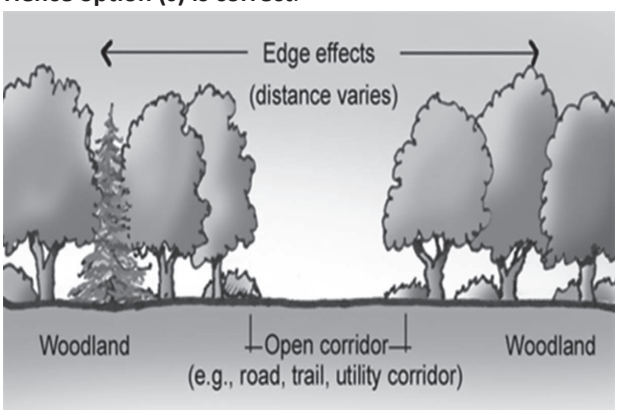
13. Which one of the following terms describes changes in the population or community along the boundary of a habitat?

(*a*) Ecological niche (*b*) Ecotone
(*c*) Edge effect (*d*) Sere

Ans: (*c*)

Changes in a population or community near a habitat's boundary are referred to as edge effects. The junction of an agricultural field and a forest is a prime illustration of this. A less evident example would be a fragmented habitat, as those found in regions affected by human development (e.g., urban greenways) or small areas of clear-cutting for ranching) or as a result of selective logging. Impacts from fragmented habitats may have edge effects that continue into the target habitat.

Hence option (*c*) is correct.



PW Only IAS Extra Edge:

Basic Definitions

- **Environment:** the natural landscape together with all of its non-human features, characteristics and processes
- **Ecology:** Subject which studies the interactions among organisms and between the organism and its physical (abiotic) environment.
- **Biosphere:** The biosphere is the biological component (supporting life) of earth which includes the lithosphere, hydrosphere and atmosphere.
- **Habitat:** A habitat is a place where an organism makes its home. A habitat meets all the environmental conditions an organism needs to survive. (All habitats are environments, but all environments are not habitats.)
- **Ecosystem:** Structural and functional unit of biosphere consisting of community of living beings and the physical environment, both interacting and exchanging materials between them.
- **Ecotone:** An "ecotone" is a transition area between two biological communities, where two communities meet and integrate. E.g. Mangroves represents an ecosystem between marine and terrestrial ecosystem.

Niche: Ecological niche is a term for the position of a species within an ecosystem, describing both the range of conditions necessary for persistence of the species, and its ecological role in the ecosystem. Ecological niche subsumes all of the interactions between a species and the biotic and abiotic environment, and thus represents a very basic and fundamental ecological concept. No two species have exact identical niche. Different types of niches are – Habitat niche, Food niche, Reproductive niche, Physical and Chemical niche.

- **Biomes:** A biome is a community of plants and animals that have common characteristics for the environment they exist in. They can be found over a range of continents. Biomes are distinct biological communities that have formed in response to a shared physical climate. Biome is a broader term than habitat; any biome can comprise a variety of habitats

14. Consider the following pairs:

Sr. No.	Name of Zone	Definition
1.	Ecocline	A gradual and continuous transition zone between two distinct ecosystems.
2.	Habitat	Area that any species regularly uses for its daily activities, such as foraging, mating, and raising young.
3.	Ecotype	Environment where a particular species or population lives.
4.	Home Range	A population (or subspecies or race) that is adapted to local environmental conditions.

How many of the pairs given above are correctly matched?

(*a*) Only one (*b*) Only two

(*c*) Only three (*d*) All four

Ans: (*a*)

Pair 1 is correctly matched: An Ecocline is a gradual transition zone between two ecosystems with a continuous change in species composition over a geographical area. The passage also mentions influencing factors like varying temperature, salinity, or vegetation, which are all relevant to ecoclines.

Definition: A gradual and continuous transition zone between two distinct ecosystems. There's a gradual continuum of characteristics from each ecosystem within the ecocline.

Key Features:

- Gradual, continuous change in species composition influenced by environmental factors (temperature, salinity, vegetation, etc.).
- No sharp dividing line between the two ecosystems.

  Example: The transition zone between a forest and a grassland, where the tree density gradually decreases while grass species become more dominant.

Pair 2 is incorrectly matched: Habitats refer to the specific environment where a particular species or population lives, not the transition between two ecosystems.

1. Provides the resources (food, shelter, water) necessary for an organism's survival.
2. Can be large or small, depending on the organism and its needs.
3. A pond habitat for frogs, or a forest habitat for a deer population.

Pair 3 is incorrectly matched: An ecotype is a population (or subspecies or race) that is adapted to local environmental conditions.

Pair 4 is incorrectly matched: The Home Range is the area that any species regularly uses for its daily activities, such as foraging, mating, and raising young.

Key Features:

- Typically, larger than an individual's habitat.
- May overlap with the home ranges of other animals of the same species.

  Example: A wolf's home range might span several miles of forest within which it hunts for prey and maintains a den.

15. Consider the following statements about ecological succession:

Statement-I: The rate of Secondary Succession is faster than the rate of Primary Succession.

Statement-II: Secondary succession begins with the colonization of pioneer species, such as grasses and weeds, while primary succession begins with the pioneer species, such as lichens and mosses.

Which one of the following is correct in respect of the above statements?

(*a*) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I

(*b*) Both Statement-I and Statement-II are correct and Statement-II is not the correct explanation for Statement-I.

(*c*) Statement-I is correct, Statement-II is incorrect.

(*d*) Statement-I is incorrect but Statement-II is correct.

Ans: (*b*)

Ecological succession describes the gradual transformation of a biological community over time. This change involves both the types of organisms present and their relative abundance.

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1 Basic Concepts of Economics

Objective Questions for Practice

1. Consider the following statements about macro and micro economics:

1. Microeconomics takes top-down approach to analyse economy while macroeconomics takes a bottom-up approach.
2. Microeconomics tries to understand the choices which consumers make and the income they earn, macroeconomics tries to understand the dynamics of inflation and growth.

Which of the above given statements are true?

(*a*) 1 only (*b*) 2 only
(*c*) Both 1 and 2 (*d*) Neither 1 nor 2

Ans: (*b*)

After the Great Depression (during the 1930s) the domain of economics got divided into two broad branches, the micro and macro-economics. John Maynard Keynes is considered the father of Macroeconomics.

Statement 1 is incorrect: Micro and macro are the Greek words which mean 'small' and 'big', respectively. Microeconomics takes a bottoms-up approach to analyze the economy, while Macroeconomics takes a top-down approach. Simply put, if macroeconomics (macro) is about the forest, microeconomics (micro) is about the trees. While the former deals with the big picture (the forest) the latter deals with the details(the trees) that make up the forest.

Statement 2 is correct: Microeconomics tries to understand the choices which consumers make and the income they earn, Macroeconomics tries to understand the dynamics of inflation and growth. Though, they appear to be different, they are actually interdependent and complementary since there are many overlapping issues between them. For example, a rise in inflation (macro effect) will cause rise in the cost of raw materials leading to rise in prices which consumers will pay (micro effect).

2. Consider the following:

1. Private consumption demand
2. Private investment demand
3. Purchase of goods and services by the government
4. Demand for net exports

Which of the above factors are part of aggregate demand in an economy?

(*a*) 2, 3, and 4 only (*b*) 1, 2, and 3 only
(*c*) 1, 2, 3 and 4 (*d*) 1 and 2 only

Ans: (*c*)

Aggregate demand measures the total amount of demand for all finished goods and services produced in an economy. It is commonly expressed as the total amount of money exchanged for those goods and services at a specific price level and point in time.

The Components of Aggregate Demand are:

- Private consumption demand (C)
- Private investment demand (I)
- Purchase of goods and services by the government (G)
- Demand for net exports (X-M)

Thus, AD = C + I + G + (X-M) (Sum of four components: Consumption, Investment, Government Purchase and Net Export)

3. With reference to the Law of Supply, consider the following statements:

1. The Law of Supply indicates a direct relationship between the price of a good and the quantity supplied.
2. There is a general increase in the supply of the commodity if the cost of production increases.

Which of the statements given above is/are correct?

(*a*) 1 only (*b*) 2 only
(*c*) Both 1 and 2 (*d*) Neither 1 nor 2

Ans: (*a*)

Statement 1 is correct: The Law of Supply states that, other things being equal, as the price of a good or service increases, the quantity supplied also increases. Producers are motivated by higher prices to increase output because it improves profitability. Conversely,

when prices decrease, supply reduces as profits decline. This highlights a direct relationship between price and quantity supplied.

Example: If the price of coffee beans rises, farmers will increase coffee production to benefit from higher profits.

Statement 2 is incorrect: Production costs are a key determinant of supply. If these costs increase, it becomes more expensive to produce goods, discouraging production and reducing the supply at current prices. On the other hand, a decrease in production costs makes it more profitable for producers to supply more at the same price, increasing supply.

Example: If fertilizer prices rise, farmers may reduce crop production, leading to lower supply.

4. Which of the following most accurately defines Market Equilibrium?

(*a*) It occurs when quantity demanded equals quantity supplied, determining the market price.

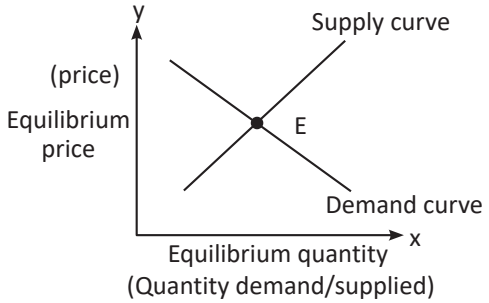
(*b*) It occurs when the quantity supplied exceeds the quantity demanded.

(*c*) It is achieved when prices are kept above the equilibrium level to prevent shortages.

(*d*) It results from the government's intervention in setting market prices.

Ans: (*a*)

Market Equilibrium occurs when the quantity demanded by consumers equals the quantity supplied by producers at a specific price level. At this point, the market is in balance, and there are no excesses or shortages of goods. This equilibrium price is determined by the intersection of the demand curve and the supply curve.



5. Consider the following statements:

1. The steel used for making cars is classified as a capital good.
2. Furniture is categorized as consumer goods.
3. A tractor is classified as an intermediate good.

How many of the statements given above are correct regarding the different types of goods?

(*a*) Only one (*b*) Only two

(*c*) All three (*d*) None

Ans: (*a*)

Statement 1 is incorrect: The steel used for making cars is considered as intermediate goods. They are unfinished items that need to undergo further processing before businesses can sell them to consumers. **Example:** Iron rods or iron sheets made from the iron extracted from iron ore.

Statement 2 is correct: Furniture is consumer goods. The consumer/consumption goods are consumed by the ultimate consumers. **Example:** Cups, Plates made from iron sheets.

Statement 3 is incorrect: Capital goods, like tractors, are goods used by businesses to produce other goods and services. They are not sold directly to consumers. Instead, businesses purchase capital goods to provide consumer goods and services. They themselves don't get transformed in the production process. They are purchased by the firms for investment purposes or for capital formation. **Example:** Sewing machine made of iron will be used to stitch clothes (used by consumers).

6. Which of the following statements best defines the concept of Opportunity cost in economic terms?

(*a*) It is the total monetary cost incurred when purchasing a good.

(*b*) The loss in the cost of benefit from the next best alternative when making a choice.

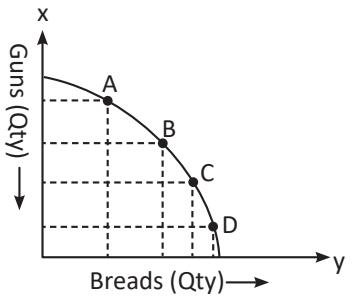
(*c*) It is the cost that refers to the direct expenses associated with a business decision.

(*d*) Opportunity cost is the additional cost incurred from producing one more unit of a good.

Ans: (*b*)

Opportunity cost represents the value of the next best alternative foregone when a decision is made.

For instance: Consider a country faced with the choice between producing guns (military spending) or bread (food for its population). If the government decides to allocate resources to produce more guns, the opportunity cost is the quantity of bread that could have been produced instead. For example, if producing one gun costs the country 100 loaves of bread, then choosing to produce 10 guns means sacrificing 1,000 loaves. **T**his opportunity cost illustrates the trade-offs economies encounter when allocating limited resources, underscoring the importance of assessing the potential benefits of alternative choices.



In the given figure, while moving from A to B, the production of bread increases while the production of guns decreases. The opportunity cost of 1 gun is 100 loaves of bread.

7. Which of the following are stock variables?

1. Output
2. Capital
3. Wealth
4. Interest on capital

Select the correct answer using the codes given below:

(*a*) 1, 2 and 3 only (*b*) 2 and 3 only
(*c*) 2 and 4 only (*d*) 1, 2, 3 and 4

Ans: (*b*)

Stocks are variables that are defined at a particular point of time. However, We can measure changes in stock over a given period, such as the number of new machines added within a year. These changes in stock are referred to as flows, which are measured over specific time intervals. While a particular machine can remain part of the capital stock for many years (unless it wears out), its contribution to the flow of new machines is limited to the single year in which it was initially installed. Some examples of stocks are:

- Capital; **Hence, point 2 is correct.**
- Wealth; **Hence, point 3 is correct.**
- Bank deposits
- Population
- National Debt

Flows are defined over a period of time. They are concepts that make sense only when a time period is specified. Therefore we need to delineate a time period to get a quantitative measure of these. Since a lot of accounting is done annually in an economy, many of these are expressed annually like annual profits or production. Some examples of flows are:

- Income
- Output; **Hence, point 1 is incorrect.**
- Profits
- Interests on capital; **Hence, point 4 is incorrect.**

8. Which of the following statements correctly describes how price changes affect the demand for various types of goods?

1. An increase in the price of a normal good will generally lead to a decrease in the quantity demand for that good.
2. The goods whose demand decreases with the increase in price are called Giffen goods.
3. When the price of a related good increases, the demand for substitute goods tends to rise.

Select the correct answer using the codes given below:

(*a*) 2 only (*b*) 3 only
(*c*) 1 and 3 only (*d*) 1, 2 and 3

Ans: (*c*)

Statement 1 is correct: According to the Law of Demand, when the price of a normal good increases, the quantity demanded typically decreases, assuming all other factors remain constant. As a good becomes more expensive, consumers typically buy less of it.

Statement 2 is incorrect: Giffen goods are a special category of inferior goods that defy the standard Law of Demand. They exhibit an upward-sloping demand curve, meaning that when the price of a Giffen good rises, its demand actually increases. This is because Giffen goods are essential items with few substitutes, and when their price rises, consumers may need more affordable alternatives, leading them to purchase more of the Giffen goods despite the price increase.

A classic example of a Giffen good is staple food items like bread, rice, or potatoes in impoverished communities under certain economic conditions.

Example: In a poor rural community where rice is a staple food and meat or vegetables are luxury items:

- When the price of rice increases, instead of reducing consumption, people may buy more rice.
- This is because rice is the cheapest source of calories, and as its price rises, households can no longer afford costlier substitutes like meat. To meet their calorie needs, they spend more on rice, despite the higher price.

Statement 3 is correct: Substitute goods are those that can replace each other in consumption. When the price of a related good (the substitute) rises, consumers will often switch their demand to the cheaper alternative, increasing demand for the substitute good.

9. Which of the following statements accurately describes "inventory" in economics?

(*a*) Inventory is considered as a flow variable and is treated as a fixed investment.
(*b*) Inventory investment includes only unsold finished goods and excludes raw materials.
(*c*) The value of inventories is calculated by subtracting sales from fixed business investments.
(*d*) Changes in inventories can be either planned or unplanned which impacts a firm's production dynamics significantly

Ans: (*d*)

Inventory refers to the stock of goods and materials that a business holds for the purpose of resale, production, or consumption. It includes finished products, work-in-progress items, and raw materials.

Option (*a*) is incorrect: Inventory is a flow variable that measures changes in levels over a specific period (e.g., annually) but is not considered a fixed investment. It is classified as a current asset on the balance sheet and can vary based on production and sales dynamics, unlike fixed investments, which refer to long-term assets like machinery and buildings.

Option (*b*) is incorrect: Inventory investment encompasses all types of inventory, including raw materials, work-in-progress, and finished goods. It reflects the total value of inventory held by a firm and is not limited to unsold finished goods.

Option (*c*) is incorrect: The value of inventories is calculated by taking the cost of goods available for sale (including purchases and production) and subtracting the cost of goods sold. It is not determined by subtracting sales from fixed business investments, as these are two separate categories in accounting.

Option (*d*) is correct: Inventory changes can be planned (strategically adjusted based on sales forecasts) or unplanned (resulting from unexpected sales fluctuations). Planned changes help manage production and supply effectively, while unplanned changes indicate shifts in market demand, affecting production decisions and financial performance.

10. Consider the following items and identify which of them qualify as intangible investments?

1. Patents and copyrights
2. Market share and customer lists
3. Real estate and machinery
4. Franchises and mortgage servicing rights
5. Import quotas and brand names

Select the correct answer using the codes given below:

(*a*) 1, 2, 3 and 4 only (*b*) 1, 2, 4 and 5 only
(*c*) 2, 3 and 5 only (*d*) 1, 4 and 5 only

Ans: (*b*)

Intangible investments refer to non-physical assets that have value but do not have a tangible form. These assets can significantly contribute to a company's long-term value and competitive advantage. Here are key categories of intangible investments:

1. **Intellectual Property:**
   - **Patents:** Legal rights granted for inventions, allowing the holder to exclude others from making, using, or selling the invention for a certain period.
   - **Copyrights:** Rights that protect original works of authorship, such as literature, music, and art.
   - **Trademarks:** Symbols, names, or slogans that distinguish goods or services of one entity from others.
2. **Brand Value:**
   - **Brand Names:** Recognition and reputation associated with a company's products or services, which can influence customer loyalty.
   - **Goodwill:** The premium a company pays over the fair value of identifiable net assets during an acquisition, reflecting its brand strength, customer loyalty, and market position.
3. **Market Positioning:**
   - **Market Share:** The portion of a market controlled by a company, reflecting its competitiveness and sales volume relative to others.
   - **Customer Lists:** Databases of existing and potential customers, which can be valuable for marketing and sales strategies.
4. **Franchises and Licenses:**
   - **Franchises:** Rights granted to an individual or group to market a company's goods or services in a particular territory.
   - **Licenses:** Permissions to use patented technology or trademarks under specific conditions.
5. **Software and Technology:**
   - **Computer Software:** Programs and applications developed for various uses, including operating systems, databases, and enterprise applications.
   - **Technology and R&D:** Investments in research and development that lead to innovative processes or products.
6. **Other Intangible Assets:**
   - **Customer Relationships:** The established connections with customers that can lead to repeat business and referrals.
   - **Mortgages and Service Rights:** Rights related to managing or servicing loans and mortgages.
   - **Fishing Licenses and Import Quotas:** Regulatory licenses that allow individuals or companies to engage in specific activities, such as fishing or importing goods.

Real estate and machinery are tangible assets, as they have a physical presence. **Hence, option (*b*) is correct.**

11. Consider the following pairs regarding market structures:

Market Structure		Characteristics
1.	Perfect Competition	Producers can set prices to earn supernormal profits.
2.	Monopolistic Competetion	A single firm controls the market and can influence prices.
3.	Oligopoly	A few firms dominate with significant market influence.

How many of the pairs given above are correctly matched?

(*a*) Only one (*b*) Only two
(*c*) All three (*d*) None

Ans: (*a*)

Pair 1 is incorrectly matched: In perfect competition, firms cannot set prices or earn supernormal profits in the long run. This market structure is characterized by numerous firms producing identical products. The price is determined by the forces of supply and demand, and firms act as price-takers with no ability to influence prices. The lack of barriers to entry allows new firms to enter the market whenever existing firms are earning supernormal profits, which helps to bring profits down to normal levels over time.

Pair 2 is incorrectly matched: A monopolistic competetive market consists of numerous firms, each providing similar yet differentiated products (such as clothing brands and restaurants). In the short run, firms

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CONTENTS

1 Biotechnology

Objective Questions for Practice

1. Consider the following pairs:

	Branches of Biotechnology	Related to
1.	Red Biotechnology	Emphasizes Agriculture interests.
2.	Grey Biotechnology	Biotech in the Food Industry
3.	Dark Biotechnology	Associated with bioterrorism

How many of the above pairs are correctly matched?

(*a*) Only one (*b*) Only two
(*c*) All three (*d*) None

Ans: (*a*)

The term biotechnology was used for the first time by Karl Erkey, a Hungarian Engineer, in 1919. It is the application of the principles of engineering and biological science to create new products from raw materials of biological origin, for example, vaccines or food.

Colour Classification of Branches of Biotechnology

- Gold biotechnology or Bioinformatics: Computational Biology addresses biological problems using computational techniques.
- **Red Biotechnology:** Biopharma relates to medicine and veterinary products. **(Hence pair 1 is incorrect.)**
- White Biotechnology: Industrial Biotech to design more energy-efficient, low-resource consuming products.
- Yellow Biotechnology: Biotech in the Food Industry.
- **Gray Biotechnology:** Environmental applications to maintain Biodiversity. **(Hence pair 2 is incorrect.)**
- Green Biotechnology: Emphasizes Agriculture interests.
- Blue Biotechnology: Based on the use of marine resources.
- Violet Biotechnology: Deals with law, ethical and philosophical issues of biotechnology.
- **Dark Biotechnology:** Associated with bioterrorism and biological weapons. **(Hence pair 3 is correct.)**

2. Consider the following pairs:

S.No	Terms	Characteristic
1.	Chromatin	Segments of DNA containing specific information for a particular characteristic
2.	DNA	Genetic material carrying information for various traits.
3.	Genes	Thread-like structure present in the Nucleus, composed of DNA and Histone
4.	Chromosomes	Coiled and condensed DNA bound with Histone Proteins

How many of the pairs given above are correctly matched?

(*a*) Only one (*b*) Only two
(*c*) Only three (*d*) All four

Ans: (*b*)

Terms	Characteristic
Chromatin	A thread-like structure present in the Nucleus, consisting of DNA and Histone proteins. (Hence, pair 1 is incorrectly matched.)
DNA	Genetic material containing the written genetic information. (Hence pair 2 is correctly matched.)
Genes	Segements of DNA carrying specific information for traits, e.g. eye color. (Hence, pair 3 is incorrectly matched.)
Chromosomes	Coiled and condensed DNA wrapped around Histone proteins. (Hence, pair 4 is correctly matched.)

3. With reference to Genetic Engineering, consider the following statements about '*Base Editing*' technology:

1. It is a method of converting or altering a DNA base by creating double-stranded breaks.
2. This editing technique can be used only to edit DNA bases and not RNA bases.
3. This technique generates lesser undesired editing by-products than the CRISPR-mediated genome editing methods.

How many of the statements given above are correct?

(*a*) Only one (*b*) Only two

(*c*) All three (*d*) None

Ans: (*a*)

Base editing is a recent advancement in genetic engineering that allows for precise modifications of DNA sequences without introducing double-stranded breaks. Developed as an advancement over CRISPR-Cas9, it modifies specific nucleotides (A, T, C, G) directly, enabling correction of genetic mutations with high accuracy.

Statement-1 is incorrect: Base editing does not involve creating double-stranded breaks. Instead, It directly converts one DNA base into another without causing double-stranded DNA breaks. It uses a fusion of a catalytically impaired CRISPR/Cas9 (which does not cut the DNA) and a deaminase enzyme to make precise changes to the DNA sequence.

Statement-2 is incorrect: Base editing is a newer genome editing approach that uses components from CRISPR systems together with other enzymes to directly install point mutations into cellular DNA or RNA without making double-stranded DNA breaks (DSBs). DNA base editors comprise a catalytically disabled nuclease fused to a nucleobase deaminase enzyme and, in some cases, a DNA glycosylase inhibitor. RNA base editors achieve analogous changes using components that target RNA.

Statement-3 is correct: Base editing is a method of directly converting one DNA base to another without the need for double-stranded breaks. However, CRISPR-mediated genome editing uses the CRISPR-Cas9 system to create double-stranded breaks (DSBs) in the DNA. These breaks are then repaired by the cell's own repair mechanisms, leading to the insertion or deletion of specific base pairs. DSBs created by nucleases such as Cas result in insertions, deletions, translocations, and rearrangements that are considered as undesirable by-products. Since base editors (in base editing) do not normally create DSBs, they minimize the formation of DSB-associated by-products.

4. Consider the following statements:

1. DNA fragments, which result from the breakup of DNA strands, cannot be separated individually.
2. Disease-causing mitochondria carried by a woman can be replaced with a healthy mitochondria.
3. We can create 'recombinant' molecules of DNA, which are composed of DNA from different genomes.
4. The DNA sequence of an organism can be altered through genome editing.

How many of the statements given above are correct in relation to the developments in the field of genetics?

(*a*) Only one (*b*) Only two

(*c*) Only three (*d*) All four

Ans: (*c*)

Statement-1 is incorrect: The cutting of DNA by restriction endonucleases results in the fragments of DNA. These fragments can be separated individually by a technique known as Gel Electrophoresis. Since DNA fragments are negatively charged molecules, they can be separated by forcing them to move towards the anode under an electric field through a medium/matrix. Restriction enzymes belong to a larger class of enzymes called nucleases. These are of two kinds; exonucleases and endonucleases. Exonucleases remove nucleotides from the ends of the DNA whereas, endonucleases make cuts at specific positions within the DNA.

Statement-2 is correct: MRT or Mitochondrial donation is a medical technique in which defective mitochondria carried by a woman is replaced with the healthy mitochondria of a donor. Mitochondrial donation is an assisted reproductive technology which can help some parents to avoid transmitting mitochondrial DNA disease to their biological children. The term collectively refers to a number of specific techniques aimed at ensuring only healthy mitochondria is passed on to an embryo.

Statement-3 is correct: Restriction endonucleases are used in genetic engineering to form 'recombinant' molecules of DNA, which are composed of DNA from different sources/genomes. When cut by the same restriction enzyme, the resultant DNA fragments have the same kind of 'sticky-ends' and these can be joined together (end-to-end) using DNA ligases.

Statement-4 is correct: Genome Editing or genome engineering, or gene editing, is a type of genetic engineering in which DNA is inserted, deleted, modified or replaced in the genome of a living organism.

5. TALENs and Zinc-finger nucleases (ZFNs) are associated with

(*a*) Methods for creation of lab grown diamond

(*b*) Clonal propagation of crop plants

(*c*) Genome editing techniques

(*d*) Production of biofertilizers

Ans: (*c*)

Genome editing, also known as genome engineering or gene editing, is a sort of genetic engineering that involves inserting, deleting, modifying, or replacing DNA in a living organism's genome.

Genome Editing Techniques:

1. **Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR)- CRISPR- Associated Protein 9 (Cas9):** CRISPR is the DNA-targeting component of the system, and it is made up of an RNA molecule, or guide, that is engineered to attach to certain DNA bases via complementary base-pairing.
2. **Transcription Activator-like Effector Nucleases (TALENs):** TALENs (Transcription Activator-Like Effector Nucleases) are genome-editing tools that combine a DNA-binding domain derived from Transcription Activator-Like Effectors (TALEs) with a nuclease [FokI (FokI is a restriction endonuclease, an enzyme originally derived from the bacterium *Flavobacterium*

okeanokoites)] to introduce specific double-strand breaks in DNA. They enable precise editing by targeting specific DNA sequences, paving the way for applications in gene therapy and functional genomics.

3. **Zinc-Finger Nucleases (ZFNs):** Zinc Finger Nucleases (ZFNs) are genome-editing tools composed of a DNA-binding zinc finger protein domain fused to a FokI nuclease, enabling targeted DNA cleavage at specific sequences. They were among the first programmable nucleases used in genetic engineering, paving the way for modern genome-editing technologies. ZFNs are fusions between a custom-designed Cys2-His2 zinc-finger protein and the cleavage domain of the FokI restriction endonuclease.
4. **Homing Endonucleases or Mega-Nucleases:** Homing endonucleases, also known as mega-nucleases. These enzymes make extensive sequence-specific contacts with their DNA substrate.
   - These enzymes make extensive sequence-specific contacts with their DNA substrate.
   - However, unlike ZFNs and TALENs, the binding and cleavage domains in homing endonucleases are not modular.
   - This overlap in form and function makes their repurposing challenging and limits their utility for more routine applications of genome editing.

Hence, option (*c*) is correct.

6. In the context of genetic technology, the CRISPR-Cas 9 is directly associated with which of the following?

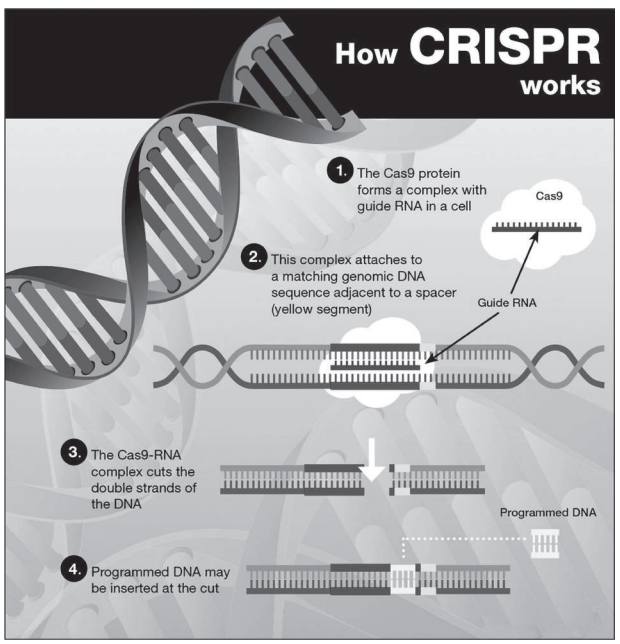
(*a*) It is related with three parents baby technique.

(*b*) It is an enzyme used in cloning.

(*c*) It is a highly effective genome editing technology.

(*d*) It is related to transgenic seeds.

Ans: (*c*)



About CRISPR-Cas9:

CRISPR-Cas9 is a unique technology that enables geneticists and medical researchers to edit parts of the genome by removing, adding or altering sections of the DNA sequence. It is currently the simplest, most versatile and precise method of genetic manipulation.

7. Consider the following statements:

1. A recombinant protein is a protein encoded by alien DNA in a host cell.
2. Recombinant DNA technology is used to produce proteins that are not naturally produced by the host organism.

Which of the statements given above are correct?

(*a*) 1 only (*b*) 2 only

(*c*) Both 1 and 2 (*d*) Neither 1 nor 2

Ans: (*c*)

Statement-1 is correct: A recombinant protein is indeed a protein encoded by alien DNA in a host cell. This means that the DNA responsible for encoding the protein comes from a different source or organism, and it has been introduced into the host cell, which then produces the protein based on this foreign DNA.

Statement-2 is correct: Recombinant DNA technology is commonly used to produce proteins that are not naturally produced by the host organism. By introducing specific genes into the host cell, researchers can instruct the cell to produce proteins that it would not naturally produce on its own. This is a key application of genetic engineering and recombinant DNA technology.

- Recombinant DNA technology involves using enzymes and various laboratory techniques to manipulate and isolate DNA segments of interest. This method can be used to combine (or splice) DNA from different species or to create genes with new functions. The resulting copies are often referred to as recombinant DNA.

8. With reference to the applications of biotechnology in medicine, consider the following statements:

1. Human insulin produced using recombinant DNA techniques is a more reliable and efficient source of insulin compared to isolating it from animals.
2. Recombinant DNA technology does not allow for the customisation of therapeutic drugs.

Which of the statements given above are correct?

(*a*) 1 only (*b*) 2 only

(*c*) Both 1 and 2 (*d*) Neither 1 nor 2

Ans: (*a*)

Statement-1 is correct: Human insulin produced using recombinant DNA techniques is indeed a more reliable and efficient source of insulin compared to isolating it from animals, such as cattle and pigs. This is because recombinant DNA technology allows for the production

of human insulin in bacteria or other host organisms, ensuring a purer and safer source of insulin. Insulin derived from animal sources can vary in composition and may lead to allergic reactions or other complications in some patients.

Statement-2 is incorrect: Recombinant DNA (rDNA) technology does allow for the customization of therapeutic drugs. This technology enables scientists to modify the genes responsible for producing therapeutic proteins or drugs, leading to the customization of these drugs. This customization can include enhancing drug effectiveness, reducing side effects, or tailoring drugs to specific patient populations. Some of its uses are:

- **Production of Biopharmaceuticals:**

  rDNA technology allows for the production of monoclonal antibodies, growth hormones, insulin, and vaccines that are tailored to specific diseases or conditions.

  For example, human insulin is produced using recombinant bacteria or yeast, offering a purified and more reliable source of insulin compared to traditional animal-derived sources.

- **Targeted Drugs:**

  With rDNA technology, drugs can be customized to interact with specific biological targets (e.g., cancer cells or specific receptors in the body). For instance, targeted therapies like monoclonal antibodies are used to treat specific cancers by binding to cancer cells and triggering the immune system to attack them.

- **Gene Therapy:**

  rDNA technology is fundamental to gene therapy, where modified genes are introduced into a patient's cells to treat genetic disorders. This allows for highly personalized treatments, potentially curing or alleviating diseases that have a genetic basis, such as cystic fibrosis or hemophilia.

9. Consider the following statements with reference to Retroviruses:

1. These are the types of viruses that can integrate their genetic material into the DNA of the host cell.
2. In Genetic Engineering, these are used as vectors to deliver genes into animal cells.

Which of the statements given above are ***incorrect***?

(*a*) 1 only (*b*) 2 only

(*c*) Both 1 and 2 (*d*) Neither 1 nor 2

Ans: (*d*)

Statement-1 is correct: A retrovirus is a virus that uses RNA as its genomic material. Upon infection with a retrovirus, a cell converts the retroviral RNA into DNA, which in turn is inserted into the DNA of the host cell. The cell then produces more retroviruses, which infect other cells. Many retroviruses are associated with diseases, including AIDS and some forms of cancer.

Statement-2 is correct: Retroviruses have been adapted and used as vectors in genetic engineering to deliver desirable genes into animal cells. However, these retroviruses are typically disarmed or modified to prevent them from causing disease. In genetic engineering applications, retroviruses are disarmed, meaning their disease-causing properties are removed or inactivated, and they are then used to deliver specific genes into animal cells.

10. Consider the following statements:

1. The messenger RNA (mRNA) functions as the carrier of genetic information from DNA to protein synthesis.
2. RNA interference is a natural process of gene silencing involving the degradation of the targeted mRNA.
3. The mRNA is a promising therapeutic tool in the fields of vaccine development and protein replacement therapy.

How many of the statements given above are correct?

(*a*) Only one (*b*) Only two

(*c*) All three (*d*) None

Ans: (*c*)

Statement-1 is correct: Messenger RNA (mRNA), and its central-dogma function as the carrier of genetic information from DNA to protein synthesis, was discovered in 1961. RNA has been investigated as a novel drug class to treat multiple diseases since 1990, when it was first demonstrated that RNA vectors could cause expression of the encoded protein in mouse muscle.

Statement-2 is correct: RNA interference (RNAi) is a naturally occurring mechanism for gene silencing induced by the presence of short-interfering RNA (siRNA). RNAi is an endogenous catalytic pathway that is triggered by double-stranded RNA (dsRNA). The trigger can occur naturally, as in the case of a cellular infection by a dsRNA virus or by the intentional introduction of dsRNA to induce user-directed degradation of the cognate transcript(s). The silencing of a gene is a consequence of the degradation of RNA into short RNAs that activate ribonucleases to target homologous mRNA.

Statement-3 is correct: Over the past decade, major technological innovation and research investment have enabled mRNA to become a promising therapeutic tool in the fields of vaccine development and protein replacement therapy. mRNA vaccines have been successfully developed and deployed for COVID-19. For instance, GEMCOVACTM-19 is India's indigenously developed mRNA vaccine. The cells in our body read this recipe and produce the protein. In the context of protein replacement therapy, the mRNA would carry the recipe for a protein that a person's body is not producing adequately due to a genetic disorder, potentially allowing the body to produce its own therapeutic proteins.

11. Consider the following statements with respect to Biomarkers:

1. It indicates the normal or abnormal process taking place inside an organism.
2. Biomarkers can be used for disease prevention, detection and monitoring.

Which of the statements given above is/are correct?

(*a*) 1 only (*b*) 2 only
(*c*) Both 1 and 2 (*d*) Neither 1 nor 2

Ans: (*c*)

Statement-1 is correct: The term biomarker, or biological marker, refers to a broad range of measures which capture what is happening in a cell or organism at a given moment. Biomarkers are objective medical signs (as opposed to symptoms reported by the patient) used to measure the presence or progress of disease, or the effects of treatment.

Statement-2 is correct: Biomarkers have many useful applications in health care, including disease prevention and detection, determination of individual disease risk, and disease monitoring. They can also be used to measure the safety or toxicity of a therapeutic regimen or certain environmental exposures. For example :

- **Cancer Detection**: Prostate-specific antigen (PSA) is used as a biomarker to screen for prostate cancer.
- **Diabetes**: HbA1c (Glycated Hemoglobin) levels are used to diagnose and monitor diabetes.
- **Cardiovascular Disease:** Troponin is a biomarker used to diagnose heart attacks by indicating damage to heart muscle cells.

12. With reference to Genome sequencing, consider the following statements:

1. Whole Genome Shotgun is a method which requires the genome to have smaller sections copied and inserted into bacteria.
2. The Clone by Clone method of genome sequencing breaks DNA into small, random pieces for sequencing and reassembly.

Which of the statements given above is/are correct?

(*a*) 1 only (*b*) 2 only
(*c*) Both 1 and 2 (*d*) Neither 1 nor 2

Ans: (*d*)

Genome sequencing is the process of determining the complete DNA sequence of an organism's genome. The DNA consists of a double-stranded molecule built up of four bases- Adenine (A), Cytosine (C), Guanine (G) and Thymine (T). The process of deciphering the order of base pairs to decode the genetic fingerprint of a human is called genome sequencing.

Statement-1 is incorrect: Whole-Genome Shotgun is a method that breaks DNA into small random pieces for sequencing and reassembly. The pieces of DNA are also cloned into bacteria for growth, isolation, and subsequent sequencing.

Statement-2 is incorrect: Clone-by-Clone is a method that requires the genome to have smaller sections copied and inserted into bacteria. The bacteria can then be grown to produce identical copies, or "clones," containing approximately 150,000 base pairs of the genome that is desired to be sequenced.

How does whole Genome Sequencing Work?

Scientists conduct whole genome sequencing by following these four main steps:

- **DNA Shearing:** Scientists begin by using molecular scissors to cut the DNA, which is composed of millions of bases (A's, C's, T's and G's), into pieces that are small enough for the sequencing machine to read.
- **DNA Barcoding:** Scientists add small pieces of DNA tags, or bar codes, to identify which piece of sheared DNA belongs to which bacteria.
- **DNA Sequencing:** The bar-coded DNA from multiple bacteria is combined and put in a DNA sequencer. The sequencer identifies the A's, C's, T's, and G's, or bases, that make up each bacterial sequence. The sequencer uses the bar code to keep track of which bases belong to which bacteria.
- **Data Analysis:** Scientists use computer analysis tools to compare sequences from multiple bacteria and identify differences. The number of differences can tell the scientists how closely related the bacteria are, and how likely it is that they are part of the same outbreak.

13. Consider the following statements:

Genome sequencing can be used to

1. Diagnose hereditary disease.
2. To develop personalised medicine.
3. Develop synthetic biological systems and biomolecules.

How many of the statements given above are ***incorrect***?

(*a*) Only one (*b*) Only two
(*c*) All three (*d*) None

Ans: (*d*)

About Genome Sequencing:

- Genome sequencing is the process of determining the complete DNA sequence of an organism's genome.
- The DNA consists of a double-stranded molecule built up by four bases – Adenine (A), Cytosine (C), Guanine (G) and Thymine (T).
- The process of deciphering the order of base pairs, to decode the genetic fingerprint of a human is called genome sequencing

Applications of Genome Sequencing:

- **Medical research and Diagnosis**: Genome sequencing can be used for genetic testing and diagnosis of hereditary diseases. **(Hence, statement 1 is correct.)**

For Example: The study of SARS-CoV-2 whole genome sequencing (WGS) data has led to many important findings about this pathogen.

- **Drug Development:** Genome sequencing can be used to identify new drug targets, optimize drug efficacy, and develop personalized medicine. **(Hence, statement 2 is correct.)**
- **Agriculture**: Genome sequencing can help breed crops and livestock with desirable traits such as higher yield, disease resistance, and nutritional content.

  For Example: Bt Cotton
- **Forensics:** Genome sequencing can be used for forensic analysis, such as identifying victims of crimes and natural disasters.

  For Example: Forensic scientists can compare DNA found at a crime scene (from blood or hair, for example) to DNA samples taken from suspects.
- **Bioengineering**: Genome sequencing can aid in the design and development of synthetic biological systems and biomolecules for various applications. **(Hence, statement 3 is correct.)**
- **Provides an insight in evolution:** Scientists studying the genome sequences of early and modern humans have shown that our ancestors interbred with other hominins like Neanderthals and Denisovans.

14. 'Gene silencing' technology has gained popularity in the last few years because:

1. It helps in the treatment of neurodegenerative disorders.
2. It facilitates cell culture.
3. It has been found helpful in cancer treatments.

How many of the statements given above are correct?

(*a*) Only one (*b*) Only two
(*c*) All three (*d*) None

Ans: (*c*)

Gene silencing is the regulation of gene expression in a cell to prevent the expression of a certain gene. When genes are silenced, their expression is reduced. Ex: The researchers designed two small RNA molecules that silence the fungal genes which produce aflatoxin in Groundnut. When genes are knocked out, they are completely erased from the organism's genome and thus, have no expression.

Application:

- Specific gene silencing using RNA interference technology is useful in cell culture. **(Hence, statement 2 is correct.)**
- Cancer treatments **(Hence, statement 3 is correct.)**
- RNA interference has been used for applications in biotechnology.
- Useful in epigenomic analysis and clinical application of molecular diagnosis.
- Neuro-degenerative disorders treatment. **(Hence, statement 1 is correct.)**

15. Consider the following with respect to Human Genome Project:

1. Genetic make up of an organism or an individual lies in the DNA sequences.
2. Repeated sequences make up a very large portion of the human genome.
3. The Human Genome Project was initiated by the Ministry of Health and Family Welfare and the Ministry of Tribal Affairs to sequence the genome of the Indian population.

How many statements given above are correct?

(*a*) Only one (*b*) Only two
(*c*) All three (*d*) None

Ans: (*b*)

Statement-1 is correct: Genetic make-up of an organism or an individual lies in the DNA sequences. If two individuals differ, then their DNA sequences should also be different, at least at some places. These assumptions led to the quest of finding out the complete DNA sequence of human genome.

Statement-2 is correct: Repeated sequences make up very large portion of the human genome. Repetitive sequences are stretches of DNA sequences that are repeated many times, sometimes hundred to thousand times. They are thought to have no direct coding functions, but they shed light on chromosome structure, dynamics and evolution.

Statement-3 is incorrect: The Human Genome Project was a 13-year project coordinated by the U.S. Department of Energy and the National Institute of Health. The project was completed in 2003.

The Human Genome Project (HGP) enables understanding of the complete genetic blueprint of humans, facilitating advancements in personalized medicine, genetic disease research, and biotechnology applications.

The Department of Biotechnology (DBT) initiated the ambitious "Genome India Project" (GIP) in January 2020. It aims to do genetic analysis of the 10,000 individuals would be carried out. This would aid our understanding of the nature of diseases affecting the Indian population, and then ultimately support the development of predictive diagnostic markers.

16. With reference to compressed biogas, consider the following statements:

1. It is produced from aerobic decomposition of plants and animals by decomposers.
2. It has higher energy potential and calorific value than compressed natural gas.
3. Compressed biogas can also be produced from press mud or filter cake.

How many of the statements given above are correct?

(*a*) Only one (*b*) Only two
(*c*) All three (*d*) None

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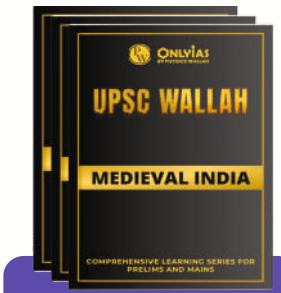

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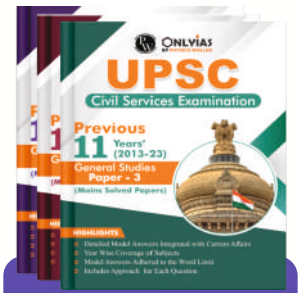

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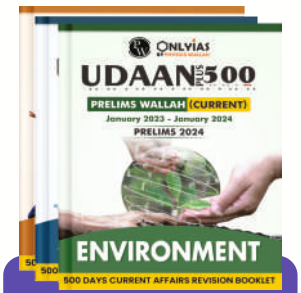

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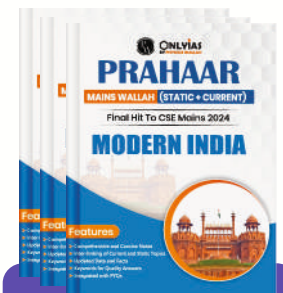

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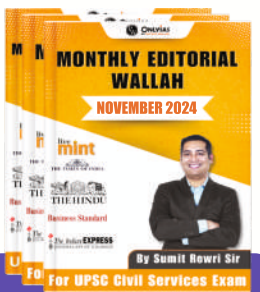

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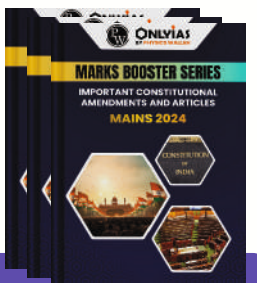

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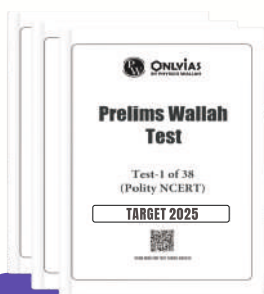

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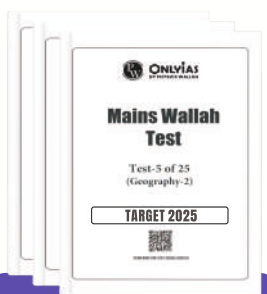

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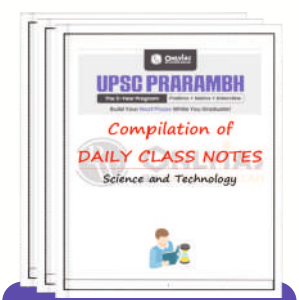

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