GATE 2026 EY Question Paper with Solutions

Time Allowed :3 Hour	**Maximum Marks :**100	**Total Questions :**65

General Instructions

Please read the following instructions carefully:

1. This question paper is divided into three sections:
   - **General Aptitude (GA):** 10 questions (5 questions $\times$ 1 mark + 5 questions $\times$ 2 marks) for a total of 15 marks.
   - **Environmental Science and Engineering + Engineering Mathematics:**
     - **Part A (Mandatory):** 36 questions (1 questions $\times$ 1 mark + 19 questions $\times$ 2 marks) for a total of 55 marks.
     - **Part B (Section 1):** Candidates can choose either Part B1 (Surveying and Mapping) or Part B2 (Section 2). Each part contains 16 questions (8 questions $\times$ 1 mark + 11 questions $\times$ 2 marks) for a total of 30 marks.
2. The total number of questions is **65**, carrying a maximum of **100 marks**.
3. The duration of the exam is **3 hours**.
4. Marking scheme:
   - For 1-mark MCQs, $\frac{1}{3}$ mark will be deducted for every incorrect response.
   - For 2-mark MCQs, $\frac{2}{3}$ mark will be deducted for every incorrect response.
   - No negative marking for numerical answer type (NAT) questions.
   - No marks will be awarded for unanswered questions.
5. Ensure you attempt questions only from the optional section (Part B1 or Part B2) you have selected.
6. Follow the instructions provided during the exam for submitting your answers.

1. One hypothesis for why the tropics have far greater species richness than higher latitudes is that the tropics are relatively aseasonal. Low seasonality can encourage high species richness through which one or more of the following mechanisms?

(A) Numerous resources are consistently available throughout the year, allowing different species to specialize on different resources, thereby minimizing competition and allowing co-existence.
(B) Low seasonality is associated with lower rates of predation, allowing large populations to thrive.
(C) Low seasonality is associated with more stable populations that are less vulnerable to demographic stochasticity and extinction.

(D) Low seasonality is associated with longer generation times, which enhances species richness.

Correct Answer: (A) and (C)

Solution:

Step 1: Understand the ecological hypothesis.
Tropical regions experience relatively low seasonal variation in temperature and resource availability. This environmental stability is hypothesized to promote higher species richness compared to highly seasonal temperate regions.

Step 2: Analyze option (A).
Low seasonality leads to consistent availability of resources throughout the year.
This allows species to specialize on different niches and resources, reducing direct competition and enabling long-term coexistence.
This mechanism is a well-accepted explanation for high tropical biodiversity.
Hence, (A) is correct.

Step 3: Analyze option (B).
There is no strong ecological evidence that low seasonality necessarily results in lower predation rates.
In fact, predation pressure in the tropics is often high.
Hence, (B) is incorrect.

Step 4: Analyze option (C).
Low seasonality promotes stable environmental conditions, leading to more stable population sizes.
Such populations are less affected by demographic stochasticity and have lower extinction risks.
This stability allows more species to persist over evolutionary timescales.
Hence, (C) is correct.

Step 5: Analyze option (D).
Low seasonality is not generally associated with longer generation times.
Moreover, longer generation times do not directly enhance species richness.
Hence, (D) is incorrect.

Step 6: Conclusion.
Low seasonality can enhance species richness by promoting resource specialization and population stability.
Therefore, the correct mechanisms are:

$$\boxed{(A) \text{ and } (C)}$$

Quick Tip

In ecology questions on tropical diversity, look for mechanisms related to **environmental stability, niche specialization, and reduced extinction risk**. These are key drivers of high species richness in the tropics.

---

2. You are a plant ecologist studying a plant in the genus *Veronica*. You notice that, at open rocky sites, *Veronica* grows as a creeper spreading low to the ground, whereas in grasslands, the stem stands upright. You collect seeds from multiple populations in each habitat type and grow them under uniform conditions in a greenhouse. You find that all the plants grown in the greenhouse have stems that stand upright. Which one or more of the following explanations best support(s) your observations?

(A) The different morphologies in the natural habitat types are due to phenotypic plasticity.
(B) Inbreeding depression has led to the creeping form in the rocky sites.
(C) High gene flow between populations has restricted local adaptation in the two environments.
(D) The morphological differences between populations demonstrates that growth form is a polygenic trait.

Correct Answer: (A)

Solution:

Step 1: Interpret the key observation.
Plants from both rocky sites and grasslands were grown under identical greenhouse conditions. Despite their different growth forms in nature, all plants developed upright stems in the greenhouse.

This indicates that the observed differences in the field are not genetically fixed.

Step 2: Analyze option (A).
Phenotypic plasticity refers to the ability of the same genotype to produce different phenotypes under different environmental conditions.
The change from creeping (rocky sites) to upright growth (greenhouse) strongly supports phenotypic plasticity.
Hence, (A) is correct.

Step 3: Analyze option (B).
Inbreeding depression typically results in reduced fitness, such as lower growth or reproduction.

There is no evidence here linking creeping growth form to inbreeding effects.
Hence, (B) is incorrect.

Step 4: Analyze option (C).
If high gene flow restricted local adaptation, populations would not show consistent habitat-specific morphologies in nature.
However, clear morphological differences are observed in the field.
Hence, (C) is not supported.

Step 5: Analyze option (D).
The experiment does not provide information about the genetic architecture (polygenic vs single-gene control) of growth form.
Environmental responsiveness alone cannot be used to infer polygenic inheritance.
Hence, (D) is incorrect.

Step 6: Conclusion.
The greenhouse experiment demonstrates that growth form in *Veronica* depends on environmental conditions rather than fixed genetic differences.
Therefore, the correct explanation is:

$$\boxed{(A)}$$

> Quick Tip
>
> If different phenotypes disappear when organisms are raised in a common environment, the variation is most likely due to **phenotypic plasticity**, not genetic differentiation.

---

3. In conservation biology, which one or more of the following is/are used to calculate the effective population size, N_e?

(A) The population size required to avoid local extinction in the next 1000 years.
(B) The carrying capacity of the environment.
(C) The sum of the sizes of all connected populations in a metapopulation.
(D) The number of breeding males and females.

Correct Answer: (D)

Solution:

Step 1: Understand effective population size (N_e).
Effective population size (N_e) is defined as the size of an idealized population that would experience the same amount of genetic drift or inbreeding as the actual population.
It is usually smaller than the census population size and depends on genetic and demographic factors.

Step 2: Analyze option (A).
The population size required to avoid extinction over a long time period refers to **minimum viable population (MVP)**.
MVP is a conservation planning concept and is not used to calculate N_e.
Hence, (A) is incorrect.

Step 3: Analyze option (B).
Carrying capacity (K) represents the maximum number of individuals an environment can sustain.
It is an ecological parameter and does not directly determine effective population size.
Hence, (B) is incorrect.

Step 4: Analyze option (C).
The sum of all connected populations represents total metapopulation size.
However, N_e depends on genetic contribution to the next generation, not simply on total numbers.
Hence, (C) is incorrect.

Step 5: Analyze option (D).
Effective population size is strongly influenced by the number of breeding males and females.
For unequal sex ratios:

$$N_e = \frac{4N_m N_f}{N_m + N_f}$$

where N_m and N_f are the numbers of breeding males and females.
Hence, (D) is correct.

Step 6: Conclusion.
The parameter used to calculate effective population size is:

$$\boxed{(D)}$$

Quick Tip

Effective population size (N_e) depends on genetic contributors to reproduction, especially **sex ratio, variance in reproductive success, and population size fluctuations**, not on carrying capacity or total census size.

4. Which one or more of the following is/are greenhouse gas(es)?

(A) Methane
(B) Water vapour
(C) Sulphur dioxide
(D) Nitrous oxide

Correct Answer: (A), (B) and (D)

Solution:

Step 1: Recall the definition of greenhouse gases.
Greenhouse gases are atmospheric gases that absorb and emit infrared radiation, thereby trapping heat in the Earth's atmosphere and contributing to the greenhouse effect.

Step 2: Analyze option (A) — Methane.
Methane (CH_4) is a major greenhouse gas with a high global warming potential.
It absorbs infrared radiation effectively and contributes significantly to climate change.
Hence, (A) is correct.

Step 3: Analyze option (B) — Water vapour.
Water vapour (H_2O) is the most abundant greenhouse gas in the atmosphere.
It plays a crucial role in regulating Earth's temperature through strong absorption of infrared radiation.
Hence, (B) is correct.

Step 4: Analyze option (C) — Sulphur dioxide.
Sulphur dioxide (SO_2) primarily contributes to aerosol formation and has a cooling effect by reflecting sunlight.
It is not considered a greenhouse gas.
Hence, (C) is incorrect.

Step 5: Analyze option (D) — Nitrous oxide.
Nitrous oxide (N_2O) is a potent greenhouse gas with a long atmospheric lifetime.
It absorbs infrared radiation and contributes to global warming.
Hence, (D) is correct.

Step 6: Conclusion.
The gases that act as greenhouse gases among the given options are:

$$\boxed{(A),\ (B) \text{ and } (D)}$$

Quick Tip

Common greenhouse gases to remember for GATE Ecology: **CO_2, CH_4, N_2O, and H_2O**. Gases like SO_2 mainly cause cooling via aerosols, not greenhouse warming.

---

5. Honey bees are haplodiploid, which means that the relatedness is, on average, expected to be 0.75 between

(A) brother-brother pairs with the same parents.
(B) brother-sister pairs with the same parents.
(C) mated female-male pair.
(D) sister-sister pairs with the same parents.

Correct Answer: (D) sister-sister pairs with the same parents

Solution:

Step 1: Understand haplodiploidy.
In haplodiploid organisms such as honey bees:
– Females (workers and queens) are **diploid**, developing from fertilized eggs.
– Males (drones) are **haploid**, developing from unfertilized eggs.

Thus, males carry only one set of chromosomes, all inherited from their mother.

Step 2: Calculate sister–sister relatedness.
Two sisters inherit:
– Half of their genes from the mother (with a probability of 0.5 of sharing maternal alleles).
– All of their genes from the father, because the father is haploid and passes the same genome to all daughters.

Therefore, relatedness between sisters is:

$$r = \frac{1}{2} \times 0.5 + \frac{1}{2} \times 1 = 0.25 + 0.5 = 0.75$$

Step 3: Analyze other options.

(A) Brother–brother pairs:
Brothers are haploid and develop from unfertilized eggs; they do not share a father.
Relatedness is lower than 0.75.

(B) Brother–sister pairs:
A sister shares only maternal genes with her brother.

Relatedness is 0.25, not 0.75.

(C) Mated female–male pair:
Mates are not genetically related.
Relatedness is approximately zero.

Step 4: Conclusion.
In haplodiploid systems like honey bees, the unusually high relatedness of 0.75 occurs between:

$$\boxed{\text{sister–sister pairs with the same parents}}$$

Quick Tip

Key concept for GATE Ecology: In haplodiploidy, **sisters are more closely related to each other than to their own offspring**, which helps explain the evolution of eusocial behavior in insects like bees and ants.

---

6. Observations of algal species showed that their diversity was higher in pools where there were grazing snails compared to pools without snails. Which one of the following statements best explains this result?

(A) Snails feed preferentially on the more abundant algal species.
(B) Snails avoid feeding on algal species.
(C) Snails feed only on the less abundant algal species.
(D) Snails feed equally on all the algal species irrespective of algal abundance.

Correct Answer: (A)

Solution:

Step 1: Identify the ecological pattern.
Algal diversity is higher in pools with grazing snails than in pools without snails.
This suggests that grazing is playing a role in maintaining or enhancing species diversity.

Step 2: Recall the concept of top-down control.
Grazers can act as top-down regulators by reducing the dominance of competitively superior species.
When dominant species are suppressed, less competitive species can persist, increasing overall diversity.

Step 3: Analyze option (A).
If snails feed preferentially on the more abundant (dominant) algal species, they prevent competitive exclusion and allow rarer species to coexist. This mechanism is well-known to increase species diversity.
Hence, (A) is correct.

Step 4: Analyze other options.

(B) Snails avoiding algae contradicts the premise of grazing effects. Incorrect.

(C) Feeding only on rare species would further reduce diversity. Incorrect.

(D) Equal feeding on all species would not specifically reduce dominance and is less effective at maintaining high diversity. Incorrect.

Step 5: Conclusion.
Higher algal diversity in the presence of snails is best explained by selective grazing on dominant species:

$$\boxed{(A)}$$

Quick Tip

In ecology, grazers and predators often **increase diversity** by suppressing dominant competitors. Look for options that describe **preferential removal of abundant species**.

---

7. An ornamental shrub species was brought from Japan in the early 1800s to India, where it was planted frequently in gardens and parks. The species persisted for many decades without spreading, and then began to spread invasively fifty years ago. Which one or more of the following processes could have led to it becoming invasive?

(A) Evolutionary adaptation to the environment
(B) Open niches due to recent habitat degradation
(C) Climate change
(D) Recent introduction of a specialized herbivore of this shrub species

Correct Answer: (A), (B) and (C)

Solution:

Step 1: Recognize the invasion lag phase.
Many invasive species show a long **lag phase**, during which they persist at low abundance before rapidly expanding.
Such delayed invasions are common and can be triggered by ecological or evolutionary changes.

Step 2: Analyze option (A).
Over time, introduced species may undergo **evolutionary adaptation** to local conditions, improving growth, reproduction, or dispersal.
This can convert a benign introduced species into an invasive one.
Hence, (A) is correct.

Step 3: Analyze option (B).
Habitat degradation can reduce native competitors and create **open ecological niches**.
Such disturbances often facilitate biological invasions.
Hence, (B) is correct.

Step 4: Analyze option (C).
Climate change can alter temperature and precipitation regimes, making environments more suitable for previously constrained species.
This can trigger rapid population expansion of introduced species.
Hence, (C) is correct.

Step 5: Analyze option (D).
The introduction of a **specialized herbivore** would increase biotic resistance and suppress shrub populations.
This would reduce, not promote, invasiveness.
Hence, (D) is incorrect.

Step 6: Conclusion.
Delayed invasions can be driven by evolutionary change, habitat disturbance, and climate change.
Therefore, the processes that could have led to invasiveness are:

$$\boxed{(A),\ (B) \text{ and } (C)}$$

Quick Tip

In invasion ecology, always consider **lag effects**. Introduced species may become invasive long after introduction due to **adaptation, disturbance, or environmental change**.

8. During the process of succession in a community, species that are good colonisers are gradually replaced by species that are good competitors. Which one or more of the following statements is/are consistent with this pattern?

(A) Initially, there is great resource limitation.
(B) Keystone species must establish first to facilitate the later establishment of higher trophic level species.
(C) Trees are the climax stage of terrestrial communities and generally have low competitive ability, but high dispersal ability.
(D) For many taxa, there is a tradeoff between dispersal ability and local competitive ability.

Correct Answer: (D)

Solution:

Step 1: Understand the successional pattern.
Ecological succession often begins with early colonisers that are excellent at dispersal and rapid establishment.
Over time, these species are replaced by late-successional species that are superior competitors for local resources.

Step 2: Analyze option (A).
In the early stages of succession, resources such as space, light, and nutrients are usually abundant, not limiting.
Resource limitation typically increases later as biomass accumulates.
Hence, (A) is incorrect.

Step 3: Analyze option (B).
This statement relates to keystone species and trophic facilitation, not directly to the coloniser–competitor replacement pattern.
Hence, (B) is incorrect.

Step 4: Analyze option (C).
Trees, which often dominate climax terrestrial communities, generally have **high competitive ability** but relatively **low dispersal ability**.
The statement reverses these traits.
Hence, (C) is incorrect.

Step 5: Analyze option (D).
A well-established ecological principle is the **tradeoff between dispersal ability and competitive ability**.

Good colonisers disperse widely but are weak competitors, while late-successional species disperse poorly but compete effectively.
This tradeoff directly explains the observed successional pattern.
Hence, (D) is correct.

Step 6: Conclusion.
The replacement of good colonisers by good competitors during succession is best explained by:

$$\boxed{(D)}$$

Quick Tip

In succession-related GATE questions, always look for **life-history tradeoffs**, especially between **dispersal** and **competitive ability**. These tradeoffs drive predictable changes in community composition over time.
