

SAMPLE QUESTIONS FOR GATE ECOLOGY AND EVOLUTION (EY) PAPER

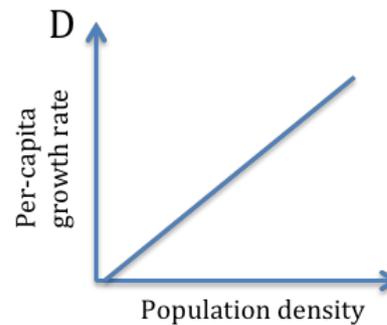
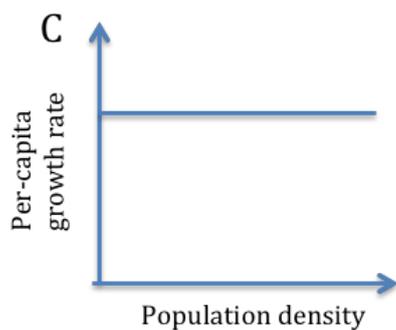
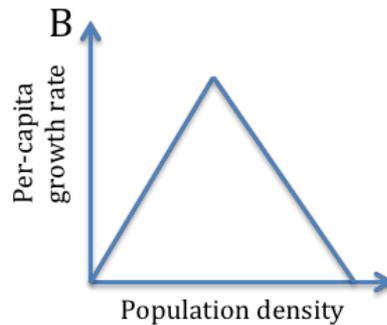
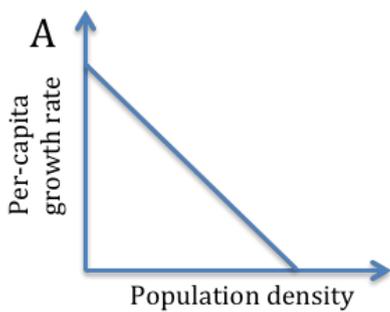
1. There are two isolated populations of different size. The frequency of alleles M1 and M2 in population 1 (N=2000) is 0.23 and 0.77, whereas the frequency of alleles M1 and M2 in population 2 (N=200) is 0.76 and 0.24. Which of the following is true:
 - (A) probability of fixation of M1 allele is greater than M2 allele in population 1.
 - (B) probability of fixation of M2 allele is greater than M1 allele in population 2.
 - (C) probability of fixation of M1 allele in population 1 is greater than M2 allele in population 2.
 - (D) probability of fixation of M2 allele in population 2 is greater than M1 allele in population 1.

2. Consider a population which is changing from one generation to the next as per the equation $N(t) = R \cdot N(t-1)$, where $N(t)$ represents the size of the population at time t and R is a constant growth parameter. Under what condition is the population likely to go extinct?
 - (A) $R=2$
 - (B) $R<1$
 - (C) $R=1$
 - (D) $R>1$

3. India and Pakistan play a one-day cricket series with 7 games. The match referee uses the same unbiased coin for the toss at each of the seven games. What is the probability that the same team wins the toss in all seven games?
 - (A) $1/2^6$
 - (B) $1/2^7$
 - (C) $1/2^8$
 - (D) This is impossible with a fair coin.

4. Which of the following primates is most closely related to humans?
 - (A) Lemur
 - (B) Macaque
 - (C) Loris
 - (D) Spider monkey

5. Most sharks need to swim continuously, because
- (A) they lack swim bladders and would sink if they did not move
 - (B) they have high metabolic rates and need to feed constantly
 - (C) they lack lateral lines and would get disoriented
 - (D) they are adapted to search for prey constantly
6. All organisms are either
- (A) autotrophs or heterotrophs
 - (B) photosynthetic or chemosynthetic
 - (C) photosynthetic or autotrophic
 - (D) herbivores or carnivores
7. Parental care is least common in which of the following groups:
- (A) Frogs
 - (B) Crocodiles
 - (C) Snakes
 - (D) Turtles
8. Which of the following does not represent density dependent population dynamics:



9. The number of species increases as a nonlinear function of forest patch size. Which of the following is not a signature of nonlinearity?
- (A) Each time the patch-size of a forest doubles, the number of species quadruples.
 - (B) Each time the patch-size of a forest doubles, the number of species doubles.
 - (C) Rate of change of number of species with patch-size is not a constant.
 - (D) Each time the patch-size of a forest doubles, the number of species decreases by a factor of four.
10. If the population density (n) of a species at time (t) is governed by the equation, $n(t) = 8 e^{-t/2}$, the population will decline by a factor of $1/e$ in
- (A) 1 time unit
 - (B) 2 time units
 - (C) 4 time units
 - (D) 8 time units.
11. Mean value of a trait in the population will increase when
- (A) trait values and fitness are not correlated
 - (B) trait values and fitness are negatively correlated
 - (C) trait values and fitness are positively correlated
 - (D) trait values and fitness are both random.

12. Consider the following areas, with multiple sites within each area. The presence or absence of each species in a given site is denoted by 1 or 0. Which of the following statements is false?

Species	Area X			Area Y		
	Site 1	Site 2	Site 3	Site 1	Site 2	Site 3
<i>i</i>	0	1	0	1	1	0
<i>j</i>	0	0	1	0	0	0
<i>k</i>	0	1	0	1	1	1
<i>l</i>	0	0	1	1	1	1
<i>m</i>	1	0	0	1	1	1
<i>n</i>	1	1	0	1	1	1
<i>o</i>	1	0	1	0	1	1
<i>p</i>	0	1	0	0	0	0

- (A) Area X has higher overall species richness because of greater turnover
- (B) Area X has lower average species richness per site than Area Y because of greater turnover
- (C) Area X has higher overall species richness because of greater Beta diversity
- (D) Area X has lower average species richness than Area Y because of lower turnover
13. Which of the following would cause a decrease in body temperature in a mammal?
- (A) an increase in metabolic rate
- (B) shifting circulation from periphery to core
- (C) evaporation of water from skin
- (D) basking next to standing water
14. A population shows three distinct mating strategies at an evolutionary equilibrium, i.e., relative frequencies of these strategies do not change with time. If the frequency of occurrence of these three strategies is in the ratio 1:2:3, the ratio of their average fitness is:
- (A) 1:2:3
- (B) 1 : 1 : 1
- (C) 1:3:6
- (D) 1 : 0.5 : 0.33

15. The derivative of a function $f(x)$ at a location x_0 is

- (A) The value of function $f(x)$ at x_0
- (B) The inverse of the value of function $f(x)$ at x_0
- (C) The slope of the tangent of the function at x_0
- (D) The inverse of the slope of the tangent of the function at x_0

16. Under normal conditions, females of a moth species attract over 90% of males in the vicinity. The mate attraction pheromone of a female moth was chemically analysed and found to contain two components, X and Y in the ratio of 4:1. The attractiveness of the two purified components was tested in bioassays in the laboratory using male moths. The following results were obtained:

Pheromone component/s	Percent of male moths reaching pheromone odour source
X alone	50%
Y alone	15%
X and Y (4:1)	95%
Pure air (No X or Y present)	15%

Which of the following statements is true?

- (A) Pheromone component X is sufficient for normal levels of mate attraction.
- (B) Pheromone component X is necessary but not sufficient for normal levels of mate attraction.
- (C) Pheromone component Y is both necessary and sufficient for normal levels of mate attraction.
- (D) Pheromone component X is both necessary and sufficient for normal levels of mate attraction.

17. In a frog chorus, the probability of an individual calling frog being eaten by a bat predator increases with the number of calling frogs (larger choruses). This is probably because

- (A) Larger choruses increase the probability of a calling individual being located by a predator.
- (B) Larger choruses increase the probability of attracting bat predators.
- (C) Larger choruses increase the detectability of individuals within them.
- (D) Larger choruses decrease the detectability of individuals within them.

18. Rats could be successfully trained to avoid a novel odour that was paired with presentation of a food item that made them vomit soon after consumption. They could not however be trained to avoid a sound stimulus paired in the same manner with the food item, even after multiple presentations. Which of the following statements is not a possible interpretation of these results?
- (A) Rats are phylogenetically constrained in the kinds of stimuli they can use to form associations.
 - (B) The sound stimulus used may have been outside the perceptual range of the rat's auditory system.
 - (C) Food and odours tend to co-occur in a rat's natural environment whereas food and sounds do not.
 - (D) Odours induce learning in animals far more effectively than sounds do.
19. Which of the following characterizes a k-selected species?
- (A) long life expectancy
 - (B) little parental care
 - (C) many offspring per reproductive bout
 - (D) early maturity
20. A Poisson distribution is often used in ecology to describe discrete data, such as counts of animals. In the Poisson distribution the variance equals the mean. For this distribution, the coefficient of variation
- (A) increases as the mean increases
 - (B) decreases as the mean increases
 - (C) is unrelated to the mean
 - (D) increases with the mean as long as the mean is less than 10.
21. Assume that Species X is a weed that was introduced into India from South America about 200 years ago. In a molecular genetic study, the diversity at a single neutral locus was determined from 100 individuals collected from across India and 100 from across South America. What of the following is likely to be true?
- (A) Allelic diversity at this locus will be higher in the South American population than the Indian population, but heterozygosity will be higher for the Indian population.
 - (B) Allelic diversity at this locus will be lower in the South American population than the Indian population, and heterozygosity will be about the same for both.

- (C) Allelic diversity at this locus will be higher in the Indian population than the South American population, but heterozygosity will be higher for the South American population.
- (D) Both allelic diversity and heterozygosity will be higher in the South American population.

22. Individual ants were trained to forage from a food source 20 m from their nest. In test trials, these ants, after walking the outbound distance to the food source, were then displaced 100 m to one side in an odourless terrain without visual landmarks. They walked 20 m in a random direction and then started searching for the nest entrance. This experiment indicates that

- (A) Ants require visual landmarks to estimate distance correctly.
- (B) Ants do not require directional information to estimate distance correctly.
- (C) Ants require directional information to estimate distance correctly.
- (D) Ants require odours to estimate direction correctly.

23. Dinosaurs were the most dominant terrestrial vertebrate for 135 million years. According to the fossil record, dinosaurs first appeared during the _____ period and were extinct by the end of the _____ period.

- (A) Triassic, Cretaceous
- (B) Jurassic, Cretaceous
- (C) Jurassic, Holocene
- (D) Cretaceous, Tertiary

24. A bat species preys exclusively on two moth species E and F. The bat chases every moth it encounters in flight and encounters are random. If chased, a moth of species E has a 20% chance of being eaten whereas a moth of species F has an 80% chance of being eaten. The relative abundance of the two moth species is 4:1 (E:F) and both have similar levels of flight activity. The proportion of the two moth species (E:F) in the diet of the bat will be

- (A) 4:1
- (B) 1:4
- (C) 1:1
- (D) 1:16

25. To investigate whether hunting reduces recruitment in a deer population, I studied a hunted forest (H+) and a forest without any hunting (H-). I laid 20 transects in H+ and 15 in H- and estimated the density of juvenile deer in both forests. I estimated a mean density of 3 juveniles per sq km (95% confidence interval = 0.2 – 5 juveniles per sq km) at H+ and a mean density of 20 juveniles per sq km (95% confidence interval = 14 – 28 juveniles per sq km) at H-. Based on these data, which of the following *statistical* inferences is most appropriate?

- (A) Mean density of juvenile deer at H+ is significantly lower than that at H-
- (B) In general, forests with hunting have lower mean density of juvenile deer than those with no hunting
- (C) Mean density of juvenile deer at H+ is significantly lower than that at H-; and, in general, forests with hunting have lower mean density of juvenile deer than those with no hunting
- (D) no statistical inferences can be made since sample sizes are not equal.

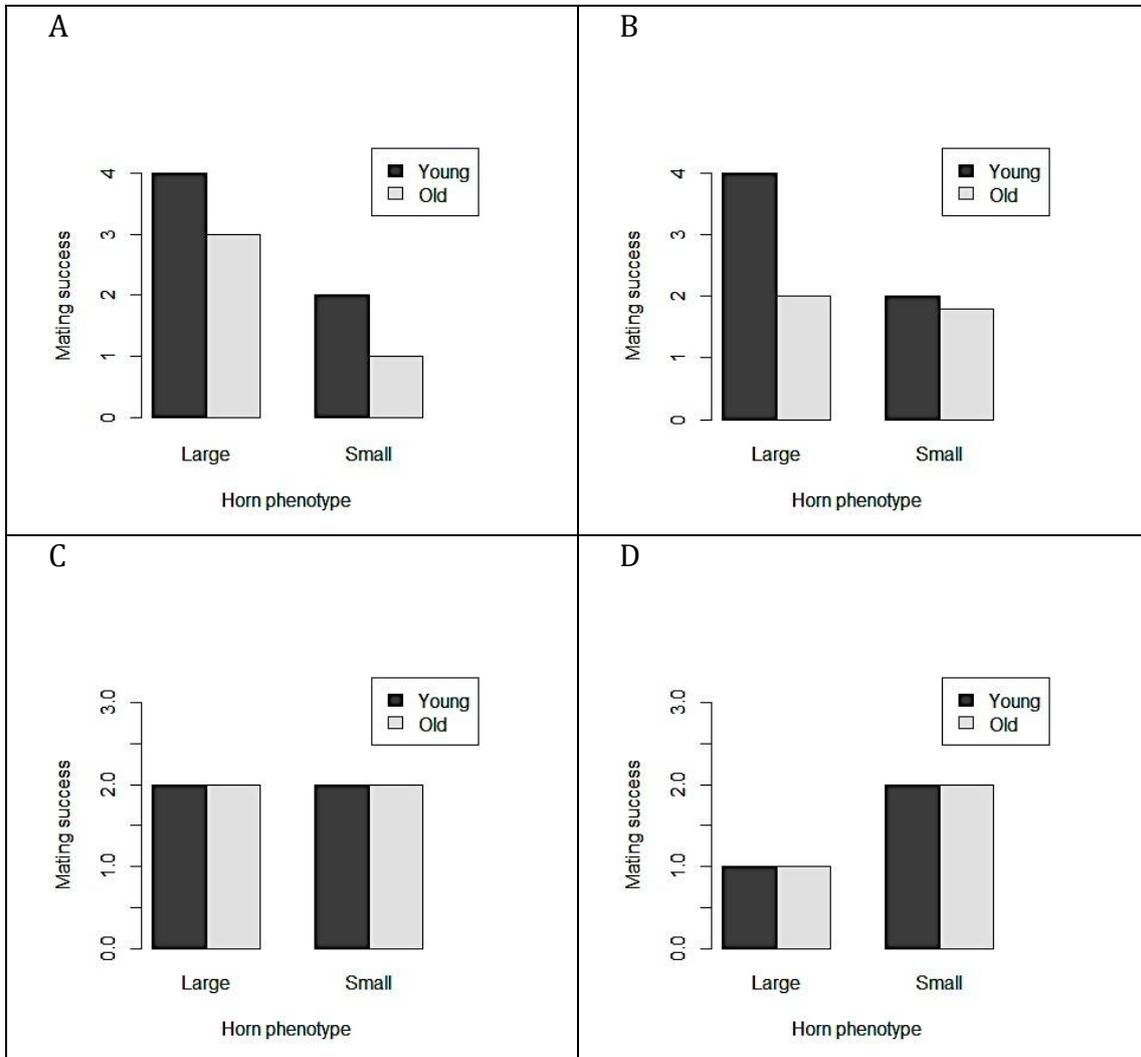
26. Which of the following is an exotic plant in India

- (A) *Shorea robusta*
- (B) *Mangifera indica*
- (C) *Casuarina equisetifolia*
- (D) *Rauwolfia serpentina*

27. Metapopulation structure is thought to reduce the risk of extinction of a species in the larger landscape. Which of the configurations of populations described below has the lowest risk of extinction?

- (A) Populations that show high connectivity and synchronised dynamics
- (B) Populations that are very isolated from each other
- (C) Populations that are very close to each other
- (D) Populations that show some connectivity and asynchronised dynamics

28. Soay sheep males show large variation in their ability to attract mates. Researchers suspect that horn size (Large-horned or Small-horned) and age (Young or Old) affect the ability of a male to attract females. Mating success of males was found to be related to both horn size and age, and the statistical analysis indicated evidence of an *interaction* between horn size and age. Which of the following graphs represents evidence for such an interaction between horn size and age?



29. In a study of tree dispersion in a forest, we divided the forest into 1 sq km grid cells, choose 50 of them at random, and counted the number of trees in each cell. The variance to mean ratio of the counts of trees per cell was much less than 1. What does this tell us about the spatial distribution of the trees? That they are:

- (A) randomly dispersed
- (B) highly aggregated
- (C) uniformly dispersed
- (D) more information is needed

30. Which of the following is not a function of melatonin

- (A) influencing circadian rhythms
- (B) protection against sunlight
- (C) antioxidant
- (D) regulation of breeding seasons

31. We study an optimally foraging bird in a habitat where its food is found in patches. Our study reveals that this bird forages within a patch as long as the yield per unit effort in the patch is greater than the average yield per unit effort in the habitat, and leaves for the next patch when this yield per unit effort falls below the average. Which of the following inferences about the system can be made from these results?

- (A) Food items are super abundant within a patch.
- (B) Patches are equal in size
- (C) The cost of moving between patches is negligible
- (D) The habitat is resource poor

32. Which of the following is characteristic of long-lived mammals compared to short-lived mammals?

- (A) lack of disease
- (B) high reproductive rate
- (C) large body size
- (D) fast metabolism

33. Which of the following plants with particular traits is most vulnerable to extinction in a fragmented forest landscape?

- (A) self-pollinated and wind-dispersed
- (B) cross-pollinated and animal-dispersed
- (C) self-pollinated and animal-dispersed
- (D) cross-pollinated and wind-dispersed

34. I sampled ants in a forest with three different vegetation types – dry deciduous forest, moist deciduous forest and evergreen forest. In order to capture as much species richness as possible, I laid 10 plots in each vegetation type, following no particular procedure for determining where each plot was laid within the vegetation type. The sampling procedure can best be described as:

- (A) Random sampling
- (B) Uniform sampling
- (C) Stratified random sampling
- (D) Stratified sampling

35. In pea plants, yellow seeds are dominant to green. If a heterozygous yellow seeded plant is crossed with a green seeded plant, what ratio of yellow and green seeded plants would you expect in the F1 generation?

- (A) 3 : 1
- (B) 50 : 50
- (C) 9 : 1
- (D) 1 : 3

36. In cladistics, monophyletic groups are those that contain all the possible descendants of a hypothetical common ancestor. In the classification of higher vertebrates, an example of a paraphyletic group is:

- (A) Reptiles, since it does not include frogs.
- (B) Herpetofauna, since it does not include birds.
- (C) Reptiles, since it does not include birds.
- (D) Mammals, since it does not include birds.

37. The evolutionary process most likely to account for the fixation of a neutral allele in small populations is:

- (A) selection
- (B) mutation
- (C) genetic drift
- (D) recombination

38. Scientists have predicted on the basis of modeling future climate change at the global scale that:
- (A) precipitation would decline globally.
 - (B) Antarctic ice would be first to melt as a result of global warming.
 - (C) Himalayan glaciers would disappear by the year 2035.
 - (D) variability in weather events would increase.
39. Atmospheric levels of carbon dioxide have been steadily increasing in recent decades as a result of fossil fuel and biomass burning. Botanists studying changes in leaf stomata have observed that:
- (A) stomatal density has been increasing over time.
 - (B) stomatal density has been decreasing over time.
 - (C) stomatal size has been increasing over time.
 - (D) stomatal size has been decreasing over time.
40. You wish to evaluate the effects of fire and grazing on grassland productivity. To do this, you set up 12 plots representing 3 replicates each of 4 treatments (ungrazed and no fire, ungrazed plus fire, grazed plus fire, grazed but no fire) and measure the biomass in each plot. An appropriate statistical test to evaluate the effects of fire and grazing on biomass would be:
- (A) a cluster analysis.
 - (B) a discriminant function analysis.
 - (C) multidimensional scaling.
 - (D) an analysis of variance.
41. Three species of lizards live in a largely rocky area with a few shrubs and some bare ground. Species A is distributed equally across all habitats, Species B is found largely on bushes, and Species C is found largely on rocks. Given the information, which of the following statements is most likely to be true?
- (A) Species A shows no preference for any of habitats.
 - (B) Species B shows a preference for bushes.
 - (C) Species C shows a preference for rocks.
 - (D) None of the lizards show a preference for bare ground.

42. A mountain chain is formed in the middle of the range of a widely distributed species, splitting it into two populations. Eventually these two populations diverge into two distinct species due to a lack of gene flow between them. This is an example of:

- (A) parapatric speciation
- (B) sympatric speciation
- (C) allopatric speciation
- (D) peripatric speciation

43. The peak of the last ice age, also known as the Last Glacial Maximum, occurred approximately how many years ago?

- (A) 800 years ago
- (B) 8000 years ago
- (C) 18000 years ago
- (D) 28000 years ago

44. Seed dispersal is likely to strongly promote recruitment in forest tree species for which seed survival _____ with distance from the parent tree and _____ with conspecific seed density.

- (A) is uniformly high; decreases
- (B) decreases; increases
- (C) increases; decreases
- (D) increases; is uniformly low

45. In a diploid organism, a locus has only two alleles A1 and A2. The heterozygosity at this locus can attain a maximum value of:

- (A) 1.00
- (B) 0.75
- (C) 0.50
- (D) 0.25

46. To call a behaviour altruistic, an evolutionary biologist will have to demonstrate that

- (A) the behaviour increases the individual fitness of the donor and decreases the individual fitness of the recipient
- (B) the donor does not bear any cost when performing the behaviour and the recipient's individual fitness increases
- (C) the behaviour increases the individual fitness of both the donor and the recipient
- (D) the behaviour decreases the individual fitness of the donor and increases the individual fitness of the recipient.