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Speciation & Reproductive Isolation

Exam — Speciation

High school / IB / pre-med level questions covering allopatric, sympatric, parapatric and peripatric speciation; gene flow, drift, selection, mutation; prezygotic vs postzygotic isolation; hybrid zones, reinforcement, ring species, and common concept traps about what counts as a species.

72 items — Printable Exam

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1 Which statement best captures what must happen for speciation to be considered complete (using the biological species concept)?

- A** Individuals develop different-looking body shapes
- B** Two populations show any allele frequency differences
- C** Gene flow between populations is effectively prevented by reproductive isolation
- D** Populations become geographically separated for at least 1 million years
- E** A mutation occurs in one population



2 Two populations of the same bird species become separated by a new mountain range. Over time they diverge genetically. This is most directly an example of:

- A** Sympatric speciation
- B** Allopatric speciation
- C** Parapatric speciation
- D** Artificial selection
- E** Horizontal gene transfer



3 Which scenario best fits sympatric speciation?

- A** A river splits one population into two isolated groups
- B** A storm carries a few individuals to a distant island
- C** A plant population produces a polyploid lineage that can reproduce with itself but not with the original diploids
- D** Two populations separated by a glacier diverge
- E** Two populations meet and merge back into one gene pool





4 Two populations live in adjacent habitats along a long coastline. Individuals mostly mate with nearby neighbors, and a stable hybrid zone exists where the habitats meet. This pattern best describes:



- A** Allopatric speciation
- B** Parapatric speciation
- C** Sympatric speciation
- D** Clonal reproduction
- E** Artificial speciation by selective breeding

5 A small group colonizes a new island and becomes isolated from the original mainland population. If speciation occurs, this is most often classified as:



- A** Sympatric speciation
- B** Peripatric speciation (a form of allopatric with a small founder population)
- C** Parapatric speciation
- D** Hybrid speciation without isolation
- E** No speciation because islands prevent evolution

6 Which statement best describes gene flow's effect on speciation?



- A** Gene flow always speeds up speciation by creating new mutations
- B** Gene flow tends to reduce divergence between populations, often opposing speciation
- C** Gene flow is the same thing as genetic drift
- D** Gene flow only happens in asexual species





- E Gene flow prevents natural selection from acting

7 Which is a prezygotic reproductive isolating mechanism?



- A Hybrid sterility (e.g., mule)
- B Hybrid breakdown in F2 generation
- C Different mating seasons (temporal isolation)
- D Embryo dies early after fertilization
- E Hybrid has reduced survival after birth

8 Which is a postzygotic reproductive isolating mechanism?



- A Different courtship rituals
- B Different habitats within the same area
- C Incompatible reproductive structures preventing mating
- D Gametes cannot fuse (gametic isolation)
- E Hybrids are viable but sterile

9 Two closely related frog species live in the same pond. One breeds in early spring; the other breeds in midsummer. This is best described as:



- A Mechanical isolation
- B Temporal isolation





- C Gametic isolation
- D Hybrid breakdown
- E Bottleneck effect

10 Two insect species court using different pheromones. Individuals rarely attempt to mate across species because they do not recognize each other as mates. This is:



- A Behavioral isolation (prezygotic)
- B Hybrid inviability (postzygotic)
- C Polyploidy (sympatric)
- D Bottleneck effect (drift)
- E Gene flow (migration)

11 Two snail species have opposite shell-coiling directions, making mating physically difficult. Which barrier is this?



- A Mechanical isolation
- B Gametic isolation
- C Hybrid breakdown
- D Temporal isolation
- E Adaptive radiation





12 Two sea urchin species release gametes into the water at the same time and place, but fertilization between species almost never occurs because sperm cannot bind to the egg surface proteins. This is:

- A Habitat isolation
- B Gametic isolation
- C Hybrid sterility
- D Temporal isolation
- E Founder effect



13 Which situation best illustrates habitat isolation (a prezygotic barrier)?

- A Hybrids die before reaching adulthood
- B Two populations live in the same region but breed in different microhabitats (e.g., one in shallow water, one in deep water)
- C Hybrids are sterile
- D A hurricane reduces population size drastically
- E Chromosome number doubles in a plant



14 Two bird populations look different and sing different songs. However, when brought together in captivity, they mate readily and produce fertile offspring. Under the biological species concept, they are best considered:

- A Definitely different species because they look different
- B Different species because they sing different songs
- C The same species because they can interbreed and produce fertile offspring
- D Different species because captivity always creates new species





- E Impossible to classify without counting chromosomes

15 Which statement best distinguishes genetic drift from natural selection?



- A Genetic drift is nonrandom and always adaptive
- B Natural selection is random changes in allele frequencies
- C Genetic drift is random change in allele frequencies; natural selection is nonrandom change based on fitness differences
- D Natural selection occurs only in small populations; drift only in large populations
- E Drift requires mutation; selection does not

16 A sudden disaster reduces a population from 10,000 to 200 individuals. The surviving allele frequencies differ from the original purely by chance. This is best described as:



- A Founder effect
- B Bottleneck effect (genetic drift)
- C Reinforcement
- D Assortative mating
- E Gene flow

17 Which statement about the founder effect is most accurate?



- A It is a type of natural selection that always improves adaptation





- B It is genetic drift when a small group starts a new population, potentially with unrepresentative allele frequencies
- C It is gene flow between populations
- D It occurs only in plants due to polyploidy
- E It prevents evolution from occurring

18 A key reason drift can accelerate divergence (and potentially speciation) in small isolated populations is that small populations:



- A Have more directed mutations
- B Experience stronger sampling error, so allele frequencies can change rapidly by chance
- C Always have higher fitness than large populations
- D Cannot experience natural selection
- E Have no gene flow by definition, even when they migrate

19 Mutation is best described as:



- A A directed change that happens because an organism needs it
- B A random change in DNA sequence that can introduce new alleles
- C The process of sorting chromosomes during meiosis
- D Always harmful and always removed immediately
- E The same as genetic drift





20 Which statement about natural selection and speciation is most accurate?



- A Natural selection always creates new species quickly
- B Natural selection can contribute to divergence, but reproductive isolation is needed for speciation
- C Natural selection cannot act unless populations are geographically separated
- D Natural selection is random, so it cannot cause consistent divergence
- E Natural selection prevents any hybrid zones from forming

21 Two populations diverge in isolation. When they come into secondary contact, hybrids have low fitness. Over time, individuals that avoid cross-mating leave more offspring. This process is called:



- A Reinforcement
- B Bottleneck effect
- C Founder effect
- D Gene flow
- E Convergent evolution

22 Which outcome is most consistent with reinforcement after secondary contact?



- A Prezygotic barriers become stronger (more mate discrimination)
- B Hybrids become more fertile immediately
- C The populations become genetically identical
- D Mutation rates drop to zero
- E The environment becomes uniform





23 A hybrid zone is best described as:

- A** A region where a species reproduces asexually
- B** A region where two diverging populations meet and produce hybrids
- C** A place where mutation cannot occur
- D** A zone of complete geographic isolation
- E** A region where natural selection stops



24 Two populations are separated by a barrier for 500 years, then the barrier disappears. They interbreed freely with no reduction in fitness of offspring. The most accurate conclusion is:

- A** Speciation has occurred because there was geographic separation
- B** Speciation has not occurred under the biological species concept because reproductive isolation is absent
- C** Speciation must have occurred but then reversed by mutation
- D** They are different species if they look different
- E** Speciation is impossible in 500 years



25 Which is the best example of a postzygotic barrier rather than a prezygotic barrier?

- A** Different courtship songs
- B** Different mating seasons
- C** Sperm cannot fertilize egg





- D Hybrid embryos fail to develop properly
- E Different habitats reduce encounters

26 A classic 'mule' scenario (horse × donkey) best illustrates which postzygotic barrier?



- A Hybrid inviability
- B Hybrid sterility (reduced hybrid fertility)
- C Habitat isolation
- D Gametic isolation
- E Temporal isolation

27 Hybrids between two plant species are healthy and fertile, but when hybrids mate with each other, the F₂ generation has low survival. This is best called:



- A Hybrid breakdown
- B Gametic isolation
- C Mechanical isolation
- D Bottleneck effect
- E Directional selection

28 Which statement about polyploidy is most accurate for speciation?



- A Polyploidy is common in animals and rarely affects plants





- B Polyploidy can cause immediate reproductive isolation in plants
- C Polyploidy always prevents reproduction entirely
- D Polyploidy is the same as gene flow
- E Polyploidy is a type of behavioral isolation

29 A diploid plant ($2n$) produces an autopolyploid offspring ($4n$). Which mating is most likely to produce fertile offspring?



- A $4n \times 2n$
- B $4n \times 4n$
- C $2n \times 2n$ always yields $4n$
- D $4n \times 1n$
- E $4n$ cannot reproduce at all

30 Allopolyploid speciation differs from autopolyploid speciation because allopolyploidy typically involves:



- A Chromosome doubling within one species only
- B Hybridization between two species followed by chromosome doubling, restoring fertility
- C Only mutations in mitochondrial DNA
- D Behavioral isolation due to mate choice
- E Geographic isolation by a mountain range





31 Which is the best reason reproductive isolation is central to defining species (biological species concept)?



- A It ensures all species look different
- B It determines whether populations share a gene pool over generations
- C It guarantees mutations stop happening
- D It prevents any environmental change
- E It means individuals cannot move

32 Which species concept is most difficult to apply to fossils?



- A Morphological species concept
- B Biological species concept
- C Phylogenetic species concept
- D Ecological species concept
- E All are equally easy to apply

33 A key limitation of the morphological species concept is that it:



- A Cannot be used for fossils at all
- B Cannot recognize cryptic species that look similar but are reproductively isolated
- C Requires DNA sequencing for every specimen
- D Depends on testing mating compatibility
- E Works only for bacteria





34 Which statement best matches the phylogenetic species concept (high school level summary)?

- A** Species are groups that can interbreed and produce fertile offspring
- B** Species are defined by a unique role in an ecosystem
- C** Species are the smallest monophyletic groups on a phylogenetic tree (shared ancestry + distinct traits)
- D** Species are defined only by geographic boundaries
- E** Species are defined by chromosome number only



35 Which scenario is **MOST** likely to produce rapid speciation by adaptive radiation?

- A** A stable environment with no new niches for millions of years
- B** A population colonizes a new area with many empty ecological niches and little competition
- C** High gene flow between all populations worldwide
- D** A complete absence of mutation
- E** All individuals are genetically identical and remain so



36 A ring species is best described as a situation where:

- A** Two species always live on islands shaped like rings
- B** Populations spread around a geographic barrier, neighboring populations interbreed, but end populations cannot
- C** All populations are completely isolated from all others
- D** Speciation happens instantly by polyploidy only
- E** Gene flow is equal between all populations





37 Which observation would most strongly support that two populations are currently experiencing allopatric speciation rather than sympatric speciation?



- A They occupy different microhabitats in the same forest
- B They have a physical barrier between them that prevents interbreeding
- C They have different courtship calls
- D They have different chromosome numbers due to polyploidy
- E They mate at different times in the same lake

38 Two fish types live in the same lake. Type 1 eats near the surface; type 2 eats near the bottom. Over time they develop different body shapes and preferentially mate with their own type. This is best interpreted as:



- A Sympatric divergence leading toward speciation driven by ecological differences and assortative mating
- B Allopatric speciation because the lake separates them
- C Bottleneck effect only
- D Gene flow increasing divergence
- E No evolution because both live in the same lake

39 Which statement about reproductive isolation is correct?



- A Reproductive isolation requires that populations never meet geographically
- B Reproductive isolation can be prezygotic, postzygotic, or both
- C Reproductive isolation only refers to sterile hybrids





- D Reproductive isolation prevents mutation from occurring
- E Reproductive isolation is the same as genetic drift

40 Which is the most direct way a physical barrier (like a canyon) promotes allopatric speciation?



- A It forces mutations to happen faster
- B It reduces gene flow, letting drift and selection act independently in each population
- C It guarantees that both sides have identical environments
- D It creates new chromosomes instantly
- E It causes immediate hybrid sterility

41 Two populations of insects are in the same region. One shifts to a new host plant and mates only on that plant. Over time, gene flow decreases. The initial isolating mechanism is best classified as:



- A Hybrid inviability
- B Habitat isolation (prezygotic)
- C Hybrid sterility
- D Polyploidy
- E Bottleneck effect

42 Which statement about 'geographic isolation' vs 'reproductive isolation' is most accurate?





- A Geographic isolation is a type of postzygotic barrier
- B Geographic isolation is not required for speciation, but reproductive isolation is central to maintaining separate gene pools
- C Reproductive isolation is only a result, never a cause, of speciation
- D Reproductive isolation always happens before geographic isolation
- E Geographic isolation means two populations must be different species

43 A student says: 'If two populations are geographically separated, they are different species.' Which is the best evaluation?



- A Correct—geographic separation automatically defines species
- B Incorrect—geographic separation can start divergence, but species status depends on reproductive isolation and gene flow
- C Correct only for plants
- D Correct only if mutation rate is high
- E Incorrect—because geographic separation prevents evolution

44 Which of the following best represents a NONrandom evolutionary mechanism that can drive divergence between populations?



- A Genetic drift
- B Founder effect
- C Natural selection
- D Bottleneck effect
- E Random sampling of alleles in small populations





45 Which mechanism introduces **NEW** alleles into a population's gene pool?



- A** Genetic drift
- B** Natural selection
- C** Mutation
- D** Nonrandom mating
- E** Reproductive isolation

46 Two populations diverge in different environments. When they meet again, they can mate, but hybrids are less fit than either parent in both environments. Over time, what outcome is most likely if selection is strong against hybrids?



- A** Reinforcement strengthens prezygotic isolation
- B** Gene flow increases and populations become identical
- C** Mutation stops
- D** Hybrid fitness increases automatically with time
- E** Drift disappears because selection is present

47 Two populations meet after long isolation. They interbreed extensively and produce viable, fertile offspring, causing the populations to merge. This outcome is sometimes described as:



- A** Fusion (collapse of divergence due to gene flow)
- B** Reinforcement
- C** Hybrid breakdown
- D** Bottleneck effect
- E** Sympatric polyploid speciation





48 Which isolating mechanism most directly prevents fertilization even when mating occurs?



- A** Behavioral isolation
- B** Gametic isolation
- C** Habitat isolation
- D** Temporal isolation
- E** Adaptive radiation

49 Which statement correctly compares prezygotic and postzygotic barriers from an energy/fitness perspective?



- A** Postzygotic barriers usually waste fewer resources because they prevent mating
- B** Prezygotic barriers can be favored because they prevent the cost of producing low-fitness hybrids
- C** Prezygotic barriers only evolve after polyploidy
- D** Postzygotic barriers always increase hybrid fitness
- E** Neither barrier affects fitness; they are neutral by definition

50 A cline is best described as:



- A** A sudden jump in chromosome number
- B** A gradual change in allele frequency or trait value across geographic space
- C** A complete lack of genetic variation
- D** A mating ritual that prevents interbreeding





- E A mutation that always produces sterility

51 Which condition makes genetic drift most powerful as a force of evolutionary change?



- A Large population size with high gene flow
- B Small population size
- C Very strong selection favoring one allele
- D No reproduction
- E High mutation rate always guarantees drift dominates

52 Which statement about assortative mating is most accurate?



- A Assortative mating always increases gene flow between groups
- B Assortative mating (like-with-like mating) can reduce gene flow between groups and promote sympatric divergence
- C Assortative mating is identical to random mating
- D Assortative mating can only occur in allopatric speciation
- E Assortative mating prevents mutation

53 Which example best fits behavioral isolation rather than habitat isolation?



- A Two insects mate only on different host plants
- B Two birds use different songs, and females respond only to their own song type





- C Two fish live at different depths in a lake
- D Two plants flower in different soils
- E Two populations are separated by a mountain

54 Which of the following is NOT typically considered a reproductive isolating mechanism by itself?



- A Hybrid sterility
- B Temporal isolation
- C Gene flow
- D Mechanical isolation
- E Gametic isolation

55 A student says: 'If hybrids exist, then the parents must be the same species.' Which is the best correction?



- A True—hybrids can only occur within a species
- B False—different species can hybridize; what matters is whether gene flow is substantial and whether hybrids are fertile and common
- C True—hybrids always have higher fitness
- D False—hybrids cannot exist in nature
- E True—hybrids always mean sympatric speciation is happening





56 Which statement best explains why polyploidy often causes speciation more easily in plants than in animals?

- A** Plants never undergo meiosis
- B** Many plants can self-fertilize or reproduce with close relatives, helping a new polyploid lineage establish
- C** Animals lack chromosomes
- D** Plants have no DNA repair systems
- E** Polyploidy cannot affect reproduction



57 Two populations become geographically separated. In one population, a new predator appears, favoring faster individuals. In the other, no predator appears. Which force is directly causing adaptive divergence?

- A** Genetic drift
- B** Natural selection
- C** Gene flow
- D** Random mating
- E** Bottleneck effect



58 Which scenario most clearly represents artificial selection potentially contributing to 'artificial speciation' over long periods?

- A** A drought causes random survival
- B** Humans repeatedly breed only the smallest dogs with each other for many generations, reducing gene flow with other dog populations
- C** Mutations stop occurring due to human presence
- D** Two populations migrate and interbreed





- E A volcano causes a bottleneck

59 Two populations differ in one trait due to genetic drift. Which statement is most accurate about drift-driven divergence and speciation?



- A Drift cannot contribute to speciation because it is random
- B Drift can contribute to divergence, and if it leads to reproductive barriers (directly or indirectly), it can contribute to speciation
- C Drift always creates adaptive traits
- D Drift guarantees speciation in all populations
- E Drift is the same as mutation

60 Which is the most direct indicator that two populations remain part of the same gene pool?



- A They live on different continents
- B They look different
- C There is substantial ongoing gene flow between them through interbreeding
- D One has slightly higher mutation rate
- E One has a larger population size

61 If two populations experience strong gene flow, which outcome is most likely unless selection is extremely strong or mating is highly assortative?



- A They rapidly become reproductively isolated





- B They tend to remain genetically similar, slowing speciation
- C They cannot mutate
- D They immediately become polyploid
- E They experience bottleneck every generation

62 Which statement correctly describes the relationship between speciation and reproductive isolation barriers?



- A A single barrier is always sufficient to produce instant speciation in animals
- B Multiple barriers often accumulate gradually; speciation can be a process rather than an instant event
- C Speciation only occurs when hybrids are completely impossible
- D Only prezygotic barriers matter; postzygotic barriers are irrelevant
- E Only postzygotic barriers exist in nature

63 A population of insects is split into two isolated groups. In group 1, allele A becomes common; in group 2, allele a becomes common. No difference in survival or reproduction is linked to these alleles. The best explanation is:



- A Directional selection
- B Genetic drift acting independently in each isolated group
- C Gene flow
- D Reinforcement
- E Artificial selection





64 A student claims: 'Selection creates mutations that organisms need.' Which statement is correct?

- A** Correct—mutations occur because organisms need them
- B** Incorrect—mutations arise randomly; selection changes which mutations become common by affecting reproductive success
- C** Correct—selection directly edits DNA sequence in response to environment
- D** Incorrect—selection cannot affect allele frequencies
- E** Correct only in bacteria, not in eukaryotes



65 Which factor most directly converts 'divergence' into 'two species' under the biological species concept?

- A** A different color pattern
- B** A different diet
- C** A barrier that prevents substantial gene flow (reproductive isolation)
- D** A higher mutation rate
- E** A larger population size



66 Which statement about parapatric speciation is most accurate?

- A** It requires complete geographic separation with no contact zone
- B** It occurs only in plants and never in animals
- C** It involves neighboring populations with limited gene flow across a boundary, often with a hybrid zone
- D** It requires polyploidy
- E** It can only happen if hybrids are always fitter than parents





67 Which pattern would most strongly suggest ongoing gene flow between two diverging populations?



- A** They have completely different DNA at all loci
- B** They have identical allele frequencies across their entire genomes
- C** They share many alleles and show intermediate individuals in a contact zone
- D** They are separated by an ocean and never meet
- E** Their chromosomes are different numbers

68 Two populations share the same habitat and time of breeding, but individuals of population A are too small to mate successfully with population B due to size mismatch of reproductive structures. This is best classified as:



- A** Mechanical isolation
- B** Temporal isolation
- C** Gametic isolation
- D** Hybrid breakdown
- E** Bottleneck effect

69 Which scenario most clearly demonstrates that speciation can occur without geographic isolation?



- A** A canyon forms, separating populations
- B** A few individuals are blown to another island
- C** A new polyploid plant lineage arises and becomes reproductively isolated in the same field





- D A glacier separates a population into two refuges
- E A drought reduces population size drastically

70 Why is a stable hybrid zone (persisting for many generations) possible at all?



- A Because mutation stops in hybrid zones
- B Because selection always favors hybrids
- C Because a balance can occur between dispersal/gene flow into the zone and selection against hybrids
- D Because reproductive isolation is complete in hybrid zones
- E Because hybrid zones only exist in labs

71 Which best explains why sympatric speciation is often considered harder to achieve than allopatric speciation?



- A Because mutation cannot happen in the same geographic area
- B Because ongoing gene flow within the same area tends to mix alleles, so strong selection and assortative mating are usually needed to maintain divergence
- C Because natural selection stops working in sympatry
- D Because allopatric speciation requires no reproductive isolation
- E Because sympatric speciation requires a physical barrier

72 A teacher says: 'Speciation always takes a very long time, so it cannot happen quickly.' Which is the best correction at this level?





- A Correct—speciation can never happen in fewer than 10 million years
- B Incorrect—some mechanisms (like polyploidy in plants) can create rapid reproductive isolation, and strong selection in isolated populations can speed divergence
- C Correct—only genetic drift can cause speciation and it is always slow
- D Incorrect—speciation is always instantaneous
- E Correct—because mutation does not occur often enough







#	Ans	Answer Text
1	C	Gene flow between populations is effectively prevented by reproductive i...
2	B	Allopatric speciation
3	C	A plant population produces a polyploid lineage that can reproduce with ...
4	B	Parapatric speciation
5	B	Peripatric speciation (a form of allopatric with a small founder populat...
6	B	Gene flow tends to reduce divergence between populations, often opposing...
7	C	Different mating seasons (temporal isolation)
8	E	Hybrids are viable but sterile
9	B	Temporal isolation
10	A	Behavioral isolation (prezygotic)
11	A	Mechanical isolation
12	B	Gametic isolation
13	B	Two populations live in the same region but breed in different microhabi...
14	C	The same species because they can interbreed and produce fertile offspri...
15	C	Genetic drift is random change in allele frequencies; natural selection ...
16	B	Bottleneck effect (genetic drift)
17	B	It is genetic drift when a small group starts a new population, potentia...
18	B	Experience stronger sampling error, so allele frequencies can change rap...
19	B	A random change in DNA sequence that can introduce new alleles
20	B	Natural selection can contribute to divergence, but reproductive isolati...
21	A	Reinforcement
22	A	Prezygotic barriers become stronger (more mate discrimination)
23	B	A region where two diverging populations meet and produce hybrids
24	B	Speciation has not occurred under the biological species concept because...
25	D	Hybrid embryos fail to develop properly
26	B	Hybrid sterility (reduced hybrid fertility)
27	A	Hybrid breakdown
28	B	Polyploidy can cause immediate reproductive isolation in plants
29	B	$4n \times 4n$
30	B	Hybridization between two species followed by chromosome doubling, resto...
31	B	It determines whether populations share a gene pool over generations
32	B	Biological species concept
33	B	Cannot recognize cryptic species that look similar but are reproductivel...
34	C	Species are the smallest monophyletic groups on a phylogenetic tree (sha...
35	B	A population colonizes a new area with many empty ecological niches and ...
36	B	Populations spread around a geographic barrier, neighboring populations ...
37	B	They have a physical barrier between them that prevents interbreeding
38	A	Sympatric divergence leading toward speciation driven by ecological diff...



