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Biology
Standard and Higher level
D4.1 Natural selection Paper 1A

11 May 2026

Zone A afternoon | **Zone B** morning | **Zone C** afternoon

1 hour 45 minutes [Paper 1A]

Instructions to candidates

- Answer all questions.
- For each question, choose the answer you consider to be the best.
- A calculator is required for this paper.
- This paper generally presents questions in the same order the concepts are presented in the syllabus guide. The earlier questions are usually but not always easier than the later questions. Although most questions focus on this topic only, some are linked to other topics.
- This paper contains challenging IB-style problems. It is meant to enrich your learning and improve your mastery of the concepts presented in this topic after you have studied it.
- The duration of this paper was scaled according to the number of marks available and based on how much time, on average, each mark is worth in examination settings. Since this is a practice paper, expect to need more time to complete it.
- Many of the questions here are original and written by me. Several questions are taken from external sources, which are referenced at the end of the paper.
- **None of the questions are from IB past papers.**
- The maximum mark for this paper 1A is **[70 marks]**.

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1. What is natural selection?

A. A process by which organisms change their traits to increase survival

B. A process by which traits become more common because they are beneficial

C. A process by which complex traits become more common with time

D. A process by which mutations become more common to improve adaptation

2. Which life functions does natural selection operate on?

A. Reproduction and homeostasis

B. Reproduction and survival

C. Reproduction and movement

D. All life functions

3. Which statement is **correct**?

A. Natural selection acts randomly on randomly generated variation

B. Natural selection acts randomly on non-randomly generated variation

C. Natural selection acts non-randomly on randomly generated variation

D. Natural selection acts non-randomly on non-randomly generated variation

4. Does natural selection act on genotypes or phenotypes?

A. It acts on the genotype but it has consequences for the phenotype

B. It acts on the phenotype but it has consequences for the genotype

C. It directly acts on both genotypes and phenotypes

D. It indirectly acts on both genotypes and phenotypes

5. Why is genetic variation important in natural selection?

A. Higher genetic variation improves the chance of successful breeding

B. It allows organisms with the best genotype to survive

C. It provides alternative alleles that increase the gene pool of a species

D. It increases the diversity of adaptations that can occur in a population

6. What can cause changes in gene phenotypes?

A. Prophase I in meiosis

B. Anaphase I in meiosis

C. Silent mutations

D. Missense mutations

7. What enables natural selection to occur?

A. Differential success in reproduction

B. Differential success in mortality

C. A large gene pool

D. A small gene pool

8. Which of the following scenarios is **least** likely to lead to natural selection?

A. Birds with longer beaks are able to eat more food

B. Longer whales have on average more offspring than other whales

C. A monkey finds an accessible source of nutrition

D. Dark tigers mate more than lighter tigers

9. What promotes natural selection?

I. Density-independent factors

II. Density-dependent factors

III. Selection-dependent factors

A. I only

B. II only

C. I and II only

D. II and III only

10. Which of the following increase(s) genetic variation in a population?

I. Mutations

II. Sexual selection

III. Mating with close relatives

A. I only

B. II only

C. I and II only

D. II and III only

11. What is correct about individuals with different adaptations?

A. They have different mechanisms that lead to genetic variation

B. They are unlikely to undergo selection if they have similar offspring numbers

C. They evolved different adaptations with time due to environmental differences

D. They have different adaptations due to similar ancestry

12. In recent years, certain strains of flies have been observed to be resistant to the effects of the insecticide DDT. What must be true about the adaptive value of the resistance trait?

A. It was present prior to the use of DDT

B. It did not become apparent until the introduction of DDT in the environment

C. The DDT resistance trait was acquired after the insecticide was used

D. Interbreeding between flies occurred after the use of the insecticide

13. Which of the following is a density-dependent selection pressure?

A. Climate change in densely populated forests

B. Flooding in highly diverse marine ecosystems

C. Air pollution in peppered moth populations

D. Disease outbreak in a birch forest

14. If there are no mutations and all immigration into a large sexually reproducing population is prevented, which one of the following statements best expresses the probable future of the population?

A. Most evolutionary change will stop because there are no mutations

B. The population will begin to decrease in size

C. The population will continue to evolve

D. Natural selection will decrease in strength

15. **[AHL]** Which of the following experiments can help distinguish between the contributions of mutations versus meiosis in the variation of flower color in a plant?

A. Cross 2 parents and determine the number of homozygous plants

B. Cross 2 parents and determine the number of heterozygous plants

C. Cross 2 parents and determine if the offspring obey Mendelian ratios

D. Cross 2 parents and determine if the offspring survive and reproduce

16. Why are all mutations the source of genetic but not phenotypic variation?

I. Some mutations are in non-coding regions

II. Some mutations in coding regions are neutral

III. Some mutations occur in gametes not somatic cells

A. I only

B. II only

C. I and II only

D. II and III only

17. In a species of birds, males vary in the number of yellow stripes on their heads. Given that each male has approximately the same number of offspring, which of the following is correct?

A. Males are experiencing sexual selection

B. Females are experiencing sexual selection

C. Males differ in survival fitness but not reproductive fitness

D. There is no sexual selection imposed on males

18. Which organism is **least** likely to survive until reproduction age?

A. A plant that has a sweet flavor before it flowers

B. A flower that produces a toxin in its buds to repel deer

C. A flower that produces a scent that attracts bees

D. A plant that contains a water tank in the desert

19. Why does overproduction of offspring in a species promote natural selection?

A. It enables the population to reach carrying capacity faster

B. It is caused by the competition arising from limited resources

C. It leads to competition for limited resources

D. It ensures that more individuals survive which makes the parents more fit

20. Elephants are hunted by poachers for their tusks, which are a source of ivory. In a National Park in 1930, 1% of the elephants were born without any tusks due to a mutation. In 1975, 15% of the females and 9% of the males did not have tusks.

Which statement(s) explain the change in number of tuskless elephants?

I. Tusked elephants are less likely to survive

II. Tusked elephants are less likely to be killed by poachers

III. Tuskless elephants mate non-randomly with each other

A. I only

B. II only

C. I and II only

D. II and III only

21. Which selection pressures will result in the strongest selection?

A. Low intraspecific and low interspecific competition

B. High intraspecific and low interspecific competition

C. Low intraspecific and high interspecific competition

D. High intraspecific and high interspecific competition

22. Which of the following is **not** an example of selection in a population of sea turtles?

A. Large females lay more eggs than smaller females

B. Large males mate with more females than smaller males

C. Large males have more wounds than smaller males

D. Large females are less likely to be killed than smaller females

23. Which of the following can be measured to estimate fitness of an organism?

A. The number of eggs it produces over its lifetime

B. The number of gametes it produces over its lifetime

C. The number of offspring it produces over its lifetime

D. The number of offspring it produces over its lifetime that survive to breed

24. What is the degree of adaptation that can occur in a population limited by?

A. The survival and reproductive need of the individuals

B. The amount and kind of genetic variation in a population

C. The amount of genetic variation in a population

D. The kind of genetic variation in a population

25. Can a population evolve without mutations?

A. Yes, through natural selection

B. Yes, through sexual selection

C. Yes, if the species reproduces sexually

D. Yes, if the species reproduces asexually

26. In what cells would mutations acquired during an individual's lifetime be considered heritable?

I. A mutation in bone marrow stem cells

II. A mutation in somatic cells

III. A mutation in germline cells

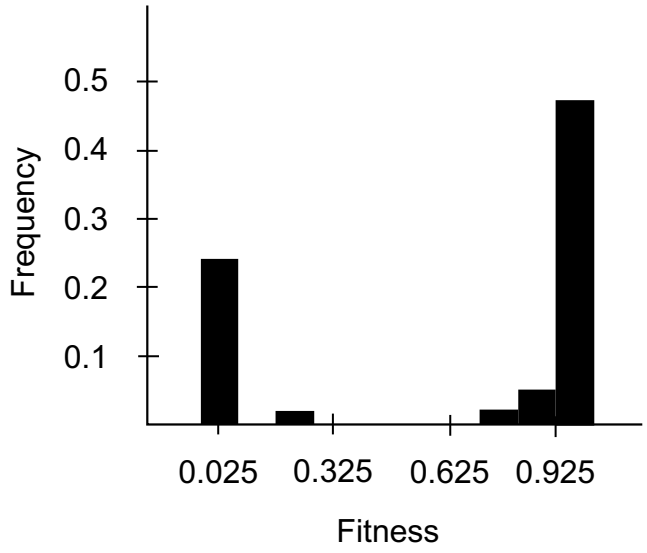
A. I only

B. III only

C. I and II only

D. I and III only

27. Two individuals from a species with a fitness of 1 give rise to a new population. The graph shows the fitness of the new mutations in this population. Which of the following best describes the fitness of the mutations in the new population?



A. Most mutations do not affect fitness

B. Most mutations are not neutral

C. All of the mutations are either very beneficial or slightly beneficial

D. All of the mutations are either very harmful or slightly harmful

28. What is sexual selection?

A. A process that increases genetic variation in a population through mating

B. A type of selection that acts on traits influencing mating success

C. The preference for individuals with traits that ensure higher survival rates

D. The competition between species for reproductive isolation and gene flow

29. How can sexual selection make it harder to classify species based on morphology?

A. Individuals of the same species can look insignificantly different

B. Individuals of different species may look similar

C. Individuals of the same species can look significantly different

D. Individuals of different species may not have the same ancestor

30. What type of traits does sexual selection tend to favor?

A. Traits that enhance survival in tough environments

B. Traits that reduce energy expenditure

C. Traits that make individuals more visible for the other sex

D. Traits that increase mating success

31. How can sexual selection produce a positive feedback loop in a population?

A. Traits that increase both survival and mating success are selected for

B. Females evolve a preference for traits that ensure random mating outcomes

C. Male traits and female preferences reinforce each other across generations

D. Genetic drift strengthens the effect of all sexually selected traits

32. Does sexual selection act on one sex only?

A. No, both sexes experience sexual selection

B. No, but it tends to favor females

C. Yes, only males experience sexual selection

D. Yes, only females experience sexual selection

33. In a cricket species, males produce a song to attract mates. Scientists mute half the males and compare their mating success. What should be used as a controlled variable?

A. Mute females

B. Using older males

C. Normal males

D. Normal females

34. In a beetle species, males have grasping spines that improve mating success but harm females. Which of the following methods can help investigate the effects of sexual selection on females?

A. Artificially select for larger spines and measure changes in female phenotype

B. Find the correlation between female injury rates and variation in spine size across the population

C. Measure the change in female fitness when mating with spined and spineless males

D. Sequence DNA responsible for spines in males and associated alleles in females

35. If natural selection and sexual selection favor opposite traits in males, what is the most likely outcome for the male phenotype over time?

A. The male phenotype will shift towards the trait favored by natural selection since sexual selection is costly

B. The male phenotype will change randomly across generations due to opposing selection pressures

C. The male phenotype will represent the maximum difference between the benefits and costs of each selection pressure’s trait

D. The male phenotype will be affected by sexual selection acting on females

36. In which scenario is sexual selection the strongest in a population of guppies?

A. High predator density

B. Intermediate predator density

C. Low predator density

D. No predators

37. What is a suitable dependent variable for John Endler's experiment on guppies?

A. The number of female guppies who mate

B. The number of offspring born over time

C. The percentage of brightly colored males in the population over time

D. The percentage of predators who feed on guppies

38. In an experiment, researchers count the number of guppies and their predators in 3 different lakes. The average coloration of guppies is also noted for each lake as shown in the table. In which lake(s) does sexual selection have the strongest effect on the phenotype of guppies?

Lake	Guppies (count)	Predators (count)			Average coloration of guppies
		Pike cichlids	Blue acara	Rivulus	
Lake 1	75	0	0	12	Brightly multi-colored with large spots
Lake 2	83	0	7	15	Medium coloration on body and tail with medium-sized spots
Lake 3	110	17	20	5	Dull coloration, very small spots concentrated near the tail

A. Lake 1 only

B. Lake 2 only

C. Lake 3 only

D. Lakes 1 and 3 only

39. **[AHL]** What is neo-Darwinism?

A. An evolutionary theory integrating modern genetics with natural selection*

B. A post-Darwinism theory of evolution

C. Darwin's updated theory of evolution before he died

D. The newly developed Darwinian theory of evolution

40. **[AHL]** What is the effect of directional selection?

A. It favors individuals with one form of a trait

B. It favors individuals with intermediate forms of a trait

C. It eliminates individuals with two forms of a trait

D. It eliminates individuals with all extreme forms of a trait

41. **[AHL]** Firecracker seed finches of Africa feed on either large or small seeds, and as a result have developed only large or small beaks. What type of selection is responsible for these phenotypes?

A. Directional selection

B. Stabilizing selection

C. Balancing selection

D. Disruptive selection

42. **[AHL]** What is **not** likely to disrupt a population that is in genetic equilibrium?

A. Small population size

B. Mutations

C. Random mating

D. Gene flow

Use this table to answer questions **43** – **47**.

Population	Relative size of population	Type of mating	Mutation rates
I.	Small	Non-random	High
II.	Large	Non-random	High
III.	Small	Random	Low
IV.	Large	Random	Low

43. **[AHL]** Which population would show the **least** change as time passes?

A. I.

B. II.

C. III.

D. IV.

44. **[AHL]** Which populations would show the **most** change as time passes?

A. I. and II.

B. II. and III.

C. III. and IV.

D. I. and IV.

45. **[AHL]** What might happen to the gene pool of population IV. if mating becomes non-random?

A. It would change slower

B. It would change faster

C. It would change at the same rate

D. It would initially change faster but eventually slow down

46. **[AHL]** Under what conditions can populations I. and III. have similar rates of evolution?

I. If mating in population III. becomes non-random

II. If mutation rates in population II. become low

III. If both populations remain in Hardy Weinberg equilibrium

A. I only

B. I and II only

C. I and III only

D. I, II, and III

47. **[AHL]** If mutation rates in all populations become equally high, which population's gene pool would change the most?

A. I.

B. II.

C. III.

D. IV.

48. **[AHL]** What happens during disruptive selection?

A. There are no consistent selective pressures

B. Selection changes the median phenotype

C. The intermediate phenotype is selected against

D. The extreme phenotypes are selected against

49. **[AHL]** What is the effect of gene flow between two isolated populations?

A. Increased genetic differences

B. Reduced genetic differences

C. Increased strength of natural selection

D. Reduced strength of natural selection

50. **[AHL]** What type of selection is being imposed when the minimum fitness lies between the extreme range values of a trait?

A. Directional selection

B. Disruptive selection

C. Stabilizing selection

D. Natural selection

51. **[AHL]** In a population, the frequency of the homozygous recessive genotype is 9%. What is the frequency of the heterozygous genotype?

A. 18%

B. 27%

C. 42%

D. 81%

52. **[AHL]** If 12% of a population is born with a severe form of sickle-cell anemia (ss), what percentage of the population will be most resistant to malaria?

A. 66%

B. 33%

C. 24%

D. 48%

53. **[AHL]** CCR5 is a receptor expressed on the surface of lymphocytes and is used by HIV-1 to enter the cell. If a mutation occurs that results in the loss of function of the CCR5 receptor, what kind of selection would be expected in human populations?

A. Disruptive selection

B. Stabilizing selection

C. Directional selection

D. Sexual selection

54. **[AHL]** In a population at Hardy-Weinberg equilibrium, the frequency of the recessive homozygous genotype is 0.16 and the frequency of the dominant phenotype is 0.84. What is the expected frequency of the heterozygous carriers?

A. 0.48

B. 0.27

C. 0.32

D. 0.64

55. **[AHL]** What is true whenever a diploid population is at Hardy Weinberg equilibrium?

A. The alleles are present in equal proportions in each chromosome

B. Individuals within the population have unchanging genotypes

C. Haploid and diploid gene pools are not changing

D. Evolutionary mechanisms of change like selection have equilibrated

56. **[AHL]** Individuals migrate into a population that is in Hardy-Weinberg equilibrium, and they do not alter that equilibrium. What is a plausible explanation?

A. The migrants arrive in large numbers

B. The migrants mate randomly in the new population

C. The migrants do not contribute their genes to the new population

D. The migrants are only male, reducing the chances of sexual selection

57. **[AHL]** In an isolated population of 500 individuals, 18% are homozygous recessive for a trait with two alleles. What is the number of heterozygotes in this population?

A. 244

B. 410

C. 90

D. 180

58. **[AHL]** In a population of 1000 birds, the pigmentation of wing feathers is determined by a single gene exhibiting codominant inheritance. 350 birds have dark brown wings (I^AI^A), 500 have light brown wings (I^AI^a), and 150 birds have light beige wings (I^aI^a). What is the allele frequency of I^A in the population?

A. 0.60

B. 0.35

C. 0.20

D. 0.85

59. **[AHL]** Scientists conduct gel electrophoresis on a population of 100 arctic foxes to identify their genotypes and determine if they are in Hardy Weinberg equilibrium. Which of the following is **incorrect**?

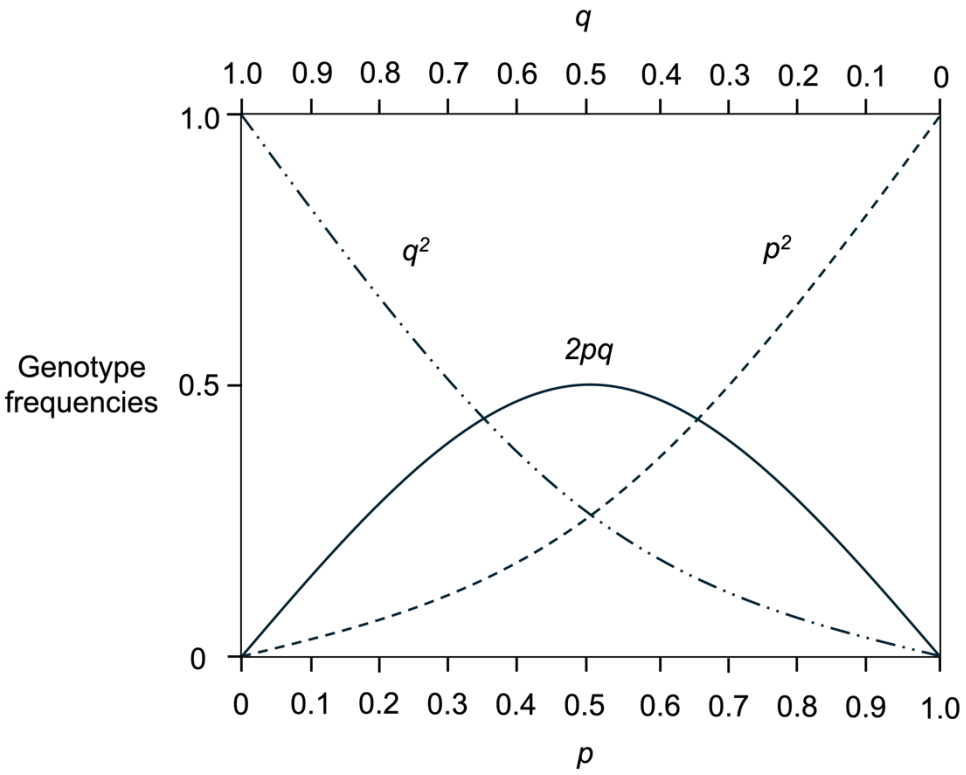
A. The null hypothesis is rejected if the sum of the frequencies of genotypes is 1

B. If the calculated chi squared value is less than the critical value, the null hypothesis is rejected

C. One of the assumptions of the Hardy Weinberg equilibrium is violated

D. A p-value greater than 0.05 indicates that the null hypothesis fails to be rejected

The graph shows the relationship between the different genotypes in the Hardy Weinberg equation for a trait with two alleles. Use this graph to answer questions **60** – **62**.



60. **[AHL]** What correctly describes the relationship between p^2 and q^2?

A. p^2 and q^2 increase together

B. When p^2 increases q^2 decreases

C. If p^2 is dominant then it will always be higher than q^2

D. If q^2 is dominant then it will always be higher than p^2

61. **[AHL]** What correctly describes the relationship between *2pq* and the other genotype frequencies?

A. *2pq* always decreases when both homozygous genotypes increase

B. *2pq* relatively decreases when one homozygous genotype increases

C. *2pq* will have the same value as p^2 and q^2 at Hardy Weinberg equilibrium

D. *2pq* will be lower than p^2 and q^2 at Hardy Weinberg equilibrium

62. **[AHL]** In a population, *q* is the dominant allele. What can you deduce about the mode of inheritance from the symmetry of the graph?

A. Dominant alleles are always more frequent than recessive ones

B. Genotype frequencies are affected by the mode of inheritance

C. Dominance affects phenotype but not genotype frequencies

D. Recessive alleles must be rare if dominant alleles are present

63. **[AHL]** What happens when a bacterial population is exposed to antibiotics?

A. Resistance increases and becomes more common

B. Antibiotics become more common in the bacterial population

C. Bacteria evolve to resist antibiotics during their lifetime

D. Bacterial mutants survive and multiply

64. **[AHL]** How does artificial selection affect the gene pool of a population?

A. It increases variation more than natural selection

B. It decreases variation more than natural selection

C. It changes variation based on human needs and wants

D. It changes variation based on natural and human pressures

65. **[AHL]** What type of selection is responsible for changes in traits of domesticated animals?

A. Stabilizing selection

B. Disruptive selection

C. Sexual selection

D. Artificial selection

66. **[AHL]** Which of the following does not cause deviation away from Hardy-Weinberg equilibrium?

A. Natural selection

B. Mutations

C. Genetic drift

D. Large population size

67. **[AHL]** In a population, 4% of individuals have a recessive disorder. If a health policy is introduced to prevent carriers from reproducing, what is the most likely outcome?

A. The frequency of the recessive allele will increase

B. The frequency of the recessive allele will decrease

C. The frequency of the recessive allele will remain stable

D. The frequency of the recessive allele will fluctuate randomly

68. **[AHL]** What type of natural selection is imposed when farmers select for increased oil concentration in crops?

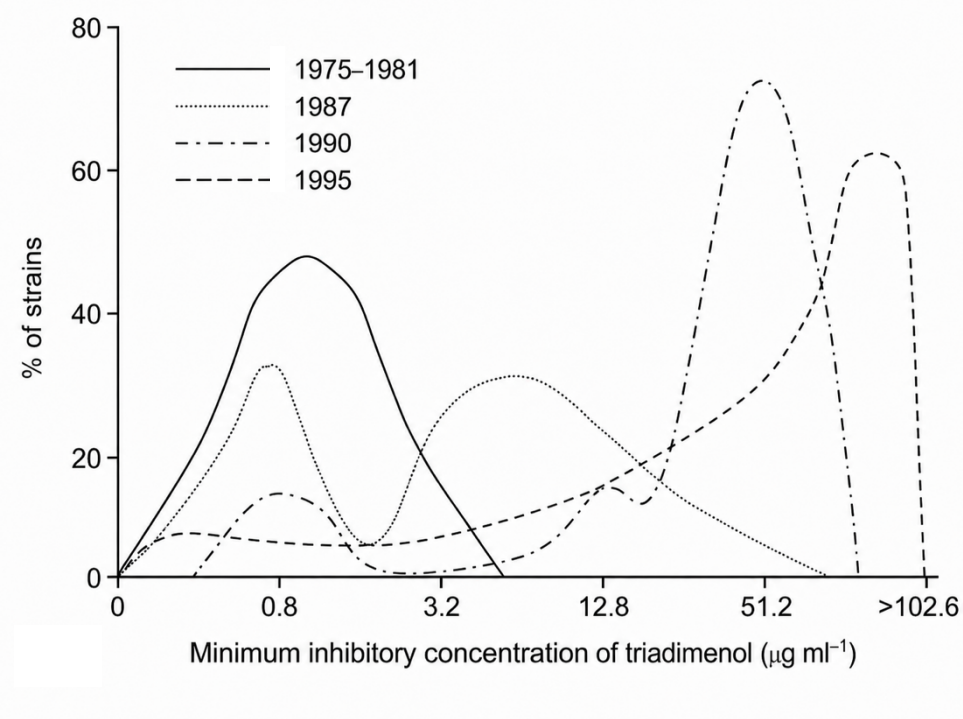
A. Disruptive selection

B. Stabilizing selection

C. Directional selection

D. Sexual selection

69. **[AHL]** Triadimenol is an antifungal drug used against the barley pathogen *Rhynchosporium secalis*. The graph shows the minimum concentration of triadimenol needed to inhibit *R. secalis* in different years.



What can be concluded?

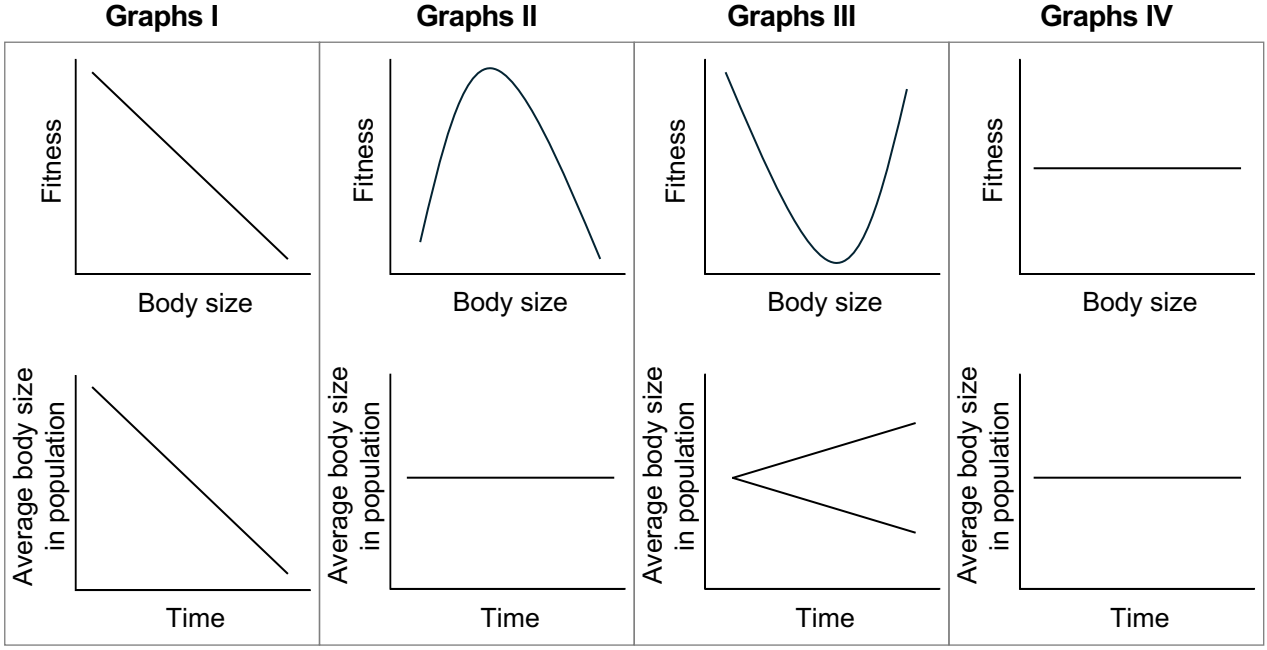
A. *R. secalis* is experiencing disruptive selection

B. *R. secalis* is experiencing diversifying selection

C. *R. secalis* is experiencing stabilizing selection

D. *R. secalis* is experiencing directional selection

70. **[AHL]** The different forms of natural selection can be distinguished according to their effect on the body size of pink salmon (*Onchorhynchus gorbuscha*). Which row correctly matches the type of selection of each set of graphs?



	Graphs I	Graphs II	Graphs III	Graphs IV
A.	Disruptive	Directional	Stabilizing	No selection
B.	No selection	Stabilizing	Directional	Disruptive
C.	Directional	Stabilizing	Disruptive	No selection
D.	Directional	Disruptive	No selection	Stabilizing

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