W2012 SC/BIOL 1001 3.0 Midterm II - March 9, 2012

Section M – Version A

Please note - the short answer key is only provided on Version A (the question was the same on ALL exam versions). If you wrote a lot of info that had nothing to do with the question or was wrong (more often than not the latter, not the former), you lost marks.

This test consists of **31 multiple choice items** (section and version indicators – these do not count in the score but must be completed) and **1 short-answer questions**. There are **10 pages**. This test is **50 minutes** long.

The entire question booklet and your scantron must be submitted to receive a grade. **Indicate your full name and student number on the scantron and on this page. (Please double-check your student number bubbling.)** Be sure to sign the sign-in sheet. **Your name must be written in permanent ink in all places.**

Please **answer all questions on the scantron**. Choose **the single best answer** out of the options for each question. Read each question (and all possible answers) carefully.

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Please check that you have bubbled your student number correctly on the scantron. Choose one answer for each question.

1. You are in Section **M** – please indicate this by filling in "B" on the scantron. (If you are NOT in Section M, see an invigilator immediately.)

   A. No **X**
   B. **Pick me**!!! ✓
   C. No **X**
   D. No **X**
   E. No **X**

2. You have exam version **A**, which must be indicated on the scantron to get credit for test questions.

   A. **Pick me**!!! ✓
   B. No **X**
   C. No **X**
   D. No **X**
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3. A woodland plant has flowers that vary from white to light red to red. Because the bee pollinators prefer red to white flowers, the plants with red flowers produce more fruit than plants with white flowers. Nevertheless, the percentage of different flower colours remains stable in the study population from year to year. This would indicate that

   A. red flowers must be adapted for pollination by bees.
   B. the relative abundance of the flower colour is genetically determined.
   C. natural selection cannot preferentially select any of the flower colours.
   D. flower colour exhibits qunatitative variation.
   E. fitness is primarily determined by fruit flower colour in this species.

4. Until recently, evolutionary theory stressed genetic mutations that alter protein amino acid sequences are a major source of variation that leads to speciation. Evo-devo (evolutionary developmental biology) offers a different understanding of the role of genetic change in evolution. Which of the following statements best summarizes this understanding?

   A. Genetic mutations are not as important in evolutionary change as the environment in which the organism develops.
   B. Changes in cell-cell interactions in a parent's body can lead to phenotypic change in offspring.
   C. Similar genes are found in most developing animal bodies; changes in the times and places they are expressed can lead to phenotypic variation.
   D. Greater numbers of genes, rather than the ways in which they are regulated, leads to the development of more complex animals over time.

5. The frequency of the B_1 allele (for an autosomal gene) in a population that is in Hardy-Weinberg equilibrium is 0.2 and the frequency of the B_2 allele is 0.8. The phenotype of allele B_1 is dominant to that of B_2. If females make up exactly half of the population, what is the frequency of the B_1 allele in the female population alone?

   A. 0.1
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   C. 0.4
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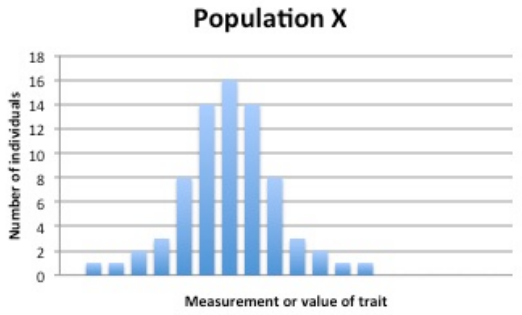
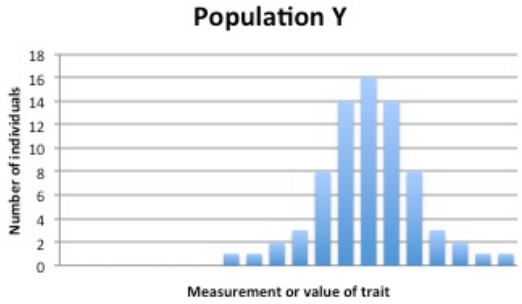
   E. Need to know if this trait is sex-linked.





6. Examine the above graphs, which describe variation for the same trait in Populations X and Y. What can you conclude based on the information in the graphs?

   A. Both populations have the same mean (average) value for this trait.
   B. Both populations exhibit the same amount of variation for this trait.
   C. Population X exhibits more variation than Population Y for this trait.
   D. Population Y exhibits more variation than Population X for this trait.
   E. Both A and B.
   F. Both B and C.

7. Recombination, due to crossing over occurs during meiosis I. The resulting allele combinations are called recombinants. Natural selection and recombination due to crossing over during meiosis I are related in which of the following ways?

   A. Recombinants are usually selected against.
   B. Recombinants may have combinations of traits that are favoured by natural selection.
   C. Recombination does not affect natural selection
   D. Non-recombinant organisms are usually favoured by natural selection if there is environmental change.

8. All of the following statements are true about mutations **EXCEPT**:

   A. Mutations are random with respect to the needs of the organism.
   B. The origin of genetic variation is mutation.
   C. The mutation rate can be affected by genetic drift.
   D. Most mutations are harmful or neutral to the organism in which they occur.
   E. Inbreeding can result in an increase in deleterious alleles.
   F. All of the above statements are true about mutations.

9. After an extreme drought on Daphne Minoret, a Galápagos island, in 1975, medium ground finches with large, deep beaks survived better than those with smaller beaks because they could more easily crack and eat the tough *Tribulus cistoides* fruits. In the late 1980s, tourist companies start visiting the island. The companies set up reliable feeding stations with a variety of different types and sizes of birdseeds, so that tourists can get a better look at the finches. Given this, which of the following is most likely to occur to finches on Daphne Minoret?

   A. Evolution of yet larger, deeper beaks over time, until all birds have relatively large, deep beaks
   B. Evolution of smaller, pointier beaks over time, until all birds have relatively small, pointy beaks
   C. Increased variation in beak size and shape over time
   D. No change in beak size and shape over time

10. Which statement about allele frequencies is **NOT** true?

   A. The sum of all allele frequencies at a locus is always 1.
   B. If there are two alleles at a locus and we know the frequency of one of them, we can determine the frequency of the other.
   C. If an allele is missing from a population, its frequency in that population is 0.
   D. If two populations have the same allele frequencies for a locus, they will have the same proportion of homozygotes for that locus.
   E. If an allele is fixed, its frequency is 1.

11. In some human populations, birth weight depends, in part, on variation in alleles, and babies of intermediate weight survive best. Which of the following statements correctly summarizes the results of selection in this case?

   A. Average birth weight increased; total phenotypic variation decreased; allele frequencies changed
   B. Average birth weight remained the same; total phenotypic variation decreased; allele frequencies changed.
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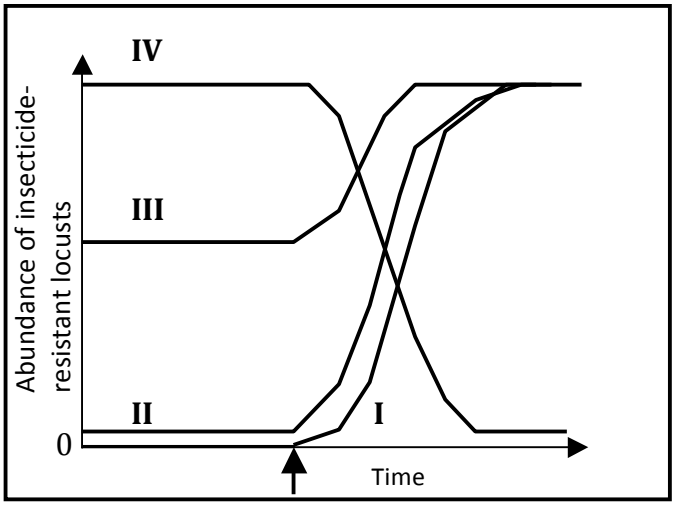
12. Immigration of individuals into a population in Hardy-Weinberg equilibrium will **NOT** alter the equilibrium if

A. females and males are in equal proportions
B. they mate randomly in the new population
C. they bring their offspring with them.
D. they are beyond the age of reproduction
E. all of the above will alter the equilibrium.
F. none of the above will alter the equilibrium.

13. The graph to the right depicts four possible patterns for the abundance of insecticide-resistant locusts in a wheat field population over time. Answer the following question based on the above graph.

If insecticide resistance is metabolically expensive for locusts, then which plot (I-IV) best represents the relative abundance of insecticide-resistant locusts in the population over time, if insecticide application to the wheat field begins at the time indicated by the arrow along the x-axis?



A. I
B. II
C. III
D. IV

14. A biologist doing a long-term study on a wild spider population observes increased variation in silk thickness produced by the spiders. She hypothesizes that the population is experiencing

A. directional selection
B. disruptive selection
C. stabilizing selection
D. sexual selection
E. genetic drift

15. Which of the following illustrates a fitness trade-off?

A. Legs originally evolved in an amphibian-like organism for swimming purposes, but then turned out to be appropriate for locomotion on land.
B. Moths are the best pollinators for datura flowers, but bees are the best pollinators for orchids.
C. In one bird species, the average number of eggs laid by a female at one time is six; in another species, it is ten.
D. Alpine skypilots plants evolve large flowers above the treeline (highest altitude have trees grow) and small flowers below the treeline
E. Garter snakes resistant to the toxin, TTX move more slowly compared to those susceptible to the toxin.
F. Male guppies have brightly coloured fins, whereas female guppies do not.

16. "Survival of the fittest" may be a misleading phrase to describe the process of evolution by natural selection because:

    A. survival matters less to natural selection than does reproductive success does.
    B. it is not possible to determine the fittest individuals in nature.
    C. reproductive success on its own does not necessarily guarantee evolution.
    D. natural variation in a population is generally too great to be influenced by differential survival.
    E. fitness has little to do with natural selection.

17. A population of 500 field mice exhibits black or grey coat colours in approximately equal proportions. An individual mouse has a mutation that results in a brown coat colour; this mutation is passed along to many of its 20 offspring, who also exhibit a brown phenotype. If frequency-dependent selection is operating, which of the following would be true?

    A. Mice within the population would breed nonrandomly to avoid inbreeding depression.
    B. Mice with the brown phenotype would have a higher fitness relative to individuals with black or grey coat colour.
    C. Mice with the brown phenotype would have a lower relative fitness to individuals with black or grey coat colour.
    D. Mice with the brown phenotype would have higher relative fitness if they were heterozygous.
    E. There would be more heterozygous individuals in the population than expected according to HWE.
    F. It is impossible to determine unless the type of selection is known.

18. Why is the Hardy-Weinberg principle useful to biologists?

    A. It is the starting point of all evolutionary studies.
    B. It specifies the conditions that need to be controlled in an evolutionary study.
    C. It specifies what genotype frequencies should be, given measured allele frequencies.
    D. It specifies what should be observed if no evolution is currently occurring at a particular gene.
    E. It specifies what genotypic frequencies should be if non-random mating is occurring.

19. Cystic fibrosis (CF) is a phenotypically recessive disease that in homozygotes causes respiratory and digestive issues, and is often associated with sterility and death at around age 30. A mutation in the CFTR gene $CFTR^{CF}$, is the underlying cause of CF, and the protein it produces confers resistance to typhoid fever. Suppose a drug-resistant form of typhoid fever became common in certain parts of the world, which of the following would you expect?

    A. The frequency of the CFTR^{CF} allele will increase in the population.
    B. The frequency of the CFTR^{CF} allele will decrease in the population.
    C. The frequency of the CFTR^{CF} allele will stay the same in the population.
    D. Homozygotes for either C*FTR* allele will increase in frequency.

20. Given a population that contains genetic variation, what is the correct sequence of the following events, under the influence of natural selection?

    1. Differential reproduction occurs.
    2. A new selective pressure arises.
    3. Allele frequencies within the population change.
    4. Poorly adapted individuals have decreased survivorship.

    A. 2, 4, 1, 3
    B. 4, 2, 1, 3
    C. 4, 1, 2, 3
    D. 4, 2, 3, 1
    E. 2, 4, 3, 1

21. The Dunkers are a religious group that moved from Germany to Pennsylvania in the mid-1700s. (They have rigid marriage customs and are only allowed to marry other members of their group.) They don't marry members outside their own immediate community. Within their community, blood type O, a recessive phenotype is more rare than in the general population. The rarity of blood type O among the Dunkers is most likely the result of

    A. mutation
    B. inbreeding
    C. founder effect
    D. bottleneck effect
    E. natural selection

22. Evolution by natural selection is a powerful force of change. What keeps organisms from becoming perfectly adapted to their environment?

    A. Environments change, so different phenotypes (and thus alleles) become more fit.
    B. Genetic drift causes random changes in allele frequencies.
    C. Mutations introduce new variation into a population.
    D. All of the above processes impede, constrain, or prohibit evolution by natural selection.

23. In some jacana (birds) species, males take care of the eggs and young, and females compete for territories against one to several males. Female jacanas are significantly larger than males. Which of these statements would you predict to be true of this bird species?

    1. Male jacana fitness is primarily limited by ability to take care of eggs and raise young.
    2. Female jacana fitness is limited by the number of males with which a female can mate.
    3. Variation in reproductive success should be greater in male jacanas than in females.
    4. Variation in reproductive success should be greater in female jacanas than in males.
    5. Males and females have similar variation in reproductive success.

    A. 1 and 3
    B. 2 and 4
    C. 1, 2, and 3
    D. 1, 2, and 4
    E. 5 only

24. In many cases, alleles that differ only in the third position of a codon in DNA—and that produce identical proteins and thus identical phenotypes—have become fixed in different human populations. How is this possible?

A. Different alleles (and their associated phenotypes) were selected for in different populations.
B. Over time, mutation led to the fixation of a novel allele in one population.
C. Different alleles drifted to fixation in different populations.
D. Gene flow eliminated all other alleles.
E. The gene in question conforms to Hardy-Weinberg expectations.

25. The lesser boatman is an aquatic insect; although they live underwater, their songs are audible on land from several metres away. Two lesser boatman populations of the same species, living in two neighbouring lakes have slightly different courtship songs. Courtship songs are genetic, but females prefer loud male boatmen to quieter boatmen, but do not distinguish between the two slightly different songs. Predict what will likely happen to the songs of the two boatmen populations after the land between the two lakes is flooded.

A. The songs become more similar to each other.
B. The songs become more different from each other.
C. There is no change in the boatmen courtship songs of the two lakes.
D. It is impossible to predict changes in the songs of the two boatmen populations.

26. How do sexual selection and inbreeding differ?

A. Unlike inbreeding, sexual selection changes allele frequencies and affects only genes involved in attracting mates.
B. Unlike sexual selection, inbreeding changes allele frequencies and involves any mating between relatives, not just self-fertilization.
C. Unlike inbreeding, sexual selection results from the random fusion of gametes during fertilization. It is particularly important in small populations, where few mates are available.
D. Inbreeding occurs only in small populations, while sexual selection can occur in any size population.

27. Many songbirds breed in North America in the spring and summer, and then migrate to Central and South America in the fall. They spend the winter in these warmer areas, where they feed and prepare for the spring migration north, and another breeding season. Two species of sparrows (A and B) overwinter together in mixed flocks in Costa Rica. In the spring, Species A goes to the east coast of North America and Species B goes to the west coast. What can you say about the isolating mechanisms of these two species?

A. They must have strong prezygotic or postzygotic isolating mechanisms in order to spend winter in such close proximity.
B. The two species do not breed in same area, so they are reproductively isolated by allopatry.
C. One of the species is probably polyploid, so they are reproductively isolated by genetic incompatibility.
D. Breeding must be occurring when they winter together.

28. If an organism with 64 chromosomes is crossed with a closely related organism with 62 chromosomes, which of the following would be expected?

    A. Many unhealthy offspring will result due to hybrid breakdown.
    B. Many unhealthy offspring will result due to hybrid inviability.
    C. No offspring will result due to hybrid sterility.
    D. Sterile offspring will result due to hybrid inviability.
    E. Sterile offspring will result due to hybrid sterility.

29. You are given a box of locusts (insects) of various species that are new to science and have not been described. Your assignment is to separate them into species. There is no accompanying information as to where or when they were collected. Which species concept will you have to use?

    A. Biological species concept
    B. Phylogenetic species concept
    C. Ecological species concept
    D. Morphological species concept

30. A species of groundhog spreads through an environmentally varying region surrounding a lake; the different populations, each in their own environments, accumulate habitat-specific traits. However, overlapping populations can breed and produce fertile, fully viable hybrid offspring. This is an example of a

    A. Cline
    B. Sub-cline species
    C. Ring species
    D. Species cluster
    E. Founder effect

31. A small number of birds arrive on an island (Island B) from a neighbouring larger island (Island A). This small population begins to adapt to the new food plants that are available on the island, and over generations their beak shape and size begin to change. About twice a year, a few birds from Island A arrive on Island B. What effect do these new arrivals have?

    A. Their arrival tends to promote adaptation to the new food plants.
    B. Their arrival slows the process of speciation.
    C. Their arrival speeds the process of speciation.
    D. Their arrival represents a colonizing event.

PART B:

THIS MUST BE FILLED OUT OR THIS PAGE WILL NOT BE MARKED.	NAME	STUDENT NUMBER	LAB SECTION (e.g., M10)

SHORT-ANSWER QUESTIONS

- **ANSWER IN THE SPACE PROVIDED**
- **Write /print clearly and neatly. We can't grade what we can't read.**
- **Write/print ONLY in the boxes provided. Anything written outside the boxes will not be graded.**
- **Complete your answers in pen. Answers completed in pencil will be marked, but are not eligible for re-evaluation.**
- **DO NOT REPEAT THE QUESTION IN YOUR ANSWER. (We already know what the question is.)**

1. Ear length in rabbits is determined by one gene and longer ears help to detect predators better.

i) (1 mark) If ear length gradually changes over time, what change do we expect to see in the population? Write only in the box below.

Should see an increase in frequency/proportion of rabbits in the population with longer ears. (The trait of longer ears increases in frequency.)

ii) (1 mark) If predators become more abundant, will more mutations occur that allow ear length to increase? Explain your answer. Write only in the box below.

No. (0.25) Mutations are random (0.5) – they don't occur because the organism needs them (0.25) (for that 0.25 could mention that natural selection will act such that the frequency of rabbits with longer ears increases in frequency in the population)

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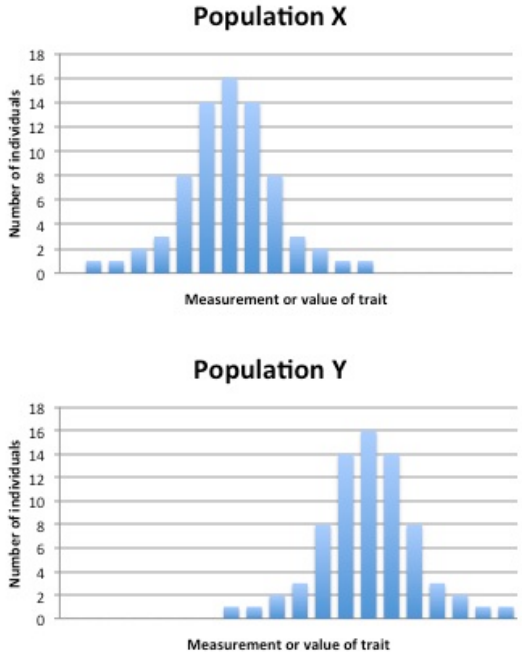

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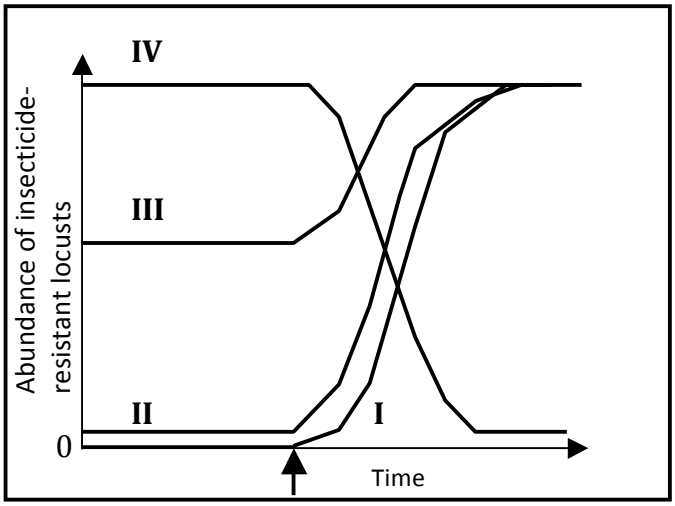
D. natural variation in a population is generally too great to be influenced by differential survival.
E. fitness has little to do with natural selection.

17. Why is the Hardy-Weinberg principle useful to biologists?

A. It is the starting point of all evolutionary studies.
B. It specifies the conditions that need to be controlled in an evolutionary study.
C. It specifies what genotype frequencies should be, given measured allele frequencies.
D. It specifies what should be observed if no evolution is currently occurring at a particular gene.
E. It specifies what genotypic frequencies should be if non-random mating is occurring.

18. The graph to the right depicts four possible patterns for the abundance of insecticide-resistant locusts in a wheat field population over time. Answer the following question based on the above graph.



If insecticide resistance is metabolically expensive for locusts, then which plot (I-IV) best represents the relative abundance of insecticide-resistant locusts in the population over time, if insecticide application to the wheat field begins at the time indicated by the arrow along the x-axis?

A. I
B. II
C. III
D. IV

19. Cystic fibrosis (CF) is a phenotypically recessive disease that in homozygotes causes respiratory and digestive issues, and is often associated with sterility and death at around age 30. A mutation in the CFTR gene $CFTR^{CF}$, is the underlying cause of CF, and the protein it produces confers resistance to typhoid fever. Suppose a drug-resistant form of typhoid fever became common in certain parts of the world, which of the following would you expect?

A. The frequency of the CFTR^{CF} allele will decrease in the population.
B. The frequency of the CFTR^{CF} allele will stay the same in the population.
C. The frequency of the CFTR^{CF} allele will increase in the population.
D. Homozygotes for either C*FTR* allele will increase in frequency.

20. A small number of birds arrive on an island (Island B) from a neighbouring larger island (Island A). This small population begins to adapt to the new food plants that are available on the island, and over generations their beak shape and size begin to change. About twice a year, a few birds from Island A arrive on Island B. What effect do these new arrivals have?

A. Their arrival tends to promote adaptation to the new food plants.
B. Their arrival speeds the process of speciation.
C. Their arrival slows the process of speciation.
D. Their arrival represents a colonizing event.

21. The lesser boatman is an aquatic insect; although they live underwater, their songs are audible on land from several metres away. Two lesser boatman populations of the same species, living in two neighbouring lakes have slightly different courtship songs. Courtship songs are genetic, but females prefer loud male boatmen to quieter boatmen, but do not distinguish between the two slightly different songs. Predict what will likely happen to the songs of the two boatmen populations after the land between the two lakes is flooded.

A. There is no change in the boatmen courtship songs of the two lakes.
B. It is impossible to predict changes in the songs of the two boatmen populations.
C. The songs become more similar to each other.
D. The songs become more different from each other.

22. Given a population that contains genetic variation, what is the correct sequence of the following events, under the influence of natural selection?

    1. Differential reproduction occurs.
    2. A new selective pressure arises.
    3. Allele frequencies within the population change.
    4. Poorly adapted individuals have decreased survivorship.

A. 2, 4, 1, 3
B. 4, 2, 1, 3
C. 4, 1, 2, 3
D. 4, 2, 3, 1
E. 2, 4, 3, 1

23. A population of 500 field mice exhibits black or grey coat colours in approximately equal proportions. An individual mouse has a mutation that results in a brown coat colour; this mutation is passed along to many of its 20 offspring, who also exhibit a brown phenotype. If frequency-dependent selection is operating, which of the following would be true?

A. Mice within the population would breed nonrandomly to avoid inbreeding depression.
B. There would be more heterozygous individuals in the population than expected according to HWE.
C. It is impossible to determine unless the type of selection is known.
D. Mice with the brown phenotype would have a higher fitness relative to individuals with black or grey coat colour.
E. Mice with the brown phenotype would have a lower relative fitness to individuals with black or grey coat colour.
F. Mice with the brown phenotype would have higher relative fitness if they were heterozygous.

24. The Dunkers are a religious group that moved from Germany to Pennsylvania in the mid-1700s. (They have rigid marriage customs and are only allowed to marry other members of their group.) They don't marry members outside their own immediate community. Within their community, blood type O, a recessive phenotype is more rare than in the general population. The rarity of blood type O among the Dunkers is most likely the result of

A. natural selection
B. founder effect
C. mutation
D. inbreeding
E. bottleneck effect

25. In many cases, alleles that differ only in the third position of a codon in DNA—and that produce identical proteins and thus identical phenotypes—have become fixed in different human populations. How is this possible?

A. Different alleles (and their associated phenotypes) were selected for in different populations.
B. Gene flow eliminated all other alleles.
C. Over time, mutation led to the fixation of a novel allele in one population.
D. Different alleles drifted to fixation in different populations.
E. The gene in question conforms to Hardy-Weinberg expectations.

26. In some jacana (birds) species, males take care of the eggs and young, and females compete for territories against one to several males. Female jacanas are significantly larger than males. Which of these statements would you predict to be true of this bird species?

    1. Male jacana fitness is primarily limited by ability to take care of eggs and raise young.
    2. Female jacana fitness is limited by the number of males with which a female can mate.
    3. Variation in reproductive success should be greater in male jacanas than in females.
    4. Variation in reproductive success should be greater in female jacanas than in males.
    5. Males and females have similar variation in reproductive success.

    A. 2 and 4
    B. 1 and 3
    C. 1, 2, and 3
    D. 1, 2, and 4
    E. 5 only

27. How do sexual selection and inbreeding differ?

    A. Unlike inbreeding, sexual selection results from the random fusion of gametes during fertilization. It is particularly important in small populations, where few mates are available.
    B. Unlike inbreeding, sexual selection changes allele frequencies and affects only genes involved in attracting mates.
    C. Unlike sexual selection, inbreeding changes allele frequencies and involves any mating between relatives, not just self-fertilization.
    D. Inbreeding occurs only in small populations, while sexual selection can occur in any size population.

28. Many songbirds breed in North America in the spring and summer, and then migrate to Central and South America in the fall. They spend the winter in these warmer areas, where they feed and prepare for the spring migration north, and another breeding season. Two species of sparrows (A and B) overwinter together in mixed flocks in Costa Rica. In the spring, Species A goes to the east coast of North America and Species B goes to the west coast. What can you say about the isolating mechanisms of these two species?

    A. They must have strong prezygotic or postzygotic isolating mechanisms in order to spend winter in such close proximity.
    B. Breeding must be occurring when they winter together.
    C. The two species do not breed in same area, so they are reproductively isolated by allopatry.
    D. One of the species is probably polyploid, so they are reproductively isolated by genetic incompatibility.

29. If an organism with 64 chromosomes is crossed with a closely related organism with 62 chromosomes, which of the following would be expected?

    A. No offspring will result due to hybrid sterility.
    B. Sterile offspring will result due to hybrid inviability.
    C. Sterile offspring will result due to hybrid sterility.
    D. Many unhealthy offspring will result due to hybrid breakdown.
    E. Many unhealthy offspring will result due to hybrid inviability.

30. You are given a box of locusts (insects) of various species that are new to science and have not been described. Your assignment is to separate them into species. There is no accompanying information as to where or when they were collected. Which species concept will you have to use?

    A. Biological species concept
    B. Ecological species concept
    C. Morphological species concept
    D. Phylogenetic species concept

31. A species of groundhog spreads through an environmentally varying region surrounding a lake; the different populations, each in their own environments, accumulate habitat-specific traits. However, overlapping populations can breed and produce fertile, fully viable hybrid offspring. This is an example of a

    A. Cline
    B. Species cluster
    C. Founder effect
    D. Sub-cline species
    E. Ring species

PART B:

THIS MUST BE FILLED OUT OR THIS PAGE WILL NOT BE MARKED.	NAME	STUDENT NUMBER	LAB SECTION (e.g., M10)

SHORT-ANSWER QUESTIONS

- **ANSWER IN THE SPACE PROVIDED**
- **Write /print clearly and neatly. We can't grade what we can't read.**
- **Write/print ONLY in the boxes provided. Anything written outside the boxes will not be graded.**
- **Complete your answers in pen. Answers completed in pencil will be marked, but are not eligible for re-evaluation.**
- **DO NOT REPEAT THE QUESTION IN YOUR ANSWER. (We already know what the question is.)**

1. Ear length in rabbits is determined by one gene and longer ears help to detect predators better.

i) (1 mark) If ear length gradually changes over time, what change do we expect to see in the population? Write only in the box below.

ii) (1 mark) If predators become more abundant, will more mutations occur that allow ear length to increase? Explain your answer. Write only in the box below.

W2012 SC/BIOL 1001 3.0 Midterm II - March 9, 2012

Section M – Version C

This test consists of **31 multiple choice items** (section and version indicators – these do not count in the score but must be completed) and **1 short-answer questions**. There are **10 pages**. This test is **50 minutes** long.

The entire question booklet and your scantron must be submitted to receive a grade. **Indicate your full name and student number on the scantron and on this page. (Please double-check your student number bubbling.)** Be sure to sign the sign-in sheet. **Your name must be written in permanent ink in all places.**

Please **answer all questions on the scantron**. Choose **the single best answer** out of the options for each question. Read each question (and all possible answers) carefully.

Calculators, cell phones, mp3 players and other electronic devices are NOT permitted, and must be put away.

Students are reminded of the Code of Conduct agreement signed at the beginning of the course, in particular: "***I understand York University's Senate Policy on Academic Honesty and will abide by this policy (avoiding cheating, plagiarism and other forms of academic dishonesty).***"

Invigilators reserve the right to move students during the test. This may not reflect any suspicion of you (e.g., someone behind you may be looking at your paper). However, please note that aiding and abetting cheating is considered an academic honesty offense in itself.

IF YOU HAVE NOT FINISHED BY 2:10 PM, YOU MUST REMAIN AT YOUR SEAT UNTIL THE EXAM IS OVER AND YOUR TEST HAS BEEN PICKED UP.

Good luck!

Last name	First name
Student number	

MUST BE FILLED OUT IN PEN.

YOU MUST ALSO FILL IN YOUR NAME AND STUDENT NUMBER ON THE LAST PAGE FOR THE SHORT ANSWER. THIS PAGE WILL BE DETACHED FROM THE REMAINDER OF THE EXAM; THUS, IT IS IMPERATIVE THAT YOU IDENTIFY IT! (SAME THING AS BIOL 1000!!!)

Please check that you have bubbled your student number correctly on the scantron. Choose one answer for each question.

1. You are in Section **M** – please indicate this by filling in "B" on the scantron. (If you are NOT in Section M, see an invigilator immediately.)

   A. No **X**
   B. **Pick me**!!! ✓
   C. No **X**
   D. No **X**
   E. No **X**

2. You have exam version **C**, which must be indicated on the scantron to get credit for test questions.

   A. No **X**
   B. No **X**
   C. **Pick me**!!! ✓
   D. No **X**
   E. No **X**

3. All of the following statements are true about mutations **EXCEPT**:

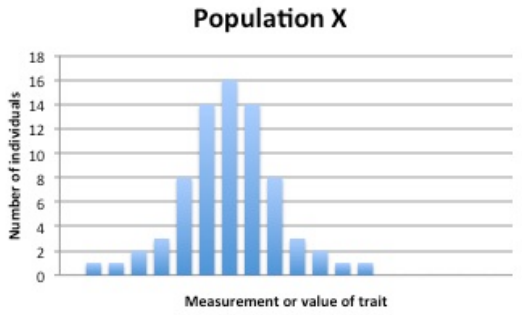
   A. Mutations are random with respect to the needs of the organism.
   B. Most mutations are harmful or neutral to the organism in which they occur.
   C. The origin of genetic variation is mutation.
   D. The mutation rate can be affected by genetic drift.
   E. Inbreeding can result in an increase in deleterious alleles.
   F. All of the above statements are true about mutations.

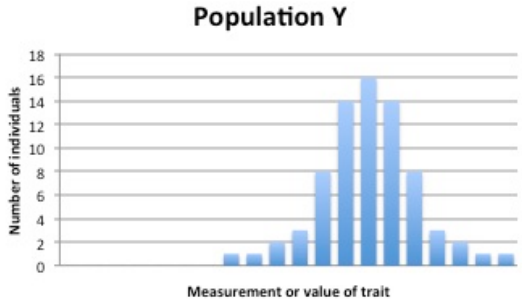
4. After an extreme drought on Daphne Minoret, a Galápagos island, in 1975, medium ground finches with large, deep beaks survived better than those with smaller beaks because they could more easily crack and eat the tough *Tribulus cistoides* fruits. In the late 1980s, tourist companies start visiting the island. The companies set up reliable feeding stations with a variety of different types and sizes of birdseeds, so that tourists can get a better look at the finches. Given this, which of the following is most likely to occur to finches on Daphne Minoret?

   A. Increased variation in beak size and shape over time
   B. Evolution of yet larger, deeper beaks over time, until all birds have relatively large, deep beaks
   C. Evolution of smaller, pointier beaks over time, until all birds have relatively small, pointy beaks
   D. No change in beak size and shape over time

5. The frequency of the B_1 allele (for an autosomal gene) in a population that is in Hardy-Weinberg equilibrium is 0.2 and the frequency of the B_2 allele is 0.8. The phenotype of allele B_1 is dominant to that of B_2. If females make up exactly half of the population, what is the frequency of the B_1 allele in the female population alone?

   A. 0.1
   B. 0.2
   C. 0.4
   D. 0.8
   E. Need to know if this trait is sex-linked.





6. Examine the above graphs, which describe variation for the same trait in Populations X and Y. What can you conclude based on the information in the graphs?

   A. Population X exhibits more variation than Population Y for this trait.
   B. Population Y exhibits more variation than Population X for this trait.
   C. Both populations exhibit the same amount of variation for this trait.
   D. Both populations have the same mean (average) value for this trait.
   E. Both A and B.
   F. Both B and C.

7. Recombination, due to crossing over occurs during meiosis I. The resulting allele combinations are called recombinants. Natural selection and recombination due to crossing over during meiosis I are related in which of the following ways?

   A. Non-recombinant organisms are usually favoured by natural selection if there is environmental change.
   B. Recombinants are usually selected against.
   C. Recombinants may have combinations of traits that are favoured by natural selection.
   D. Recombination does not affect natural selection

8. Which statement about allele frequencies is **NOT** true?

   A. The sum of all allele frequencies at a locus is always 1.
   B. If there are two alleles at a locus and we know the frequency of one of them, we can determine the frequency of the other.
   C. If two populations have the same allele frequencies for a locus, they will have the same proportion of homozygotes for that locus.
   D. If an allele is missing from a population, its frequency in that population is 0.
   E. If an allele is fixed, its frequency is 1.

9. In some human populations, birth weight depends, in part, on variation in alleles, and babies of intermediate weight survive best. Which of the following statements correctly summarizes the results of selection in this case?

   A. Average birth weight decreased; total phenotypic variation remained the same; allele frequencies did not change.
   B. Average birth weight increased; total phenotypic variation decreased; allele frequencies changed
   C. Average birth weight remained the same; total phenotypic variation decreased; allele frequencies changed.
   D. Average birth weight remained the same; total phenotypic variation decreased; allele frequencies did not change.
   E. Average birth weight remained the same; total phenotypic variation remained the same; allele frequencies did not change.

10. Given a population that contains genetic variation, what is the correct sequence of the following events, under the influence of natural selection?

    1. Differential reproduction occurs.
    2. A new selective pressure arises.
    3. Allele frequencies within the population change.
    4. Poorly adapted individuals have decreased survivorship.

   A. 2, 4, 1, 3
   B. 4, 2, 1, 3
   C. 4, 1, 2, 3
   D. 4, 2, 3, 1
   E. 2, 4, 3, 1

11. The Dunkers are a religious group that moved from Germany to Pennsylvania in the mid-1700s. (They have rigid marriage customs and are only allowed to marry other members of their group.) They don't marry members outside their own immediate community. Within their community, blood type O, a recessive phenotype is more rare than in the general population. The rarity of blood type O among the Dunkers is most likely the result of

   A. mutation
   B. inbreeding
   C. bottleneck effect
   D. founder effect
   E. natural selection

12. Evolution by natural selection is a powerful force of change. What keeps organisms from becoming perfectly adapted to their environment?

A. Mutations introduce new variation into a population.
B. Environments change, so different phenotypes (and thus alleles) become more fit.
C. Genetic drift causes random changes in allele frequencies.
D. All of the above processes impede, constrain, or prohibit evolution by natural selection.

13. Immigration of individuals into a population in Hardy-Weinberg equilibrium will **NOT** alter the equilibrium if

A. they are beyond the age of reproduction
B. females and males are in equal proportions
C. they mate randomly in the new population
D. they bring their offspring with them.
E. all of the above will alter the equilibrium.
F. none of the above will alter the equilibrium.

14. A woodland plant has flowers that vary from white to light red to red. Because the bee pollinators prefer red to white flowers, the plants with red flowers produce more fruit than plants with white flowers. Nevertheless, the percentage of different flower colours remains stable in the study population from year to year. This would indicate that

A. red flowers must be adapted for pollination by bees.
B. natural selection cannot preferentially select any of the flower colours.
C. the relative abundance of the flower colour is genetically determined.
D. fitness is primarily determined by fruit flower colour in this species.
E. flower colour exhibits qunatitative variation.

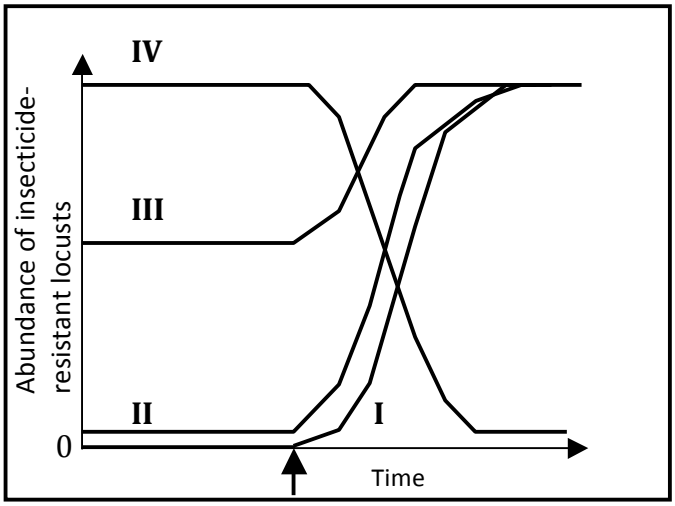
15. Until recently, evolutionary theory stressed genetic mutations that alter protein amino acid sequences are a major source of variation that leads to speciation. Evo-devo (evolutionary developmental biology) offers a different understanding of the role of genetic change in evolution. Which of the following statements best summarizes this understanding?

A. Similar genes are found in most developing animal bodies; changes in the times and places they are expressed can lead to phenotypic variation.
B. Genetic mutations are not as important in evolutionary change as the environment in which the organism develops.
C. Changes in cell-cell interactions in a parent's body can lead to phenotypic change in offspring.
D. Greater numbers of genes, rather than the ways in which they are regulated, leads to the development of more complex animals over time.

16. A biologist doing a long-term study on a wild spider population observes increased variation in silk thickness produced by the spiders. She hypothesizes that the population is experiencing

A. sexual selection
B. genetic drift
C. disruptive selection
D. directional selection
E. stabilizing selection

17. The graph to the right depicts four possible patterns for the abundance of insecticide-resistant locusts in a wheat field population over time. Answer the following question based on the above graph.



If insecticide resistance is metabolically expensive for locusts, then which plot (I-IV) best represents the relative abundance of insecticide-resistant locusts in the population over time, if insecticide application to the wheat field begins at the time indicated by the arrow along the x-axis?

A. I
B. II
C. III
D. IV

18. Which of the following illustrates a fitness trade-off?

A. In one bird species, the average number of eggs laid by a female at one time is six; in another species, it is ten.
B. Alpine skypilots plants evolve large flowers above the treeline (highest altitude have trees grow) and small flowers below the treeline
C. Garter snakes resistant to the toxin, TTX move more slowly compared to those susceptible to the toxin.
D. Legs originally evolved in an amphibian-like organism for swimming purposes, but then turned out to be appropriate for locomotion on land.
E. Moths are the best pollinators for datura flowers, but bees are the best pollinators for orchids.
F. Male guppies have brightly coloured fins, whereas female guppies do not.

19. "Survival of the fittest" may be a misleading phrase to describe the process of evolution by natural selection because:

A. reproductive success on its own does not necessarily guarantee evolution.
B. natural variation in a population is generally too great to be influenced by differential survival.
C. fitness has little to do with natural selection.
D. survival matters less to natural selection than does reproductive success does.
E. it is not possible to determine the fittest individuals in nature.

20. Why is the Hardy-Weinberg principle useful to biologists?

A. It is the starting point of all evolutionary studies.
B. It specifies the conditions that need to be controlled in an evolutionary study.
C. It specifies what genotype frequencies should be, given measured allele frequencies.
D. It specifies what should be observed if no evolution is currently occurring at a particular gene.
E. It specifies what genotypic frequencies should be if non-random mating is occurring.

21. A population of 500 field mice exhibits black or grey coat colours in approximately equal proportions. An individual mouse has a mutation that results in a brown coat colour; this mutation is passed along to many of its 20 offspring, who also exhibit a brown phenotype. If frequency-dependent selection is operating, which of the following would be true?

    A. There would be more heterozygous individuals in the population than expected according to HWE.
    B. It is impossible to determine unless the type of selection is known.
    C. Mice within the population would breed nonrandomly to avoid inbreeding depression.
    D. Mice with the brown phenotype would have a higher fitness relative to individuals with black or grey coat colour.
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    A. The frequency of the CFTR^{CF} allele will decrease in the population.
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23. If an organism with 64 chromosomes is crossed with a closely related organism with 62 chromosomes, which of the following would be expected?

    A. Many unhealthy offspring will result due to hybrid breakdown.
    B. Many unhealthy offspring will result due to hybrid inviability.
    C. Sterile offspring will result due to hybrid inviability.
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    E. No offspring will result due to hybrid sterility.

24. You are given a box of locusts (insects) of various species that are new to science and have not been described. Your assignment is to separate them into species. There is no accompanying information as to where or when they were collected. Which species concept will you have to use?

    A. Biological species concept
    B. Phylogenetic species concept
    C. Morphological species concept
    D. Ecological species concept

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A. Species cluster
B. Cline
C. Sub-cline species
D. Ring species
E. Founder effect

27. A small number of birds arrive on an island (Island B) from a neighbouring larger island (Island A). This small population begins to adapt to the new food plants that are available on the island, and over generations their beak shape and size begin to change. About twice a year, a few birds from Island A arrive on Island B. What effect do these new arrivals have?

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B. Their arrival slows the process of speciation.
C. Their arrival represents a colonizing event.
D. Their arrival speeds the process of speciation.

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29. The lesser boatman is an aquatic insect; although they live underwater, their songs are audible on land from several metres away. Two lesser boatman populations of the same species, living in two neighbouring lakes have slightly different courtship songs. Courtship songs are genetic, but females prefer loud male boatmen to quieter boatmen, but do not distinguish between the two slightly different songs. Predict what will likely happen to the songs of the two boatmen populations after the land between the two lakes is flooded.

    A. There is no change in the boatmen courtship songs of the two lakes.
    B. The songs become more similar to each other.
    C. The songs become more different from each other.
    D. It is impossible to predict changes in the songs of the two boatmen populations.

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    A. Unlike inbreeding, sexual selection changes allele frequencies and affects only genes involved in attracting mates.
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    C. Unlike sexual selection, inbreeding changes allele frequencies and involves any mating between relatives, not just self-fertilization.
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    A. Breeding must be occurring when they winter together.
    B. They must have strong prezygotic or postzygotic isolating mechanisms in order to spend winter in such close proximity.
    C. The two species do not breed in same area, so they are reproductively isolated by allopatry.
    D. One of the species is probably polyploid, so they are reproductively isolated by genetic incompatibility.

PART B:

THIS MUST BE FILLED OUT OR THIS PAGE WILL NOT BE MARKED.	NAME	STUDENT NUMBER	LAB SECTION (e.g., M10)

SHORT-ANSWER QUESTIONS

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- **Write /print clearly and neatly. We can't grade what we can't read.**
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- **DO NOT REPEAT THE QUESTION IN YOUR ANSWER. (We already know what the question is.)**

1. Ear length in rabbits is determined by one gene and longer ears help to detect predators better.

i) (1 mark) If ear length gradually changes over time, what change do we expect to see in the population? Write only in the box below.

ii) (1 mark) If predators become more abundant, will more mutations occur that allow ear length to increase? Explain your answer. Write only in the box below.

W2012 SC/BIOL 1001 3.0 Midterm II - March 9, 2012

Section M – Version D

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Please **answer all questions on the scantron**. Choose **the single best answer** out of the options for each question. Read each question (and all possible answers) carefully.

Calculators, cell phones, mp3 players and other electronic devices are NOT permitted, and must be put away.

Students are reminded of the Code of Conduct agreement signed at the beginning of the course, in particular: "***I understand York University's Senate Policy on Academic Honesty and will abide by this policy (avoiding cheating, plagiarism and other forms of academic dishonesty).***"

Invigilators reserve the right to move students during the test. This may not reflect any suspicion of you (e.g., someone behind you may be looking at your paper). However, please note that aiding and abetting cheating is considered an academic honesty offense in itself.

IF YOU HAVE NOT FINISHED BY 2:10 PM, YOU MUST REMAIN AT YOUR SEAT UNTIL THE EXAM IS OVER AND YOUR TEST HAS BEEN PICKED UP.

Good luck!

Last name	First name
Student number	

MUST BE FILLED OUT IN PEN.

YOU MUST ALSO FILL IN YOUR NAME AND STUDENT NUMBER ON THE LAST PAGE FOR THE SHORT ANSWER. THIS PAGE WILL BE DETACHED FROM THE REMAINDER OF THE EXAM; THUS, IT IS IMPERATIVE THAT YOU IDENTIFY IT! (SAME THING AS BIOL 1000!!!)

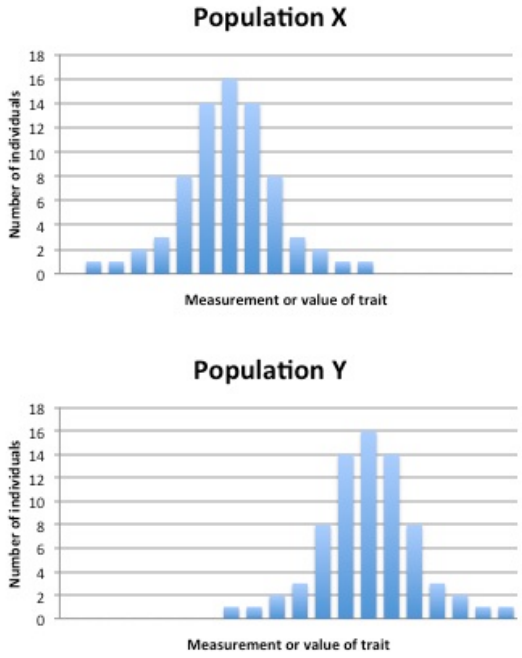
Please check that you have bubbled your student number correctly on the scantron. Choose one answer for each question.

1. You are in Section **M** – please indicate this by filling in "B" on the scantron. (If you are NOT in Section M, see an invigilator immediately.)

   A. No **X**
   B. **Pick me**!!! ✓
   C. No **X**
   D. No **X**
   E. No **X**

2. You have exam version **D**, which must be indicated on the scantron to get credit for test questions.

   A. No **X**
   B. No **X**
   C. No **X**
   D. **Pick me**!!! ✓
   E. No **X**



3. Examine the above graphs, which describe variation for the same trait in Populations X and Y. What can you conclude based on the information in the graphs?

   A. Both populations have the same mean (average) value for this trait.
   B. Both populations exhibit the same amount of variation for this trait.
   C. Population X exhibits more variation than Population Y for this trait.
   D. Population Y exhibits more variation than Population X for this trait.
   E. Both A and B.
   F. Both B and C.

4. A woodland plant has flowers that vary from white to light red to red. Because the bee pollinators prefer red to white flowers, the plants with red flowers produce more fruit than plants with white flowers. Nevertheless, the percentage of different flower colours remains stable in the study population from year to year. This would indicate that

   A. red flowers must be adapted for pollination by bees.
   B. the relative abundance of the flower colour is genetically determined.
   C. natural selection cannot preferentially select any of the flower colours.
   D. flower colour exhibits qunatitative variation.
   E. fitness is primarily determined by fruit flower colour in this species.

5. Until recently, evolutionary theory stressed genetic mutations that alter protein amino acid sequences are a major source of variation that leads to speciation. Evo-devo (evolutionary developmental biology) offers a different understanding of the role of genetic change in evolution. Which of the following statements best summarizes this understanding?

   A. Genetic mutations are not as important in evolutionary change as the environment in which the organism develops.
   B. Changes in cell-cell interactions in a parent's body can lead to phenotypic change in offspring.
   C. Similar genes are found in most developing animal bodies; changes in the times and places they are expressed can lead to phenotypic variation.
   D. Greater numbers of genes, rather than the ways in which they are regulated, leads to the development of more complex animals over time.

6. The frequency of the B_1 allele (for an autosomal gene) in a population that is in Hardy-Weinberg equilibrium is 0.2 and the frequency of the B_2 allele is 0.8. The phenotype of allele B_1 is dominant to that of B_2. If females make up exactly half of the population, what is the frequency of the B_1 allele in the female population alone?

   A. 0.1
   B. 0.2
   C. 0.4
   D. 0.8
   E. Need to know if this trait is sex-linked.

7. Recombination, due to crossing over occurs during meiosis I. The resulting allele combinations are called recombinants. Natural selection and recombination due to crossing over during meiosis I are related in which of the following ways?

   A. Recombinants are usually selected against.
   B. Recombinants may have combinations of traits that are favoured by natural selection.
   C. Recombination does not affect natural selection
   D. Non-recombinant organisms are usually favoured by natural selection if there is environmental change.

8. All of the following statements are true about mutations **EXCEPT**:

   A. Mutations are random with respect to the needs of the organism.
   B. The origin of genetic variation is mutation.
   C. The mutation rate can be affected by genetic drift.
   D. Most mutations are harmful or neutral to the organism in which they occur.
   E. Inbreeding can result in an increase in deleterious alleles.
   F. All of the above statements are true about mutations.

9. After an extreme drought on Daphne Minoret, a Galápagos island, in 1975, medium ground finches with large, deep beaks survived better than those with smaller beaks because they could more easily crack and eat the tough *Tribulus cistoides* fruits. In the late 1980s, tourist companies start visiting the island. The companies set up reliable feeding stations with a variety of different types and sizes of birdseeds, so that tourists can get a better look at the finches. Given this, which of the following is most likely to occur to finches on Daphne Minoret?

   A. Evolution of yet larger, deeper beaks over time, until all birds have relatively large, deep beaks
   B. Evolution of smaller, pointier beaks over time, until all birds have relatively small, pointy beaks
   C. Increased variation in beak size and shape over time
   D. No change in beak size and shape over time

10. Which statement about allele frequencies is **NOT** true?

   A. The sum of all allele frequencies at a locus is always 1.
   B. If there are two alleles at a locus and we know the frequency of one of them, we can determine the frequency of the other.
   C. If an allele is missing from a population, its frequency in that population is 0.
   D. If two populations have the same allele frequencies for a locus, they will have the same proportion of homozygotes for that locus.
   E. If an allele is fixed, its frequency is 1.

11. Given a population that contains genetic variation, what is the correct sequence of the following events, under the influence of natural selection?

   1. Differential reproduction occurs.
   2. A new selective pressure arises.
   3. Allele frequencies within the population change.
   4. Poorly adapted individuals have decreased survivorship.

   A. 2, 4, 1, 3
   B. 4, 2, 1, 3
   C. 4, 1, 2, 3
   D. 4, 2, 3, 1
   E. 2, 4, 3, 1

12. In some human populations, birth weight depends, in part, on variation in alleles, and babies of intermediate weight survive best. Which of the following statements correctly summarizes the results of selection in this case?

A. Average birth weight increased; total phenotypic variation decreased; allele frequencies changed
B. Average birth weight remained the same; total phenotypic variation decreased; allele frequencies changed.
C. Average birth weight remained the same; total phenotypic variation decreased; allele frequencies did not change.
D. Average birth weight decreased; total phenotypic variation remained the same; allele frequencies did not change.
E. Average birth weight remained the same; total phenotypic variation remained the same; allele frequencies did not change.

13. Immigration of individuals into a population in Hardy-Weinberg equilibrium will **NOT** alter the equilibrium if

A. females and males are in equal proportions
B. they mate randomly in the new population
C. they bring their offspring with them.
D. they are beyond the age of reproduction
E. all of the above will alter the equilibrium.
F. none of the above will alter the equilibrium.

14. The Dunkers are a religious group that moved from Germany to Pennsylvania in the mid-1700s. (They have rigid marriage customs and are only allowed to marry other members of their group.) They don't marry members outside their own immediate community. Within their community, blood type O, a recessive phenotype is more rare than in the general population. The rarity of blood type O among the Dunkers is most likely the result of

A. mutation
B. inbreeding
C. founder effect
D. bottleneck effect
E. natural selection

15. In some jacana (birds) species, males take care of the eggs and young, and females compete for territories against one to several males. Female jacanas are significantly larger than males. Which of these statements would you predict to be true of this bird species?

1. Male jacana fitness is primarily limited by ability to take care of eggs and raise young.
2. Female jacana fitness is limited by the number of males with which a female can mate.
3. Variation in reproductive success should be greater in male jacanas than in females.
4. Variation in reproductive success should be greater in female jacanas than in males.
5. Males and females have similar variation in reproductive success.

A. 1 and 3
B. 2 and 4
C. 1, 2, and 3
D. 1, 2, and 4
E. 5 only

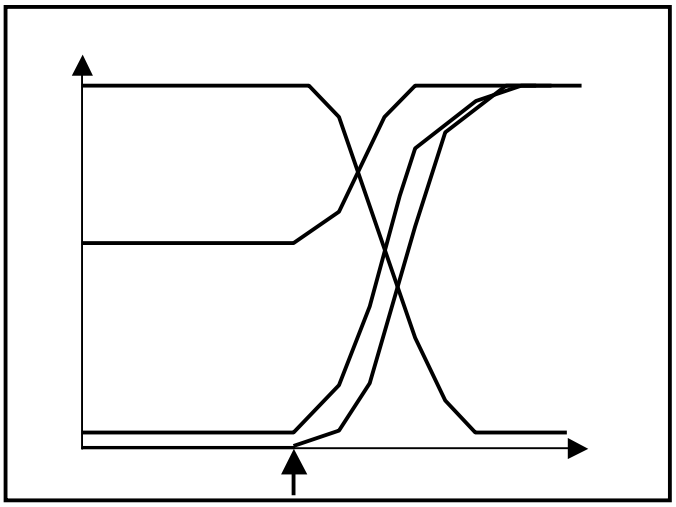
16. Evolution by natural selection is a powerful force of change. What keeps organisms from becoming perfectly adapted to their environment?

A. Environments change, so different phenotypes (and thus alleles) become more fit.
B. Genetic drift causes random changes in allele frequencies.
C. Mutations introduce new variation into a population.
D. All of the above processes impede, constrain, or prohibit evolution by natural selection.

17. In many cases, alleles that differ only in the third position of a codon in DNA—and that produce identical proteins and thus identical phenotypes—have become fixed in different human populations. How is this possible?

A. Different alleles (and their associated phenotypes) were selected for in different populations.
B. Over time, mutation led to the fixation of a novel allele in one population.
C. Different alleles drifted to fixation in different populations.
D. Gene flow eliminated all other alleles.
E. The gene in question conforms to Hardy-Weinberg expectations.

18. The graph to the right depicts four possible patterns for the abundance of insecticide-resistant locusts in a wheat field population over time. Answer the following question based on the above graph.



If insecticide resistance is metabolically expensive for locusts, then which plot (I-IV) best represents the relative abundance of insecticide-resistant locusts in the population over time, if insecticide application to the wheat field begins at the time indicated by the arrow along the x-axis?

A. I
B. II
C. III
D. IV

19. A population of 500 field mice exhibits black or grey coat colours in approximately equal proportions. An individual mouse has a mutation that results in a brown coat colour; this mutation is passed along to many of its 20 offspring, who also exhibit a brown phenotype. If frequency-dependent selection is operating, which of the following would be true?

A. Mice within the population would breed nonrandomly to avoid inbreeding depression.
B. Mice with the brown phenotype would have a higher fitness relative to individuals with black or grey coat colour.
C. Mice with the brown phenotype would have a lower relative fitness to individuals with black or grey coat colour.
D. Mice with the brown phenotype would have higher relative fitness if they were heterozygous.
E. There would be more heterozygous individuals in the population than expected according to HWE.
F. It is impossible to determine unless the type of selection is known.

20. The lesser boatman is an aquatic insect; although they live underwater, their songs are audible on land from several metres away. Two lesser boatman populations of the same species, living in two neighbouring lakes have slightly different courtship songs. Courtship songs are genetic, but females prefer loud male boatmen to quieter boatmen, but do not distinguish between the two slightly different songs. Predict what will likely happen to the songs of the two boatmen populations after the land between the two lakes is flooded.

    A. The songs become more similar to each other.
    B. The songs become more different from each other.
    C. There is no change in the boatmen courtship songs of the two lakes.
    D. It is impossible to predict changes in the songs of the two boatmen populations.

21. A biologist doing a long-term study on a wild spider population observes increased variation in silk thickness produced by the spiders. She hypothesizes that the population is experiencing

    A. directional selection
    B. disruptive selection
    C. stabilizing selection
    D. sexual selection
    E. genetic drift

22. Which of the following illustrates a fitness trade-off?

    A. Legs originally evolved in an amphibian-like organism for swimming purposes, but then turned out to be appropriate for locomotion on land.
    B. Moths are the best pollinators for datura flowers, but bees are the best pollinators for orchids.
    C. In one bird species, the average number of eggs laid by a female at one time is six; in another species, it is ten.
    D. Alpine skypilots plants evolve large flowers above the treeline (highest altitude have trees grow) and small flowers below the treeline
    E. Garter snakes resistant to the toxin, TTX move more slowly compared to those susceptible to the toxin.
    F. Male guppies have brightly coloured fins, whereas female guppies do not.

23. “Survival of the fittest” may be a misleading phrase to describe the process of evolution by natural selection because:

    A. survival matters less to natural selection than does reproductive success does.
    B. it is not possible to determine the fittest individuals in nature.
    C. reproductive success on its own does not necessarily guarantee evolution.
    D. natural variation in a population is generally too great to be influenced by differential survival.
    E. fitness has little to do with natural selection.

24. Why is the Hardy-Weinberg principle useful to biologists?

    A. It is the starting point of all evolutionary studies.
    B. It specifies the conditions that need to be controlled in an evolutionary study.
    C. It specifies what genotype frequencies should be, given measured allele frequencies.
    D. It specifies what should be observed if no evolution is currently occurring at a particular gene.
    E. It specifies what genotypic frequencies should be if non-random mating is occurring.

25. Cystic fibrosis (CF) is a phenotypically recessive disease that in homozygotes causes respiratory and digestive issues, and is often associated with sterility and death at around age 30. A mutation in the CFTR gene $CFTR^{CF}$, is the underlying cause of CF, and the protein it produces confers resistance to typhoid fever. Suppose a drug-resistant form of typhoid fever became common in certain parts of the world, which of the following would you expect?
    A. The frequency of the CFTR^{CF} allele will increase in the population.
    B. The frequency of the CFTR^{CF} allele will decrease in the population.
    C. The frequency of the CFTR^{CF} allele will stay the same in the population.
    D. Homozygotes for either C*FTR* allele will increase in frequency.

26. How do sexual selection and inbreeding differ?
    A. Unlike inbreeding, sexual selection changes allele frequencies and affects only genes involved in attracting mates.
    B. Unlike sexual selection, inbreeding changes allele frequencies and involves any mating between relatives, not just self-fertilization.
    C. Unlike inbreeding, sexual selection results from the random fusion of gametes during fertilization. It is particularly important in small populations, where few mates are available.
    D. Inbreeding occurs only in small populations, while sexual selection can occur in any size population.

27. A species of groundhog spreads through an environmentally varying region surrounding a lake; the different populations, each in their own environments, accumulate habitat-specific traits. However, overlapping populations can breed and produce fertile, fully viable hybrid offspring. This is an example of a
    A. Cline
    B. Sub-cline species
    C. Ring species
    D. Species cluster
    E. Founder effect

28. A small number of birds arrive on an island (Island B) from a neighbouring larger island (Island A). This small population begins to adapt to the new food plants that are available on the island, and over generations their beak shape and size begin to change. About twice a year, a few birds from Island A arrive on Island B. What effect do these new arrivals have?
    A. Their arrival tends to promote adaptation to the new food plants.
    B. Their arrival slows the process of speciation.
    C. Their arrival speeds the process of speciation.
    D. Their arrival represents a colonizing event.

29. Many songbirds breed in North America in the spring and summer, and then migrate to Central and South America in the fall. They spend the winter in these warmer areas, where they feed and prepare for the spring migration north, and another breeding season. Two species of sparrows (A and B) overwinter together in mixed flocks in Costa Rica. In the spring, Species A goes to the east coast of North America and Species B goes to the west coast. What can you say about the isolating mechanisms of these two species?

    A. They must have strong prezygotic or postzygotic isolating mechanisms in order to spend winter in such close proximity.
    B. The two species do not breed in same area, so they are reproductively isolated by allopatry.
    C. One of the species is probably polyploid, so they are reproductively isolated by genetic incompatibility.
    D. Breeding must be occurring when they winter together.

30. If an organism with 64 chromosomes is crossed with a closely related organism with 62 chromosomes, which of the following would be expected?

    A. Many unhealthy offspring will result due to hybrid breakdown.
    B. Many unhealthy offspring will result due to hybrid inviability.
    C. No offspring will result due to hybrid sterility.
    D. Sterile offspring will result due to hybrid inviability.
    E. Sterile offspring will result due to hybrid sterility.

31. You are given a box of locusts (insects) of various species that are new to science and have not been described. Your assignment is to separate them into species. There is no accompanying information as to where or when they were collected. Which species concept will you have to use?

    A. Biological species concept
    B. Phylogenetic species concept
    C. Ecological species concept
    D. Morphological species concept

PART B:

THIS MUST BE FILLED OUT OR THIS PAGE WILL NOT BE MARKED.	NAME	STUDENT NUMBER	LAB SECTION (e.g., M10)

SHORT-ANSWER QUESTIONS

- **ANSWER IN THE SPACE PROVIDED**
- **Write /print clearly and neatly. We can't grade what we can't read.**
- **Write/print ONLY in the boxes provided. Anything written outside the boxes will not be graded.**
- **Complete your answers in pen. Answers completed in pencil will be marked, but are not eligible for re-evaluation.**
- **DO NOT REPEAT THE QUESTION IN YOUR ANSWER. (We already know what the question is.)**

1. Ear length in rabbits is determined by one gene and longer ears help to detect predators better.

i) (1 mark) If ear length gradually changes over time, what change do we expect to see in the population? Write only in the box below.

ii) (1 mark) If predators become more abundant, will more mutations occur that allow ear length to increase? Explain your answer. Write only in the box below.