Use the following information for the next three questions. A natural area in Africa that didn't used to have leopards now has leopards hunting the gazelles. Researchers believe that the gazelles are now evolving to run faster.

1. This would be an example of

A. Acclimation
B. **Directional selection**
C. Disruptive selection
D. Inheritance of acquired traits
E. Stabilizing selection

2. Compared to situations where evolution is causing less change, this situation is likely to lead to relatively more _____ selection on *rare alleles*.

A. balancing
B. frequency-dependent
C. negative
D. **positive**

3. If the leopards remain for a long time, we would expect gazelle speed to increase to a well-adapted level, after which it would likely be subject to

A. Acclimation
B. Directional selection
C. Disruptive selection
D. Inheritance of acquired traits
E. **Stabilizing selection**

4. Vestigial structures like the human tailbone provide evidence that evolution is;

A. based on the inheritance of acquired characteristics
B. driven by natural selection
C. goal directed
D. **history-dependent**

5. Eastern and western meadowlarks look very similar, but actively avoid breeding with each other. We believe that they are separate evolutionary units. This scenario illustrates a strength of the _____ species concept and a weakness of the _____ species concept.

A. biological; ecological
B. **biological; morphological**
C. phylogenetic; ecological
D. phylogenetic; morphological

6. Frequency-dependent selection at the trait level is generally associated with _____ selection *at the allele level*.

A. **balancing**
B. directional
C. disruptive
D. negative
E. positive

7. Under genetic drift, the frequency of a given allele has a tendency to _____ unless it reaches a of 0 or 1.

A. jump around in each generation with no dependence on the frequency of the previous generation
B. **move gradually in either direction in any given generation**
C. move in the same direction it has been moving
D. move towards balance with other alleles

Use the following information for the next two questions. A new population that arises by polyploidy is generally less likely to lead to species divergence than one that arises by vicariance.

8. A primary reason for this is _____.

A. **Competition**
B. Disruptive selection
C. Gene flow
D. Genetic drift

9. A reason that is likely work in the *opposite* direction is _____.

A. Competition
B. Disruptive selection
C. **Gene flow**
D. Genetic drift

10. According to the paradigm of science shared in class, scientists _____ believe in God, and _____ use religious texts as scientific evidence

A. can; can
B. **can; cannot**
C. cannot; can
D. cannot; cannot

11. Whale flippers and human hands have similar bone layouts. This is considered a _____ because it is believed that it is caused by _____.

A. homology; adaptation
B. **homology; shared ancestry**
C. vestigial trait; adaptation
D. vestigial trait; shared ancestry

12. Which of the following is *not* an example of a tradeoff?

A. Brightly colored cardinals are attractive to potential mates and to predators
B. Finches with heavier beaks can crack more seeds, and take longer to develop and reproduce
C. **Humans are not well designed to be upright**
D. Hawthorn flies that hatch early do well on apple trees but not on hawthorn trees

13. Two children are born in Kenya to Kenyan parents. One moves to Canada as an infant. The child raised in Canada is able to function better in cold weather. This scenario describes _____ differences that are directly due to _____.

A. genotypic; acclimation
B. **phenotypic; acclimation**
C. genotypic; adaptation
D. phenotypic; adaptation

14. A researcher believes that apple-raised hawthorn flies are more likely to mate with apple-raised flies, and hawthorn-raised flies are more likely to mate with hawthorn-raised flies. This idea would be supported if they look at genes related to feeding in a population containing both types and found evidence that the population:

A. is in Hardy-Weinberg equilibrium
B. is *not* in Hardy-Weinberg equilibrium
C. **has more homozygotes than expected by the Hardy-Weinberg distribution**
D. has fewer homozygotes than expected by the Hardy-Weinberg distribution

Use the following information for the next two questions. Two populations of pine trees have occasional hybrid offspring that usually do not grow well. They also release (and accept) pollen (which carries the male reproductive cells to female reproductive cells) at different times of the year.

15. _____ is an example of _____ and may have arisen in response to _____.

A. **Different timing; pre-zygotic isolation; low hybrid fitness**
B. **Different timing; post-zygotic isolation; low hybrid fitness**
C. Low hybrid fitness; pre-zygotic isolation; different timing
D. Low hybrid fitness; post-zygotic isolation; different timing

Pre-zygotic isolation is correct. We are giving a point for "post" only because we accidentally posted the wrong answer, and don't like taking points from people.

16. This scenario describes an example of

A. Exclusion
B. Fusion
C. Polyploidy
D. **Reinforcement**

17. According to the paradigm of science shared in class, the experiment that showed that bacteria grow after boiling in regular flasks, but not in swan-necked flasks, should be seen as a test of whether the experiment would _____ the _____ theory.

A. **falsify; cell**
B. falsify; spontaneous generation
C. prove; cell
D. prove; spontaneous generation

We focus on theories we like, and we attempt to support them by constructing experiments that could falsify them. Also, we discussed that this experiment cannot really falsify the idea of spontaneous generation, since there are many contexts in which spontaneous generation might happen.

18. Which of the following is the *least* likely reason to prefer an observational study to an experimental study?: The proposed experimental study is _____.

A. **not convincing**
B. not ethical
C. not possible
D. not practical

19. When the Central American land bridge linked up to separate the Pacific Ocean from the Caribbean Sea about 3 million years ago, this represented a _____ event for ocean fish, and a _____ event for monkeys.

A. reunification; reunification
B. reunification; vicariance
C. **vicariance; reunification**
D. vicariance; vicariance

Use the following information for the next two questions. In a large flood many years ago, a large population of turkeys was split by a new river. About a quarter of the turkeys were isolated into a new, Northern population. In the same flood, a few turkeys were washed out to sea, and formed a new Island population.

20. We would say that formation of the Northern population was a _____ event, and formation of the Island population was a _____ event.

A. dispersal; dispersal
B. dispersal; vicariance
C. **vicariance; dispersal**
D. vicariance; vicariance

21. Compared to the Northern population, we expect the Island population to experience _____ genetic drift and _____ founder effects

A. **stronger; stronger**
B. stronger; weaker
C. weaker; stronger
D. weaker; weaker

22. In a population of zebras, researchers observe that: some zebras run faster than others, and that fast zebra tend to survive better and have more offspring on average. To show that natural selection for speed is operating in this population, the researchers still have to _____.

A. Find the genetic basis for these differences
B. Show that fast-running zebras on average have higher fitness than other zebras
C. **Show that running fast is heritable in this population**
D. Show that fast-running zebras are more attractive to mates
E. None of the above, their described observations are sufficient.

23. Which of the following is *not* one of the logical steps underlying the theory of natural selection?

A. Differential success linked to traits
B. **Dominant and recessive traits**
C. Heritability of traits
D. Variation in traits

24. Which of the following provides the best evidence for adaptation via natural selection *as opposed to inheritance of acquired characteristics*?

A. Evolution of very fast antelope
B. Geographic patterns of related species
C. Patterns of homologies
D. **Results of laboratory-based evolution experiments.**

25. We define a "biological island" as an area that is isolated ...

A. by water
B. by inhospitable habitat
C. from the point of view of all of the species that live there
D. **from the point of view of a particular species of interest**

26. Species divergence is _____ likely to happen in sympatry than in allopatry, in part because the effects of _____ are usually greater in sympatry

A. **less; gene flow**
B. less; genetic drift
C. more; gene flow
D. more; genetic drift

27. Male, but not female, elk, have heavy antlers that are used primarily in sexual competition. This is likely an adaptive response due to the fact that _____ are selected to be more choosy about mates because they have _____ maximum reproductive output.

A. **females; lower**
B. females; higher
C. males; lower
D. males; higher

28. The primary source of *new* alleles is

A. gene flow
B. genetic drift
C. **mutations**
D. natural selection
E. sex

29. "Only cardinals can aquitate" would be falsified by:

A. A cardinal who cannot aquitate
B. **A non-cardinal who can aquitate**
C. Either of the above
D. None of the above

30. Ignore everything you know, and assume the following statements are true: everything with four legs is a mammal; lizards have four legs; people have two legs. Under these assumptions, you can conclude:

A. **lizards are mammals**
B. people are not mammals
C. both of the above
D. none of the above

31. Tapirs are large mammals that look a bit like pigs but are more closely related to horses. Temperate South America has many places that can get very cold weather, while tropical South America does not. Compared to tropical tapirs, temperate tapirs are able to grow hair quickly when the weather gets cold, and shed it when the weather gets warmer.

a) (2 points) What part of this story describes acclimation, and why?

Tapirs growing hair when the weather is cold is a direct response to the environment, so it's an acclimation. We don't expect it to affect their offspring.

1 point for growing hair, 1 point for either direct response to environment, or unlikely to be passed on to offspring.

b) (2 points) What part of this story likely describes adaptation, and why?

The fact that temperate tapirs are better at growing hair than tropical tapirs is very likely an adaptation. They have more need for the ability to acclimate, because of the colder weather, and have probably gained the ability through natural selection.

One point for temperate tapirs having more ability to acclimate. One point for something sensible about natural selection.

32. A population of peppered moths has two alleles for their primary color locus: a D allele, associated with dark-colored moths, and an L allele, associated with light-colored moths. The population has 100 individuals, 20 D alleles, and 180 L alleles. The D allele is dominant with respect to the L allele.

a) (2 points) What are the allele frequencies in this population?

There are 200 total alleles, so the frequency of D=20/200 = 10%, and the frequence of L = 180/200 = 90%

One point for trying to calculate a proportion for D and one L. One point for getting the numbers right.

b) (2 points) What genotype frequencies would the Hardy-Weinberg assumptions predict for this population?

The proportions are DD = $p_D^2 = 0.01$, DL = $2p_Dp_L = 0.18$, $LL = p_L^2 = 0.81$

One point for calculating the correct three things as genotype frequencies. One point for getting the numbers right.

c) (1 point) What proportion of the moths would have dark appearance under this assumption?

Since the D allele is dominant, both DD and DL will have dark appearance. The total proportion of dark moths will be 1% + 18% = 19%.

d) (1 point) If the population has more homozygotes than expected under Hardy-Weinberg, would the proportion of dark moths go up or down?

Since the heterozygotes are dark, more homozygotes means less heterozygotes means less dark moths. The proportion would go down. For example, if all moths were homozygous, there would be 10% dark DD moths, and 90% light LL moths.

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