Question 4: Conceptual Analysis — 4 points

Twenty million years ago the Caribbean Sea and Pacific Ocean were connected, and water flowed freely between the two bodies of water. Many of the same marine species were found in both areas. Over millions of years, the land referred to as the Isthmus of Panama formed, eventually closing off the connection between the Caribbean Sea and Pacific Ocean and creating two separate bodies of water. The ecology of these two marine habitats was dramatically altered by this land formation. The warmer Caribbean water could no longer flow west, so the Pacific water cooled and became more nutrient-rich, while the Caribbean water became warmer.

A	**Describe** the genetic evidence that evolution is occurring in a population. Examples of acceptable responses may include the following: • There are changes in allele/gene frequencies. • There are heritable changes in phenotypes.	**1 point**
B	**Explain** how the isolation of marine species by the formation of a land barrier can lead to divergent evolution of those species. Examples of acceptable responses may include the following: • Selective pressures could result in different allele/gene frequencies. • (The land barrier) results in reproductive isolation/lack of gene flow/allopatric speciation. • Different environmental conditions/pressures select for different alleles/genotypes/phenotypes.	**1 point**
C	The formation of the Isthmus of Panama connected two continents, North America and South America. Many North American land animal species migrated to South America after the formation of the isthmus and occupied similar niches as South American species. **Predict** the effect the formation of the isthmus had on resource availability for South American species. • (Resource availability) would have decreased.	**1 point**
D	**Justify** your prediction in part C. • More species would now be competing for the same resources, (resulting in fewer resources for each individual).	**1 point**

Question 4: Conceptual Analysis — 4 points

Existing isolated brook trout populations in Newfoundland, Canada, were once part of a larger population that was fragmented at the end of the most recent glaciation period about 10,000 to 12,000 years ago. Researchers investigated 14 naturally separated stream populations of brook trout. They found that the populations are all genetically distinct and show differences in morphology.

(a) **Describe** the prezygotic barrier that results in these genetically distinct populations. **1 point**

- Geographic isolation prevents gene flow between the populations.

(b) Brook trout with longer fins are able to swim faster than brook trout with shorter fins. In one of the Newfoundland streams, the main prey of the brook trout evolved to move faster. For brook trout living in this stream, **explain** why there is a difference in fitness between longer-finned individuals and shorter-finned individuals. **1 point**

- Individuals with longer fins are more likely to capture prey and reproduce.

(c) If two morphologically and behaviorally distinct populations of brook trout remain isolated for many generations, **predict** the likely impact on both populations. **1 point**

Accept one of the following:

- The two populations will become separate species.
- The two populations will continue diverging (behaviorally/morphologically/genetically).

(d) Researchers claim that there are more genetic differences between any two current brook trout populations than there are between any single current population and the ancestral brook trout population from which all the trout are descended. Provide reasoning to **justify** their claim. **1 point**

Accept one of the following:

- Each single population has accumulated mutations/experienced genetic drift (distinguishing it from the ancestral population). The mutations each population accumulated are likely to differ (as a result of different selective pressures).
- Allele production (as a result of random mutation) and genetic drift/selection by local environmental conditions has resulted in a collection of alleles unique to each population.

Total for question 4 — 4 points