BIL 160 - Spring 2003 – EXAM I **Krempels**

Choose the *BEST* answer for each multiple choice question. Two points each.

1. When Louis Pasteur performed his experiments with boiled chicken broth in both open and swan-necked flasks, he was trying to
   a. determine whether spontaneous generation of bacteria could occur
   b. determine whether boiling could effectively destroy living cells
   c. determine whether cells would grow at different rates in different shaped flasks
   d. determine whether living things were made of cells
   e. develop a new recipe for his mom's deli

2. Organic evolution in natural populations can result from
   a. artificial selection
   b. spontaneous generation
   c. natural selection
   d. uniformitarianism
   e. common ancestry

3. When you say that a characteristic is HERITABLE, you mean that the characteristic
   a. is subject to evolution
   b. is maladaptive
   c. is not variable within a single population
   d. can be passed to the next generation
   e. can change, depending on environmental conditions

4. What was Anton van Leeuwenhoek's contribution to the development of cell theory?
   a. He discovered the difference between prokaryotic and eukaryotic cells.
   b. He was the first to describe the molecular structure of DNA.
   c. He demonstrated that the oldest fossils lay in the deepest layer of stratified rock.
   d. He invented the microscope, through which he was first to view cells.
   e. He discovered that ALL living things were composed of cells.

5. A phylogeny is
   a. a tree-like diagram
   b. a conserved sequence of DNA
   c. a species' geographic distribution
   d. an organism's embryonic development
   e. a taxon's evolutionary history

6. Which of the following is most likely to be the result of several generations of inbreeding?
   a. a population with relatively low resistance to pathogens
   b. a population in which male and female individuals are morphologically different
   c. a high degree of heterozygosity at major histocompatibility complex (MHC) loci
   d. decreased frequency of expression of lethal alleles
   e. a president who can't correctly pronounce "nuclear"

7. Linnaeus spent his scientific career naming and describing organisms. A staunch creationist, he wrote early in his career that "the invariability of species is the condition for order [in nature]." Linnaeus should thus most accurately be considered a
   a. biosystematist
   b. evolutionary biologist
   c. taxonomist
   d. geneticist
   e. more than one of the above

8. Because both Bacteria (Domain Bacteria) and Archaebacteria (Domain Archaea) are prokaryotic, and all members of Domain Eukarya are eukaryotic, one should assume that members of Domain Bacteria and Domain Archaea share a more recent common ancestry than either does with members of Domain Eukarya.
   a. true
   b. false
   c. what the heck is a Domain?

FORM 0

9. Interviewed at a recent "Save the Whales" rally, Connie and Bob were asked why they believe there should be an end to whale hunting. They replied, "Because whales are beautiful and we love them!" Bob and Connie express the _____ view of a species' worth.
   a. ecocentric c. biocentric e. amniocentric
   b. anthropocentric d. egocentric

10. A characteristic is said to be VESTIGIAL if it
   a. improves the evolutionary fitness of the organism expressing it
   b. changes in response to environmental stimuli
   c. is known to have existed in its current form in an ancestral taxon
   d. is rudimentary, and no longer has a function
   e. is virginal

11. Darwin's phrase "descent with modification" refers to
   a. changes in an individual's DNA over time
   b. changes in an individuals morphology over time
   c. changes in populations over time
   d. changes in embryonic development as an individual grows
   e. the number of new mutations in each new generation

12. The middle toenail on your foot and the hoof on a horse's hind leg
   a. are derived from a similar structure in a common ancestor
   b. have different shapes because of convergent evolution
   c. are derived from different ancestral sources
   d. perform similar functions in both you and in the horse
   e. are both acquired characteristics that evolved in response to "felt need"

13. Which of the following is NOT one of the observations or inferences upon which Darwin's theory of evolution by natural selection is based?
   a. Differential reproduction between members of a population leads to adaptation.
   b. Individuals poorly suited to a particular environment leave fewer offspring than better suited individuals.
   c. Individuals of a particular species show heritable variations in phenotype.
   d. When a resource is limited, those best adapted to exploit it will leave the most offspring.
   e. Competition for limited resources leads to differential reproduction.

14. "Spontaneous generation" describes the idea that
   a. life is generated from non-living matter (such as eels springing, fully formed, from mud)
   b. all living organisms have an innate drive to reproduce
   c. boiling broth makes the broth permanently unfit to support microorganisms
   d. life tends to diversify following a mass extinction
   e. people born between 1980 and 2000 always do the first thing that pops into their head

15. Charles Darwin was always a critically-thinking scientist, and even as a child, he disbelieved in the idea of divine creation.
   a. true b. false c. this question is heretical.

16. The changing of an ermine's white winter fur to brown for summer is an example of
   a. microevolution c. speciation e. none of the above
   b. macroevolution d. adaptation

17. Which of the following statements is TRUE of an organism undergoing embryogenesis?
    a. If it is a protostome, its blastopore will become its anus
    b. It changes from a more primitive species to a more advanced species as it develops
    c. It actually passes through all the adult stages its species passed through during its evolution
    d. It may exhibit synapomorphies with species to which it is very distantly related
    e. It may exhibit synapomorphies with species to which it is closely related.

18. A population of parrots in the Brazilian rainforest shows variation in feather color from dark, green to yellow green. Over several generations, you observe that birds with the intermediate feather color have become scarce, and that almost all the parrots left are either very dark green or yellow green. Which of the following is the most likely explanation for this change?
    a. directional selection c. sexual selection e. resource partitioning
    b. stabilizing selection d. diversifying selection

19. The genetic diversity of wild populations can be explained, at least in part, by the fact that some random mutations are not directly affected by selective pressures in the environment, and—in the absence of selection for or against them--may be passed on to the next generation. This statement is consistent with the _____ Model of evolution.
    a. Classical b. Neutral Mutation c. Balancing d. Punctuated Equilibrium

20. The various demes of Red-winged Blackbirds have proven unlikely to undergo reproductive isolation, despite wide geographic separation. The species is thus said to be
    a. primitive b. derived c. fertile d. cohesive e. polymorphic

<u>Use the following information to answer #21 - 24</u>
A population of 10,000 voles (small rodents) has a monogenic trait with two alleles, a dominant allele (P) coding for dark agouti fur, and recessive allele coding for pale agouti fur (p). The two alleles are present in the population in *equal frequency*.

21. If this population is *not evolving*, how many of the voles in your population should be heterozygous at the P locus?
    a. 1000 b. 1500 c. 2500 d. 5000 e. 7500

22. You have a magical device that allows you to determine the genotype of every individual vole at the P locus, and you have found that although the two alleles are present in equal frequency, the frequencies of the three possible phenotypes are 45% AA, 10% Aa and 45% aa. Which of the following is the most likely explanation for this deviation from the expected?
    a. heterozygote advantage c. negative assortative mating e. selection against
    b. random genetic drift d. positive assortative mating dark agouti fur

23. A nasty blizzard swept through the prairie, knocking over bushes and squishing the hapless voles in its path. Only 100 of your original 10,000 voles survived. Twenty of these were dark agouti (Pp) and 80 of these were pale agouti (pp). Once the survivors re-establish their numbers, which of the following is the <u>*most precise*</u> term one would use to describe the change in allele (and genotype) frequencies in the population?
    a. selectional drift c. random genetic drift e. parapatric speciation
    b. Founder effect d. bottleneck effect

24. If the population of voles underwent no further evolutionary change after the blizzard, and stayed in Hardy-Weinberg equilibrium until its numbers were back up to 10,000, what would you expect the genotype frequencies of the new population to be, with respect to the P locus?
a. 2000 Pp and 8000 pp
b. 1600 Pp and 8400 pp
c. 1000 PP, 1000 Pp and 8000 pp
d. 100 PP, 1800 Pp and 8100 pp
e. need more information to determine

25. The Red-legged Frog (*Rana aurora*) has a range that extends across the southern California coastal mountain canyons. Sub-populations of the frogs live in fast-moving streams in separate canyons, and there is little or no migration between the stream systems. A group of frogs living in a particular stream represents _____ of the *Rana aurora* population at large.
a. a subspecies b. a genus c. a deme d. a race e. an offshoot

26. Lyell's theory of uniformitarianism stated that
a. over geological time, regular, large-scale natural disasters have wiped out great numbers of species
b. all species have an equal chance to reproduce, given the same environmental conditions
c. the earth's surface has been uniform and unchanging over geological time
d. constant forces of climate (erosion, volcanic disturbance, etc.) have resulted in the slow, constant change of the earth's topography over geological time
e. guys in uniform, even if they are dweebs, always have the highest reproductive success

27. A species of wildflower exists on an elevated plain overlooking a highly saline marshland. The vast majority of the population is unable to withstand the salty soil, and cannot grow there. However, during one season, a small cohort of seeds was blown onto the salty marsh, and by some happy accident of mutation, was able to grow and thrive there. Pollen can easily be transported from one area (plain) to the other (marsh), but hybrid seeds between the salt-tolerant population could not survive if they landed in the marsh. Only the plants who had two salt-tolerant parents could survive and reproduce in the salty marsh. Eventually, the salt-tolerant group, in the absence of gene flow between itself and the original population, became reproductively isolated from them. The end result is best described as an example of
a. allopatric speciation
b. sympatric speciation
c. peripatric speciation
d. behavioral isolation
e. temporal isolation

28. A population of garter snakes living on the leeward side of a large mountain has several different phenotypes, including black with blue stripes, black with green stripes, yellow with red stripes and yellow with black stripes. All of these individuals can interbreed to produce fertile offspring, and each generation of baby snakes can be expected to exhibit the multiple phenotypes of their parents. Such a population is said to be
a. subspecific b. atypical c. mutational d. clinal e. polymorphic

29. Ontogeny is defined as
a. a taxon's evolutionary history
b. a species' embryonic development
c. a taxon's relationship to other taxa
d. the generation of true layers of tissue
e. the process of a blastula's invagination

30. The little green lizards in the bushes out behind the Cox building have scales that are actually extensions of their skin. The little white egret about to eat one of the little green lizards has feathers that are extensions of its skin. If you were to monitor the ontogeny of these two vertebrates inside their eggs, you'd see that the embryonic tissues that become scales in the lizard are the same as those that become feathers in the bird. Without comparing these species to any other species, you could most correctly state that the scales and feathers are

a. primitive
b. analogous
c. symplesiomorphies
d. homologous
e. derived

31. Pepper moths in industrial areas of England are melanistic (black), whereas those living in rural areas are spotted. Kettlewell and his students demonstrated that this could be due to natural selection by birds who could more easily locate moths on tree trunks that they did not match. However, a team of American researchers demonstrated that pepper moth larvae exposed to industrial pollutants hatched out as black moths, even if their parents were spotted. Further, this change to the black form was heritable to the new black moths' offspring. The acquired characteristic had become heritable due to

a. natural selection
b. embryogenesis
c. apomorphism
d. epigenesis
e. Lamarckianism

32. The evolutionary fitness a you attain by baby sitting your bratty little cousins (reducing their chance of eliminating themselves and any genes they share with you) is gained via

a. inclusive fitness
b. relative fitness
c. kin selection
d. The Poison Control Center
e. capitalism

33. A gene pool consists of

a. all alleles at all loci in a particular population
b. all alleles subject to natural selection
c. all genes in a single, reproducing individual
d. allele frequencies in a population
e. all potential gametes in a population

34. Which of the following statements is NOT TRUE of honeybees?

a. a worker bee is 100% genetically related to her drone father
b. sister worker bees share more alleles with each other than they would with their own offspring
c. a worker bee's fitness is gained only via kin selection
d. because workers are sterile, they have an evolutionary fitness of zero
e. a worker bee will be the most fit if she eats royal jelly and becomes queen

35. The beloved octopus (Phylum Mollusca, a protostome) and the beloved bunny rabbit (Phylum Chordata, a deuterostome) have a complex, image-forming "camera" eye with a lens that focuses light on a photoreceptor-rich retina. The morphological similarity between the two eyes is most likely due to

a. common ancestry
b. adaptive radiation
c. homology of the eyes
d. similar selective pressure
e. interbreeding between octopus and rabbits

36. Eldredge and Gould assert that taxa remain relatively unchanged for long periods, but may undergo relatively rapid, major changes in genotype and phenotype. This process is known as

a. gradualism
b. catastrophism
c. cohesionism
d. selectionism
e. punctuated equilibrium

37. In general, a primitive character is not as well adapted to performing its task as is a more derived character.
    a. true b. false c. I'm falling asleep here.

38. This man's optical invention reopened the controversy about whether spontaneous generation could actually happen.
    a. Charles Lyell c. Louis Pasteur e. Gianni Versace
    b. Anton van Leeuwenhoek d. Francesco Redi

39. Ontogeny is informative about evolutionary relationships because
    a. closely related species usually have very different ontogenies
    b. the more closely related two taxa are, the more persistent their developmental similarities
    c. it allows one to estimate the extent of inbreeding in natural populations
    d. distantly related taxa often exhibit ontogenetic synapomorphies
    e. fossilized embryos are cheap and plentiful

40. Darwin's theory of evolution by natural selection implies that
    a. organisms engage in constant physical battles with each other to survive
    b. the most evolutionarily fit organisms always survive to a ripe old age
    c. the fastest, strongest and smartest organisms are always the most evolutionarily fit
    d. an individual who leaves many genes to the next generation has a high level of fitness
    e. the individual who dies with the most toys wins

Use the following information to answer #41 - 44.

In a population of tree frogs found in the Costa Rican Rainforest, there are three genotypes with respect to an allele controlling the striping pattern on the frogs' flanks. Frogs with genotype SS have dark blue sides with bright yellow stripes. Frogs with genotype Aa have pale blue flanks with bright yellow stripes, and Frogs with genotype aa have pale blue flanks with pale yellow stripes.

You have been monitoring the relative reproductive success of each genotype for several generations, and over the course of three seasons. According to your data, the following number of offspring from each genotype successfully reached maturity and produced eggs of their own:

Genotype AA: 1000 Genotype Aa: 5000 Genotype aa: 500

41. What is the relative fitness (W) of genotype aa?
    a. 0.1 b. 0.2 c. 0.5 d. 1.0 e. 0.0

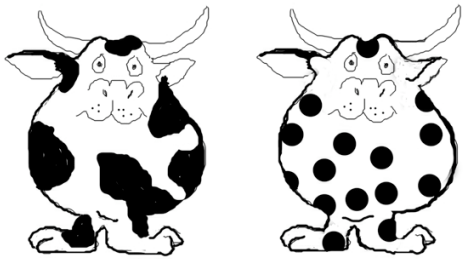
42. What is the selection coefficient for genotype Aa?
    a. 0.1 b. 0.2 c. 0.5 d. 1.0 e. 0.0

43. Which of the genotypes above appears to be under the highest selective pressure?
    a. AA b. Aa c. aa d. cannot tell from information given

44. From the information given, what can you confidently say about this population of frogs?
    a. The frogs are exhibiting signs of non-random mating
    b. Frogs with genotype aa will probably eventually disappear completely from the population
    c. Eventually, all frogs hatched in this population will have genotype Aa.
    d. There appears to be a heterozygote advantage with respect to gene locus A
    e. more than one of the above

45. If a phenotypic character in a particular species develops different forms under varying environmental conditions, it is probable that
    a. the variation is entirely under environmental control
    b. the variation is limited by an individual's genetic makeup
    c. the expression of genes is influenced by the environment
    d. two of the above
    e. all of the above

Have a look at the rare and elusive Piebald Glork (*Baliocorpus pumilio*):



The two individuals above are members of the same species, though each shows a different spotting pattern commonly found in the population. The presence of spots is controlled by a single gene locus, and both the individuals above have the same genotype at this locus.

46. The difference in Piebald Glork color pattern shown above is most likely due to
    a. paedogenesis b. neoteny c. allometric growth d. heterochrony e. mutation

47. Natural selection acts *directly* on
    a. genotype
    b. phenotype
    c. the entire genome
    d. the alleles of a particular gene
    e. a population's gene pool

48. *Systema naturae* is
    a. a series of monophyletic groups devised by biosystematists
    b. the natural order of species, as determined by natural selection
    c. a listing of natural toxins produced by plants that can be used as (or made into) medicines
    d. a system of binomial scientific nomenclature devised by Linnaeus
    e. a new breakfast beverage that helps keep you regular in a gentle, all natural way

49. In a species of beetle, a certain mutation results in an insect with two wings instead of four. If this change were to be maintained in the population and was not under immediate selective pressure (though this might change in the future), it could be considered an example of
    a. paedomorphy
    b. exaptation
    c. allometric growth
    d. macroevolution
    e. adaptive radiation

50. If humans and raccoons belong to the same Class, then they must also belong to the same _____, although they are *not* necessarily members of the same _____.
    a. Phylum; Order
    b. Kingdom; Phylum
    c. Domain; Kingdom
    d. Order; Family
    e. species; Class