UNIVERSITY OF BRITISH COLUMBIA

Biology 121 Section 225

Practice Final 2010

Instructor: Dr. Carol Pollock

Name: _____ Student number: _____
(Please print)

Student signature _____

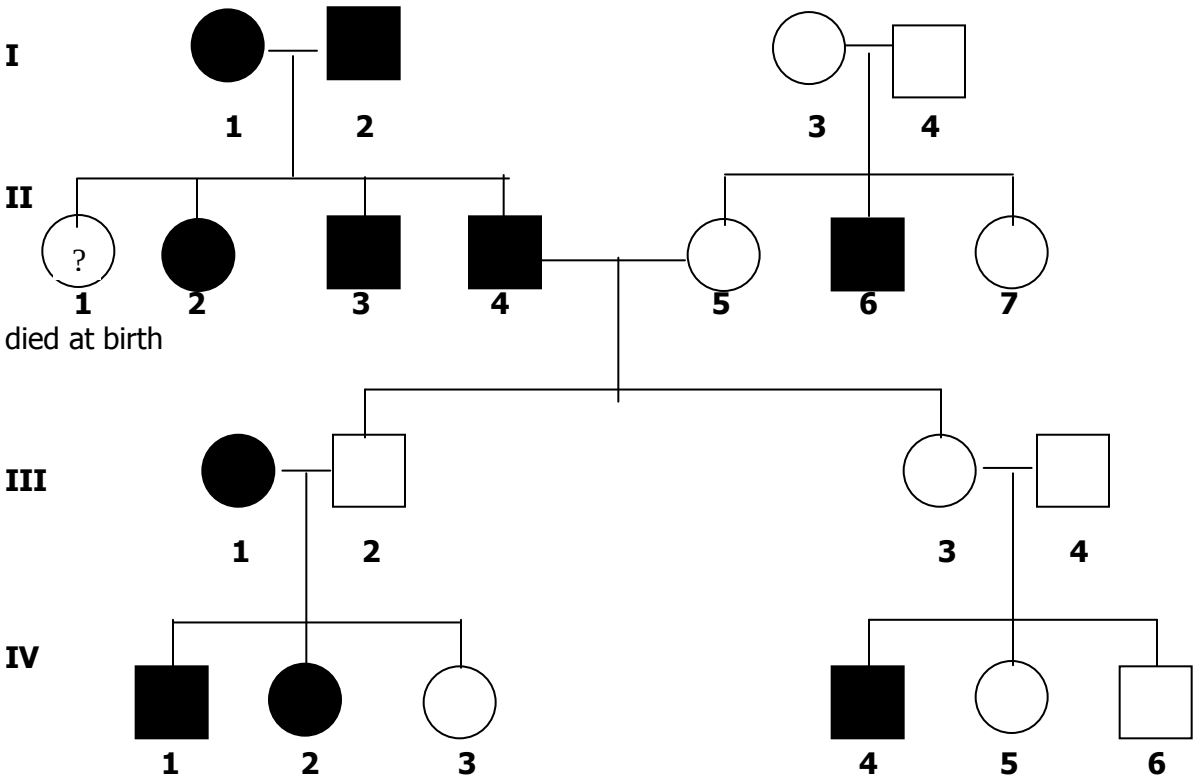
Instructions:

1. This is the first of **10** pages.
2. Answer all questions in the space provided.
3. All writing must be in **INK**.
4. Illustrations can be included where appropriate but must be annotated.
5. Students suspected of any of dishonest practices will be immediately dismissed from the examination and will be subject to disciplinary action.
6. Other than a **one-page** hand-written summary on one side of one standard 8.5 x 11 inch sheet of paper, no other memory devices are permitted.
7. Students should bring a non-programmable calculator.
8. Students may not speak or in any other way communicate with other students while in the examination room.
9. Students may not expose their written paper to other students. The excuse of accidental exposure, forgetfulness, or ignorance will not be accepted.

Mark allocation:

Question	Marks possible	Your mark
1.	16	
2.	13	
3.	14	
4.	9	
5.	18	
6.	9	
7.	9	
8.	7	
9.	2	
Total	**97**	

1. An Ethiopian family has a history of lactose intolerance, which is a genetic condition where adults cannot digest lactose, the sugar in milk. Here is a pedigree for lactose intolerance in this family. (16 marks)



a) How is lactose intolerance inherited? Justify your answer by referring to specific individuals from the pedigree. (4 marks)

b) Write the possible genotypes of the following individuals: (3 marks)

c) If individuals II-4 and II-5 had a third child, what is the probability that it would be lactose intolerant? Show all your work. (2 marks)

d) The Asian population is 90% lactose intolerant. What is the frequency of homozygous normal people (people who can digest lactose) in Asia? Assume Hardy-Weinberg equilibrium. Show all your work. (4 marks)

e) Two Asians who can digest lactose (genotype unknown) give birth to a child. What is the probability the child will be lactose intolerant? Show all your work. (3 marks)

2. Zebrafish are a type of fish well studied by geneticists. Two alleles of the *cyclops* gene exist in zebrafish. The wild-type allele makes fish with a normal brain and two eyes on opposite sides of the head, the *cyclops* allele causes fish to have smaller brains and one big eye in the centre of their forehead. When a homozygous wild-type fish is mated with a homozygous *cyclops* mutant fish the resulting F1 offspring are all normal.

a) Explain Mendel's Law of Segregation by drawing an F1 (from the cross above) zebrafish cell undergoing Metaphase I of Meiosis, then Telophase I, Metaphase II and then the 4 resulting gametes. Your meiotic cells should contain chromosomes labeled appropriately with alleles of the *cyclops* gene. Assume 2N = 4. (6 marks)

Metaphase I

telophase I

Metaphase II

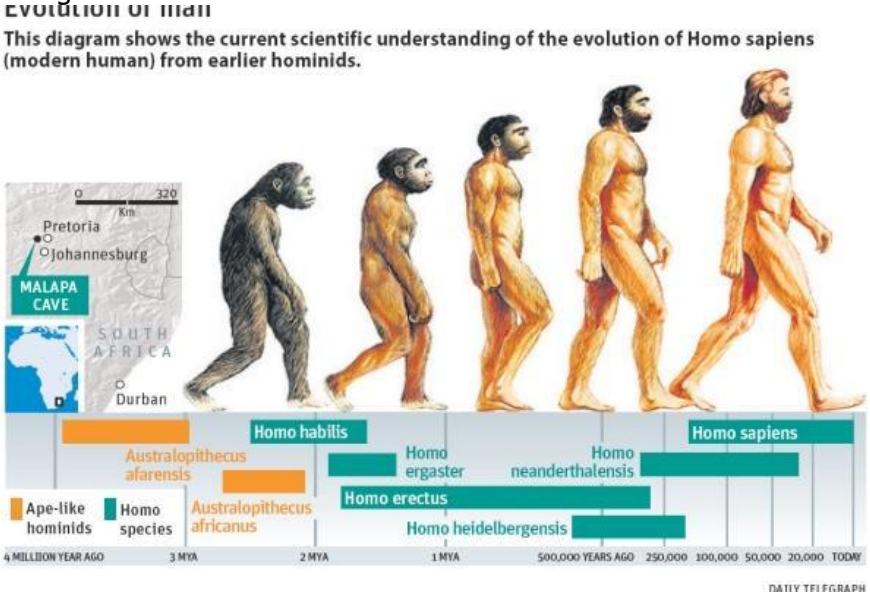
gametes

b) Two F1 individuals from above mate. What combinations of alleles for the *cyclops* gene from the gametes drawn above can come together during fertilization to make the F2? (3 marks)

c) If the alleles of the *cyclops* gene are behaving according to Mendel's Law of Segregation, what phenotypes and phenotypic ratio would you expect to see in the F2 (if F1 fish mated with each other)? Show all your work. (4 marks)

3a. This photo appeared in the Vancouver Sun on Apr. 5 2010 along with a story about how the discovery of a new fossil in South Africa (between *Australopithecus* and *Homo habilis* in age) could provide new information about the evolution of humans. Based on ideas about evolution presented in Biology 121, do you agree with this presentation of the evolution of species of *Homo*? Present at least two pieces of evidence to support your answer. (6 marks)

Figure 1 Human evolution



b) If you were to describe the common ancestor of the reptiles and mammals what would it look like: i) more like a mammal ii) more like a reptile iii) equal characteristics of both iv) not like either. Justify your answer. (4 marks)

c) Darwin's theory included his mechanism for evolution; natural selection. Give one example of natural selection that was discussed in class this term and explain how it is an example of natural selection. (4 marks)

4. The cheetah is the fastest land animal. It was once widely distributed in Africa and Asia but is now very limited in its distribution (see Figure 2). (9 marks)
Figure 2 distribution of cheetahs in Africa and Asia.

a) List one abiotic factor that could have caused this change in distribution and explain how it has affected the distribution of cheetahs (3 marks)

b) Explain how the genetics of cheetahs could have been a factor in its reduced distribution. (3 marks)

c) List one biotic factor that could have caused this change in distribution and explain how it has affected the distribution of cheetahs. (3 marks)

5. In the Lake Erie region of Ontario there are two kinds of non-poisonous water snakes. On the shores of the lake most of the snakes have a banded colouration while on the islands in the lake most are not banded. You have been hired by the Ontario government to work on a project designed to protect these snakes from becoming endangered. (18 marks)

a) The first thing you have to do is to determine whether banded and unbanded snakes represent different morphological forms (morphs) of one species or are two separate species. What would you do to determine if they were one species with two morphs or two species? (2 marks)

b) Suppose you determine that they are in fact one species. What could be causing the difference in distribution of the two morphs? (2 marks)

c) Suppose you determine that they are in fact two species. What are two reproductive isolating mechanisms that could be causing them to remain separate species? (2 marks)

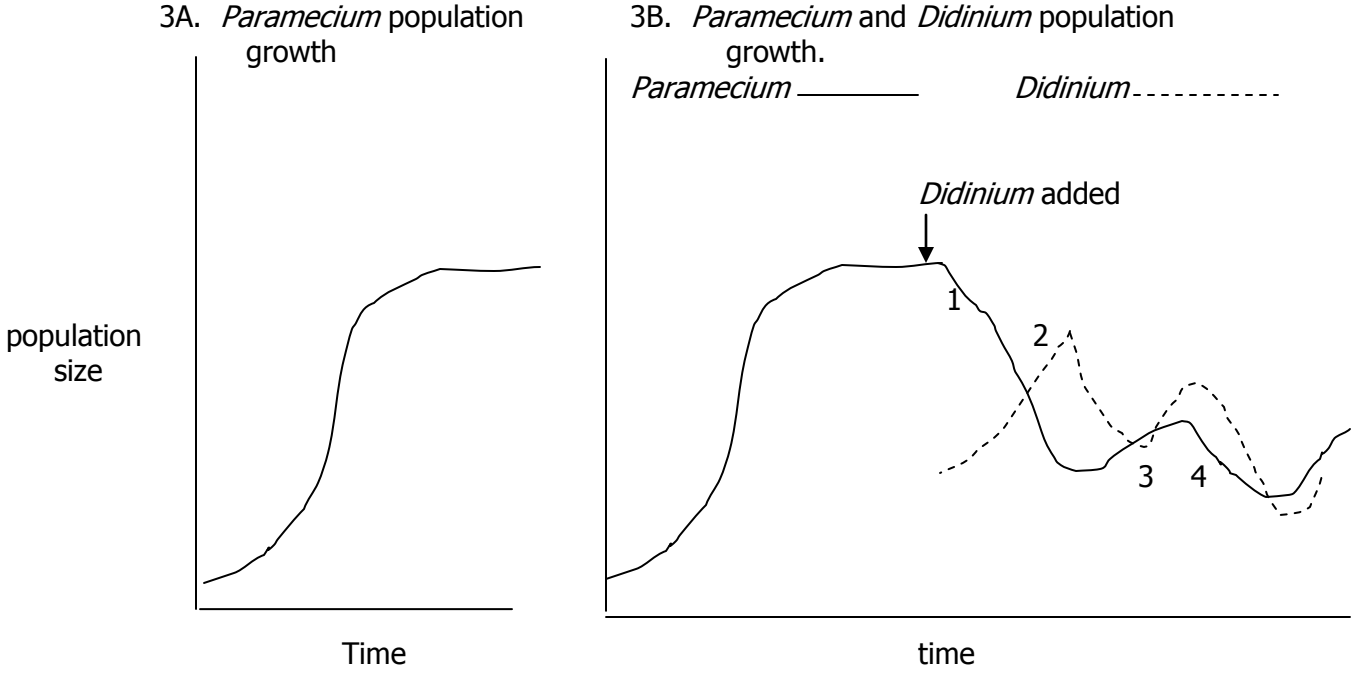
d) Your next task is to count the snakes in a 3 ha area along the shore and in a similar-sized area on one of the islands. What method would you use to count them? Why would you use this method? What is one drawback of using this method? (4 marks)

e) Once you have counted them, your boss asks you to come up with a minimum viable population size for the shore and the island (the shore snakes swim out to the island and mate with the snakes there). What does she mean by this? (2 marks)

f) What effect could low fecundity have on population size? (2 marks)

g) Describe one factor, other than fecundity, that could be important in maintaining the numbers of this species of snakes in this region and explain why it is important. (4 marks)

6. *Paramecium* are unicellular eukaryotic organisms that can be easily grown in the lab in a liquid medium. (9 marks)
Figure 3A below represents a typical growth curve for *Paramecium*.



a) On the graph in A, indicate *K* for this culture of *Paramecium*. (1 mark)
b) What are two density-dependent factors that could influence *K*? (2 marks)

c) What are two characteristics of species with a high r_{max}? (2 marks)

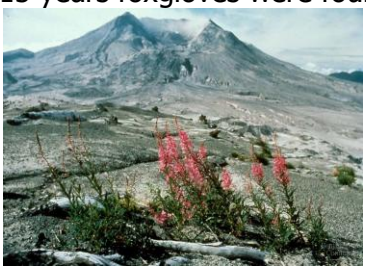
d) *Didinium* are organisms that eat *Paramecium*. *Didinium* were added to the *Paramecium* culture at the time of the arrow in B above. The *Paramecium* and *Didinium* populations followed the pattern presented in B above. Explain the changes that are occurring in the two populations after the *Didinium* has been added by explaining what is happening at points 1-4 above. (4 marks)

7. After Mount St. Helens exploded in 1980, the area was completely cleared of all living organisms (Figure 4).

a) Would primary or secondary succession occur at this site? Why? (3 marks)

b) What types of organisms would be likely to be pioneer species (two general characteristics)? (2 marks)

Within 15 years foxgloves were found at the site (Figure 5).



c) The population of foxgloves closest to this site was 90% purple in colour and 10% pink. The foxgloves at this site were all pink. What evolutionary process occurred that resulted in the pink foxgloves being found at the site? How could this have occurred? (2 marks)

d) Which allele is likely to be dominant in foxgloves – the one for purple flowers or pink flowers? Why? (2 marks)

8a) Explain the concept of an ecological footprint (2 marks)

b) How is an ecological footprint similar to the carrying capacity of a population? (2 marks)

c) What is the greatest threat to the sustainability of human life on this planet? Explain your answer. (3 marks)

9. REFLECTION QUESTION

   What did you learn in this course that has been the most interesting or valuable to you? Explain. (2 marks)