

Group Number from Canvas

Max Group Members = 6

Name	Student Number
1)	
2)	
3)	
4)	
5)	
6)	

Question 1

- a) The phylogeny in Figure 1 shows the relationship among genera of orchids. Add taxon labels to Figure 2 so that both trees show the same relationships among the orchid genera. (3 marks)

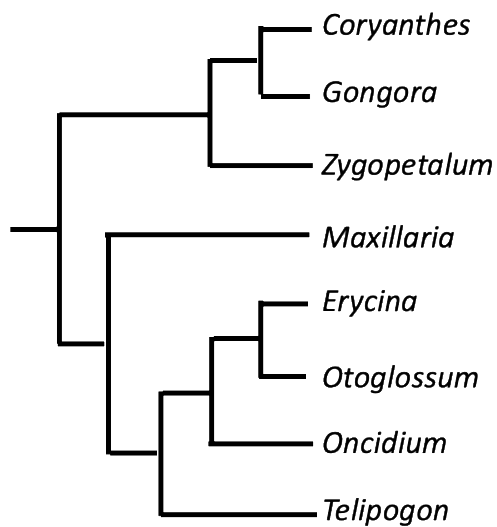


Figure 1

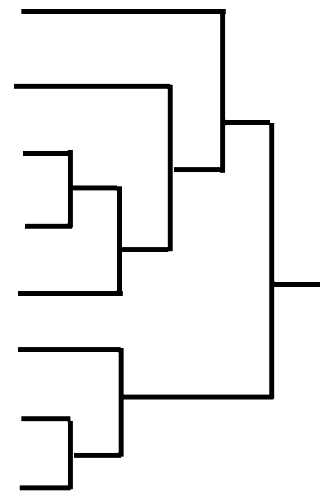


Figure 2

- b) What genus/genera is/are most closely related to *Maxillaria*? (2 marks)

- c) Did the ancestor of *Coryanthes* and *Gongora* look like *Zygopetalum*? Briefly explain your reasoning. (3 marks)

Question 2

- a) You are studying a population of four o'clock flowers in a field in 2017. White flowers are $F^W F^W$, pink flowers are $F^W F^P$ and purple flowers are $F^P F^P$. The table below summarizes the numbers of each flower morph in the field. Fill in the blank cells in the tables. Give answers to two decimal places (4 marks)

	Number of Individuals Observed in 2017	Observed Frequency in 2017	Expected Frequency in 2017
White	78		
Pink	128		
Purple	22		

F^W Frequency	
F^P Frequency	

Space for rough work – will not be graded.

b) Is the population in Hardy-Weinberg equilibrium? Explain how you arrived at this conclusion. (**3 marks**)

c) Over the course of monitoring the field you collect data on the frequencies of the alleles for flower color. These are summarized in the table below. Your lab mate is very excited about your results and states that you are seeing natural selection for the F^P allele. Is natural selection responsible for the change in allele frequency? Explain your reasoning with specific reference to the criteria for natural selection.

Year	2018	2019	2020	2021
Frequency of the F^P allele	0.39	0.44	0.45	0.57

Question 3

Tuberculosis in humans is caused by the bacterium, *Mycobacterium tuberculosis* (*M. tuberculosis*). A vaccine for tuberculosis has been developed. This is a live vaccine where living *M. tuberculosis* cells are injected just under the skin. The bacteria used in the vaccine is an attenuated (non-virulent) genotype. This attenuated genotype doesn't cause disease but elicits an immune response. The attenuated strain was produced by isolating a single cell from a human host and then growing it in the laboratory in broth containing glycerin, bile and potato. The culture was maintained by periodically transferring a sample to new broth. The transferred sample contained several thousand cells. Regular transfer of cells to new media and subsequent growth, resulted in a large number of generations being grown in the lab outside of host animal (humans). In addition to losing virulence in humans after many transfers to new media, the bacteria were observed to grow more rapidly in culture than the original isolate. Given your knowledge of evolution, explain how both virulence is lost and growth rate increased after prolonged growth in the lab. Your answer should be clear, legible, logically organized and refer to specific evolutionary mechanisms acting on the bacterial population. (8 marks)