Question 2:

The average number of packets in a queue that has an infinite sized buffer increases exponentially as the utilization of the queue increases. The logic behind this follows as the more packets are added to an infinite queue the more packets will be in the queue.

This graph shows that much like the behavior that is present between average packets in queue vs utilization, the average sojourn time also increases exponentially as utilization increases. This makes sense since as more packets are generated there are more chances for a queue to form increasing the sojourn time.

This graph shows a negative linear relationship between Pidle and the utilization of the queue. The graph is in line with the programming logic as more packets are generated, there are more instances where packets will need to be serviced. Overall, this will result in a decrease in idle time.

Question 4:

A logarithmic relationship exists between the utilization of the queue and the average number of packets in the queue. This occurs due to their being a limitation on the queue size. Even as you try to increase the amount of packets generated per second, once you max out the queue, the majority of the time it is impossible to increase the average amount of packets in the queue past capacity. As the buffer size increases the amount of packets available for the queue also increases but the relationship between average number of packets and utilization of the queue remains the same.

The behavior between the average processing time and the utilization of the queue is also on a logarithmic scale. This is similar to the previous graph, the amount of time needed to process a packet will increase with the more items in the queue. As more items are generated per minute the queue will be full more constantly increasing the amount of time needed. However, as the queue reaches capacity more frequently the amount of time needed to process a packet will begin to stabilize. Also, as the value of K increases the relationship remains the same with higher limits.

This graph demonstrates that as queue utilization is increased, the amount of time the server spends idle decreases. This occurs since as the number of packets sent increases, there are less instances when the server is not servicing a packet which directly correlates with idle time. However, is slopes towards 0 because idle time cannot be less than 0 and increasing the amount of packets sent past a threshold has diminishing returns.

Our final graph shows that as the utilization of the queue increases, the amount of packets lost also increases. This occurs since the limitation of a buffer size will be more frequent as you are trying to send out more packets. As you fill the queue faster, there are more instances where a packet will be lost. Our graph also shows that past a certain threshold the queue cannot keep up with the amount of packets being sent at all and starts to lose packets in an increasing exponential way. It is also noted that as you increase your buffer size the threshold mentioned gets pushed back and you can send more packets safely. However, after you hit that threshold, regardless of queue size, you will start to lose many packets.