# Question 1

## A = 5

## A = 6

## A = 7

# Question 2

## N = 20

## N = 40

## N = 60

# Question 3

## A = 5

## A = 6

## A = 7

# Question 4

## N = 20

## N = 30

## N = 40

# Question 5

## Non-Persistent

### Throughput

In this graph, the number of packets transmitted peaks at an arrival rate of 4 packets/sec. After that peak, the graph levels off and in fact there is a gradual decline in the number of packets transmitted thereafter. For this non-persistent case, the number of packets transmitted increases linearly until a rate of 4 packets/sec. This occurs because the packet arrival rate is still relatively low and so even though there is a random wait before sensing the medium, the number of packets transmitted isn’t affected negatively. In other words, the number of collisions is still minimal because the packet arrival rate is relatively low. However, at a certain point (in our case, > 4 packets/sec) it is likely that packets start queuing up and there are a lot of nodes that need to randomly wait before they sense the medium to check if they can transmit those packets on the medium. As a result, the number of packets successfully transmitted gradually decreases as demonstrated by the graph.

### Delay

In this graph, the average delay per packet increases but shows signs that it will gradually plateau at some arrival rate > 10 packets/sec. When the arrival rate is low, i.e. 2 packets/sec, the average delay per packet is also low because the number of collisions will be minimal, so the binary exponential back off will also be low, hence the lower average delay. Also, since nodes randomly sense the medium to check if it is not busy, this also reduces the chance of collisions hence lowering the average delay per packet. However, when the arrival rate of packet increases, the average delay per packet also increases (at a slightly lower rate) because there will be more collisions and hence there will be greater binary exponential back off before nodes retransmit. However, at very high arrival rate, the delay will likely plateau because the re-transmissions of packets will be spaced out, so collisions will occur less often and hence the BEB won’t increase. As a result, the delay will just plateau.

## P-Persistent

### Throughput

When the p-value is very low (i.e. 0.01), there is a very high chance that the probability will be greater than the p-value and so the packet will be transmitted and hence the number of packets transmitted will be high. As the arrival rate is increased while keeping the p-value very low (i.e. 0.01), the number of packets transmitted will likely increase until some peak, at which point collisions will start to occur when the arrival rate is too high and hence the number of packets transmitted will decrease as packets might get dropped. When the p-value is very high (i.e. 1), there is no chance that the probability will be greater than the p-value and so the packet will not be transmitted and hence the number of packets transmitted will be around 0. As the arrival rate is increased, while keeping the p-value very high (i.e. 1), there will be minimal to no affect on the number of packets transmitted.

### Delay

When the p-value is very low (i.e. 0.01), there is a very high chance that the probability will be greater than the p-value and so the packet will be transmitted and hence there is more chance of collisions which will result in a greater BEB and hence a greater delay. As the arrival rate is increased while keeping the p-value very low (i.e. 0.01), the number of packets transmitted will likely increase until some peak, at which point collisions will start to occur when the arrival rate is too high and hence the number of packets transmitted will decrease as packets might get dropped. When the p-value is very high (i.e. 1), there is no chance that the probability will be greater than the p-value and so the packet will not be transmitted and hence the delay will be around 0. As the arrival rate is increased, while keeping the p-value very high (i.e. 1), there will be minimal to no affect on the delay.