Solutions to Assignment 5 Questions

1) Problem R8, R11 and R14, Chapter 5

a) 2^{48} MAC addresses; 2^{32} IPv4 addresses; 2^{128} IPv6 addresses

b) After the 5^{th} collision, the adapter chooses from {0, 1, 2, …, 31}. The probability that it chooses 4 is 1/32. It waits 204.8 microseconds.

c) 2 (the internal subnet and the external internet)

2) Problem P1, Chapter 5

The rightmost column and bottom row are for parity bits

1 1 1 0 1

1 1 0 0 0

1 0 0 0 1

1 0 1 0 0

0 0 0 0 0

3) Problem P7, Chapter 5

a) R = 110

4) Problem P13, Chapter 5

a) $\frac{1}{N}$

b) $\frac{1}{e}$

5) Problem P5, Chapter 5

a) $(1-p(a))^3 \times p(A)$ where $p(A) =$ probability that A succeeds in a slot.

$$p(A) = p(A\ transmits\ and\ B\ does\ not\ and\ C\ does\ not\ and\ D\ does\ not)$$
$$= p(A\ transmits) \times p(B\ does\ not) \times p(C\ does\ not) \times p(D\ does\ not)$$
$$= p(1-p) \times (1-p) \times (1-p) = p(1-p)^3$$

Hence,

$$p(A\ succeeds\ for\ first\ time\ in\ slot\ 4) = (1-p(A))^3 \times p(A)$$
$$= (1-p(1-p)^3)^3 \times p(1-p)^3$$

b) $p(A\ succeeds\ in\ slot\ 2) = p(1-p)^3$
$p(B\ succeeds\ in\ slot\ 2) = p(1-p)^3$
$p(C\ succeeds\ in\ slot\ 2) = p(1-p)^3$
$p(D\ succeeds\ in\ slot\ 2) = p(1-p)^3$
$p(either\ A\ or\ B\ or\ C\ or\ D\ succeeds\ in\ slot\ 2) = 4p(1-p)^3$
(because these events are mutually exclusive)

c) $p(some\ node\ succeeds\ in\ a\ slot) = 4p(1-p)^3$
$p(no\ node\ succeeds\ in\ a\ slot) = 1-4p(1-p)^3$
Hence, $p * first\ success\ occurs\ in\ slot\ 4) = p(no\ node\ succeeds\ in\ firs\ 3\ slots) \times$
$p(somenode\ succeeds\ in\ 4th\ slot) = (1-4p(1-p)^3)^3 \times 4p(1-p)^3$

d) Efficiency $= p(success\ in\ a\ slot) = 4p(1-p)^3$

6) Problem P9, Chapter 5

a) The length of a polling round is

$$N\left(\frac{Q}{R}+\ d_{poll}\right)$$

The number of bits transmitted in a polling round is NQ. The maximum throughput therefor is

$$\frac{NQ}{N\left(\frac{Q}{R}+d_{poll}\right)}=\frac{R}{1+\frac{d_{poll}R}{Q}}$$