1.

(a) 10

(b) 1/10

(c) $\binom{40}{n}(0.1)^n(0.9)^{40-n}$

(d) $1-\sum_{n=0}^{10}\binom{40}{n}(0.1)^n(0.9)^{40-n}$

2.

$$\sum_{i=0}^{N-1}\frac{iL}{R}=\frac{(N-1)L}{2R}$$

3.

(a) d = $10^7/2.5*10^8$=0.04 ; R*d=$4x10^4$ bits

(b) $4x10^4$ bits

(c) max number of bits that can be in the link

(d) 40000bits = 10000000m; 1bit = 250m

(e) m/(R*dprop)=m/ (m/s * R) = s/R

4.

Non-parallel

Time to transmit 10 obj = 100000/150 * 10 = 6666.67

Time to transmit initial obj = 100000/150 = 666.67

Parallel

Time to transmit 10 obj = 100000/(150/10) = 6666.67

Time to transmit initial obj = 100000/150 = 666.67

Parallel download does not provide any improvement in data transmission.
Ttran = 7333.34

RTT is approx. 2*200/150 = 2.67

Non-persistent +parallel

2RTT(for initial obj) +2RTT + T_{tran} = 7344.02

Non-persistent + non-parallel

2RTT(for initial obj) +20RTT + T_{tran} = 7392.08

So with parallel transmission, we only improves the response time about 0.6%

5.

(a)

Let u=u1+u2+…+uN

us <= (us+u)/N => u >= (N-1)us

Server can divide F into N parts, and send ith part to peer i at rate ri=(ui/u)us. Hence, r1+r2+…+rN = us

Each peer can send what it receives to (N-1) peers at rate ri.

(N-1)ri=(N-1) (ui/u)us <= ui since u >= (N-1)us

Hence, each peer can receives the file at rate r=ri + $sum_{i!=j}$rj=us. That is, the transmission time = F/r=F/us.

(b)

Let u=u1+u2+…+uN

us >= (us+u)/N => u<= (N-1)us

Server can divide F into (N+1) parts, and send ith part to peer I at rate ri=ui/(N-1), and send (N+1)th part to each peer at rate r_{N+1}=(us-u/(N-1))/N. Hence, r1+r2+…+r_{N+1} =u/(N-1) + (us-u/(N-1))/N*N = us

Each peer can send what it receives to (N-1) peers at rate ri.

(N-1)ri=(N-1)* ui/(N-1)=ui

Hence, each peer can receives the file at rate r=ri + $sum_{i!=j}$rj+r_{N+1}=u/(N-1)+ (us-u/(N-1))/N=(u+us)/N. That is, the transmission time = F/r=FN/(u+us)

(c)

From (a), (b) and textbook we know that we can do no better than F/us when us <= (us+ u1+u2+…+uN)/N, and FN/(us+u1+u2+…+uN) when us >= (us+ u1+u2+…+uN)/N. Since this includes all possible us, we can conclude that the minimum time is
max{ F/us , FN/(us+u1+u2+…+uN) }