P6) (a) $d_{prop} = \frac{m}{s}$ seconds

(b) $d_{trans} = \frac{L}{R}$ seconds

(c) $d_{end\text{-}to\text{-}end} = \frac{m}{s} + \frac{L}{R}$ seconds

(d) The last bit is just leaving the Host A.

(e) As $d_{prop} > d_{trans}$ at $t = d_{trans}$, the first bit is still in the link and has not reached ~~to~~ the Host B.

(f) $d_{prop} < d_{trans}$ this implies the first bit has reached the Host B.

(g) $m = \frac{Ls}{R} = \frac{1500}{10 \times 10^6} \times (2.5 \times 10^8) = 37500\ m$
$= 37.5\ km$

P7) Bit generation time $= \frac{56 \times 8}{64 \times 10^3} = 7\ ms$

Transimition Delay $= \frac{56 \cdot 8}{10 \times 10^6} = 44.8\ \mu s$

Propagation Delay $= 10ms$

Total time req $= 7ms + 44.8\mu s + 10ms = 17.0448\ ms$

P8) (a) $\frac{10 \times 10^6}{200 \times 10^3} = 50$ people

(b) $p = 0.1$

(c) $\binom{120}{n}(0.1)^n(0.9)^{120-n}$

(d) $$1 - \sum_{n=0}^{50}\binom{120}{n}(0.1)^n(0.9)^{120-n}$$

P10) $$d_{\text{end-to-end}} = \frac{L}{R_1} + \frac{L}{R_2} + \frac{L}{R_3} + \frac{d_1}{s_1} + \frac{d_2}{s_3} + \frac{d_3}{s_3} + d_{proc} + d_{proc}$$

$$d_{\text{end-to-end}} = \frac{1500 \times 8}{2.5 \times 10^6} \times 3 + \frac{5000 \times 10^3}{2.5 \times 10^8} + \frac{4000 \times 10^3}{2.5 \times 10^8} + \frac{1000 \times 10^3}{2.5 \times 10^8} + 3\text{ms} \times 2$$

$$\Rightarrow 0.0144 + 0.04 + 0.006 = 0.0604\text{s}$$
$$= 60.4 \text{ ms}$$

P15) Total delay $= \frac{\frac{L}{R}}{1 - I} = \frac{\frac{L}{R}}{1 - \frac{aL}{R}} = \frac{1/\mu}{1 - a/\mu} = \frac{1}{\mu - a}$

P16) $N = \cancel{10+}100 + 1 = 101$

$N = ad \Rightarrow 101 = a \times (20\text{ ms} + \frac{1}{100})$

$a = 3366.67$ packets/sec.

P23) (a) $\frac{L}{R_s}$

(b) If bottle necked, second packet arrives before second link finishes transmission of first packet.

$\therefore \frac{L}{R_s} \times 2 + d_{prop} < L/R_s + d_{prop} + L/R_c$

T seconds later we have; time most be greater:

$\frac{L}{R_s} \times 2 + d_{prop} + T \geq L/R_s + d_{prop} + L/R_c$

$\therefore T \geq L/R_c - L/R_s$

$\Rightarrow$ T minimum value is $L/R_c - L/R_s$.

P 25) (a) $R \cdot d_{prop} = 5 \times 10^6 \times \frac{20000 \times 10^3}{2.5 \times 10^8}$

$= 400000$

(b) $\cancel{\frac{5 \times 10^6}{800,000}}$ ~~= 6.25 bits~~

(b) 400000

(c) Maximum number of bits in a link.

(d) $\text{Width} = \frac{20000 \times 10^3}{400000} = 50m$

(e) $\text{width} = \frac{\cancel{m}}{R \cdot \frac{\cancel{m}}{s}} = \frac{s}{R}$

P 29) (a) Distance = 36000 km

$d_{prop} = \frac{36000 \times 10^3}{2.4 \times 10^8} = 0.15\,s = 150\,ms$

(b) $R \cdot d_{prop} = 10 \times 10^6 \times 0.15 = 1500000$ bits

(c) $10^7 \times 60 = 600,000,000$ bits

P31)

(a) Source to first switch time = $\frac{10^6}{5 \times 10^6} = \frac{1}{5} = 0.2$ sec

$\therefore$ For store-forward switching $\Rightarrow$

total time = [illegible] $0.2 \times 3 = 0.6$ s

(b)

time 1st packet from source host to first switch

$$= \frac{10000}{5 \times 10^6} = \frac{1}{500} = 2 \text{ ms}$$

Time second packet fully received = 2×2 ms
= 4 ms

(c) Time for first packet at dest host = $2\text{ms} \times 3$
= 6 ms

$\therefore$ 100th packet recieved at = 6 ms + 99×2 ms
= 204 ms = ~~204 s~~ 0.204 s

It can be seen store-forward switching is much ~~faster~~ slower at 0.6 s vs ~~204~~ 0.204 s for message segmentation.

(d)(i) W/out message segmentation, if bits errors are not tolerated, if there is a single bit error whole message has to retransmitted.

(ii) Huge packets need to accomodated by routers, and suffer unfair delays.

(e) (i) Packests have to be put in sequence

(ii) Total number of bytes is more for messages segmentation ~~sing~~ since header size is constant.