Q1. (a) ~~RTT~~ T_t=Transmission time ≈ 0.

T_p = Propagation = $100\text{ km} / 1\text{km}/5\mu s = 500\ \mu s$

Total packet = $\dfrac{x \text{ bytes}}{8\times 1000 \text{ bytes}}$

Throughput = $\dfrac{x \text{ bytes}}{\dfrac{x\text{ bytes}}{8\times1000\text{ bytes}} \times (T_t + 2T_p)} = 64$ Mbps.

Q.1 (b). Yes, Because the divisor polynomial has both x^0 term and x^k term. Hence, it can detect the error.

Q.1 (c). $T_f = \dfrac{100 \text{ bytes}}{100 \text{ Mbps}} = 8\times10^{-6}$ s.

$RTT = 2T_p \le T_f$.

$\Rightarrow T_p \le \dfrac{T_f}{2} = 4\times10^{-6} s = 4\mu s$. , So the maximum one-way propagation time is $4\ \mu s$.

Q.1 (d) ~~Succef~~ Successful: one host use the slots but others not.

~~0.1×0.9~~ $10\times0.1\times(1-0.1)^9 = 0.387$.

Q.1 (e) Host A —①— router 1 —②— router 2 —③— router 3 —④— ~~Router~~ Host B

100 Mbps, 100 Mbps, 100 Mbps, 100 Mbps

$T_t = \dfrac{1000 \text{ byte}}{100 \text{ Mbps}} = 8\times10^{-5}$ s.

① retransmitte. 5 Mbps

② 10 Mbps

③ 15 Mbps

④ 20 Mbps.

Q.2(a)

(i) {4, 5}.

Although receiver sends RR1, senders don't receive it, the window won't change.

(ii). {5}.

After that, the window will shrink 1 bit.

(iii) {5},

Senders ~~don't~~. haven't received the RR3

(iv) {5, 6, 7, 0, 1}.

RR3 means data before 3 (7, 0, 1, 2) have been received, the window will expand 4 bit.

Q.2 (b) $T_t = \frac{500 \text{ byte}}{10 \text{ Mbps}} = 0.4 \text{ ms}$

$T_p = 500 \text{ km} \times 5 \mu s/\text{km} = 2.5 \text{ ms}.$

$a = \frac{T_p}{T_f} = 6.25$

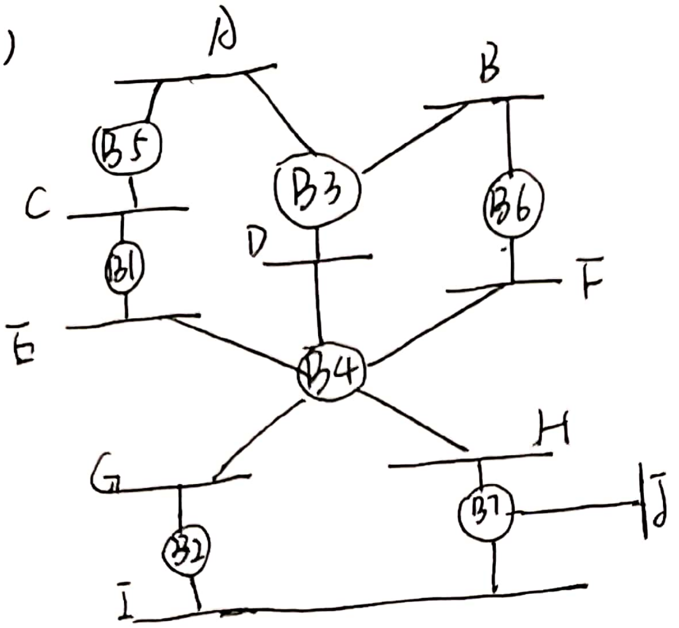
$1+2a = 13.5 < W.$

So the data can be sent continuously.

~~To~~ Total frames per second $= \frac{1 s}{\frac{500 \text{ byte}}{10 \text{M bps}}} = 2500$ frames per second.

~~Q.2 (c)~~

Q.2(c)



B5 receives (B1, 0, B1) on LAN C

B4 receives (B1, 0, B4) on LAN E.

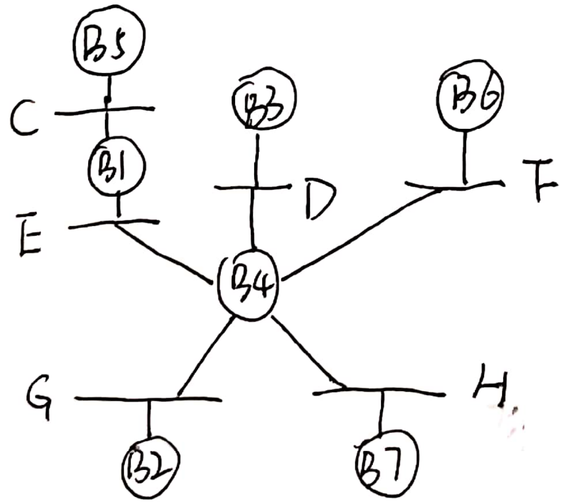
B3 receives (B1, ф, B3) on Lan D (from B4)

B6 receives (B1, 1, B6) on Lan F. (from B4)

B2: (B1, 1, B2) on Lan G (from B4)

B7: (B1, 1, B4) on Lan H (from B4)

⇓.



Q.2 (d)

T.	RTS	CTS	Successful
0	A to B A to D A to E B to A B to C B to E C to B C to D	B to A	NO.
15.	~~A~~ E to D C to B.	B to C. D to C.	NO
50	B to A B to C B to E	E to B	A to B C to B C to D
60	\	\	A to B C to B C to D.

Q.3

(a) (i). ~~192.168.128.144~~

192.168.128.128/27.

(ii) starting IP: 192.168.128.129

Ending IP: 192.168.128.158

(iii) 192.168.128.128

(iv) 192.168.128.159

(V) ~~Same~~ It could lead to stifling of innovation and diffcult maintenance.

(b) Yes.

A: 192.168.128.0/25

B: 192.168.128.128/26

C: 192.168.128.192/26.

(c) Removing Edge C-D. Yes. Becaus.after that no node can reach node D, But S, A, B, don't know, they will cont to infinity.

Removing Edge S-A. No. Because S can reach A via S-B-C-A.

Removing Edge S-A, S-B. Yes. The reason is same as first. No node can reach node S, and node C, d don't know. The will count to infinit.

Removing Edge A-C and B-C. Yes. ~~The rea~~ S, A, B and C, D can't reach each other.

Q.3

(d).

Edge	(i) Tree 1	(ii) Order of edges.
S-A	✓	1
S-B	✓	1
A-C	✓	2
B-C	×	
C-D	✓	3.

(iii).

Destination	Next Hop	Cost to Destination
A	A	2
B	B	3
C	A	3
D	A	5.

(iv) When $x+y \geq 2+1$, the results is true.

~~≤~~ $\Rightarrow y \geq -7$ (y is a integer).

Q.4

(a) Because TCP is fair, ~~其~~ but UDP not. ~~因为~~ The router will satitity UDP first, and after TCP flow share the remair throughput together

UDP: 20Mbps

$$TCP\text{-}1 = TCP\text{-}2 = TCP\text{-}\cancel{3} = TCP\text{-}4 = \frac{60Mbps - 20Mbps}{4} = 10\ Mbps.$$

(b) If use max-min fair allocation, these flows will get same bandwidth until ~~本~~ they are satisified.

$$UDP = TCP\text{-}1 = TCP\text{-}2 = TCP\text{-}3 = TCP\text{-}4 = \frac{60\ Mbps}{5} = 12\ Mbps.$$

(c) Same as (i) UDP = 20 Mbps.

TCP use AIMD, it incremene CW by one packet per RTT

And sender can send at most one packet per RTT.

So: TCP-1 = TCP-2 = 13.33Mbps

TCP-3 = TCP-4 = 6.67 Mbps.

(d) ~~i) Time out: round 6-7; round 22-23.~~

(i) Packet losS: ~~14~~-16.

~~(ii)~~

(ii) Time-out: round 6-7; round 22-23

(iii) round ~~15-16~~ 15-16.

(iv) Slow start

(v) AIMD (Additive Increase / Multipicative Decreae)