① @ ① Prefix Mask = /12

11111111.11110000.00000000.00000000
255 240 0 0

∴ subnet mask = 255.240.0.0

IPv4 address = 200.100.50.25
= 11001000.01100100.00110010.00011001

IP: 11001000.01100100.00110010.00011001
subnet: 1111 1111.1111 0000.00000000.00000000
AND: 11001000.01100000.00000000.00000000

∴ Network Address = 200.96.0.0/12

(11)

(11) Host bit = (32-12) bits = 20 bits

∴ number of hosts = $2^{20} - 2 = 1048574$

default-gateway = second last usable host

/12 network range:

Increment 16 in 2nd octet

∴ network range: 200.96.0.0 → 200.111.255.255

Last usable host = 200.111.255.254

second last usable host = 200.111.255.253

∴ Default gateway = 200.111.255.253/12

(5)

S3 : $1024+2 = 1026 = 2^{11} = 8$ (3rd octet)

S3(LAN): $250+2 = 252 = 2^{8} = 01$ (3rd octet)

S1 : $100+2 = 102 = 2^{7} = 128$ (4th octet)

R-R : $2+2 = 4 = 2^{2} = 4$ (4th octet)

R-R1 : $2+2+2 = 6 = 2^{3} = 8$ (4th octet)

R-R2 : $2+2 = 4 = 2^{2} = 4$ (4th octet)

00001000 00000000

8

000 0001 00000000

1

10000000

00000100

S3: 200.06.0.0/21

S3(LAN): 200.06.8.0/24

S1 : 200.06.9.0/25

R-R : 200.06.9.128/30

R-R : 200.06.9.136/29

R-R : 200.06.9.140/30

(2) (a) (i) Data fragment = 268 − 20
= 248 bytes

Fragment offset of 7th fragment = 186

Data before last fragment = 186 × 8
= 1488 bytes

Last fragment data = 248 bytes

Total data = (1488 + 248) bytes
= 1736 bytes

∴ Original packet size = 1736 + 20
= 1756 bytes

(ii) since all fragments have the same packet size, MTU = 268 bytes

Each fragment carries 248 bytes

offset increase per fragment = 248 ÷ 8
= 31.

1st = 0
2nd = 0 + 31 = 31
3rd = 0 + 31 + 31 = 62
4th = 62 + 31 = 93
5th = 93 + 31 = 124

(iii) MF=0, since 7th fragment is the Last fragment

(5) (i)

* Wrong DHCP network statement: Here written network 1.1.0.0 255.255.254.0 for R4 but R4 LAN is 1.1.1.0.0/24, which showing mismatch

* Incorrect default gateway: Here written default-router 1.1.0.255, but .255 is used for broadcast address. Default-gateway should be a router interface IP.

* DHCP is on another network: DHCP Server 2 is not in R4_LAN. DHCP uses broadcast but Router do not forward broadcast.

(11) Here DHCP requests from RH_LAN cannot reach DHCP server 2.

To solve it ip helper-address is needed on RH's LAN interface

interface f0
ip helper-address DHCP_server2_IP

(3) (a) The topology uses Dijkstra's Shortest Path First algorithm. This is a Link-state routing algorithm used by protocol like OSPF.

(11)

Node	Distance
A	0
B	~~∞~~ 5
C	~~∞~~ 2
D	~~∞~~ 4+2=6
E	~~∞~~ 9
F	~~∞~~ 4
G	∞
H	∞
I	~~∞~~ 1+4=5
J	∞
K	∞

∴ Path = A → C → F → B → I

cost = 2+4+5+5

= 16

(b) Link state is better.

Reasons:

↳ Has full topology knowledge

↳ Uses Dijkstra's algorithm

↳ Faster convergence

↳ No count to infinity problem

↳ More accurate shortest path calculation

(c) The main cause is the count-to-Infinity problem.

Explanation:

* Routers only know neighbor information
* Bad news travels slowly
* Routing loops occur before convergence
* Incremental metric updates cause delay.

(9) (i) ip route 0.0.0.0 0.0.0.0 1.1.1.2

1.1.1.2 because Next hop from R4 is R1

(ii) Assign higher AD. Let AD = 10

ip route 0.0.0.0 0.0.0.0 1.1.2.2 10

(b) (i)

Network	usable Range
1.1.0.244/29	224 – 231
1.1.0.232/29	232 – 239
1.1.0.240/29	240 – 247
1.1.0.248/29	248 – 255

∴ full continuous range = 224 – 255 = 32 address

∴ /27 = 32 address

/27 = 255.255.255.224

- summarized static route command:

ip route 1.1.0.224 255.255.255.254 nexthop

(ii) Effect of route summarization:

↳ Reduces routing table size
↳ Faster Lookup
↳ Lower CPU and memory usage
↳ improves scalability

④ Floating static default route

AD = 50 because:

↳ Normal static route AD = 1

↳ AD increased to 50 to make it a backup route

↳ Used only if a lower AD route fails.

5

ⓐ IPv6 multicast address start with FF00::/8.

Multicast replaces broadcast.

IPv6 does not use broadcast. Uses multicast groups instead. Hosts join only relevant multicast groups, reduces unnecessary network traffic.

(b) IPv6 uses Extension Headers which carries extra information.
It is inserted between IPv6 header and payload.
If 20 bytes are added:
* Base IPv6 header remains
* total packet size increases
* Header size does not change.

~~(c) DAD is not required in Stateful DHCPv6 because,~~

(6) (a) MAC Address : A2-FE-22-32-3D-4F

A2 — 1010 0010

1st bit — 1

∴ Locally administered

Portability:
* MAC Address move with the device
* works on any network interface
* Not tied to location

(b) → ARP request from Host A for Host D

→ switch behaviour:

* Learns MAC of Host A on incoming port

* ARP is a broadcast

* Floods frame to all ports except source

→ Only Host A entry may be updated

No change for B, C, D