1(a)

Given,

default gateway IP = 109.0.8.253

network supports → 2045 devices

(i) subnet mask ⇒ 32 − 11 = 21 bits

255.255.248.0

broadcast address →

block size in 3rd octet = 8

109.0.8.253 falls in —

109.0.8.0 – 109.0.15.255

broadcast address —

109.0.15.255

(ii) host size —

$2^{11} - 2 = 2046$ hosts

1(b)

base network address –

109.0.8.0/21

LAN- 500 hosts

needs 9 host bits → /23

LAN–255 hosts

needs 8 host bits → /24

switched network (4 routers)

needs 4 IPs → /29

hosts = 6

WAN link –

needs 2 IPs → /30

hosts = 2

2(a)

When TTL reaches destination, the destination sends an ICMP echo reply or UDP port unreachable.

Traceroute stops when it receives a response from the destination itself instead of a router.

2(b)

(i)

data per large fragment –

$1945 - 25 = 1920$ bytes

Total data $= (12 \times 1920) + 900 = 23940$ bytes

original datagram size $= 23940 + 25$

$= 23965$ bytes

(ii)

Fragment size $= 1920$ bytes

2nd last packet offset →

$11 \times 1920 = 21120$ bytes

offset field value (in 8-byte units) –

~~decimal values~~ $21120 \div 8 = 2640$

(iii)

More fragments (MF) flag $= 0$

2(c)

Source IP address 192.168.1.1 is a private IP address; private addresses are reserved for use within internal local area networks (LAN). They are not unique globally.

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Solution : Network Address Translation (NAT)

As the internal network has 500 hosts, the most suitable NAT method is PAT (Port Address Translation).

It allows many internal hosts to share a single public IP address, efficient & scalable for large networks & translates –

Private IP + Port → Public IP + Unique Port.

5(a)

Stateless	Stateful
done by SLAAC	done by DHCPv6
for small/simple networks	for enterprise networks
DHCP server does not keep state	DHCP server keeps state
does not track assigned addresses	track assigned address.

When to use which?

Stateless: for simple, automated setups where address management overhead isn't required.

Stateful: when administrators want full control over IPv6 address

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5(b)

Flow label identifies packets that belong to the Same traffic flow.

It enables faster packet processing, helps routers provide quality of service & is useful for real-time applications needing low delay

5(c)

Tunneling Strategy-

tunneling works best in scenarios where two IPv6 islands need to communicate accross an existing IPv4 only infrastructure. The IPv6 packet is encapsulated inside an IPv4 header to traverse the old network.

Placement of dual stack router —

at the edges of IPv6 networks

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6(a)

MAC address	IP address
data link layer	Network layer
permanent	can change depending on network
used for local network communication	used for logical routing across networks

6(b)

Host A & Host M are located on different Network segments seperated by R1 & R2.

Target IP: Host A will send an ARP request for the IP address of Router R1's FA 0/1 interface (its default gateway).

Next step: Once host A receives the ARP reply, it will encapsulate the packet into a frame using R1's MAC address as the destination & send it to the router.

6(c)

Switching behaviour:

Flooding: the ARP request is a broadcast, both SW1 & SW2 flood it out of all ports except the receiving port.

Unicasting: The ARP reply from host C is a unicast; switches use their learned tables to send the frame directly to host B.

Updated MAC Tables —

SW1 —

Device	MAC address	Port/Interface	Status
Host A	00.90.21.D0.DD.48	Fa0/1	Pre existing
Host D	00.0C.85.75.64.90	Fa0/3	Pre-existing (via SW2)
Host B	00.04.9A.10.C6.78	Fa0/2	newly learned
Host C	00.01.C9.59.7A.C2	Fa0/3	newly learned

SW2 —

Host B	00.09.9A.10.C6.78	Fa0/2	newly learned
Host C	00.01.C9.59.7A.C2	Fa0/1	newly learned
Host D	00.0C.85.75.64.90	Fa0/3	newly learned

3(a)

(i) Distance vector Routing (Bellman-Ford algorithm)

(ii) updated table —

$$D_T(D) = \min \{ c(T,U) + D_U(dest), \; c(T,Y) + D_Y(dest), \; \text{direct link to } V \}.$$

Destination	Equation / Calculation	Updated Distance
T	self distance	0
U	min(2+0, 7+∞)	2
V	min(2+3, 7+8, direct 9)	4
W	min(2+3, 7+∞)	5
X	min(2+∞, 7+6)	13
Y	min(2+∞, 7+0)	7
Z	min(2+∞, 7+12)	19

3(b)

Distance Vector	Link State
Sends routing table periodically	Send update only on change
sends to direct neighbours only	floods to all routers
slower convergence	

3(c)

Slow convergence—

suffers from count to infinity problem,

no complete network view — routers only know neighbor information, and updates propagate hop by hop.

4(a)

LanB (43.11.192.0/25)

Static route command on Router-C:

ip route 43.11.192.0 255.255.255.128

191.10.55.129

4(b) Floating static route:

command on router B—

ip route 21.1.64.0 255.255.255.192
112.24.205.2 10

difference:
multi access network (like ethernet) require the next hop IP address in the command so the router can use ARP to find the specific neighbours MAC address. Point-to-Point links can function with just the exit interface.

4(c)
Routing table identification—
identification: static routes are identified by the code 'S' at the beginning of the routing table entry.

Router C Output (directly connected only): since no routing protocols or static routes are configured, Router C only displays its four directly connected networks.

code	Networkaddress/Prefix	Interface
C	100.9.128.128/27	Fast Ethernet 1
C	112.191.63.0/29	Fast Ethernet 0
C	191.10.55.128/30	Serial 0/1
C	191.20.255.192/30	Serial 0/0