Final

1.

IPv4：32 bits
MAC ：48 bits

2.

NAT
DHCP

3.

1. 每經過一個 router，TTL 的值就會減 1，當記數到 0 時，封包就會被丟掉，並向 sender 發送錯誤訊息，防止封包在路由中產生迴圈
2. 會的，TTL 會隨著經過一個路由器而減 1

4.

data plane ：forwarding
control plane：routing

5.

我會選擇 random access protocols
因為使用 channel partitioning protocols，就算你只有一個節點要傳輸，也會被受限於平均的傳送速率
而使用 random access protocols，在只有一個節點要傳輸，可以有最大速率傳輸，且不會有人跟他碰撞

6.

D = 1011010111
G = 11001 = 25
D * 2^r = 10110101110000 = 11632

R = 0010
output = 10110101110010 G = 11001

7.

max broadcast throughput：$L/(d_{poll}+L/R)$ bps

8.

1. 關於基於交換器的乙太 LAN，沒有 MAC 協定
2. NO，基於交換器不會有封包碰撞的情形
3. NO，交換器會自己學習配置

9.

Step	N'	D(2),p(2)	D(3),p(3)	D(4),p(4)	D(5),p(5)	D(6),p(6)
0	1	5,1	7,1	3,1	1,1	∞
1	15	5,1	2,5	3,1		9,5
2	153	4,3		3,1		6,3
3	1534	4,3				6,3
4	15342					6,3
5	153426					

1. (10%) (a) What is the length of the IPv4 internet address (in bits)?
   (b) What is the length of the Ethernet MAC address (in bits)?

2. (10%) A coffee shop is equipped with a Wi-Fi wireless router that provides free internet service to all customers. Assume that this router connects to the ISP (Internet Service Provider) with a single assigned IPv4 address of 140.124.185.123. List the **two** major network protocols or functions that this router has to provide such that the mobile devices of customers in this shop can obtain their temporary IPv4 addresses and enjoy surfing the internet simultaneously.

3. (10%) What is the main usage of the TTL (Time To Live) field in the IPv4 packet header? Will this value be changed along with the IP packet transmission from the source node to the destination node?

4. (10%) The network layer functionality can be broadly divided into data plane functionality and control plane functionality. Identify **one** main function of the **data plane**. Identify **one** main function of the **control plane**.

5. (10%) Consider the following two categories of the MAC protocols in the broadcast channel: **channel partitioning protocols** and **random access protocols**. If there is only one node with data to send at any time, which category should we choose to achieve the higher network efficiency ? **State your reason.**

6. (10%) Assume the CRC (Cyclic Redundancy Check) coding scheme is used as the error-detection method. Assume the generator, G = 11001. The data bits to be sent is D = 1011010111. What is the **encoded output bit pattern** ?

7. (10%) Consider a broadcast channel with N nodes and a transmission rate of R bps. Assume that the broadcast channel uses polling (with an additional master polling node) for multiple access. The amount of time from when a node completes transmission until the subsequent node is permitted to transmit (that is, the polling delay) is d_{poll}. Within a polling round, a given node is allowed to transmit at most L bits. What is the maximum throughput (in bps) of the broadcast channel?

8. (15%) In a switch-based Ethernet LAN, network nodes are connected by a Ethernet switch. Answer the following **three** questions: (a) Which MAC protocol is used in this network? (b) Will there be possible packet collisions? (c) Do we need to configure the switching table of the Ethernet switch manually?

9. (15%) Use the Dijkstra's link-state algorithm to find the least-cost paths from Node 1 to all other nodes of the following graph. The number above each link is the associated cost of the link. **Show your results step by step**.