

2.1 Networks including the internet

Name: _____ Class: _____ Date: _____

Total: 45 marks

KEY WORDS router 路由器 • wide area network 广域网 • ip address IP 地址 • star 星形 • mesh 网状

Objective

Build the skills to answer exam questions on **networks** 网络 — the types and topologies of networks, the client-server and peer-to-peer models, IP addressing, and how a web page is found.

You must be able to:

- compare a **LAN** 局域网 and a **WAN** 广域网, and the **client-server** and **peer-to-peer** models
- describe the **bus**, **star** and **mesh** topologies
- explain **IP addresses** (IPv4 / IPv6, public / private, static / dynamic)
- explain how a **URL**, the **DNS** and the difference between the **internet** and the **WWW** work

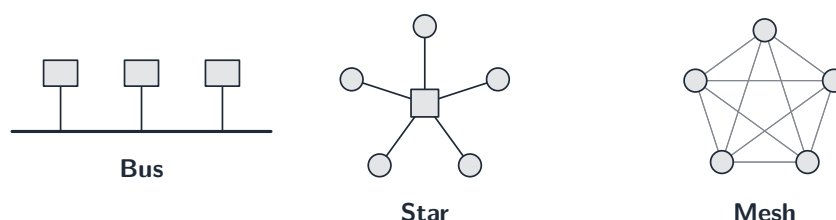
1 Worked examples

Study these first. Each one shows the method for a question type used later — follow the steps and you can do the Practice and Exam-style questions yourself.

■ Network types and topologies

A **LAN** (local area network) covers a **small area** (one site), is owned by the organisation, and is fast. A **WAN** (wide area network) covers a **large area** using telecom links — the internet is the biggest WAN. A WAN joins LANs together.

The **topology** 拓扑 is how the devices are linked:



- **bus** — one shared cable: cheap, but the whole LAN fails if the cable does. Only one device can send at a time, so devices must **detect and manage collisions**

冲突 — if two send at once, they stop, wait a random time, and resend.

- **star** — each device to a central switch: one device failing doesn't affect others (most common).
- **mesh** — every device linked to others: very **fault-tolerant** (traffic reroutes), but lots of cabling.

■ Network hardware

- a **router** 路由器 joins different networks and sends (routes) data between them — it connects a LAN to the internet.
- a **switch** 交换机 connects devices **inside** one LAN and sends each message only to the device it is addressed to.
- a **network interface card (NIC)** gives a device its fixed physical **MAC address** 物理地址 and connects it to the network.

■ Client-server vs peer-to-peer

	client-server	peer-to-peer
Roles	servers 服务器 provide; clients 客户端 request	every node is both client and server
Control	central, easy to manage and back up	no central control
Weakness	server is a single point of failure	harder to secure / keep consistent

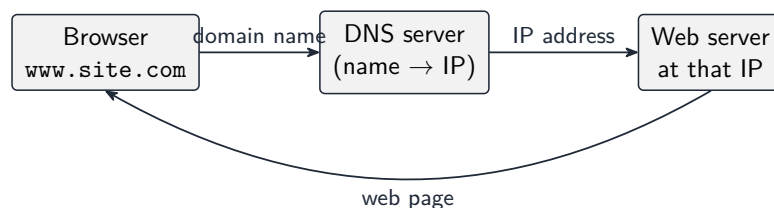
■ IP addresses

Every device on a network has an **IP address**.

- **IPv4** — four numbers 0–255, e.g. 192.168.0.5. **IPv6** — much longer (hex), created because IPv4 addresses ran out.
- **public** = unique across the whole internet; **private** = used only inside a LAN (not reachable directly from outside → safer).
- **static** = fixed; **dynamic** = assigned when the device joins and may change.

■ Finding a web page: URL and DNS

The **internet** is the global network of hardware; the **World Wide Web (WWW)** is the pages and resources carried on it. To open a page, the browser turns the **URL's** domain name into an IP address using the **DNS** (Domain Name Service):



2 Practice

Now apply the methods above.

2.1 State **two** benefits of connecting computers in a network. [2]

2.2 State **two** differences between a LAN and a WAN. [2]

2.3 Name the topology in which every device connects to a central switch, and give one advantage of it. [2]

2.4 State the difference between a **public** and a **private** IP address. [1]

3 Exam-style questions

3.1 (a) Describe the **client–server** model of a network. [2]

(b) Give one advantage **and** one disadvantage of client–server compared with peer-to-peer. [2]

3.2 (a) State the format of an **IPv4** address. [1]

(b) Give one reason **IPv6** was introduced. [1]

(c) State the difference between a **static** and a **dynamic** IP address. [2]

3.3 Describe how the **DNS** is used when a user types a URL into a browser. [3]

3.4 (a) State the difference between the **internet** and the **World Wide Web**. [2]

(b) Give one advantage **and** one disadvantage of a wireless connection compared with a wired one. [2]

3.5 A company has offices in two cities, each with a star-topology LAN.

(a) Name the type of network that connects the two offices together. [1]

(b) State one benefit of using a mesh topology for the links between the key servers. [1]

3.6 A home has a router and several devices connected to a switch.

(a) State the role of the **router**. [1]

(b) State **one** difference between a **switch** and a **router**. [2]

3.7 A LAN uses a single shared cable (a bus). Describe how the network deals with a

collision when two devices send data at the same time. [2]

3.8 A college streams recorded lectures to students and also runs live question-and-answer sessions.

(a) **Complete** the table by describing each type of IP address. [3]

type of IP address	description
public	_____
private	_____
static	_____

(b) Consider the address 2001:0db8:0000:0000:0000:ff00:0042:8329. **Identify** which version of IP this is, and **give** one advantage of it over the other version besides the number of addresses available. [2]

(c) **Describe** the difference between **real-time** and **on-demand** bit streaming, giving one example of each. [4]

(d) **Explain** why a high **bit rate** and a large enough **buffer** both matter when streaming video. [4]

(e) A student watching an on-demand lecture sees the video pause repeatedly to reload. **Explain**, in terms of the buffer, why this happens, and **give** one change that would reduce it. [3]

Solutions

2.1 Any two of: share resources (printers, files); share/access the same data; central management and backup; communication; remote access.

2.2 Any two differences, e.g.: LAN covers a small area / WAN a large area; LAN owned by the organisation / WAN uses telecom links; LAN faster, lower latency / WAN slower.

2.3 Star; advantage e.g. one device (or its cable) failing does not affect the others.

2.4 A public IP is unique across the whole internet; a private IP is used only inside a local network.

3.1 (a) Powerful **servers** provide services (files, web pages); **client** machines request those services.

(b) Advantage e.g. central management / easier backup and security. Disadvantage e.g. the server is a single point of failure / cost of the server.

3.2 (a) Four numbers 0–255 separated by dots, e.g. 192.168.0.5.

(b) IPv4 addresses ran out / IPv6 gives many more addresses.

(c) Static = fixed and does not change; dynamic = assigned when the device joins and can change.

3.3 The browser takes the domain name from the URL and sends it to a DNS server, which looks it up and returns the matching IP address; the browser then connects to the web server at that IP to fetch the page.

3.4 (a) The internet is the global **network of hardware**; the WWW is the **pages and resources** carried over it.

(b) Advantage e.g. mobility / no cabling. Disadvantage e.g. slower / less secure / more interference.

3.5 (a) A **WAN** (wide area network).

(b) Many paths, so if one link fails the traffic reroutes — high fault tolerance.

3.6 (a) It joins the home LAN to the internet and routes data between the two networks.

(b) A switch sends data only to devices **within** the same LAN; a router sends data **between different networks** (e.g. the LAN and the internet).

3.7 The two devices detect that they sent at the same time, stop transmitting, then each waits a **random** length of time before resending, so they are unlikely to collide again.

3.8 (a) **Public** — unique across the whole internet, assigned by an ISP, and routable on it. **Private** — used only inside a LAN, not routable on the internet, so the same range can be reused in every building. **Static** — the same address every time the device connects, rather than one allocated afresh by DHCP.

(b) **IPv6** — eight groups of four hexadecimal digits separated by colons. Any one of: it has a simpler header so routers process packets faster; it has built-in support for encryption and authentication; it removes the need for network address translation.

(c) **Real-time**: the event is broadcast as it happens, encoded and sent immediately, and cannot be paused or rewound past the live point — for example the live question-and-answer session. **On-demand**: the file already exists on a server and is streamed when the user asks for it, so it can be paused, rewound and replayed — for example a recorded lecture.

(d) The **bit rate** must be at least as large as the rate at which the video consumes data, or the stream cannot keep up whatever else is done; a higher bit rate also allows a higher resolution. The **buffer** stores data ahead of the play position, so short dips in the connection speed are covered by data already downloaded and playback continues smoothly.

(e) The data arrives more slowly than it is played, so the buffer **empties**, and playback must stop until it refills. Any one of: choose a lower-resolution stream so the required bit rate falls; use a wired connection or move closer to the router; allow a larger buffer before playback starts.