

Week 4

A-Level Computer Science

Homework bundle for this week

本周作业合集

exercises.lol

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2. Communication

Starter Quiz · 课前小测

A-Level Computer Science

Name: _____ Score: _____

1. Select **all** the genuine benefits of using a network.

- ☐ sharing one printer between many computers
- ☐ backing up everyone's files once on a server
- ☐ communicating by email and video call
- ☐ making each computer slower

Tick every correct option.

2. In a star topology, what happens if one device's cable fails?

- ☐ only that device is cut off; the others keep working
- ☐ the whole network goes down
- ☐ traffic reroutes around it automatically
- ☐ the switch must be replaced

3. What is the relationship between the internet and the World Wide Web?

- ☐ the WWW is a service (web pages) that runs over the internet
- ☐ they are exactly the same thing
- ☐ the internet runs over the WWW
- ☐ the WWW replaced the internet

4. In 'https://www.example.com/about/contact.html', what is 'https'?

- ☐ the protocol
- ☐ the domain name
- ☐ the path
- ☐ the IP address

5. Which best describes a LAN?

- ☐ a network over a small area, usually owned by one organisation, with high speed
- ☐ a network spanning the whole country
- ☐ the global internet
- ☐ a network with no cables at all

6. In a star topology, how does a packet get from PC A to PC B?

- ☐ A sends it to the switch, which forwards it down B's cable

- ☐ A puts it on a shared cable and every PC reads it
- ☐ it is passed from PC to PC around a ring until it reaches B
- ☐ A broadcasts it by radio to all PCs

7. How many bits are in an IPv4 address?

_____ bits

8. Which of these are characteristics of a LAN? Select **all** that apply.

- ☐ it covers a single site or building
- ☐ the hardware is owned by the organisation
- ☐ it runs over infrastructure leased from a telecom company
- ☐ data rates are high and latency low

Tick every correct option.

9. A NIC's unique, fixed 48-bit hardware address is called its _____ address.

10. Why does the web use DNS rather than having users type IP addresses? Select **all** that apply.

- ☐ names are easier for people to remember than numbers
- ☐ a site can move to a new server without changing its name
- ☐ it makes the page download faster
- ☐ no single server needs to hold every name

Tick every correct option.

2. Communication

1. sharing one printer between many computers; backing up everyone's files once on a server; communicating by email and video call

Sharing resources, central backup, and communication are all benefits. Networks do not make computers slower.

2. only that device is cut off; the others keep working

Each device has its own link to the central switch, so one cable failing affects only that device. (If the switch fails, all go down.)

3. the WWW is a service (web pages) that runs over the internet

The internet is the global network; the WWW is one service on it (hyperlinked documents). Email and file transfer are other internet services.

4. the protocol

'https' is the protocol; 'www.example.com' is the domain name; '/about/contact.html' is the path.

5. a network over a small area, usually owned by one organisation, with high speed

A LAN covers a small area (home/office/school), is usually organisation-owned, and is fast with low latency. A WAN covers a large area.

6. A sends it to the switch, which forwards it only down B's cable

The switch reads the destination MAC address and forwards to one port, which is why other pairs can talk at the same time.

7. 32 bits

IPv4 is 32-bit (four numbers 0–255). IPv6 is 128-bit.

8. it covers a single site or building; the hardware is owned by the organisation; data rates are high and latency low

Leased telecom infrastructure is the mark of a WAN. A LAN is small, owned and fast.

9. MAC

The MAC address is burned into the network interface card. (DHCP hands out IP addresses, which can change.)

10. names are easier for people to remember than numbers; a site can move to a new server without changing its name; no single server needs to hold every name

DNS is about names, flexibility and distribution. The lookup adds a few milliseconds; it does not speed up the page itself.

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

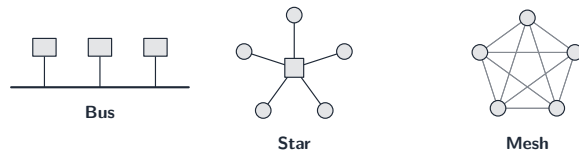
1 Worked examples

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

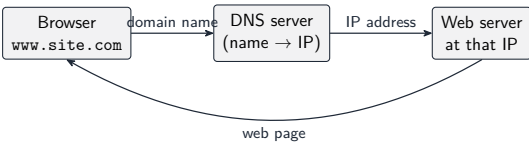
■ IP addresses

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

Each answer shows the steps, then the **result**.

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
- it 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, and stop transmitting
- 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

- 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
- 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

- a higher bit rate also allows a higher resolution
- the **buffer** stores data ahead of the play position
- short dips in the connection speed are covered by data already downloaded, so 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

7 Web browsers use Internet Protocol (IP) addresses.

(a) Complete the table by describing the following types of IP address.

Type of IP address	Description
Static	
Public	

[2]

(b) Consider the following IP address:

256.0.0.A

Circle whether this IP address is IPv4, IPv6 or an invalid IP address.

IPv4 IPv6 Invalid

Justify your choice.

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.....

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..... [2]

(c) A user types a Uniform Resource Locator (URL) into the address bar of a web browser to access a web page.

Explain how the web browser uses the URL to access the web page.

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(d) A bitmap file is downloaded. The image has a maximum of 256 colours and measures 512 pixels wide by 2048 pixels high.

(i) Calculate an estimate of the file size of the bitmap in kibibytes.

Show your working.

Working

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File size of bitmap kibibytes [2]

(ii) Explain why the actual file size may be larger than the one calculated in **(d)(i)**.

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..... [2]

(iii) Explain how a bitmap image is compressed using run-length encoding (RLE).

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..... [2]

5 A local area network (LAN) has five computers, one switch and one server.

(a) Describe the characteristics of a LAN.

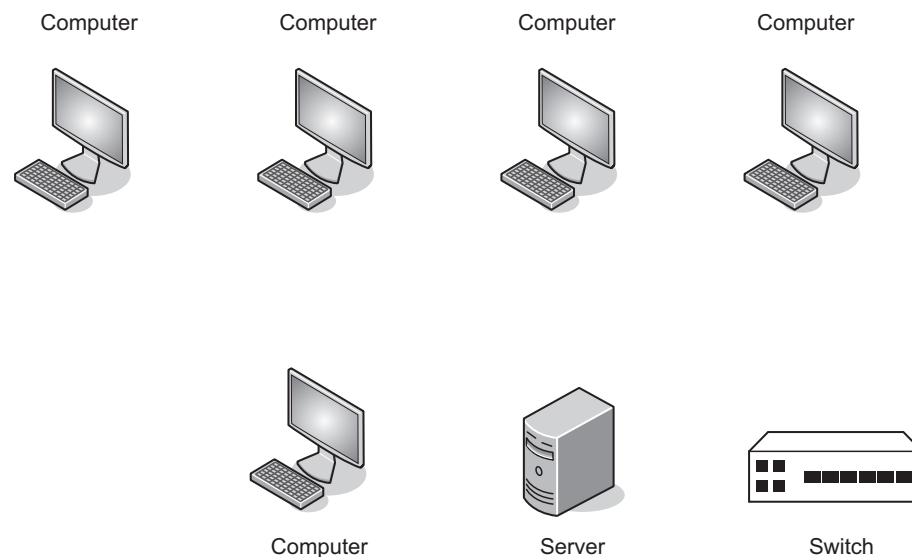
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..... [2]

(b) Complete the following diagram to show how these devices are connected in a star topology.



[2]

(c) Describe how packets are transmitted between two hosts using a star topology.

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..... [3]

(d) Another type of network is a bus network.

Ethernet is used to transmit and receive data between the devices on the bus network.

Describe how collisions are detected and managed on this network.

[3]

(e) Complete the table by identifying **one** threat to computer and data security posed by networks and the internet.

Describe the threat and give a method of prevention.

Threat	Description	Prevention

[3]

8 A restaurant accesses software and stores data using cloud computing.

(a) (i) Give **two** benefits of storing data using cloud computing.

1

2

[2]

(ii) Give **two** drawbacks of using cloud computing.

1

2

[2]

(b) The restaurant uses touchscreens as input devices to allow staff to select items from a menu.

(i) Explain how a touchscreen converts the point of touch to a selection from the menu.

[4]

(ii) The image files that are displayed on the touchscreen have been corrupted.

Identify **two** examples of utility software that could be used to recover the images.

1

2

[2]

4 A network engineer is setting up a Local Area Network (LAN) in an office. The network uses both wired and wireless connectivity.

(a) Give **three** advantages of a wireless network compared to a wired network.

- 1
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2
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3
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[3]

(b) Give **one** drawback of using a wireless network.

-
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[1]

(c) Complete the table by writing the name of the type of memory technology for each description.

Description	Memory technology
A read only memory where the contents can be erased using a voltage pulse. The contents can be changed multiple times without physically removing the memory.	
A read only memory where the contents are erased using ultraviolet (UV) light. The memory must be physically removed to be reprogrammed.	
A read only memory where the contents can be written only once after manufacture.	

[3]



6 A company has multiple sites in different cities.
The company has drivers who deliver products to customers. Each driver can connect to the company's WAN (Wide Area Network) whilst out of the office using a smartphone.

(a) State **two** ways that a WAN is different to a LAN (Local Area Network).

- 1
.....
2
.....

[2]

(b) The smartphones use the cell phone network to connect to the WAN.

Explain how data is transmitted using the cell phone network.

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[4]

(c) Devices that connect to the WAN have an IP address.

Complete the following description of IP addresses by writing the missing words.

IPv4 is displayed as four groups of 8-bit numbers separated by

Each IPv4 address is 32 bits.

IPv6 is made of eight groups of 4 numbers separated by colons.

Multiple consecutive groups of can be replaced with a double colon.

Each IPv6 address is bits.

A IP address can change each time the computer connects to a network.

A IP address can only be accessed by other devices in the same LAN and is assigned by the router within the LAN.



[6]

(d) The main office for the company has four wired computers, one server, two printers, one central switch and a device providing a single point of access for the internet. The network is set up as a star topology.

Draw the topology for the main office network. Label all devices.

[4]

(e) Describe the role of a switch in a network.

[3]



9 A computer is connected to a Local Area Network (LAN) that connects to a Wide Area Network (WAN).

(a) Describe the characteristics of a WAN.

[2]

(b) Copper cable can be used to transmit data in a network.

Complete the table by identifying **and** describing **two other** transmission media that can be used to transfer data in the WAN.

Transmission medium	Description

[4]



- (c) The computer on the LAN is used for real-time video conferences, where people connected to the internet communicate in real-time using video and audio.

Explain how bit streaming is used in a real-time video conference.

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[4]

- (d) The LAN has a router. The router has a public IP address and a private IP address.

- (i) State the purpose of a public IP address and a private IP address.

Public IP address

.....

Private IP address

.....

[2]

- (ii) The LAN uses subnetting.

Describe the purpose of subnetting in a network.

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.....

[2]

- 8 A business is creating a local area network (LAN) in its office.

- (a) The business is deciding which topology to use.

Tick (✓) **one or more** boxes in each row to identify the topology, or topologies, each statement describes.

Statement	Bus	Star	Mesh
all devices connect to one central device			
all devices connect to a central cable			
multiple paths for the packets to travel along			
robust against damage because if any line fails, the rest of the network retains full functionality			
most likely to lose data through collisions			

[5]

- (b) The LAN will connect to the internet through a router. The router has a public IPv6 address.

- (i) State why the router has a public IP address.

.....

.....

[1]

- (ii) One difference between an IPv4 and IPv6 address is that the numbers in an IPv4 address are separated by full stops and in an IPv6 address they are separated by colons.

Identify **two other** differences between an IPv4 and IPv6 address.

1

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2

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.....

[2]