

Week 42

A-Level Computer Science

Homework bundle for this week

本周作业合集

exercises.lol

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14. Communication and internet technologies

Starter Quiz · 课前小测

A-Level Computer Science

Name: _____ Score: _____

- A network protocol is:
 - ☐ a set of rules both devices follow so they can communicate
 - ☐ a physical cable
 - ☐ a type of computer
 - ☐ a programming language
- HTTPS is:
 - ☐ HTTP over TLS — encrypted web traffic
 - ☐ a faster version of FTP
 - ☐ an email protocol
 - ☐ a file format
- In circuit switching:
 - ☐ a dedicated path is reserved for the whole conversation
 - ☐ data is split into independent packets
 - ☐ each packet may take a different route
 - ☐ there is no setup time
- What does a protocol define? Select **all** that apply.
 - ☐ the format of the data, including where the addresses sit
 - ☐ the order of messages and when to acknowledge
 - ☐ the timing, such as timeouts and retransmissions
 - ☐ the speed of the physical cable

Tick every correct option.
- What does HTTPS add over plain HTTP? Select **all** that apply.
 - ☐ the traffic is encrypted, so an eavesdropper sees only ciphertext
 - ☐ the server proves its identity with a certificate
 - ☐ tampering with the data in transit is detected
 - ☐ pages are compressed so they download faster

Tick every correct option.
- What is the main drawback of circuit switching?

- ☐ the reserved line sits idle during silences and nobody else may use it
- ☐ data can arrive out of order
- ☐ it needs sequence numbers
- ☐ the delay is unpredictable

7. A benefit of splitting networking into layers is:

- ☐ modularity — one layer can be replaced without changing the others
- ☐ it removes the need for protocols
- ☐ it makes the network slower on purpose
- ☐ it stores more data

8. The internet layer (IP) guarantees that every packet arrives.

- ☐ True ☐ False

9. IMAP leaves mail on the server and syncs it across all your devices, while POP3 typically downloads the mail and deletes it from the server.

- ☐ True ☐ False

10. Because each packet carries a sequence number, the destination can reassemble the message in the right order and re-request any missing packet.

- ☐ True ☐ False

14. Communication and internet technologies

Answers · 答案

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1. a set of rules both devices follow so they can communicate

A protocol defines the format, order, meaning, timing and error handling of messages — both ends must agree.

2. HTTP over TLS — encrypted web traffic

HTTPS runs HTTP over TLS encryption (port 443), protecting the data in transit.

3. a dedicated path is reserved for the whole conversation

Circuit switching reserves one path end-to-end (reserved bandwidth) — but it wastes the line during silences.

4. the format of the data, including where the addresses sit; the order of messages and when to acknowledge; the timing, such as timeouts and retransmissions

Format, order, meaning, timing and error handling. The cable's speed is a property of the hardware, not of the agreement.

5. the traffic is encrypted, so an eavesdropper sees only ciphertext; the server proves its identity with a certificate; tampering with the data in transit is detected

TLS supplies confidentiality, authentication and integrity. Compression is a separate feature of HTTP itself.

6. the reserved line sits idle during silences and nobody else may use it

Reserving the path guarantees the rate and the order, and that is exactly what makes it wasteful. The other three describe packet switching.

7. modularity — one layer can be replaced without changing the others

Each layer has one job and a clear interface, so (e.g.) Ethernet can be swapped for Wi-Fi without touching higher layers.

8. False

IP forwards packets and does not guarantee delivery. Reliability is added above it, by TCP, and UDP deliberately does without it.

9. True

That is why IMAP shows the same inbox on your phone and laptop, whereas POP3 ties mail to one device.

10. True

Packets may arrive out of order or be lost; the sequence numbers (and TCP) put everything right.

14.1 Protocols

Name: _____ Class: _____ Date: _____ **Total: 34 marks**

KEY WORDS protocol 协议 • application layer 应用层 • http 超文本传输协议
• transport layer 传输层 • smtp 简单邮件传输协议

Objective

Build the skills to answer exam questions on **protocols** 协议 — why they are needed, the TCP/IP layered model, and the common application protocols.

You must be able to:

- explain why a **protocol** is essential, and the benefit of a **layered** model
- describe the four layers of the **TCP/IP** suite
- state the purpose of **HTTP, FTP, SMTP, POP3, IMAP, BitTorrent** and compare **TCP/UDP**

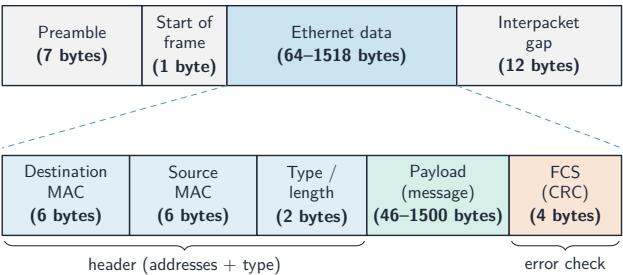
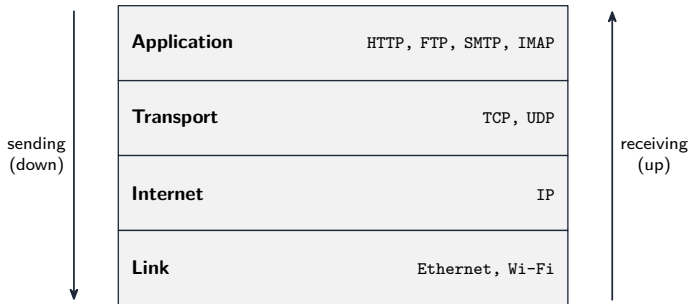
1 Worked examples

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.

■ Why protocols, and layers

A **protocol** is an agreed **set of rules** for communication — the data **format**, the **order** of messages, their **meaning**, **timing** and **error handling**. Both ends must follow the same rules or the bytes are meaningless.

Networking is split into **layers**, each with one job, talking only to the layers above and below. Benefits: **modularity** (swap one layer without touching the others), **standardisation**, and **abstraction**.



An Ethernet frame carries the protocol data

Each layer has one job:

- **Application** — provides network services to programs (HTTP for the web, SMTP for email).
 - **Transport** — splits the data into **packets** and provides reliable, in-order delivery (TCP) or fast send-and-forget (UDP); adds **port numbers**.
 - **Internet** — adds **IP addresses** and **routes** the packets across networks.
 - **Link** — sends the bits over the physical connection (Ethernet, Wi-Fi) using **MAC addresses**.
- **TCP vs UDP (transport layer)**
- **TCP** — **connection-oriented**: reliable, in-order delivery, retransmits lost packets (HTTP, email). Higher overhead.
 - **UDP** — **connectionless**: send-and-forget, no ordering or acknowledgements (streaming, gaming, DNS). Low overhead.

■ Application protocols

Protocol	Purpose
HTTP	fetch web pages
FTP	transfer files
SMTP	send email
POP3 / IMAP	retrieve email (IMAP keeps it on the server)
BitTorrent	peer-to-peer file sharing

2 Practice

Now apply the methods above.

2.1 State what a **protocol** is. [1]

2.2 State **one** benefit of using a **layered** model for networking. [1]

2.3 Name the **four** layers of the TCP/IP suite, **from top to bottom**. [2]

2.4 State which protocol is used to **send** an email. [1]

3 Exam-style questions

3.1 State **two** differences between **TCP** and **UDP**. [2]

3.2 State the purpose of each protocol: **HTTP**, **FTP**, **SMTP**. [3]

3.3 Explain why a protocol is **essential** for communication between two computers. [2]

3.4 State **one** difference between **POP3** and **IMAP**. [2]

3.5 Describe the purpose of the **Application layer** and the **Transport layer** of the TCP/IP suite. [4]

3.6 A company's staff use email and a web application over the internet.

(a) **Explain** why protocols are essential for communication between computer systems.[3]

(b) **Complete** the table by naming the protocol used for each task. [4]

task	protocol
retrieving email, deleting it from the server	_____
sending email to a mail server	_____
transferring a large file to a server	_____
requesting a web page securely	_____

(c) **Describe** two ways in which **packet switching** ensures a complete message arrives correctly, even though the packets may travel by different routes. [4]

(d) **State** the layer of the TCP/IP model at which each of the following operates: an IP address, a port number, and HTTP. [3]

(e) **Explain** why the layered model makes it easier to introduce a new application protocol. [2]

Solutions

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

2.1

- an agreed **set of rules** governing how devices communicate (format, order, meaning, timing, errors)

2.2

- any one: **modularity** (change one layer without the others); standardisation/interoperability; abstraction (hide details)

2.3

- **Application** → **Transport** → **Internet** → **Link**

2.4

- **SMTP**

3.1

- any two: TCP is **connection-oriented**, UDP **connectionless**; TCP **guarantees delivery and order**, UDP does not; TCP **retransmits** lost packets, UDP does not; TCP has higher overhead

3.2

- **HTTP** — request/transfer **web pages**
- **FTP** — transfer **files**
- **SMTP** — **send** email

3.3

- without an agreed protocol the two computers have no shared rules for **format/order/meaning**
- so each side cannot interpret the other's data and communication **fails**

3.4

- **POP3** usually **downloads and removes** mail from the server
- **IMAP keeps** mail on the server and syncs across devices

3.5

- **application layer** — provides network services to the user's programs (e.g. HTTP, SMTP) and formats the data
- **transport layer** — splits the data into packets and provides reliable, in-order delivery (TCP) using port numbers

3.6

(a) a protocol is an agreed **set of rules** for the exchange

- covering the format of the data, the order of the messages, the speed, and how errors are handled
- without agreement on all of that, two systems from different manufacturers could not interpret each other's bits at all

(b) retrieving and deleting email — **POP3**

- sending email — **SMTP**
- transferring a large file — **FTP**
- a secure web page — **HTTPS**

(c) any two, developed: each packet carries a **sequence number**, so the receiver can reassemble them in the right order however they arrive

- each packet carries a **checksum or error check**, and a packet that fails it is **re-requested** from the sender

(d) an IP address — the **internet (network)** layer

- a port number — the **transport** layer
- HTTP — the **application** layer

(e) each layer only has to work with the layer directly above and below it through a defined interface

- so a new application protocol can be added at the top without changing the transport, internet or link layers, or any of the hardware

3 (a) Explain why protocols are essential for communication between computer systems.

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..... [2]

(b) POP3 is an email communication protocol.

Identify and describe **two** other communication protocols that are used when sending or receiving emails.

Protocol 1

Description

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Protocol 2

Description

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..... [4]

(c) Describe **two** ways in which packet switching ensures a complete message is received when passing messages across a network.

1

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[4]

- 3 (a)** HTTP and IMAP are examples of protocols used in the Application Layer of the TCP/IP protocol suite.

State the purpose of the HTTP and IMAP protocols.

HTTP

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IMAP

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[2]

- (b)** Describe how files are shared using the BitTorrent protocol.

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[4]

- 4** Identify **and** describe **three** protocols that are used in the Application Layer of the TCP/IP protocol suite.

Protocol 1

Description

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Protocol 2

Description

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Protocol 3

Description

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[6]

3 (a) The Application Layer and Transport Layer are two layers of the TCP/IP protocol suite.

Describe the purpose of the Application Layer **and** the purpose of the Transport Layer.

Purpose of Application Layer

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Purpose of Transport Layer

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[5]

(b) Describe packet switching as a method of transmitting messages across the internet.

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[4]

4 (a) The Internet layer and Link layer are two layers of the TCP/IP protocol suite.

Describe the purpose of the Internet layer **and** the purpose of the Link layer.

Purpose of Internet layer

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Purpose of Link layer

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[5]

(b) Describe the function of a router in packet switching.

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[4]

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- 4 The TCP/IP protocol may be viewed as a stack that contains four layers: Application, Transport, Internet, Link.

Describe how the layers of the TCP/IP protocol stack interact with each other.

[4]

- 5 (a) Name and describe **two** protocols used by the Application Layer of the TCP/IP protocol suite.

Protocol 1

Description

.....

.....

Protocol 2

Description

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[4]

- (b)** Explain the purpose and function of the Application Layer in the TCP/IP protocol suite.

[3]

14.2 Circuit switching, packet switching

Name: _____ Class: _____ Date: _____ **Total: 14 marks**

KEY WORDS packet switching 分组交换 • circuit switching 电路交换 • switch 交换机
• packets 数据包 • routers 路由器

Objective

Build the skills to answer exam questions on **circuit switching** 电路交换 and **packet switching** 分组交换.

You must be able to:

- describe **circuit switching** and its trade-offs
- **describe packet switching** clearly (a frequent 4-mark question)
- compare the two and justify which the internet uses

1 Worked examples

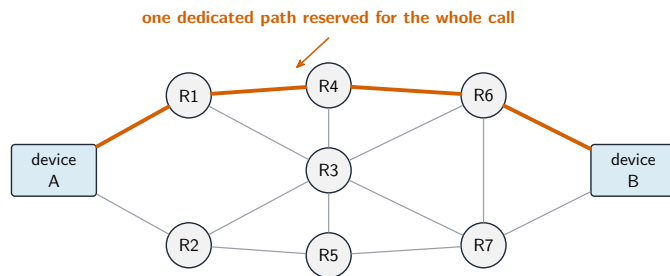
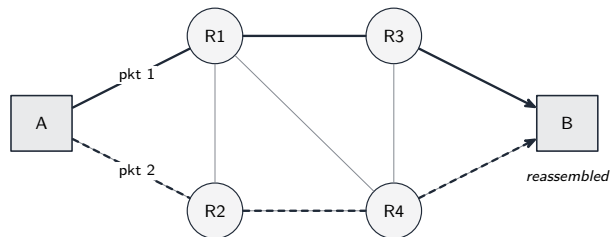
Study these first. Each one shows the method for a question type used later — follow the steps and you can do the Practice and Exam-style questions yourself.

- Circuit switching

A **dedicated path** is reserved end-to-end **before** any data is sent, kept for the whole conversation, then released. It gives **reserved bandwidth** and in-order delivery, but **wastes** the link during silences and is slow to set up (the old telephone network).

- Packet switching

The message is split into **packets** that travel **independently**; routers choose each packet's next hop, so packets may take **different routes** and arrive out of order, then are **reassembled** at the destination:



Circuit switching contrasted with packet switching

How to describe it (4 marks): the message is broken into **packets**; each carries the **destination/source address** and a **sequence number**; each packet is routed **independently**; packets may take **different paths** and arrive **out of order**; the destination uses the sequence numbers to **reassemble** them.

■ Comparison

Aspect	Circuit switching	Packet switching
Path	dedicated, reserved	shared, per-packet
Setup	slow	none
Bandwidth	inefficient	efficient
Robustness	one failure cuts the call	reroutes around failures
Suits	voice (constant rate)	web/email (bursty)

2 Practice

Now apply the methods above.

2.1 State what **circuit switching** is.

[1]

2.2 State what **packet switching** is.

[1]

2.3 State **one** benefit of circuit switching.

[1]

2.4 State **one** benefit of packet switching.

[1]

3 Exam-style questions

3.1 Describe packet switching as a method of transmitting a message across the internet.

[4]

3.2 State **two** benefits and **two** drawbacks of **circuit switching**.

[4]

3.3 Explain why the internet uses **packet switching** rather than circuit switching.

[2]

Solutions

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

2.1

- setting up a **dedicated path** between the two ends, reserved for the **whole** communication

2.2

- splitting the message into **packets** that are sent **independently** across the network and reassembled at the destination

2.3

- any one: **reserved bandwidth**; in-order delivery; consistent/low latency once set up

2.4

- any one: **efficient** use of links (shared/multiplexed); **robust** (reroutes around failures); no slow setup

3.1

- any four: message split into **packets**
- each packet has **destination/source address** and a **sequence number**
- each packet routed **independently**, routers choose the next hop
- packets may take **different routes** / **arrive out of order**
- destination **reassembles** using sequence numbers / requests missing packets — max 4

3.2

- benefits (any two): reserved bandwidth; guaranteed in-order delivery; predictable latency
- drawbacks (any two): wastes capacity during silences; slow to set up; a single link failure cuts the whole circuit

3.3

- packet switching uses links **efficiently** (shared between many conversations)
- and is **robust** — it can reroute packets around a failed link, so the network keeps working

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4 (a) Identify **one** benefit of circuit switching **and one** benefit of packet switching.

Circuit switching

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Packet switching

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[2]

(b) Identify **two** differences between circuit switching and packet switching.

1

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2

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[2]

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3 Describe how packet switching is used to pass messages across a network. Do **not** include checking for completeness and resending packets in your answer.

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[4]

4 Circuit switching may be used as a method of data transmission.

State **two** benefits and **two** drawbacks of circuit switching.

Benefit 1

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Benefit 2

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Drawback 1

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Drawback 2

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[4]

3 (a) Describe circuit switching as a method of data transmission.

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..... [3]

(b) State **one** benefit and **one** drawback of circuit switching as a method of data transmission.

Benefit

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Drawback

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[2]

1 (a) Describe how packet switching is used to transmit messages across a network.

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..... [3]

(b) State **two** benefits and **two** drawbacks of packet switching as a method of transmitting messages across a network.

Benefit 1

.....

Benefit 2

.....

Drawback 1

.....

Drawback 2

.....

[4]

3 (a) Describe circuit switching as a method of data transmission.

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..... [3]

(b) State **one** benefit and **one** drawback of circuit switching as a method of data transmission.

Benefit

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Drawback

..... [2]