

HOLIDAY HOMEWORK 假期作业

IGCSE Computer Science

Exercise sheets and past-paper practice, topic by topic.

每个单元：练习卷 + 历年真题。

For class or self-study • no answer keys included.

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1 Binary numbers – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
binary	二进制	_____
bit	位	_____
denary	十进制	_____

Recall

Computers store everything in **binary** 二进制—using only the digits 0 and 1. Each digit is a **bit** 位.

New ideas

Read these first, then do the Practice.

■ 1 Binary to denary

Each binary column has a place value (a power of 2). Add the values where there is a 1:

128	64	32	16	8	4	2	1
0	0	1	0	1	1	0	1
= 32 + 8 + 4 + 1 = 45							

■ 2 Binary addition

Add in binary just like in **denary** 十进制, but carry when a column reaches 2:

$$\begin{array}{r}
 0101 \\
 + 0011 \\
 \hline
 1000
 \end{array}
 \quad 5 + 3 = 8$$

Watch out: read binary place values from the **left**: 128, 64, 32, 16, 8, 4, 2, 1. When adding, **carry** to the next column whenever a column reaches 2 ($1 + 1 = 10$ in binary).

Practice

Try these in order.

1.1 Which two digits does binary use? [1]

1.2 What is a *bit*? [1]

1.3 Convert the binary number 1010 to denary. [2]

1.4 Convert the binary number 0001 0000 to denary. [1]

1.5 Work out $0011 + 0001$ in binary. [2]

1.6 Challenge. Convert the binary number 1101 0010 to denary. [3]

2 Hypertext markup language (HTML) colour codes can be represented as hexadecimal.

(a) Tick (✓) **one** box to show which statement about the hexadecimal number system is incorrect.

- A

It uses the values 0 to 9 and A to F.

☐
- B

It can be used as a shorter representation of binary.

☐
- C

It is a base 10 system.

☐
- D

It can be used to represent error codes.

☐

[1]

(b) Denary numbers can be converted to hexadecimal.

Convert the **three** denary numbers to hexadecimal.

- 20
- 32
- 165

[3]

Working space

.....

.....

.....

.....

1 Hex and representing data – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
Hexadecimal	十六进制	_____
ASCII	美国信息 交换标准 代码	_____

Recall

Long binary numbers are hard to read, so we also use hexadecimal. All data —text, sound, images —is stored as binary.

New ideas

Read these first, then do the Practice.

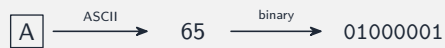
■ 1 Hexadecimal

Hexadecimal 十六进制 (hex) uses 16 digits: 0–9, then A–F. One hex digit equals four binary digits:

denary	binary	hex
10	1010	A
11	1011	B
15	1111	F

■ 2 Representing text

Each character has a number code (e.g. **ASCII** 美国信息交换标准代码), which is then stored in binary:



Watch out: one **hex digit** maps to exactly **four** binary digits, which is why hex is a short way to write long binary. Each character is stored as a *number code* (e.g. ASCII), then that number is stored in binary.

Practice

Try these in order.

1.6 How many digits does hexadecimal use? [1]

1.7 Which hex digit equals denary 15? [1]

1.8 How many binary digits does one hex digit represent? [1]

1.9 Why do we use hexadecimal instead of long binary numbers? [1]

1.10 The letter 'A' has ASCII code 65. What is actually stored for the letter 'A'? [1]

1.11 Challenge. Convert the binary number 1111 1010 to hexadecimal. [3]

2 A student has an image file stored on their computer.

(a) The image file was taken by a digital camera.

Tick (✓) **one** box to show whether a digital camera is an example of an input, output, process or storage device.

- A

input

☐
- B

output

☐
- C

process

☐
- D

storage

☐

[1]

(b) The size of the image file is 3072 bytes.

(i) Give the size of the image file in kibibytes (KiB).

..... [1]

(ii) State the number of nibbles in 1 byte.

..... [1]

Working space

.....

.....

.....

.....

(c) The image file has a colour depth of 32 bits.

(i) State what is meant by a colour depth of 32 bits.

.....

..... [1]

(ii) The colour depth of the image file is changed to 64 bits.

Explain what effect this change has on the image file.

.....

.....

.....

(d) The student uses lossless compression to compress the image file.

Explain how the image file is compressed using lossless compression.

[3]

1 The size of a file can be measured using different units.

(a) Tick (✓) **one** box to show which of these is **not** a unit of measurement for a file.

- A

bit

☐
- B

bot

☐
- C

nibble

☐
- D

byte

☐

[1]

(b) The size of a file can be reduced by compressing it.

(i) Give **two** types of compression that can be used to reduce the size of a file.

- 1
- 2 [2]

(ii) Give **three** benefits of reducing the size of a file for storage and transmission.

- 1
.....
- 2
.....
- 3
..... [3]

2 Data packets – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
packets	数据包	_____
header	报头	_____
payload	有效载荷	_____
trailer	报尾	_____
serial	串行	_____
parallel	并行	_____

Recall

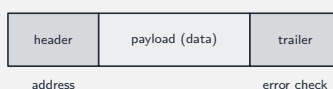
Data is sent across a network in small **packets** 数据包.

New ideas

Read these first, then do the Practice.

■ 1 A data packet

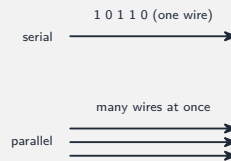
A packet has three parts:



- the **header** 报头 holds the address and packet number;
- the **payload** 有效载荷 is the actual data;

- the **trailer** 报尾 holds an error check.

■ 2 Serial and parallel



- **serial** 串行 sends bits one at a time, down one wire;
- **parallel** 并行 sends several bits at once, down many wires.

Watch out: a packet's three parts have set jobs —the **header** holds the address and packet number, the **payload** is the data, the **trailer** holds the error check. **Serial** (one wire, one bit at a time) suits long distances; **parallel** is faster but only over short ones.

Practice

Try these in order.

2.1 What is a *packet*? [1]

2.2 Name the three parts of a packet. [2]

2.3 What is held in the header of a packet? [1]

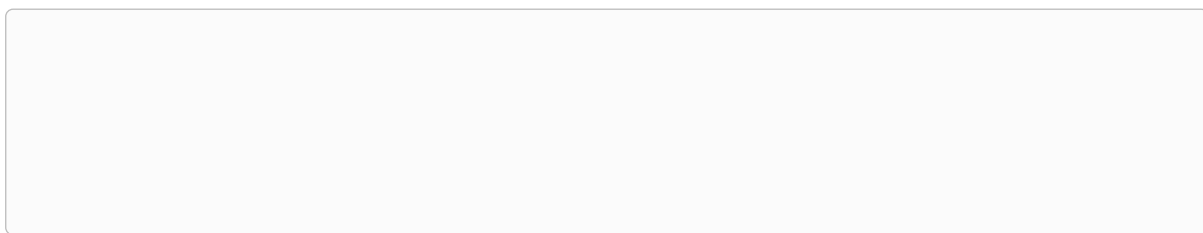
2.4 How is serial transmission different from parallel? [2]

2.5 Which is usually used over long distances —serial or parallel? [1]

2.6 Challenge. Explain why serial transmission, not parallel, is used to send data over

a long distance such as the Internet.

[2]



2 Data can be transmitted from one device to another.

(a) Tick (✓) **one** box to show which of the terms is **not** a method for transmitting data.

- A** serial ☐
- B** simplex ☐
- C** parallel ☐
- D** parity ☐

[1]

(b) Data is broken down into smaller units to be transmitted from one device to another.

Give the name of the unit that data is broken down into.

..... [1] _____



(c) Data is often encrypted when it is transmitted from one device to another.

(i) Explain how data is encrypted using symmetric encryption.

.....

.....

.....

.....

.....

.....

.....

..... [4]

(ii) Give the purpose of encryption.

.....

..... [1]

2 Checking for errors – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
parity bit	奇偶校验位	_____
error	错误	_____

Recall

Data can get corrupted as it travels, so we check it for errors.

New ideas

Read these first, then do the Practice.

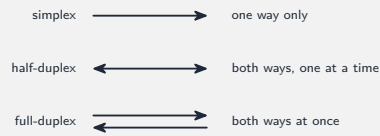
■ 1 Parity check

A **parity bit** 奇偶校验位 is an extra bit added to make the number of 1s even (even parity) or odd:

```
data: 1 0 1 1 0 0 1
count the 1s: four (even)
parity bit = 0 (keep it even)
sent: 1 0 1 1 0 0 1 0
```

If the count is wrong when the data arrives, there is an **error** 错误.

■ 2 Transmission modes



Watch out: a **parity bit** is set so the *total* number of 1s matches the agreed parity (even or odd). It catches a **single** flipped bit, but not two flips that cancel out. Simplex = one way; half-duplex = one way at a time; full-duplex = both at once.

Practice

Try these in order.

2.6 Why do we check data for errors? [1]

2.7 What is a *parity bit*? [1]

2.8 Some data has three 1s. For **even** parity, what should the parity bit be? [1]

2.9 A walkie-talkie lets you talk one way at a time. Which transmission mode is this? [1]

2.10 A phone call lets both people talk at once. Which mode is this? [1]

2.11 Challenge. Even parity is used, with the parity bit added at the end. The 7-bit data 1011010 is to be sent. State the parity bit and the full 8-bit code sent. [3]

6 The table contains statements about error detection methods.

Complete the table by giving the correct error detection method for each statement.

error detection method	statement
.....	An odd or even process can be used.
.....	A value is calculated from the data, using an algorithm. This happens before and after the data is transmitted.
.....	A copy of the data is sent back to the sender by the receiver.
.....	Acknowledgement and timeout are used.
.....	A value is appended to data that has been calculated using the data. This value is checked on data entry.

[5]

7 Data is encrypted to keep it safe during transmission.

Complete the paragraph about asymmetric encryption.

Use the terms from the list.

Some of the terms in the list will **not** be used. You should only use a term once.

- asymmetric certificate cipher text
- decrypted encrypted parallel key plain text private key
- protected public key serial key symmetric

..... is encrypted into
using a The encrypted data is then transmitted from the
sender to the receiver. The encrypted data is then decrypted using a
..... .

[4]

3 Input, process, output – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
CPU	中央处理器	_____
input device	输入设备	_____
output device	输出设备	_____

Recall

A computer follows the **input** → **process** → **output** pattern. The **CPU** 中央处理器 does the processing.

New ideas

Read these first, then do the Practice.

■ 1 Input, process, output



- an **input device** 输入设备 puts data into the computer;
- an **output device** 输出设备 gives results out.

■ 2 Devices

INPUT	OUTPUT
keyboard	monitor
mouse	printer
scanner	speaker

Watch out: an **input device** sends data *into* the computer (keyboard, mouse, scanner); an **output device** gives results *out* (monitor, printer, speaker). The **CPU** does the *processing* in the middle.

Practice

Try these in order.

3.1 What does CPU stand for? [1]

3.2 What is an *input device*? [1]

3.3 Give two examples of input devices. [2]

3.4 Give two examples of output devices. [2]

3.5 Is a printer an input or an output device? [1]

3.6 Challenge. A touchscreen is used both to control a phone and to show pictures. Explain why it counts as both an input and an output device. [2]

1 A flower shop has a room that has an air-conditioning system. It is used to keep the room at a constant temperature for storing flowers.

The owner uses a keypad to set the temperature for the room.

(a) Tick (✓) **one** box to show whether a keypad is an example of an input, output, process or storage device.

- A

input

☐
- B

output

☐
- C

process

☐
- D

storage

☐

[1]

(b) The owner of the shop enters a denary number to set the temperature for the room.

The denary number is converted to a binary number to be processed. The binary number is stored in a register in the air conditioning system.

(i) Give the binary number that would be stored when the denary number 24 is entered.
..... [1]

(ii) Give the binary number that would be stored when the denary number 101 is entered.
..... [1]

(iii) The binary number 00010011 is stored in the register.
Give the denary number that has been entered for this binary number to be stored.
..... [1]

(iv) The binary number 00100010 is stored in the register.
Give the denary number that has been entered for this binary number to be stored.
..... [1]

Working space
.....
.....
.....
.....
.....
.....

(c) If the air-conditioning system detects an error, it displays an error code. The error code is displayed as a hexadecimal number. The binary number for each error code is stored in a register.

(i) Give the binary number that is stored in the register to display the error code 51.

..... [1]

(ii) Give the binary number that is stored in the register to display the error code E3.

..... [1]

(iii) Give the hexadecimal number that is displayed when the binary number 10000010 is stored in the register.

..... [1]

(d) If the owner of the shop wants to make the room very cold, she may need to enter a negative denary number.

The negative denary number could be represented using two’s complement.

Give the two’s complement 8-bit binary integer that would be stored for the temperature –5.

Show all your working.

Working space

.....

.....

.....

Two’s complement 8-bit binary integer [2]

(e) The air-conditioning system uses a temperature sensor and a microprocessor to keep the temperature of the room at a constant level.

(i) Tick (✓) **one** box to show whether the sensor is an example of an input, output, process or storage device.

- A

input

☐
- B

output

☐
- C

process

☐
- D

storage

☐

[1]

(ii) The temperature sensor continuously sends analogue data to the microprocessor. This data is then converted to digital.

Explain how the microprocessor keeps the temperature of the room at a constant level.

.....

.....

.....

.....

.....

.....

[3]

(f) The air-conditioning system is an example of an embedded system.

Explain why the air-conditioning system is an embedded system.

.....

.....

.....

.....

[2]

8 A robot vacuum cleaner uses sensors to navigate around obstacles in a room.

(a) Tick (✓) **one** box to show which sensor would be the most suitable for this purpose.

- A

proximity

☐
- B

flow

☐
- C

pressure

☐
- D

level

☐

[1]

(b) An expert system can be used to diagnose an error with a robot vacuum cleaner.

Circle **three** components that are part of an expert system.

- knowledge base

operating system

firewall
- server

printer

actuator

inference engine
- rule base

encryption

[3]

(c) Explain how the robot vacuum cleaner can make use of machine learning.

.....

.....

.....

.....

.....

.....

[3]

3 Memory and storage – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
RAM	随机存取存储器	_____
volatile	易失性	_____
ROM	只读存储器	_____
non-volatile	非易失性	_____
Secondary storage	辅助存储	_____

Recall

A computer needs memory to hold data and programs. There are two main kinds.

New ideas

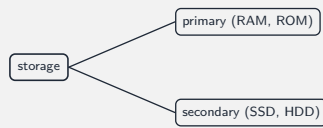
Read these first, then do the Practice.

■ 1 RAM and ROM

RAM	ROM
volatile	non-volatile
can change	cannot change
running programs	startup (BIOS)

- **RAM** 随机存取存储器 is **volatile** 易失性—it loses its contents when the power is off;
- **ROM** 只读存储器 is **non-volatile** 非易失性—it keeps its contents.

■ 2 Primary and secondary storage



Secondary storage 辅助存储 (like an SSD) keeps files permanently, even when the power is off.

Watch out: **RAM** is *volatile* (loses everything when the power goes off) and holds running programs; **ROM** is *non-volatile* and holds the startup instructions. **Secondary storage** (SSD/HDD) keeps your files permanently.

Practice

Try these in order.

3.6 Which memory loses its contents when the power is off —RAM or ROM? [1]

3.7 What does *volatile* mean? [1]

3.8 What is stored in ROM? [1]

3.9 Give one example of secondary storage. [1]

3.10 Why do we need secondary storage? [1]

3.11 Challenge. When you switch a computer off, the program you were running disappears but your saved file does not. Explain why, using RAM and secondary storage.[2]

1 A student has a portable tablet computer.

(a) Identify **two** input devices that could be built into the portable tablet computer.

- 1
- 2 [2]

(b) Identify **one** output device that could be built into the portable tablet computer.

..... [1]

(c) Identify **one** type of storage device that could be built into the portable tablet computer.

..... [1]

5 A computer uses both random access memory (RAM) and read only memory (ROM).

(a) Tick (✓) **one** box to show which statement is correct about RAM.

- A It is non-volatile storage.

B It stores the bootloader.

C It stores data that is currently in use.

D It is **not** directly accessible by the central processing unit (CPU).
- ☐

☐

☐

☐
- [1]

(b) ROM is a type of primary storage.

State the characteristic of ROM that makes it a type of primary storage.

..... [1]

.....

7 A computer has both a media access control (MAC) address and an internet protocol (IP) address.

(a) Tick (✓) **one** box to show which of the statements is correct about the MAC address.

- A

It is assigned by the manufacturer.

☐
- B

It is assigned by a router.

☐
- C

It can be static or dynamic.

☐
- D

It is made up of three different parts.

☐

[1]

(b) An IP address can have an IPv4 or IPv6 format.

(i) Give an example of an IP address that has an IPv4 format.

..... [1]

(ii) Give **two** characteristics of the IPv6 format.

- 1
-
- 2
-

[2]

4 Hardware and software – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
hardware	硬件	_____
software	软件	_____
system software	系统软件	_____
operating system	操作系统	_____
application software	应用软件	_____

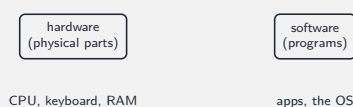
Recall

A computer is made of **hardware** 硬件 (the physical parts) and **software** 软件 (the programs).

New ideas

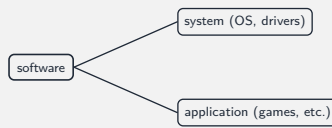
Read these first, then do the Practice.

■ 1 Hardware vs software



You can touch hardware; you cannot touch software.

■ 2 Two types of software



- **system software** 系统软件 runs the computer (e.g. the **operating system** 操作系统);
- **application software** 应用软件 lets you do a task (e.g. a game).

Watch out: **hardware** is the physical parts you can touch; **software** is the programs you cannot. **System software** (e.g. the operating system) runs the computer; **application software** (e.g. a game) does a task *for you*.

Practice

Try these in order.

4.1 What is the difference between hardware and software? [2]

4.2 Give one example of hardware. [1]

4.3 Give one example of software. [1]

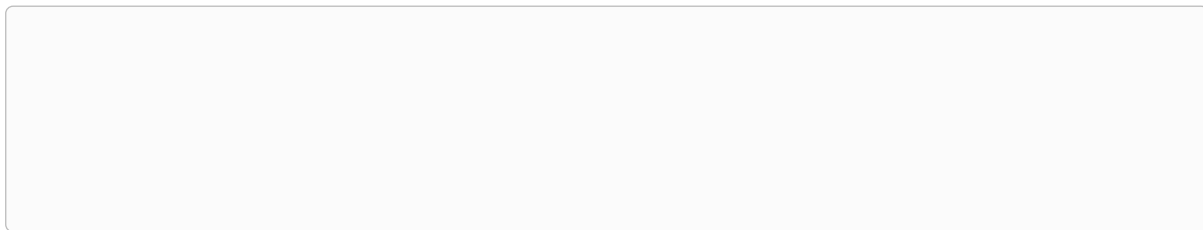
4.4 What is the job of system software? [1]

4.5 Is a word processor system software or application software? [1]

4.6 Challenge. Classify each as system or application software: (a) the operating

system, (b) a web browser, (c) a printer driver.

[3]



7 A computer has an operating system.

(a) The operating system provides several functions.

(i) Tick (✓) **one** box to show which of these is **not** a function of the operating system.

- A

managing files

☐
- B

providing an interface

☐
- C

handling interrupts

☐
- D

loading the bootstrap

☐

[1]

(ii) Identify **one** other function of an operating system.

Describe the purpose of this function.

.....

.....

.....

.....

[2]

(b) Give the name of the set of instructions that are provided to the operating system to allow it to run.

.....

[1]

4 Languages and translators – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
high-level language	高级语言	_____
translator	翻译程序	_____
machine code	机器码	_____
compiler	编译器	_____
interpreter	解释器	_____

Recall

We write programs in a language that is easy for people, but the CPU only understands binary.

New ideas

Read these first, then do the Practice.

■ 1 High and low level

A **high-level language** 高级语言 (like Python) is easy for people. A **translator** 翻译程序 turns it into **machine code** 机器码 (binary) for the CPU:



■ 2 Compiler and interpreter

There are two kinds of translator:

compiler	interpreter
all at once	line by line
fast to run	slower
makes a file	no saved file

- a **compiler** 编译器 translates the whole program at once;
- an **interpreter** 解释器 translates and runs it line by line.

Watch out: the CPU only runs **machine code** (binary), so a **translator** is needed. A **compiler** translates the *whole* program at once into a runnable file; an **interpreter** translates and runs it *line by line* (no saved file).

Practice

Try these in order.

4.6 Why does code need to be translated? [1]

4.7 What is machine code? [1]

4.8 Name the two types of translator. [2]

4.9 Which translator works line by line? [1]

4.10 Which translator makes a separate file you can run? [1]

4.11 Challenge. A program will be sold to customers who must not see the source code. Explain whether a compiler or an interpreter is more suitable, and why. [2]

7 A computer programmer uses an integrated development environment (IDE) when creating a computer program.

Explain the purpose of the IDE.

[4]

5 Internet and the Web – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
Internet	互联网	_____
World Wide Web	万维网	_____
URL	统一资源 定位符	_____

Recall

The **Internet** 互联网 and the **World Wide Web** 万维网 are not the same thing.

New ideas

Read these first, then do the Practice.

■ 1 Internet vs World Wide Web

Internet = the worldwide network of computers

WWW = the web pages carried on it

- the **Internet** is the worldwide network of connected computers;
- the **World Wide Web** is the collection of web pages on it.

■ 2 A web address (URL)

A **URL** 统一资源定位符 is a web address. It has three parts:

```
https://www.bbc.com/news
```

```
https = protocol
```

```
www.bbc.com = domain name
```

```
/news = the page
```

Watch out: the **Internet** is the global *network of computers*; the **World Wide Web** is the *web pages* carried on it—they are not the same. A **URL** has three parts: the protocol (https), the domain name, and the page/path.

Practice

Try these in order.

5.1 What is the Internet? [1]

5.2 What is the World Wide Web? [1]

5.3 Are the Internet and the WWW the same thing? [1]

5.4 What does URL stand for? [1]

5.5 In `www.bbc.com/news`, which part is the domain name? [1]

5.6 Challenge. In the URL `https://www.bbc.com/news`, name the three parts and say what each one does. [3]

8 A computer is connected to a network and assigned an IPv4 address.

(a) Tick (✓) **one** box to show which device would assign the IPv4 address to the computer.

- A

Domain name server (DNS)

☐
- B

Network interface card (NIC)

☐
- C

Router

☐
- D

Web server

☐

[1]

(b) Describe the characteristics of an IPv4 address.

[4]

5 How a page reaches you – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word *three times*. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
client	客户端	_____
web server	网络服务器	_____
cookie	网络跟踪文件	_____

Recall

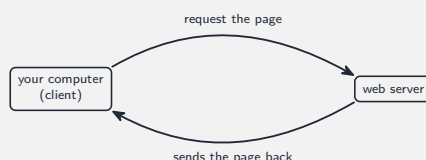
When you open a web page, your computer asks another computer for it.

New ideas

Read these first, then do the Practice.

■ 1 Client and server

Your computer (the **client** 客户端) asks a **web server** 网络服务器 for a page; the server sends it back:



■ 2 Cookies

a cookie

a small text file
stored on your computer
remembers settings / login

A **cookie** 网络跟踪文件 remembers things like your login or your settings.

Watch out: your computer is the **client** that *requests* a page; the **web server** *sends it back* —request, then response. A **cookie** is a small text file stored *on your computer* (in the browser), remembering things like your login or settings.

Practice

Try these in order.

5.6 What name is given to your computer when it asks for a web page? [1]

5.7 What sends the web page back to you? [1]

5.8 What is a cookie? [1]

5.9 Give one thing a cookie can remember. [1]

5.10 Where is a cookie stored? [1]

5.11 Challenge. A shopping website remembers the items in your basket even after you close the browser and come back. Explain how a cookie makes this possible. [2]

12 Digital currency can be used to pay for products and services.

Digital currencies are often tracked using digital ledgers.

(a) Give **two** other features of digital currency.

- 1
-
- 2
-
- [2]

(b) Identify the process that uses a digital ledger to track the use of digital currency.

-
- [1]

- 1 Malware can be used to corrupt data stored on a computer.
- (a) Tick (✓) **one** box to show which cyber security threat is **not** a type of malware.
- A Phishing

B Ransomware

C Virus

D Worm
- [1]
- (b) Identify **one** other example of malware than those given in **part 1(a)**.
- [1]
- (c) Identify the type of software that is used to find and remove malware from a computer.
- [1]

6 Automated systems – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
automated system	自动化系统	_____
sensor	传感器	_____
microprocessor	微处理器	_____
actuator	执行器	_____
feedback	反馈	_____

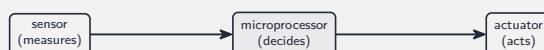
Recall

An **automated system** 自动化系统 does a job by itself, with no person controlling it.

New ideas

Read these first, then do the Practice.

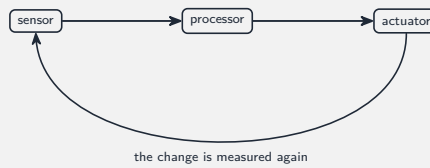
■ 1 Sensor, processor, actuator



- a **sensor** 传感器 measures something (e.g. temperature);
- the **microprocessor** 微处理器 decides what to do;
- an **actuator** 执行器 carries out the action (e.g. a motor).

■ 2 Feedback

The action changes the world, and the sensor measures it again —this is **feedback** 反馈:



For example, a thermostat keeps a room at a set temperature.

Watch out: the order is always **sensor** → **microprocessor** → **actuator** —the sensor *measures*, the processor *decides*, the actuator *acts*. **Feedback** means the sensor re-measures the result so the system can adjust.

Practice

Try these in order.

6.1 What is an *automated system*? [1]

6.2 What is the job of a sensor? [1]

6.3 What is the job of an actuator? [1]

6.4 Put these in order: actuator, sensor, microprocessor. [2]

6.5 What is *feedback* in a control system? [1]

6.6 Challenge. A thermostat keeps a room at 20 °C. Describe the role of the sensor, the microprocessor and the actuator in keeping the temperature steady. [3]

11

(a)

Identify what a flow sensor measures.

.....

..... [1]

(b)

.....

.....

..... [2]

(c)

..... [2]

6 Robots and AI – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
robot	机器人	_____
Artificial intelligence	人工智能	_____

Recall

Robots and artificial intelligence are special automated systems.

New ideas

Read these first, then do the Practice.

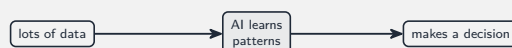
■ 1 Robots

A **robot** 机器人 is a machine that can carry out tasks. It uses sensors, a processor and actuators:



■ 2 Artificial intelligence

Artificial intelligence 人工智能 (AI) is software that learns from data and makes decisions:



For example, AI can recognise faces or recommend videos.

Watch out: a **robot** uses the same three parts as any automated system — *sensors*, *a processor*, *actuators*. **AI** is software that *learns from data* to make decisions, rather

than following fixed rules.

Practice

Try these in order.

6.6 What is a *robot*? [1]

6.7 Name the three kinds of part a robot uses. [2]

6.8 What does AI stand for? [1]

6.9 What does AI learn from? [1]

6.10 Give one real example of AI. [1]

6.11 Challenge. A self-driving car is described as using AI. Explain what makes it AI rather than a simple automated system. [2]

9 A company uses robots in its factory to manufacture large pieces of furniture.

(a) One characteristic of a robot is that it is programmable.

State **two** other characteristics of a robot.

1

.....

2

.....

[2]

(b) Give **two** advantages to company employees of using robots to manufacture large pieces of furniture.

1

.....

2

.....

[2]

(c) Give **one** disadvantage to the company’s owners of using robots to manufacture large pieces of furniture.

.....

.....

[1]

9 One component of an expert system is the inference engine.

(a) Identify the **three** other components in an expert system.

- 1
- 2
- 3 [3]

(b) Describe the role of the inference engine in an expert system.

.....

.....

.....

..... [2]

7 The development life cycle – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
development life cycle	开发生命周期	_____
analysis	分析	_____
design	设计	_____
coding	编码	_____
testing	测试	_____
flowchart	流程图	_____

Recall

To make a program, programmers follow a **development life cycle** 开发生命周期—a set of stages.

New ideas

Read these first, then do the Practice.

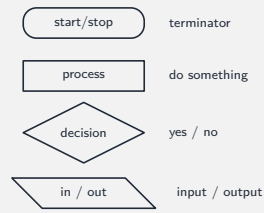
■ 1 The life cycle



- **analysis** 分析—work out what is needed;
- **design** 设计—plan the solution;
- **coding** 编码—write the program;
- **testing** 测试—check that it works.

■ 2 Flowchart symbols

A **flowchart** 流程图 plans an algorithm using shapes:



Watch out: the life cycle runs in order: **analysis** → **design** → **coding** → **testing**. In a flowchart a **decision** is a *diamond* (two branches) and **start/stop** is a *rounded box* —don't mix the shapes up.

Practice

Try these in order.

7.1 Name the four main stages of the development life cycle. [2]

7.2 What happens in the analysis stage? [1]

7.3 What happens in the testing stage? [1]

7.4 What flowchart shape is used for a decision? [1]

7.5 What flowchart shape is used for the start and the stop? [1]

7.6 Challenge. Match each flowchart shape to its job: a diamond, a rounded box, a rectangle (decision / start–stop / process). [3]

7 Flowcharts and tracing – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
decision	判断	_____
trace table	跟踪表	_____

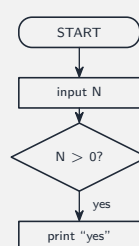
Recall

A flowchart and a trace table help you plan and check an algorithm.

New ideas

Read these first, then do the Practice.

■ 1 A flowchart



The arrows show the order the steps run in. A **decision** 判断 (diamond) has yes/no branches.

■ 2 A trace table

A **trace table** 跟踪表 records the value of each variable as the program runs, so you can find errors:

count	total	output
1	5	
2	12	
3	20	20

Watch out: a flowchart's **arrows** show the *order* the steps run. A **trace table** records each variable's value step by step—work through it *one row at a time* to find where a bug appears.

Practice

Try these in order.

7.6 What do the arrows in a flowchart show? [1]

7.7 A decision box has how many branches? [1]

7.8 What is a *trace table* used for? [1]

7.9 In a trace table, what goes in each column? [1]

7.10 Why is it useful to trace through a program by hand? [1]

7.11 Challenge. A program sets `count = 0`, then repeats `count = count + 2` three times. Trace it and give the final value of `count`. [2]

8 Variables and data types – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
variables	变量	_____
constants	常量	_____
data type	数据类型	_____

Recall

A program stores data in **variables** 变量 and **constants** 常量.

New ideas

Read these first, then do the Practice.

■ 1 Variables and constants

A **variable** is a named store whose value can change. A **constant** keeps the same value:



■ 2 Data types

Each variable has a **data type** 数据类型:

integer	whole number: 7
real	decimal: 3.5
char	one letter: 'A'
string	text: "hello"
boolean	true or false

Watch out: a **variable**'s value can change; a **constant** stays fixed. Pick the data type to fit the value —*integer* for whole numbers, *real* for decimals, *string* for text, *boolean* for true/false.

Practice

Try these in order.

8.1 What is a *variable*? [1]

8.2 How is a constant different from a variable? [1]

8.3 What data type is the value 7? [1]

8.4 What data type is the value "hello"? [1]

8.5 What data type is **true** or **false**? [1]

8.6 Challenge. State the most suitable data type for each: (a) a person's age, (b) a price like 3.99, (c) whether a box is ticked. [3]

- 3** Tick (✓) **one** box to identify the operator that returns the quotient of a calculation with the fractional part discarded.

- A** / ☐
- B** DIV ☐
- C** ^ ☐
- D** MOD ☐

[1]

- 1** Tick (✓) **one** box to complete this sentence.

The result of the arithmetic operation $4 \wedge 2$ is

- A** 2 ☐
- B** 8 ☐
- C** 16 ☐
- D** 42 ☐

[1]

- 2** Tick (✓) **one** box to complete this sentence.

A pseudocode example of a selection statement is

- A** CALL Sorting(Value1, Value2) ☐
- B** DECLARE Count : INTEGER ☐
- C** IF X = 7 THEN Y ← 21 ENDIF ☐
- D** WHILE X <> -1 DO ☐

[1]

8 The three structures – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
sequence	顺序	_____
selection	选择	_____
iteration	迭代	_____
counter	计数器	_____
total	累加	_____

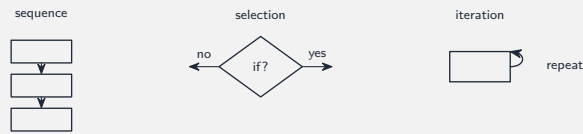
Recall

Programs are built from just three basic structures.

New ideas

Read these first, then do the Practice.

■ 1 The three structures



- **sequence** 顺序—steps run one after another;
- **selection** 选择—a choice with IF (yes/no);
- **iteration** 迭代—a loop that repeats steps.

■ 2 Counting and totalling

Inside a loop, a program often uses a **counter** 计数器 or builds a **total** 累加:

<code>count = count + 1</code>	count up by 1
<code>total = total + value</code>	add to a running total

Watch out: every program is built from three structures —**sequence** (in order), **selection** (a choice, IF), **iteration** (a loop). A **counter** (`count = count + 1`) counts how many; a **total** (`total = total + value`) builds a running sum.

Practice

Try these in order.

8.6 Name the three basic programming structures. [3]

8.7 Which structure makes a choice? [1]

8.8 Which structure repeats steps? [1]

8.9 What does `count = count + 1` do? [1]

8.10 Inside a loop, what does `total = total + value` do? [1]

8.11 **Challenge.** A program sets `total = 0`, then for each of the numbers 5, 3, 2 it

runs `total = total + value`. What does `total` hold at the end? [2]

- them in the array `Names [ ]`

```
FOR Count  $\leftarrow$  1 TO 10
```

```
OUTPUT "Please enter a name"
```

INPUT Name

```
Names[Count] ← Name
```

NEXT Count

Rewrite the algorithm in pseudocode, using a condition-controlled loop instead of a count-controlled loop.

[4]

2 Tick (✓) **one** box to complete this sentence.

The pseudocode to store a hotel name held in the variable `Name` to a text file is

A `READFILE Hotels.txt, Name`

☐

B `WRITEFILE Hotels.txt, Name`

☐

C `WRITEFILE Name, Hotels.txt`

☐

D `STOREFILE Hotels.txt, Name`

☐

[1]

9 Databases – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
database	数据库	_____
record	记录	_____
field	字段	_____
primary key	主键	_____
Validation	验证	_____

Recall

A **database** 数据库 stores data in an organised way, usually as a table.

New ideas

Read these first, then do the Practice.

■ 1 Records and fields

ID	name	age
1	Ana	16
2	Ben	15
3	Cara	17

row = a record

column = a field

ID = primary key

- a **record** 记录 is one row (all the data about one thing);
- a **field** 字段 is one column (one piece of data);
- a **primary key** 主键 is a field with a **unique** value that identifies each record (e.g. an ID).

■ 2 Validation

Validation 验证 checks that data entered makes sense—for example a range check:

```
age field: range check 0–120
enter 16 → accepted
enter 200 → rejected
```

Watch out: in a table, a **record** is a *row* (everything about one thing) and a **field** is a *column* (one piece of data)—don’t swap them. A **primary key** is a field with a *unique* value, so no two records share it.

Practice

Try these in order.

9.1 What is a *database*? [1]

9.2 In a table, what is a record? [1]

9.3 In a table, what is a field? [1]

9.4 What is a *primary key*? [1]

9.5 Why must a primary key be unique? [1]

9.6 Challenge. A school stores data about students. Suggest a suitable primary key field, and explain why “surname” would be a poor choice. [2]

9 Field types and SQL – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
SQL	结构化查询语言	_____

Recall

Each field has a type, and we use SQL to ask the database questions.

New ideas

Read these first, then do the Practice.

■ 1 Field data types

text	a name
number	an age
date/time	a birthday
boolean	yes / no

■ 2 Asking a question with SQL

SQL 结构化查询语言 lets you get data out of a database:

```
SELECT name
FROM students
WHERE age > 15
```

gets the names of students older than 15

- **SELECT** picks the fields;
- **FROM** names the table;
- **WHERE** sets a condition.

Watch out: match each field to its **data type** —text for names, number for ages, date/time for dates, boolean for yes/no. An SQL query reads **SELECT** (which fields) **FROM** (which table) **WHERE** (the condition).

Practice

Try these in order.

9.6 What data type would you use for a person's name? [1]

9.7 What data type would you use for an age? [1]

9.8 What does SQL stand for? [1]

9.9 In SQL, what does **SELECT** do? [1]

9.10 In SQL, what does **WHERE** do? [1]

9.11 Challenge. Write an SQL query to show the **name** of every student in the **students** table whose **age** is greater than 15. [3]

10 Logic gates – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
Boolean logic	布尔逻辑	_____
Logic gates	逻辑门	_____
AND	与门	_____
OR	或门	_____
NOT	非门	_____
truth table	真值表	_____

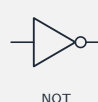
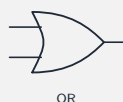
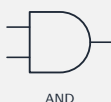
Recall

Boolean logic 布尔逻辑 uses just two values: TRUE (1) and FALSE (0). **Logic gates** 逻辑门 work on these.

New ideas

Read these first, then do the Practice.

■ 1 AND, OR, NOT



- **AND** 与门: output 1 only if **both** inputs are 1;
- **OR** 或门: output 1 if **either** input is 1;

- **NOT** 非门: flips the input ($0 \rightarrow 1$, $1 \rightarrow 0$).

■ 2 A truth table

A **truth table** 真值表 lists the output for every input:

A	B	A · B
0	0	0
0	1	0
1	0	0
1	1	1

AND

Watch out: **AND** outputs 1 only when *both* inputs are 1; **OR** outputs 1 when *either* (or both) is 1; **NOT** *flips* the single input. Don't confuse AND with OR —AND is the stricter one.

Practice

Try these in order.

10.1 What two values does Boolean logic use? [1]

10.2 When does an AND gate output 1? [1]

10.3 When does an OR gate output 1? [1]

10.4 What does a NOT gate do? [1]

10.5 What is the output of 1 AND 0? [1]

10.6 Challenge. Give the output of (a) 1 AND 1, (b) 1 OR 0, (c) NOT 0. [3]

10 More logic gates – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
NAND	与非门	_____
NOR	或非门	_____
XOR	异或门	_____

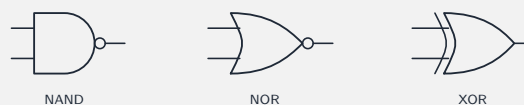
Recall

By combining the basic gates we get three more.

New ideas

Read these first, then do the Practice.

■ 1 NAND, NOR, XOR



- **NAND** 与非门 = NOT AND (the opposite of AND);
- **NOR** 或非门 = NOT OR (the opposite of OR);
- **XOR** 异或门: output 1 if the inputs are **different**.

■ 2 The OR truth table

A	B	A+B
0	0	0
0	1	1
1	0	1
1	1	1

OR

Watch out: **NAND** and **NOR** are just AND and OR with the output *flipped* (NOT). **XOR** outputs 1 only when the two inputs are **different** (1 and 0) —not when they are the same.

Practice

Try these in order.

10.6 NAND is the opposite of which gate? [1]

10.7 NOR is the opposite of which gate? [1]

10.8 When does an XOR gate output 1? [1]

10.9 What is the output of 0 OR 0? [1]

10.10 What is the output of 1 OR 0? [1]

10.11 Challenge. Give the output of (a) 1 NAND 1, (b) 0 NOR 0, (c) 1 XOR 1. [3]