

*Programming
and Artificial Intelligence*
**Introduction to ICT
First Year Secondary
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CONTENTS

Chapter 1 What is Information?

1-1 Information and Media

1-2 Information Ethics

Chapter 2 Regulations and Rights in the Information Society

2-1 Personal Information

2-2 Intellectual Property Rights

2-3 Utilization and Disclosure of Information

Chapter 3 Information Security

3-1 Threats and Countermeasures in Information Security [1]

3-2 Threats and Countermeasures in Information Security [2]

3-3 Threats and Countermeasures in Information Security [3]

Chapter 6 Information Design

6-2 Binary and Amount of Information

6-3 Hexadecimal

6-4 Digital Representation of Characters

6-5 Numerical Calculations [1]

6-6 Numerical Calculations [2]

6-7 Digitalization of Sound

6-8 Digitization of Images

6-9 Digital Representation and Compression Technology for Videos

6-10 Information Design

Chapter 7 Computers

7-1 Computer Configuration

7-2 Computer Software

7-3 Logic Circuits

1-1 Information and Media

Point!

1) Data, Information, Knowledge

(1) (**Data**): Facts or matters represented using numbers, characters, or symbols.

(2) (**Information**): Something that holds meaning or value for the recipient and serves as a basis for decision-making. Unlike objects, information has no form.

- Information has the following characteristics.

[1] (**Persistence**): Information, once created, cannot be completely erased.

[2] ("**Reproducibility**): Information can be easily copied in large quantities.

[3] (**Propagation**): Information is easy to convey and spread.

Information can easily spread through ("**mass media**") such as newspapers and television, as well as the internet.

(3) (**Knowledge**): Information that has been analyzed and systematized to aid in problem-solving.

(4) (**Primary information**) and secondary information

[1] (**Primary information**): Information obtained through direct personal experience or acquired through research and experiments.

<Examples> Experimental reports, survey results, tabulations of questionnaire results, etc.

[2] (**Secondary information**): Information not obtained directly by oneself, but acquired through a third party.

<Example> Books, newspapers, television, etc.

- Secondary information can sometimes differ from the original information or have interpretations added to it. In other words, it is necessary to compare the obtained information from multiple perspectives with other information to determine the degree of its accuracy and reliability. This is called ("**cross-checking**").

2) Media

(1) ("**Media**): Media for conveying information to people.

(2) Types of media

Name	Content	Example
("Expression media)	Media used as a means of expressing information.	Text, images, audio, video
("Propagation/ Transmission media)	Media used as an intermediary for the transmission and communication of information	Television, radio, newspapers, books, telephone, internet
Recording media	Media used for recording and storing information.	Paper, USB drives, DVDs, cloud storage

(3) ("**Media literacy**): The ability to accurately interpret information obtained from media.

Warm Up

Answer the following questions.

(1) [1] For the following items a to c, answer whether they are related to:

1) Data, 2) Information, or 3) Knowledge. Write "1," "2," or "3" as your answer.

- a) Temperature and humidity values
- b) Analysis results of temperature and humidity over the past 10 years
- c) Weather forecast

[2] Choose one statement that is not suitable as a characteristic of information from the options A to D, and answer using the letters.

- A) It has a form just like an object.
- B) The meaning or value changes depending on the recipient.
- C) It has the characteristic of persistence.
- D) It has the characteristic of propagation.

[3] Choose the content related to the following sentences a to c from the group of words labeled A to C below, and answer using the letters.

- a) Even if you purchase a commercially available music CD, you are not allowed to make copies to distribute to friends.
- b) Emails can be sent instantly overseas.
- c) Rumors about people and false information can persist indefinitely.

[Word group] A Persistence B Reproducibility C Propagation

(2) [1] For the following media from a to f, answer whether they are classified as

1) Expression media, 2) Propagation/Transmission media, or 3) Recording media.

Write "1," "2," or "3" as your answer.

- a) Television b) Cloud storage c) Photograph
- d) Internet e) Text character f) Book

[2] What is the term for the ability to accurately interpret information obtained from media?

Explanation

(1) [1] a: 1 b: 2 c: 3

[2] Unlike objects, information does not have form. Therefore, **A**

[3] a: The characteristic of being easily copied is reproducibility. **B**

b: The characteristic of being able to be sent instantaneously is propagation. **C**

c: The characteristic of information, once created, that never disappears is persistence. **A**

(2) [1] a: 2 b: 3 c: 1 d: 2 e: 1 f: 2

[2] Media literacy

Try

1- Answer the following questions.

(1) What is the term for the representation of facts or matters using numbers, characters, or symbols?

(2) For the following items a to c, answer whether they are related to: 1) Data, 2) Information, or 3) Knowledge. Write "1," "2," or "3" as your answer.

a- Results on mock exam

b- Analysis results for admission to the

c- Scores on mock exam desired school

(3) Choose the characteristic of information that is appropriate from the options A to D below, and answer using the letters.

A- Information does not have the characteristic of reproducibility.

B- The meaning or value of the information does not change depending on the recipient.

C- Information has form like an object.

D- Information that has been disseminated cannot be easily deleted.

(4) Choose the content related to the following sentences [1] to [3] from the group of words labeled A to C below, and answer using the letters.

[1] It is possible to copy commercially available music and movies in large quantities without any degradation.

[2] Rumors about people persist and never completely disappear.

[3] Information published on the internet spreads widely in a short period of time.

[Word group] A- Persistence B- Reproducibility C- Propagation

(5) What is the term for information obtained through personal experience or from investigations and experiments that were personally conducted?

2- Answer the following questions.

(1) What is the term for the medium used to convey information to people?

(2) Choose all the media corresponding to the following a to c from the options A to F, and answer using the letters.

a- Expression media

b- Propagation/Transmission media

c- Recording media

A- USB drive

B- Radio

C- Telephone

D- DVD

E- Video

F- Audio

(3) Choose the explanation of media literacy that is appropriate from the options A to D below, and answer using the letters.

A- The ability to accept information disseminated by the media without question

B- The ability to understand the meaning and characteristics of media and to accurately interpret information

C- The ability to capture content for media distribution

D- The ability to use media to edit information in accordance with the intent of the sender

Exercise

1- Cover the Point section on pages 3,4 with a red sheet and test yourself by writing the items in order in your notebook.

2- Read the following passage and answer each question.

We obtain (a) such as weather forecasts from sources such as newspapers and television, and use it as a basis for deciding on our actions. Weather forecasts organize (b) such as weather conditions, precipitation, and atmospheric pressure patterns, and add meaning and value to them. Additionally, this can be generalized to accumulate (c), such as "it often rains in May and June every year."

(1) Fill in the blanks with the appropriate words for (a) to (c).

(2) For each of the following options A to C, use the corresponding letter to indicate which blank, (a) to (c), it is related to.

A- Temperature graph

B- Temperature

C- Analysis results of the lowest temperatures over the past 20 years

(3) Choose the content related to the following sentences [1] to [3] from the group of words labeled A to C below, and answer using the letters.

[1] False information once disseminated on the internet can persist indefinitely.

[2] Not only mass media, but also individuals are now able to disseminate large amounts of information throughout the world.

[3] A person copied a commercially available music CD and distributed it to their friends.

A- Persistence

B- Reproducibility

C- Propagation

(4) For the following statements about information, mark "o" if the statement is correct, and "x" if it is incorrect.

- [1] Primary information refers to information obtained through surveys or investigations conducted by the person themselves.
- [2] The statistical data published on the Statistics Bureau's website is considered primary information.
- [3] Information found by a person on a website is considered primary information.
- [4] Information obtained through a third party is considered secondary information.

3- Answer the following questions.

(1) Choose all of the following media from A to F that qualify as Propagation/Transmission media.

- A- Internet B- Text character C- USB drive
- D- Audio E- Radio F- Book

(2) What is the term for the ability to understand the meaning and characteristics of media and to accurately interpret information?

1-2 Information Ethics

Point!

Information Ethics

- (1) (**Information ethics**): The foundational concepts and attitudes necessary for conducting appropriate activities in the information society. This is regardless of the presence or absence of (**laws**).
- (2) Points to consider when disseminating information
- [1] Characteristics of Information on the internet: Information is easily (**spread**) and, once disseminated, it tends (**not to disappear**) easily.
- [2] Infringement of Others' Rights
- You must not publicly share images or videos for which others hold the (**copyright**) without permission
 - You must not leak the (**personal information**) of another person on the internet.
 - You must not infringe upon others' (**privacy**).
 - You must not post comments that slander or defame others or engage in (**online bullying**).
- [3] (**Geotag (Geotagging)**): Information that includes latitude and longitude embedded in photos and videos taken with smartphones and mobile phones. There is a risk of being identified, such as having your home pinpointed based on the location where the photo was taken.
- [4] (**Disinformation and rumors**): False information that is deliberately spread or baseless rumors.

2- Problems that occur with smartphones and social media

(1) ("Social media): Services that provide platforms where individuals can connect with each other on the internet.

(2) Problems that occur with smartphones and social media

[1] (**Internet addiction**): A state where one becomes excessively immersed in the internet to the extent of interfering with daily life.

[2] (**Using smartphone while walking**): The act of using a smartphone while walking.

[3] (**Cybercrime**): The misuse of computers and networks for criminal activities.

[4] (**Identity theft**): The act of a third party pretending to be a certain individual or organization to steal IDs or passwords.

[5] (**Leakage of personal information**): When personal information that should remain confidential is disclosed to a third party.

Warm Up

Answer the following questions.

(1) What is the term for the foundational concepts and attitudes necessary for conducting appropriate activities in the information society?

(2) For the following statements A to D, mark "o" if the statement is correct, and "x" if it is incorrect.

A- Social media is nothing more than a dangerous tool that causes trouble.

B- There is a risk that your home address could be identified from geotags embedded in photos and videos.

C- You can write whatever you want on an anonymous bulletin board because no one can ever know who wrote it.

D- Be mindful that there are real people on the other side of the internet, and try to share information with consideration for their perspective.

Explanation

(1) Information ethics

(2) A- Social media is a convenient tool on the internet that allows individuals to connect with each other. However, social media can be a dangerous tool if not used properly. Therefore, x

B- O

C- Never post defamatory content, disinformation, or rumors, even anonymously.

Therefore, x

D- O

Try

1- Answer the following questions.

(1) Fill in the blanks with the appropriate words.

- [1] () is the term for the foundational concepts and attitudes necessary for conducting appropriate activities in the information society.
- [2] () is the term for false information that is deliberately spread or baseless rumors.
- [3] () is the collective term for crimes involving the misuse of computers and networks.

(2) Choose the phrases that best fit into the blanks [1] to [3] from the options A to D below.

When transmitting information on the internet, you must be very careful with handling others' ([1]) and with images or videos in which others have ([2]). Additionally, photos and videos taken with a smartphone have a feature that can add information such as the latitude and longitude of the location where they were taken, which is referred to as ([3]). ([3]) is convenient because it enables the confirmation or search of the location where a photo was taken, but caution is needed as there is a risk of having your home address identified.

- A- Copyright B- Personal Information C- Industrial Property Rights
D- Geotag

(3) From the following options A to D, choose the one that is a general term for services that provide platforms for individuals to connect with each other on the internet. Answer by writing the corresponding letter.

- A- Social engineering B- Social marketing
C- Social networking service D- Social network system

(4) The following statements A to D describe information ethics. Mark "o" if the statement is appropriate, and "x" if it is inappropriate.

A- You can write freely on an anonymous bulletin board because no one can know who wrote it.

B- Websites are legally required to always provide accurate information.

C- You must be careful not only with your own personal information, but also with how you handle the personal information of others.

D- For any content, it is better to use a bulletin board for information dissemination as it can reach a larger audience.

(5) Choose one statement that is appropriate as etiquette when using a smartphone from the options A to D below.

A- I operated on a smartphone while driving my car.

B- I turned off the smartphone at places like movie theaters or art museums.

C- I posted negative comments about others on the internet.

D- I sent my photo to a stranger I met online.

Exercise

1- Cover the Point! section on pages 11,12 with a red sheet and test yourself by writing the items in order in notebook.

2- Answer the following questions.

(1) Fill in the blanks with the appropriate words. your

[1] () is the term for a state in which a person prioritizes internet usage over aspects of life such as studies, work, physical and mental health, and is unable to control the time spent or the manner of internet usage.

[2] () is the collective term for services that facilitate the building of relationships over the internet.

[3] () is the term for location information that can be added to various media such as photos and videos.

(2) From the following options A to H, choose the phrases that best fit into the blanks [1] to [4].

([1]) is the term for the foundational concepts and attitudes necessary for conducting appropriate activities in the information society. Even if something is not prohibited by ([2]), you should still refrain from engaging in inappropriate behavior.

Furthermore, information on the internet is easily ([3]) and, once disseminated, it tends ([4]). With all of this in mind, we must be careful not to become involved in internet-related crimes or problematic behavior.

A- Information etiquette

B- Information ethics

C- Spread

D- Online backlash

E- To Disappear

F- Not to Disappear

G- Laws

H- System

(3) The following statements A to D describe information ethics. Mark "o" if the statement is appropriate, and "x" if it is inappropriate.

- A- When interacting through a network, it is important to communicate appropriately to avoid misunderstandings
- B- You can write freely on an anonymous bulletin board because no one can ever know who wrote it.
- C- Websites are legally required to always provide accurate information.
- D- Since a celebrity was at a nearby shopping mall, I took a photo and shared it on social media. I assumed that this is OK since the photo was taken in a public place.

(4) Choose one correct statement regarding the use of the internet and social media from the options A to D below.

- A- It is acceptable to copy a commercially available CD and post it on social media without permission.
- B- Social media is nothing more than a dangerous tool that causes trouble.
- C- If you live a life disconnected from the internet, you won't be a victim of cybercrime.
- D- When disseminating information, ensure that it does not infringe on the privacy of others.

2-1 Personal Information

Point!

1- Personal Information

(1) (**Personal information**): Information related to a living person. This also includes information that can be combined with other data and used to identify an individual.

<Example> Name, address, date of birth, gender, telephone number, email address, educational background, driver's license or My Number information, iris or fingerprint data, etc.

• Among the different types of personal information, name, address, date of birth, and gender are referred to as the (**Four Basic Items**), while numbers such as those on passports, driver's licenses, or My Number are known as (**Personal Identification Codes**).

• Information that requires careful handling to prevent prejudice and other disadvantages (for example, race, creed, social status, medical history, and criminal record) is referred to as (**Special Care-Required Personal Information**).

(2) (**Act on the Protection of Personal Information**): A law that stipulates the proper handling of personal information.

(3) Provision of Personal Information to Third Parties

• The Act on the Protection of Personal Information states that one cannot provide the personal information of an individual to a third party without the individual's consent. However, in the following cases, it is permissible to provide personal information without obtaining the individual's consent.

[1] When provision is based on laws and regulations.

[2] When necessary for the protection of human life, body, or property.

[3] When especially necessary for public health or the healthy development of children.

[4] When cooperating with national or local governments, etc.)

2- Protection of Privacy and Image Rights

- (1) (**Right to Privacy**): The right of an individual to protect personal information that the individual does not want others to know.
- (2) (**Image Rights**): The right of an individual to prevent others from photographing or using their face or appearance without permission.
- (3) (**Publicity Rights**): A right that protects the economic interests of celebrities in their likeness, among other things.

*These rights are recognized not by law but through court (precedents).

3- Protection of Personal Information in Corporations and Organizations

- (1) (**Privacy policy**): A policy that stipulates how companies and organizations manage personal information.
- (2) (**Privacy Mark**): A mark (shown on the right) awarded to companies or organizations that implement appropriate protective measures for personal information.
- (3) (**Opt-in system**): A method in which a provider does not offer a service to a user unless prior consent is given.
- (4) (**Opt-out system**): A method in which a service provider continues to offer a service to the user until the user requests the provider to discontinue the service.



Warm Up

Answer the following questions.

(1) Choose all the items from A to E that can be considered personal information as defined by the Act on the Protection of Personal Information.

- A- Email address B- Fingerprint data Address of a deceased person
D- Passport number E- Criminal record

(2) The following statements A to D describe personal information and privacy.

Mark "o" if the statement is appropriate, and "x" if it is inappropriate.

- A- If everyone in a photo is your family member, you can upload group photos to social media without permission.
- B- Posting information such as the past criminal record of a person suspected of a crime on social media, thinking it might aid the investigation, is not a violation of the Act on the Protection of Personal Information.
- C- Although a driver's license number or a My Number consists merely of a sequence of digits, it can be considered personal information because it allows for the identification of an individual when combined with other information.
- D- It is acceptable to print a photo of your favorite celebrity on a T-shirt yourself and sell the T-shirt online.

Explanation

(1) Personal information refers to information concerning a living individual. Information about deceased individuals is not considered to be personal information.

Therefore, **A, B, D, and E**

(2)

A- Uploading a person's photo to the internet or social media without their permission constitutes a violation of image rights. Therefore, x

B- Past criminal records and medical histories are referred to as special care-required personal information. As a general rule, they should not be provided to third parties without the individual's consent. Therefore, x

C- Personal information refers to data related to a living individual and includes information that can o

D- be used to identify an individual when combined with other information.

Therefore, x

The likeness of famous people (such as celebrities or athletes) holds economic value, and one should not sell that likeness for profit without permission.

Therefore, x

Try

1- Answer the following questions.

- (1) What is the term for information related to living individuals?
- (2) From among (1), what is the term for the collective reference to name, address, date of birth, and gender?
- (3) From among (1), what is the term for the numerical information found in items like passports, driver's licenses, and My Number cards?
- (4) What is the term for the law that stipulates the proper handling of personal information?
- (5) Since the likenesses of celebrities hold economic value, celebrities possess rights recognized to protect the economic benefits arising from their popularity. What is the term for these rights?
- (6) What is the term for the mark awarded to companies or organizations that implement appropriate protective measures for personal information?
- (7) Choose the appropriate terms for [1] and [2] to complete the following sentence.

When providing services to users, the system where services are not provided without prior consent is called the ([1]) system, while the system where services continue to be provided until the user requests the provider to stop is called the ([2]) system.

2- Answer the following questions.

(1) Choose one correct statement regarding personal information from the options A to D below.

- A- Personal information is protected until 70 years after the individual's death.
- B- Although your passport, driver's license, and My Number information are merely sequences of numbers, they still constitute personal information.
- C- The names, addresses, dates of birth, and gender of individuals that have already been published in newspapers or on the internet do not constitute personal information.
- D- The criminal record and family structure of a person who has already been reported in newspapers and news as being pronounced guilty in a court of law is not considered personal information.

(2) Choose one correct statement regarding image rights from the options A to D below.

- A- The right of an individual to protect personal information that the individual does not want others to know.
- B- The right to protect economic benefits arises from the fact that the likeness of a celebrity possesses economic value.
- C- The right of an individual to prevent others from photographing or using their face or appearance without permission.
- D- The right to protect one's thoughts and feelings as expressed in the form of a work.

(3) The following statements A to D describe personal information and privacy.

Mark "o" if the statement is appropriate, and "x" if it is inappropriate.

- A- Taking a photo of a portrait of a famous person that you drew yourself and saving it on your smartphone does not violate the Act on the Protection of Personal Information.
- B- If a person is your friend, you can upload a photo of their face to social media without permission.
- C- The transfer of personal information of an individual to third parties without the consent of the individual is prohibited.
- D- It's permissible to sell fan merchandise of your favorite celebrity if you create it personally.

(2) Choose one correct statement regarding publicity rights from the options A to D below.

- A- The right of an individual to protect personal information that the individual does not want others to know.
- B- A right that protects the economic interests of celebrities in their likeness, among other things.
- C- The right of an individual to prevent others from photographing or using their face or appearance without permission.
- D- The right to protect one's thoughts and feelings as expressed in the form of a work.

(3) The following statements A to D describe behavior related to personal information and privacy. Mark "o" if the statement is appropriate, and "x" if it is inappropriate.

- A- I received an email asking to verify my personal information from an unknown email address, so I replied to the contact provided in the email.
- B- I shared widely on social media the personal information of an individual rumored to be the perpetrator in a crime. I thought my action would aid in the criminal investigation.
- C- After paying the admission fee and entering the concert, I took a photo of the singer with my smartphone and posted it on social media.
- D- After destroying the list of final test scores with a shredder, I discarded the shredded documents as combustible waste.

2-2 Intellectual Property Rights

Point!

1- Intellectual Property Rights

(**Intellectual Property Rights**): Rights that protect creations and ideas generated by human intellectual activities. These rights are mainly divided into Industrial Property Rights and Copyrights.

2- Industrial Property Rights

(1) (**Industrial Property Rights**): Rights primarily related to the manufacturing of industrial or commercial products. This follows the principle in which rights come into effect once an application is filed with and registered by the (**Japan Patent Office**). This is known as the (**Formality**) Principle.

(2) Types of Industrial Property Rights

Name	Subject of Rights	Protection Period
(⁵ Patent Rights)	Rights to advanced technological ideas and inventions.	20 years from the application
(⁶ Utility Model Rights)	Rights to the shape or structure of a product.	10 years from the application
(⁷ Design Rights)	Rights to a design, such as the shape and patterns of a product.	25 years from the application
(⁸ Trademark Rights)	Rights related to items such as product names, logos, text, and sound.	10 years from the registration (Updated)

3- Copyrights

(1) (**Copyrights**): Rights related to creative activities in the arts and cover works such as novels, movies, paintings, photographs, music, and computer programs. It follows the (Non-Formality) Principle, under which rights are established at the moment a copyrighted work is created, regardless of whether the creator is an amateur or a minor.

(**Copyright Act**): A law that protects the rights of creators.

<Rights of Creators>

[1] (**Moral rights of creator**): Rights that protect the personal interests of the creator.

[2] (**Copyrights (property rights)**): Rights that protect the economic interests of the creator.

(3) (**Neighboring Rights**): Rights that arise for individuals or entities who communicate or transmit copyrighted works. Granted to performers such as singers, directors, and actors, as well as record companies and broadcasting organizations.

(4) Copyright protection period: The lifetime of the creator plus (**70**) years after their death.

(5) Copyright infringement: As a general rule, when reproducing someone else's copyrighted work or using it on a website, it is necessary to obtain (**permission**) from the creator. Using a work without permission would constitute a (**copyright infringement**).

Warm Up

Answer the following questions.

(1) Insert the appropriate terms for [1] to [6] to complete the following sentence.

The rights granted to a creator when they produce something through intellectual activity are called ([1]). ([1]) are primarily composed of ([2]), which contribute to the development of industry, and ([3]), which contribute to the development of culture. ([2]) are established under the ([5]) in which rights are granted upon approval after filing a notification with ([4]). On the other hand, ([3]) do not require reporting or registration, and the rights are granted at the time of creation. Furthermore, the protection period for ([3]) is ([6]) years after the death of the creator.

(2) For the following statements concerning the laws and rights of information society, mark "o" if the statement is appropriate, and "x" if it is incorrect.

- [1] Posting Natsume Soseki's novel "Kokoro" on your website without permission does not constitute copyright infringement.
- [2] Downloading music or videos that are for sale while knowing that they have been illegally uploaded constitutes copyright infringement.
- [3] Posting the audio data of Beethoven's Symphony No. 5 "Fate" played exceptionally well by someone else on social media does not constitute copyright infringement.
- [4] Trademark rights conclude 10 years after registration with the Patent Office, but the rights can be maintained through renewal procedures.

Explanation

- (1) [1] Intellectual Property Rights [2] Industrial Property Rights
[3] copyrights [4] Japan Patent Office
[5] Formality Principle [6] 70

(2)

- [1] Novelists like Natsume Soseki and Dazai Osamu can be used copyright-free as over 70 years have passed since their death. Therefore, o
- [2] Downloading music or movies while knowing they have been illegally uploaded constitutes copyright infringement. Therefore, o
- [3] Musical compositions by Beethoven, Mozart, and similar composers are no longer under copyright protection, as more than 70 years have passed since their death. However, performers and record companies have neighboring rights, so it is necessary to verify the usage permissions. Therefore, x
- [4] Trademark rights conclude 10 years after registration with the Patent Office, but the rights can be maintained for an additional 10 years through renewal procedures. Therefore, o

Try

1- Answer the following questions.

(1) From the following terms A to H, choose the terms that best fit into the blanks [1] to [4].

Rights related to creations resulting from human intellectual activity are collectively referred to as [1]). ([1]) can be largely divided into Industrial Property Rights and ([2]). A copyrighted work is something created through academic or artistic creative activity. Copyrighted Works include novels, scripts, ([3]), musical compositions, works of art, buildings, photographs, computer programs, etc. Illustrations or web pages that you create yourself are also considered copyrighted works. In principle, to use someone else's copyrighted work, you are required to obtain permission from the creator. Using a work without permission will be considered ([4]) and may be subject to penalties.

A Copyrights

B-Intellectual Property Rights

C- Patent Rights

D- Utility Model Rights

E- Movies

F- Ideas

G- Copyright Infringement

H- Patent Infringement

(2) From the following terms A to H, choose the terms that best fit into the blanks [1] to [3].

Industrial property rights include rights such as ([1]) rights, which protect designs like those of automobiles, and ([2]) rights, which protect inventions such as ideas for shapes that improve water drainage in washing machines. To receive protection as an industrial property right, it is ([3]) to file an application.

A Utility model

B Trademark

C Creative works

D Design

E Patent

F Unnecessary

G Necessary

H Necessary when obtaining rights for commercial purposes

2- Read the following passage and answer the questions.

As a general rule, it is necessary to obtain permission from the creator when reproducing someone else's copyrighted work or publishing it on a website. Using the work without permission constitutes (A) copyright infringement. However, under certain conditions, it is possible to freely use a copyrighted work without obtaining permission from the creator. For example, works that have passed more than (B) years after the death of the creator fall under this category.

(1) For the underlined section A, choose all statements that apply as copyright infringement, and answer using the letters.

- A- I recorded a movie broadcast on television and distributed it.
- B- I posted Natsume Soseki's novel "Kokoro" on my website without permission.
- C- I copied an illustration that was distributed for free and sold the copies at a low price.
- D- Even though I knew that a video was illegally uploaded, I downloaded it solely for personal use.

(2) Answer by writing the appropriate number in blank B.

Exercise

1- Cover the Point! section on pages 27,28 with a red sheet and test yourself by writing the items in order in your notebook.

2- Answer the following questions.

(1) Among intellectual property rights, what is the term for the rights that pertain to the manufacturing of industrial and manufactured products?

(2) Out of the following statements A to D, choose all statements that are incorrect in relation to copyrights.

- A- Copyrights are granted through recognition upon application to the Patent Office.
- B- Copyrights are related to the quality of a work.
- C- Copyrights are maintained for 50 years after the death of the creator.
- D- Copyrights arise even if the creator is a minor.

(3) What is the term for the rights that protect the marks used to distinguish goods and services?

(4) What is the term for the rights that protect inventions of things or methods?

(5) For the following statements concerning the laws and rights of information society, mark "o" if the statement is appropriate, and "x" if it is incorrect.

[1] A design right is recognized for ideas related to the technical aspects of a product's shape or structure that can be immediately implemented.

[2] Copyrights tend to be recognized less frequently for creations by amateurs or children, as copyrights are often related to the quality of the work.

[3] Recording a movie broadcast on television and then distributing that movie constitutes a copyright infringement.

[4] The protection period for a patent right is 20 years from the date of application.

[5] There is no problem with posting the full text of Matsuo Basho's "Oku no Hosomichi (The Narrow Road to the Deep North)" on one's blog without obtaining permission if you are very fond of its prose.

3- Read the following passage and answer the questions.

There are four types of Industrial Property Rights: Patent Rights, Utility Model Rights, Design Rights, and (A) Rights. Among these, Utility Model Rights are rights pertaining to ([1]). Additionally, (A) rights refer to the rights concerning product names or logos, and the protection period is (B) years from the date of registration.

(1) Answer by filling in blank A with the appropriate term.

(2) Answer by filling in blank B with the appropriate number.

(3) Choose the most appropriate phrase to fill in blank [1] from the options A to D below, and answer using the letters.

A- Reproduction or sale of products B- Conveyors of products

C- Product design D- Ideas for the structure and shape of a product

2-3 Utilization and Disclosure of Information

Point!

Utilization and Disclosure of Information

(1) Purpose of Copyright

A copyright aims to contribute to cultural development by ensuring the ('fair use) of copyrighted works and the (**protection of rights**).

(2) Exceptions

Under the purpose of copyright, there are exceptions where the copyright can be limited to allow use without obtaining permission from the copyright holder.

<Example> Reproduction for private use, reproduction within educational institutions, non-profit performances, etc.

(3) (**Quotation**): The act of using a portion of another person's copyrighted work in your own copyrighted work.

If certain requirements are met, portions of a copyrighted work can be quoted without obtaining permission from the author.

<Quotation Methods and Rules>

[1] Your own copyrighted work takes precedence, while the quoted work is subordinate.

(Your own copyrighted work is the subject.)

[2] There must be a necessity to engage in quotation.





[3] Ensure that the quoted material is clearly identifiable by enclosing it in quotation marks. [4] The source is clearly specified.

[5] Do not alter the quoted material.

(4) Setting the duration of protection: The economic rights of the author expire (**70**) years after the death of the creator.

(5) (**Creative Commons License**) (CC License): A mark indicating the conditions for using copyrighted works.

<Types of Creative Commons Licenses>

Mark	Condition	Content
	⁽⁶⁾ Credit to creator (BY)	Display the title of the work and name of the creator.
	⁽⁷⁾ Non-commercial (NC)	Do not use for ⁽⁸⁾ commercial purposes.
	⁽⁹⁾ No derivatives (ND)	Do not alter the original copyrighted work.
	⁽¹⁰⁾ Same terms for adaptations (SA)	Publish under the same combination of licenses as the original work.

Warm Up

Answer the following questions.

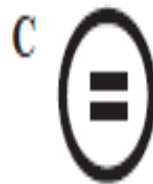
(1) Choose all statements that allow for the use of copyrighted works without permission as an exception from the options A to D below, and answer using the letters.

- A- I copied the materials and distributed them to students in my social studies class.
- B- I copied commercially available music CDs and distributed them to friends.
- C- We charged an admission fee and performed a K-pop medley at our band's regular concert.
- D- I quoted a section of a book when writing a report.

(2) Choose all statements that correctly describe the method and rules of quotations from the options A to D below, and answer using the letters.

- A- Even when quoting, it is always necessary to obtain permission from the creator.
- B- There is a necessity to quote, and the portion being cited is subordinate.
- C- Clearly indicate the quoted material by enclosing it in quotation marks.
- D- Regardless of the reason, you must not modify the material you are quoting.

(3) When publishing a photo, you took on a web page, you want to allow others to use it on the conditions that "the name of the photographer and the title of the work are displayed" and "the work is not altered." At this time, choose all the Creative Commons licenses that should be displayed in combination from the options A to D below, and answer using the letters.



Explanation

(1)

- A- The use of copyrighted works in the course of teaching falls under reproduction in educational institutions and works can therefore be utilized without obtaining permission from the copyright holder.
- B- Copying commercially available CDs and distributing them to friends does not qualify as reproduction for personal use and constitutes copyright infringement.
- C- Since an admission fee is charged and the usage does not fall under the condition of a performance not for profit, this usage constitutes a copyright infringement.
- D- In the case of quotation, a copyrighted work can be used in one's own creation without obtaining permission from the creator of the other work.

Therefore, A and D

(2) **B, C, D**

(3) **A** represents display, **B** represents non-commercial, **C** represents no derivative works, and **D** represents same terms for adaptations.

Therefore, A and C

Try

Answer the following questions.

(1) Insert the appropriate terms in blanks [1] and [2] to complete the following sentence.

A copyright aims to contribute to cultural development by ensuring the ([1]) of copyrighted works and the ([2]).





(2) For each of the following statements A to D, mark "o" if the statement does not constitute copyright infringement, and "x" if it is infringement.

- A- The sheet music for a regular concert was copied and distributed to all members of the wind orchestra.
- B- At a school cultural festival, the drama club performed a play using a script selected from a collection of commercially-available scripts.
- C- A Spanish work written by a Spanish person was translated into Japanese and published without obtaining permission from the copyright holder, as the languages were different.
- D- In a report assigned for class, a student cited a portion of statistical data from a web page.

(3) Choose all statements that correctly describe the method and rules of quotations from the options A to D below, and answer using the letters.

- A- Even in the case of a quotation, permission from the copyright holder must always be obtained.
- B- Clearly indicate quotes through measures such as enclosing the quoted materials in quotation marks.
- C- If the quoted material is clearly distinguished, it is not necessary cite the source from which the quoted material was taken
- D- Quoted texts must not be altered, regardless of one's own argument.

(4) The following table is a summary of Creative Commons licenses. Complete the table by filling in the blanks [1] to [4] with the appropriate terms.

Mark	Condition	Content
	([1])	Display the title of the work and name of the creator.
	Non-commercial	Do not use for ([2]) purposes.
	([3])	Do not alter the original copyrighted work.
	([4])	Publish under the same combination of licenses as the original work.

(5) Choose one statement that correctly represents the conditions indicated by the Creative Commons license shown on the right from the options A to D below. Answer using the letters.



- A- Display the name of the creator and do not use the work for commercial purposes.
- B- Display the name of the creator and do not alter the original work.
- C- Do not use the work for commercial purposes and do not alter the original work.
- D- Do not use the work for commercial purposes. Also, if you modify the work, publish it under the same license as the original work.

Exercise

1- Cover the Point! section on pages 35,36 with a red sheet and test yourself by writing the items in order in your notebook.

2- Answer the following questions.

(1) Choose the term that best fit into the blanks [1] to [3] from the options A to D below, and answer using the letters.

If you want to use another person's copyrighted work, you must clarify the purpose and method of use, as well as the place where it will be published, and obtain permission from the copyright holder. However, usage is permitted without obtaining permission in cases such as ([1]) in educational institutions, reproduction for ([2]) use, and ([3]) from texts.

A- Quotation

B- For-profit

C- Personal

D- Classes

(2) Choose the one that does not constitute copyright infringement from the options A to D below, and answer using the letters.

A- I made a copy of a commercially purchased music CD and gave it to a friend.

B- I listen to music by recording commercial music CDs that I have purchased onto my smartphone





C- I shared and disseminated on social media the audio data of a popular artist's song.

D- I copied an illustration that is distributed for free and sold the copies at a low price.

(3) Choose all statements that correctly describe the method and rules of quotations from the options A to D below, and answer using the letters.

- A- There is a necessity to engage in quotation.
- B- You cannot quote without obtaining permission from the copyright holder.
- C- Do not alter quoted material without permission.
- D- The source is clearly specified.

(4) The following table is a summary of Creative Commons licenses. Complete the table by filling in the blanks [1] to [4] with the appropriate terms.

Mark	Condition	Content
	([1])	Display the title of the work and name of the creator.
	([2])	Do not use for commercial purposes.
	([3])	Do not alter the original copyrighted work.
	([4])	Publish under the same combination of licenses as the original work.

(5) When publishing a photo, you took on a web page, you want to allow others to use it on the conditions that "the name of the photographer is displayed" and "the work is not used for commercial purposes." At this time, choose all the Creative Commons licenses that should be displayed in combination from the options A to D below, and answer using the letters. B



3-1 Threats and Countermeasures in Information Security [1]

Point!

1- Information Security

(1) (**Information security**): The act of properly managing information and keeping it safe.

(2) The three essential elements of information security

[1] (**Confidentiality**): A state in which only authorized individuals can access the information.

[2] (**Integrity**): A state in which the information is not destroyed, tampered with, or erased.

[3] (**Availability**): A state in which information can be accessed at any time when needed.

2- Various threats to information security

(1) (Unauthorized access): When someone without permission gains access to a computer system.

(2) (**Cracking**): The act of unlawfully accessing a system to tamper with, erase, or steal data. A person who commits such acts is called a (cracker).

(3) (**Malware**): A general term for malicious programs designed to harm computers. Infection can occur through websites, email attachments, USB drives, or networks.

[1] (**Computer virus**): A program designed to intentionally cause harm, such as destroying data or programs.

[2] (**Trojan horse**): A program disguised as a legitimate one that infiltrates a system and quietly initiates attacks.

[3] (**Worm**): A program that replicates itself and spreads across the internet like a worm, expanding the infection.

[4] (**Spyware**): A program that collects personal information without the user's knowledge and sends it to third parties.

- **(Keylogger)**: Software that monitors and records keystrokes.
- **(Adware)**: A program that displays unwanted advertisements without the user's consent.

[5] **(Ransomware)**: A program that renders data inaccessible and demands a ransom to restore access.

(4) **(Cybercrime)**: Criminal acts committed over computer networks.

[1] **(Violation of the Unauthorized Computer Access Law)**: Illegally accessing a computer using someone else's user ID or password.

[2] Crimes involving computer or electronic records: Crimes involving tampering with stored data or unauthorized manipulation of devices.

[3] Network-based crimes: Crimes committed using networks, such as fraud, defamation, or copyright infringement.

Warm Up

Answer the following questions.

(1) Choose the one in which availability is compromised in terms of information security from the options A to C below.

- A- A cyberattack caused a website to go down.
- B- Incorrect data was entered due to a keyboard typing error.
- C- Personal information was leaked due to a malware infection on the computer.

(2) Choose all actions that constitute a violation of the Unauthorized Computer Access Law from the options A to D below.

- A- Illegally used another person's user ID and password to access a computer.
- B- Stored a password that was obtained illegally on a computer.
- C- Shared a friend's user ID and password with someone else without the friend's permission
- D- Published a website selling quasi-legal drugs or containing unlawful and inappropriate content.

Explanation

(1) Information security consists of three elements: integrity, confidentiality, and availability.

- A- When information becomes unavailable, availability is compromised.
- B- When information is no longer accurate, integrity is compromised.
- C- When unauthorized individuals can view the information, confidentiality is compromised. Therefore, the correct answer is A.

(2)

A- Using a computer without having access rights constitutes unauthorized access and is prohibited under the Unauthorized Computer Access Law.

B- Storing a password obtained illegally for the purpose of unauthorized access is prohibited under the Unauthorized Computer Access Law.

C- Sharing someone else's password with a third party without valid reason or permission promotes unauthorized access and is also prohibited by law.

D- Publishing illegal content may fall under network-related crimes.

Therefore, the correct answers are A, B, and C.

Try

1- There are three elements of information security: Integrity, Confidentiality, and Availability. For each of these elements, choose the one most appropriate measure from the following options A to E.

(1) Integrity

(2) Confidentiality

(3) Availability

A- Report your arrival at work to the network administrator.

B- Handle special data such as personal ID numbers in a room where only authorized personnel are allowed to enter.

C- Keep logs of data access and modifications to enable traceability.

D- Install backup power supplies for all devices related to critical information systems in preparation for power outages.

E- Run malware in order to always have access to important information.

2- Choose the terms that best fit into the blanks [1] to [5] from the options A to H below, and answer using the letters.

When a third party without network access rights uses someone else's ID and password to illegally enter a computer system, it is called ([1]). Incidents have occurred in which individuals known as hackers or ([2]) have destroyed systems. Programs that destroy internal computer data or cause abnormal operations are called ([3]). Among these are [4]), which disguise themselves as legitimate programs and silently infiltrate systems to carry out attacks, and ([5]), which replicate themselves and spread across the internet like worms to increase infections.

A Worm

B Cracker

C Unauthorized access

D Trojan horse

E Computer virus

F Adware

G Keylogger

H Impersonation

3- Answer the following questions.

(1) Choose all items from A to D that present a risk of computer virus infection.

- A- An email attachment sent from a computer infected with a virus.
- B- Connecting to a network infected with a virus.
- C- A USB memory stick that was used on a computer infected with a virus.
- D- A movie DVD played on a computer infected with a virus.

(2) Choose one act from A to D that constitutes a violation of the Unauthorized Computer Access Law.

- A- Provided personal information to a third party without the individual's consent.
- B- Took a photo of a magazine page with a smartphone and uploaded it to social media.
- C- Acquired a computer virus capable of automatically infiltrating networks.
- D- Used another person's user ID and password without permission to purchase products through online shopping.

Exercise

1- Cover the Point! section on pages 43,44 with a red sheet and test yourself by writing the items in order in your notebook.

2- For each of the three elements of information security, select:

- The most appropriate description from Group A (A-C), one per element
- All applicable potential damages from Group B (a-f) that may occur if that element is not ensured

(1) Confidentiality (2) Integrity (3) Availability

<Group A>

A- Ensuring uninterrupted access to information when needed.

B- Ensuring that only authorized individuals can access the information.

C- Ensuring that information has not been destroyed, tampered with, or deleted.

<Group B>

a- Eavesdropping on the network

b- Service interruptions such as system downtime

c- Password leakage

d- Tampering with or destruction of information

e- Information leakage

f- Unauthorized use of computers or networks

3- Answer the following questions.

(1) Choose the most suitable option for the blank from the options A to G below, and answer using the letters. (_____)

[1] A virus that displays advertisements the user did not intend to see is called ().

[2] The act of illegally infiltrating a computer to tamper with, erase, or steal data is called ().

[3] Software that leaks data stored on a computer to the outside is called ().

[4] Malicious software including computer viruses and Trojan horses is collectively referred to as ().

A- Malware B- Keylogger C- Adware D- Cracking

E- Hacking F- Phishing G- Spyware

(2) Choose the one correct statement from A to D regarding computer virus infection.

A- As long as the computer is connected to a network, there is always a risk of infection by a computer virus.

B- If you do not connect to a computer or network and only transfer data using a USB memory stick, infection will not occur.

C- If you avoid accessing harmful or illegal websites, you will not get infected.

D- As long as you do not open emails, you are safe from infection, so being cautious with emails is sufficient.

3-2 Threats and Countermeasures in Information Security [2]

Point!

Passwords and Authentication

(1) Password: A string of characters used to verify that the user of a given user ID is the legitimate account holder.

(2) Guidelines for creating passwords:

- Use a string that is as (**long**) as possible.
- (**Combine**) uppercase letters, lowercase letters, numbers, and symbols.
- Do not use personal information such as your birthday, email address, or user ID.
- Do not reuse passwords used for other services.

(3) (**One-time-password**): A password that changes at regular intervals and can only be used once.

(4) (**Authentication**): The process of verifying the identity of a user on a computer or network.

(5) Types of authentication:

Name	Method	Examples
[1] (⁵ Knowledge-based authentication)	Authentication using information known only to the individual.	User ID and password, PIN code
[2] (⁶ Biometric authentication (Biometrics))	Authentication using physical or behavioral characteristics of the individual.	Fingerprint, Iris, Vein pattern, Handwriting
[3] (⁷ Possession-based authentication)	Authentication using an item that the individual possesses.	IC card, One-time password, SMS-based verification

[4] (**Two-factor authentication**): A method that combines two different types of factors from "knowledge," "biometrics," and "possession" to perform authentication.

[5] (**Two-step authentication**): A method that performs authentication in two steps using two pieces of information from the same type of factor.

2- Information Security Measures

- (1) (**Access control**): A method of limiting access to computer systems or data so that only specific users, verified through authentication, are allowed to use them.
- (2) (**Firewall**): A system installed at network entry points to prevent ("unauthorized access) from outside and to stop (**data leaks**) from within.
- (3) Countermeasures against computer viruses
 - Install (**antivirus software**) to remove or isolate viruses, and keep the virus definitions within the software up to date.
 - Always keep the operating system (OS) and application software (**updated**) to prevent (**security holes**) (vulnerabilities) in the software.
 - Regularly create (**backups**) of your data.)

Warm Up

Answer the following questions.

(1) Choose the one incorrect statement regarding password best practices from the options A to D below, and answer using the letter.

- A- Do not reuse the same password across multiple services.
- B- It is best to keep using the default password that was initially assigned.
- C- Combine letters, numbers, and symbols when creating a password.
- D- Avoid using easily guessable information such as your name or birthday.

(2) Choose all correct statements about one-time passwords from the options A to D below, and answer using the letters.

- A- If a one-time password is leaked, it can easily lead to unauthorized access.
- B- Using a one-time password strengthens overall security.
- C- A one-time password has a limited usage time and becomes invalid after expiration.
- D- It can prevent unauthorized access using leaked passwords.

(3) Choose the one correct example of biometric authentication from the options A to D below, and answer using the letter.

- A- Authentication using a user ID and password assigned to each individual
- B- Authentication using an SMS sent to a smartphone
- C- Authentication by scanning a fingerprint on a sensor
- D- Authentication using a one-time password

(4) If a password can use the digits 0 to 9 and lowercase letters a to z, how many different combinations are there for a 3-character password? Give your answer in the form of aⁿ.

Explanation

(1) If an initial password is assigned via email or memo, there is a possibility that the password has been leaked to a third party. Therefore, the initial password must be changed. The correct answer is **B**.

(2) A one-time password is a password that changes at fixed intervals and can only be used once. This strengthens security. The correct answers are **B, C, and D**.

(3) Biometric authentication refers to the use of an individual's physical or behavioral characteristics for verification. Examples include fingerprint, iris, vein, or handwriting-based authentication. The correct answer is **C**.

Note: A is knowledge-based authentication, B is possession-based authentication, and D is also possession-based authentication.

(4) There are 10 digits (0-9) and 26 letters (a-z), making 36 possible characters. Since each character in the password can be any of the 36, the total number of combinations for a 3-character password is $36 \times 36 \times 36 = \mathbf{36^3 \text{ combinations}}$.

Try

Answer the following questions.

(1) Choose the one incorrect statement regarding password best practices from the options A to D below, and answer using the letter.

- A- Do not use information such as phone numbers, birthdays, email addresses, or user IDs.
- B- It is best to continue using the initial password without changing it.
- C- Do not reuse the same password across different services.
- D- Use a mix of uppercase and lowercase letters, numbers, and symbols.

(2) Choose the one thing that can be prevented by using a one-time password from the options A to D below, and answer using the letter.

- A- Password theft during transmission over a network
- B- Tampering with confidential files after unauthorized access
- C- Infection by a virus through malicious software
- D- Unauthorized access using a leaked password

(3) Choose the one correct example of biometric authentication from the options A to D below, and answer using the letter.

- A- Authentication using the shape of a fingerprint or vein pattern
- B- Authentication using a digital certificate
- C- Authentication based on whether the user can correctly read distorted text in an image
- D- Authentication using a one-time password

(4) Choose the terms that best fit into the blanks [1] to [4] from the options A to F below, and answer using the letters.

To protect computers and networks from threats such as unauthorized access and computer viruses, it is necessary to implement various security measures. For example, determining whether a person is authorized to access a computer or network is called ([1]). As countermeasures against computer viruses, there are the introduction of ([2]) and the ([3]) of hardware and operating systems. Furthermore, a system that hides internal LAN computers from external networks and prevents unauthorized access is called a |([4]).

A- Firewall

B- Antivirus software

C- Encryption

D- Authentication

E- Update

F- Security hole

(5) What is the term for restricting access so that only specific users can operate a computer system or network?

(6) If a password uses 26 characters (A to Z), how many times greater is the maximum number of brute-force attempts required to crack the password when increasing the length from 4 characters to 6 characters?

Exercise

1- Cover the Point! section on pages 51,52 with a red sheet and test yourself by writing the items in order in your notebook.

2- Answer the following questions.

(1) Choose the one incorrect statement regarding password creation from the options A to D below, and answer using the letter.

- A- Use the shortest possible string to make it easy to remember.
- B- Do not reuse passwords used for other services.
- C- Do not write passwords down in a notebook or on sticky notes.
- D- Combine uppercase and lowercase letters, numbers, and symbols.

(2) Choose the one threat that can be prevented by using a one-time password from the options A to D below, and answer using the letters.

- A- Theft of user ID through social engineering
- B- Unauthorized access through brute-force attacks
- C- Unauthorized access using a leaked password
- D- Virus infection through a security hole

(3) Choose the one correct example of biometric authentication from the options A to D below, and answer using the letter.

- A Authentication using a personal ID or password
- B Authentication using physical characteristics such as fingerprints or irises
- C Authentication based on an individual's problem-solving ability
- D Authentication using physical performance such as grip strength or flexibility

(4) Choose the terms that best fit into the blanks [1] to [5] from the options A to F below, and answer using the letters.

System administrators must implement measures such as installing a ([1]) to prevent unauthorized access from outside the system and to minimize data tampering or leakage as much as possible. In order to deal with the constant emergence of new ([2]), it is essential to introduce [3]) and patch [4]). To prevent unauthorized access, ([5]) is useful for restricting system or network usage to specific users only.

A- Firewall

B- Antivirus software

C- Security

D- Access control

-E Computer virus

F- Security hole

(5) What is the name of the authentication method that combines two different elements from "knowledge," "biometric," and "possession"?

(6) If a password can use the digits 0-9 and lowercase letters a-z, how many possible combinations are there for a 4-character password? Give your answer in the form of a^n

3-3 Threats and Countermeasures in Information Security [3]

Point!

1- Fraudulent Billing

(**Fraudulent billing**): A scam in which a person is billed for a fictitious service they have never used, with the intent to fraudulently extract money.

(**One-click fraud**): A scam where clicking a URL in a website or email automatically triggers a message pretending a contract has been concluded, followed by an exorbitant payment demand.

2- Unauthorized Acquisition of Information

(1) (**Phishing**): A scam that uses fake websites disguised as financial institutions or public agencies to steal personal information such as PINs or account details.

(2) (**Social engineering**): A method of fraudulently obtaining information by exploiting human psychology, carelessness, or lack of awareness.

[1] (**Impersonation**): The act of pretending to be someone else—such as making a phone call in their name—to obtain information.

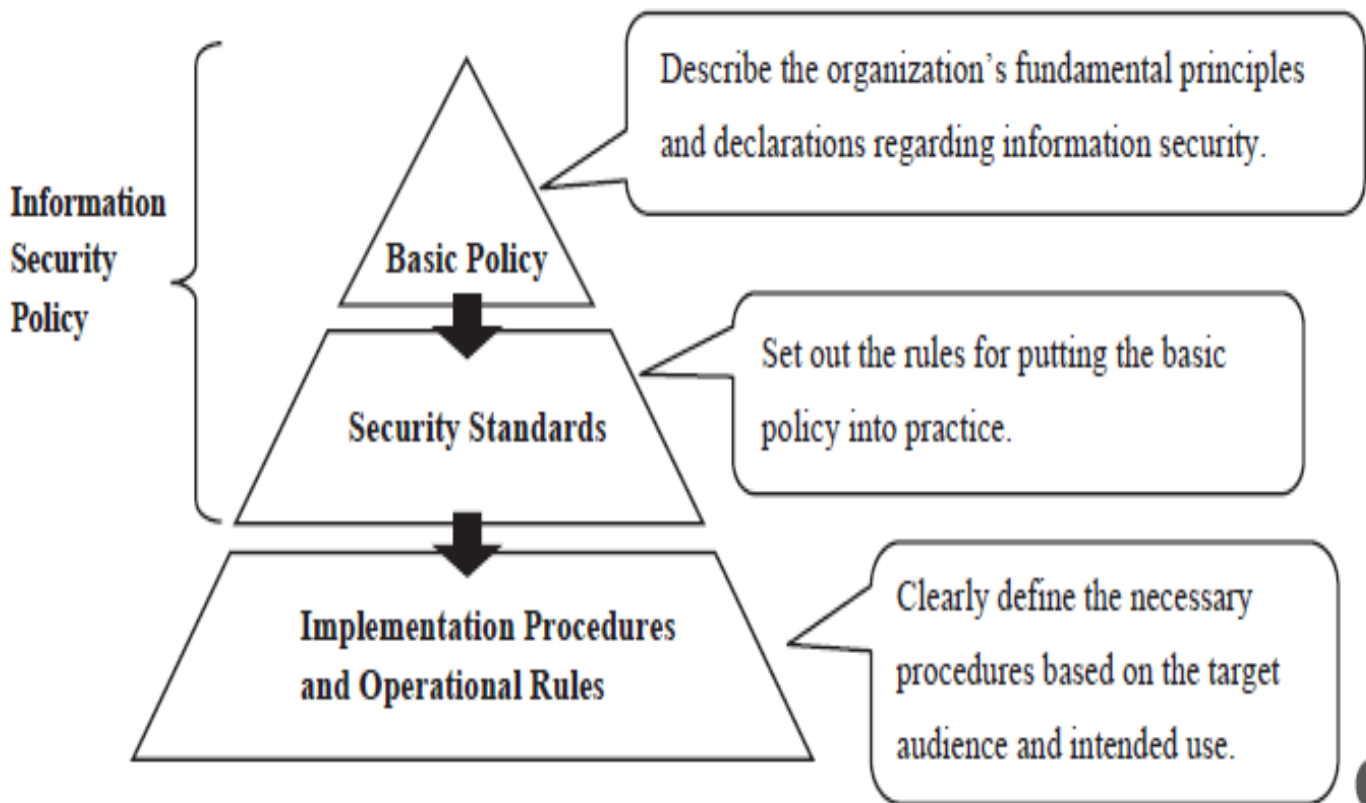
[2] (**Shoulder surfing**): The act of peeking over someone's shoulder to steal passwords or PIN codes.

[3] (**Dumpster diving**): The act of rummaging through trash to obtain discarded confidential information

(3) (**Skimming**): The act of illegally extracting data from someone's credit or debit card and using it to create a counterfeit card.

3- Information security policy

(Information Security Policy): A set of fundamental rules and guidelines established by a company or organization to maintain and protect information security.



Warm Up

Answer the following questions.

(1) Choose the one that correctly describes phishing from the options A to D below, and answer using the letter.

- A- A program that unknowingly steals personal information from inside a computer and sends it to a third party.
- B- Pretending to be an email from a financial institution to lure someone to a fake website and illegally obtain their PIN or credit card number.
- C- Clicking a URL once in a website or email triggers a false declaration of contract and a demand for a large payment.
- D- Being billed for a service you don't recognize and being defrauded of money.

(2) Choose all that correspond to social engineering from the options A to D below, and answer using the letters.

- A- Disabling access to data on a computer and demanding a ransom for its recovery.
- B- Creating a fake website posing as a bank to steal the PIN of a bank account.
- C- Eavesdropping on conversations with other users.
- D- Rummaging through trash to obtain discarded confidential information.

Explanation

(1) A is spyware, C is one-click fraud, and D is fraudulent billing. Answer: B

(2) A is ransomware, B is phishing. Answers: C, D

Try

Read the following passage and answer the questions that follow.

As more people use the internet, cases of fraud involving the misuse of computers and smartphones are also increasing. For example, there are scams where simply clicking a URL on a website is treated as agreeing to a service contract, and a large fee is demanded ([1]), or emails pretending to be from financial institutions lead users to fake websites in order to steal. PINs or credit card numbers ([2]). Various deceptive methods exist. In addition, (A) exploiting gaps in human psychology or carelessness can also lead to the unauthorized acquisition of information.

(1) Write the terms that best fit in blanks [1] and [2].

.....
.....

(2) What is the term used to describe the kind of activity mentioned in the underlined part A?

.....
.....

(3) Choose all that are related to the answer in (2) from the options A to D below, and answer using the letters.

- A- Individuals can communicate with each other over the internet.
- B- Data on a computer is made inaccessible, and a ransom is demanded for its recovery.
- C- Eavesdropping on conversations with other users.
- D- Peeking while someone is entering their user ID or password.

6-2 Binary and Amount of Information

Point!

1) Bits and Bytes

(1) ('**Bit**): The smallest unit of information, having only two possible states: "0" and "1". One bit is capable of representing two states; for example, "a switch is on or off," "voltage is high or low," "or the orientation of a magnet is north or south."

- Actual information is represented by the arrangement of bits. In general, n bits can represent (2) different pieces of information

Example

1 bit: 2 possibilities: 0 or 1

2 bits: 4 possibilities: 00, 01, 10, 11 ← $2^2 = 4$ possibilities

3 bits : 8 possibilities: 000, 001, 010, 011, 100, 101, 110, 111 ← $2^3 = 8$ possibilities

(2) (**Byte**): A unit consisting of 8 bits. The notation is ("B").

1B = ('**8 bits**), which can represent (**256**) possibilities. ← $2^8 = 256$ possibilities

(3) Unit of information: The basic unit is 1 B. The unit changes every 20 = (**1,024**) times.

[1] 1 (**KB**) = 1,024 B

[2] 1 (**MB**) = 1,024 KB

[3] 1 ("**GB**") = 1,024 MB

[4] 1 ("**TB**") = 1,024 GB

2) Decimal and Binary

- (1) (**Decimal**): A method of representing numbers using ten digits from "0" to "9". A number expressed in decimal notation is denoted as ("**decimal**").
- (2) (**Binary**): A method of representing numbers using two types of digits, "0" and "1". A number represented in binary is sometimes written with a subscript placed at the bottom right of the number, such as (**binary number**).
- (3) Conversion between Decimal and Binary

[1] Conversion from binary to decimal

[2] Starting from the rightmost digit, multiply each digit by 1, 2', 2o, 2o, sum the results.

<Example> Convert the binary number 1011 into decimal form

$$1011 = (1 \times 1 + 1 \times 2^1 + 0 \times 2^2 + 1 \times 2^3) = 11$$

(2) Conversion from decimal to binary

Take a decimal number and keep dividing it by 2 until the quotient becomes: 1, then arrange the resulting quotients and remainders in reverse order from the left.

<Example> Represent the number "6" in decimal as a number in binary.

$$2 \overline{)6}$$

$$\begin{array}{r} 2 \overline{)3} \dots 0 \\ 1 \dots 1 \end{array}$$

Therefore, $6 = (110_{(2)})$

Warm Up

Answer the following questions.

(1) [1] Complete the following sentences by filling in the blanks A to E with the appropriate terms and numbers.

The smallest unit of information is called a bit, which corresponds to (A) digit in binary notation. This makes it possible to represent (B) different types of information. Additionally, a group of (C) bits is called one (D), and is represented as 1 B. For example, 24 bits is (E) B.

[2] How many bits of information are required to represent all possible outcomes when throwing a set of dice (one large and one small)?

[3] How many B is 1 MB? Answer in the form of a power of 2.

[4] How many times greater is 4 bits of information compared to 2 bits of information?

(2) [1] Express the following binary numbers in decimal form.

(A) 11010₍₂₎ (B) 1010112₍₂₎

[2] Express the following decimal number in binary.

(A) 39 (B) 120

Explanation

(1) [1] A: A single digit in binary can represent two different values. 1 B: 2 C: 8

D: Byte E: Since 8 bits = 1 B, 24 bits ÷ 8=3 B

[2] When you roll two dice (one large and one small), there are 6 x 6 = 36 possible combinations of outcomes.

With 5 bits, you can represent $2^5 = 32$ combinations, and with 6 bits, you can represent $2^6 = 64$ combinations, so the needed information is 6 bits

With n bits, it is possible to represent 2^n different pieces of information.

[3] 1 MB = 1,024 KB, and 1 KB = 1,024 B,

therefore, 1 MB = 1,024 KB = 1,024 × 1,024 B = $2^{10} \times 2^{10}$ B = 2^{20} B

[4] The amount of information that can be represented with 2 bits is $2^2=4$ possibilities, and the amount of information that can be represented with 4 bits is $2^4=16$ possibilities. Therefore, $16 \div 4 = 4$ times

$$(2) [1] (A) 11010_{(2)} = 0 \times 1 + 1 \times 2^1 + 0 \times 2^2 + 1 \times 2^3 + 1 \times 2^4 \\ = 0 + 2 + 0 + 8 + 16 = \underline{26}$$

$$(B) 101011_{(2)} = 1 \times 1 + 1 \times 2^1 + 0 \times 2^2 + 1 \times 2^3 + 0 \times 2^4 + 1 \times 2^5 \\ = 1 + 2 + 0 + 8 + 0 + 32 = \underline{43}$$

[2] (A)

$$[2] (A) \quad \begin{array}{r} 2) \underline{39} \\ 2) \underline{19} \dots 1 \\ 2) \underline{9} \dots 1 \\ 2) \underline{4} \dots 1 \\ 2) \underline{2} \dots 0 \\ 1 \dots 0 \end{array}$$

Therefore, 100111₍₂₎ ← Add (2) to the bottom right

$$(B) \quad \begin{array}{r} 2) \underline{120} \\ 2) \underline{60} \dots 0 \\ 2) \underline{30} \dots 0 \\ 2) \underline{15} \dots 0 \\ 2) \underline{7} \dots 1 \\ 2) \underline{3} \dots 1 \\ 1 \dots 1 \end{array}$$

Therefore, 1111000₍₂₎

Try

Answer the following questions.

(1) Complete the following sentences by filling in the blanks [1] to [3] with the appropriate terms and numbers.

The numbers we use in our daily lives are expressed in ([1]), using digits from 0 to 9. There is also ([2]) using the digits 0 and 1, and the information handled by computers primarily utilizes ([2]). However, because this unit is too small and difficult to understand, one byte, which consists of ([3]) bits, is often used to represent information.

(2) How many bits are in 5 bytes?

.....

(3) How many different pieces of information can be represented by 1 byte?

.....

(4) How many times is the amount of information in bits compared to the amount of information in 3 bits?

.....

(5) How many MB are in 1 GB? Also, how many B is it? Answer in the form of a power of 2.

.....

(6) How many bits of information are needed to represent the four seasons of spring, summer, autumn, and winter?

.....

(7) How many bits of information are needed to represent a deck of 52 playing cards, excluding the jokers?

.....

(8) How many bits of information are needed to record all possible outcomes when tossing a coin three times?

.....

2) Answer the following questions.

(1) Express the following binary numbers in decimal form.

[1] $110_{(2)}$

[2] $10100_{(2)}$

[3] $111001_{(2)}$

(2) Express the following decimal number in binary.

[1] 65

[2] 106

[3] 143

3) How many 4.7 GB DVDs worth of data can be stored on a 1 TB hard disk?
Round your answer to the nearest whole number.

.....

Exercise

1 Cover the Point! section on pages 64,65 with a red sheet and test yourself by writing the items in order in your notebook.

2- Answer the following questions.

(1) Choose the number or equation that best fit into the blanks [1] to [6] from the options A to J.

The amount of information that can be represented by 1 bit is ([1]) possibilities. Additionally, since 1 byte consists of ([2]) bits, the amount of information that can be represented by 1 byte is [3]) possibilities. For example, 32 bits equal ([4]) bytes. Additionally, 1 KB is expressed as [5]) B. To calculate how many bits are in 24 KB, you need to calculate the expression ([6]).

- A) 1 B) $2 \times 1,024$ C) 4 D) 8
- E) 256 F) 1,024 G) $24 \times 1,024$ H) $1,024 \times 24$
- I) $24 \times 1,024 \times 8$ J) $24 \times 1,024 \div 8$

(2) Choose one option that represents the correct order of the amount of information from the options A to D below.

- A- $1KB < 1 MB < 1 GB < 1TB$
- B- $1KB < 1 MB < 1TB < 1GB$
- C- $1TB < 1KB < 1MB < 1GB$
- D- $1KB < 1TB < 1MB < 1GB$

(3) How many different combinations of designs can be created using one 100-yen coin, one 50-yen coin, and one 10-yen coin? Also, how many bits of information does this represent?

.....
.....

(4) How many bits of information are needed to represent 16 directions?

.....

(5) What is the minimum number of bits needed to represent the 47 prefectures?

.....

3) Answer the following questions.

(1) Express the following binary numbers in decimal form.

[1] $101_{(2)}$

[2] $10101_{(2)}$

[3] $101101_{(2)}$

(2) Express the following decimal number in binary.

[1] 13

[2] 128

[3] 138

4) How many photos, each with a size of 2 MB, can be stored on a 32 GB USB flash drive?

.....
.....

6-3 Hexadecimal

Point!

Hexadecimal

(1) (**Hexadecimal**): A method of representing numbers using the digits 0 to 9 and the alphabet letters A to F. A number represented in hexadecimal is sometimes written with a subscript (16) placed at the bottom right of the number. This is known as a (**hexadecimal number**).

(2) Correspondence Between Decimal, Binary, and Hexadecimal

Decimal	Binary	Hexadecimal
0	0000	0
1	0001	1
2	0010	2
3	0011	3
4	0100	4
5	0101	5
6	0110	6
7	0111	7
8	1000	8

Decimal	Binary	Hexadecimal
9	1001	9
10	1010	(A)
11	1011	(B)
12	1100	(C)
13	1101	(D)
14	1110	(E)
15	1111	(F)
16	10000	10

(3) Conversion between Decimal, Binary, and Hexadecimal

[1] Conversion from binary to hexadecimal

Separate the binary number into groups of 4 digits starting from the least significant bit, convert each group into a hexadecimal value, and arrange these values in sequence.

<Example> Convert the binary number $10011010_{(2)}$ to a hexadecimal number.

Separate into groups of 4 digits starting from the least significant bit:

$1001/1010_{(2)}$

$1001_{(2)}$ is $(9_{(16)})$, $1010_{(2)}$ is $(A_{(16)})$, so $10011010_{(2)} = (9A_{(16)})$

[2] Conversion from hexadecimal to binary

Convert each digit of the hexadecimal number into a 4-bit binary number, and arrange those numbers sequentially.

<Example> Express hexadecimal $A4_{(16)}$ in binary.

$(A_{(16)})$ is $(1010_{(2)})$, $(4_{(16)})$ is $(0100_{(2)})$, so $(A4_{(16)}) = (10100100_{(2)})$

[3] Conversion from hexadecimal to decimal

Convert the hexadecimal number to a binary number, and then convert that binary number to a decimal number.

<Example> Express the hexadecimal $C6_{(16)}$ in decimal format.

First, to convert the hexadecimal $C6_{(16)}$ to binary, $C_{(16)}$ is $(1100_{(2)})$.

$6_{(16)}$ is $(0110_{(2)})$, so $C6_{(16)} = (11000110_{(2)})$

Next, to convert the binary number 110001102 into a decimal number,

$$(11000110_{(2)}) = (0 \times 1 + 1 \times 2^1 + 1 \times 2^2 + 0 \times 2^3 + 0 \times 2^4 + 0 \times 2^5 + 1 \times 2^6 + 1 \times 2^7) \\ = 198$$

Warm Up

Answer the following questions

(1) Convert the following binary numbers to hexadecimal, and the hexadecimal numbers to binary.

$$[1] 11011011_{(2)} \quad [2] 11110110_{(2)} \quad [3] 9E_{(16)}$$

(2) Convert the following hexadecimal numbers to decimal

$$[1] A5_{(16)} \quad [2] 4C_{(16)}$$

Explanation

[1] Separate the binary number into groups of four digits starting from the least significant bit, then convert each group into a hexadecimal number and list them sequentially.

$$1101_{(2)} \text{ is } D_{(16)}, 1011_{(2)} \text{ is } B_{(16)}, \text{ so } 11011011_{(2)} = \underline{DB}_{(16)}$$

$$[2] 1111_{(2)} \text{ is } F_{(16)}, 0110_{(2)} \text{ is } 6_{(16)}, \text{ so } 11110110_{(2)} = \underline{F6}_{(16)}$$

[3] Convert each digit into a 4-bit binary number and list them sequentially.

$$9_{(16)} \text{ is } 1001_{(2)}, E_{(16)} \text{ is } 1110_{(2)}, \text{ so } 9E_{(16)} = 10011110_{(2)}$$

(2) Convert from hexadecimal to binary, and then to decimal

$$[1] A_{(16)} \text{ is } 1010_{(2)}, 5_{(16)} \text{ is } 0101_{(2)} \text{ So } A5_{(16)} = 10100101_{(2)}$$

$$\text{Therefore, } 10100101_{(2)} = 1 \times 1 + 0 \times 2^1 + 1 \times 2^2 + 0 \times 2^3 + 0 \times 2^4 + 1 \times 2^5 + 0 \times 2^6 + 1 \times 2^7 = \underline{165}$$

$$[2] 4_{(16)} \text{ is } 0100_{(2)}, C_{(16)} \text{ is } 1100_{(2)} \text{ So } 4C_{(16)} = 01001100_{(2)}$$

$$\text{Therefore, } 01001100_{(2)} = 0 \times 1 + 0 \times 2^1 + 1 \times 2^2 + 1 \times 2^3 + 0 \times 2^4 + 0 \times 2^5 + 1 \times 2^6 + 0 \times 2^7 = \underline{76}$$

Try

Answer the following questions.

(1) Convert the following binary numbers to hexadecimal, and the hexadecimal numbers to binary.

[1] 11010101₍₂₎ [2] 011101102₍₂₎ [3] C5₍₁₆₎ [4] BB₍₁₆₎

(2) Convert the following hexadecimal numbers to decimal.

[1] 31₍₁₆₎ [2] C7₍₁₆₎ [3] 9F₍₁₆₎ [4] AB₍₁₆₎

Exercise

1- Cover the Point! section on page 58 with a red sheet and test yourself by writing the items in order in your notebook.

2- Answer the following questions.

(1) Convert the following binary numbers to hexadecimal, and the hexadecimal numbers to binary.

[1] 01010011₍₂₎ [2] 01101100₍₂₎ [3] 10100111₍₂₎ [3] 10100111₍₂₎
[5] 2B₍₁₆₎ [6] F1₍₁₆₎ [7] EE₍₁₆₎ [8] DB₍₁₆₎

(2) Convert the following hexadecimal numbers to decimal.

[1] 17₍₁₆₎ [2] C2₍₁₆₎ [3] 3D₍₁₆₎ [4] AF₍₁₆₎

6-4 Digital Representation of Characters

Point!

Digital Representation of Characters

- (1) (**Character code**): A unique numerical value assigned to each character, symbol, etc.
- (2) (**Character code system**): Summarizes the correspondence between characters and their respective character codes.

[1] (**ASCII code**): Only alphanumeric characters, symbols, and control characters (symbols used to control the computer). No Japanese characters (kanji, hiragana, or katakana).

		Most Significant 4 Bits									
		Binary	0000	0001	0010	0011	0100	0101	0110	0111	
Least Significant 4 Bits	Binary	Hexadecimal	0	1	2	3	4	5	6	7	
		0000	0	Symbols for Controlling Computers (Omission)		SP	0	@	P	'	p
		0001	1		!	1	A	Q	a	q	
		0010	2		"	2	B	R	b	r	
		0011	3		#	3	C	S	c	s	
		0100	4		\$	4	D	T	d	t	
		0101	5		%	5	E	U	e	u	
		0110	6		&	6	F	V	f	v	
		0111	7		'	7	G	W	g	w	
		1000	8		(	8	H	X	h	x
		1001	9		)	9	I	Y	i	y
		1010	A		*	:	J	Z	j	z	
		1011	B		+	;	K	[	k	{
		1100	C		,	<	L	¥	l	|	
		1101	D		-	=	M	]	m	}
		1110	E		.	>	N	^	n	~	
	1111	F	/		?	O	_	o	DEL		

<Example> Convert the string "Hello" into a binary character code and a hexadecimal character code.

String	H	e	l	l	o
Character code (binary)	01001000	01100101	01101100	01101100	01101111
Character Code (hexadecimal)	48	65	6C	6C	6F

[2] (**Shift JIS code**): An extension of the ASCII code that includes Japanese characters such as karji, hiragana, and katakana. Alphanumeric characters and symbols are represented by (1) byte, while Japanese kanji and hiragana are represented by (2) bytes.

1 byte = 8 bits, so $2^8 = 256$ possibilities of representing information (characters)

[3] (**Unicode**): A character code standard that consolidates characters from around the world into a single character code. Due to differences in code assignments, there are variations such as UTF-8 and UTF-16.

(3) (**Encoding**): Representing a string with character codes. The opposite is known as (**decoding**).

(4) (**Character corruption**): A phenomenon that occurs due to mismatched encoding and decoding methods.

(5) ("**Font**): The shape data of characters corresponding to character codes.

<Examples Sans-serif, Serif, Semi-cursive, etc. >

- To display characters on a computer screen or printer output, two elements are required: ("**character code**) and (**font**).

Warm Up

Answer the following questions.

(1) Choose the numbers or terms that best fit into the blanks [1] to [5] from the options A to H below.

Characters and symbols can also be represented by combinations of 0s and 1s. A system that maps characters and symbols to binary or hexadecimal is called a ([1]). There are several types within the ([1]), including ([2]), which accommodates the writing systems of countries around the world. Alphanumeric characters and symbols are represented by [3]) byte, while characters like karji and hiragana, which have a wide variety, are represented by ([4]) bytes. If no special techniques are used, 1 byte can represent ([5]) types of characters.

- A) 1 B) 2 C) 128 D) 256
 E) Character code F) Character corruption G) Unicode H) ASCII code

(2) Use the character code table on the right to answer the following questions.

[1] Use binary to represent the character code for "M".

[2] Use hexadecimal to represent the character code for "MILK".

[3] What is the character string corresponding to the character code "4C6F7665)?

		Most Significant 4 Bits								
		Binary	0000	0001	0010	0011	0100	0101	0110	0111
Least Significant 4 Bits	Binary	Hexadecimal	0	1	2	3	4	5	6	7
	0000	0	Symbols for Controlling Computers (Omission)		SP	0	@	P	'	p
	0001	1			!	1	A	Q	a	q
	0010	2			"	2	B	R	b	r
	0011	3			#	3	C	S	c	s
	0100	4			\$	4	D	T	d	t
	0101	5			%	5	E	U	e	u
	0110	6			&	6	F	V	f	v
	0111	7			'	7	G	W	g	w
	1000	8			(	8	H	X	h	x
	1001	9			)	9	I	Y	i	y
	1010	A			*	:	J	Z	j	z
	1011	B			+	;	K	[	k	{
	1100	C			,	<	L	¥	l	|
	1101	D			-	=	M	]	m	}
	1110	E			.	>	N	^	n	~
1111	F	/			?	O	_	o	DEL	

(3) Calculate the following data size.

[1] The data size when "Good Morning" is entered in half-width using Shift JIS code.

.....

[2] The data size when is entered in full-width using Shift JIS code.

.....

Explanation

(1) [1] E [2] G [3] A [4] B [5] D

(2) [1] From the character code table, the most significant 4 bits of "M" are 0100 and the least significant 4 bits are 1101; therefore, 01001101 ⁽²⁾

[2] According to the character code table, the character codes corresponding to "M, I, L, K" are 4D, 49, 4C, and 4B, respectively, in the order of most significant to least significant. Connecting these character codes results in 4D494C4B ₍₁₆₎

[3] Consider the character code as separated into "4C/6F/76/65".

"4C" corresponds to the character "L" because it is located at the intersection of the most significant 4 and the least significant C.

Similarly, "6F" corresponds to "o", "76" to "v", and "65" is "e", so the resulting character string is Love

(3) [1] The character count is 11. A single English character is 1 byte, so 11 bytes

[2] The character count is 9. Since a single hiragana character is 2 bytes, the total is 18 bytes

Try

1- Answer the following questions.

(1) Complete the following sentences by filling in the blanks [1] to [4] with the appropriate terms and numbers.

The rule for how characters and symbols is represented in binary or hexadecimal is called a ([1]). Alphanumeric characters and symbols are represented by ([2]) byte, while kanji and hiragana are represented by ([3]) bytes due to the large number of characters. In principle, 1 byte can represent ([4]) types of characters, and 2 bytes can represent 65,536 types of characters.

(2) Briefly explain the characteristics of the character code system Unicode.

(3) Use the character code table below to answer the following questions.

		Most Significant 4 Bits									
		Binary	0000	0001	0010	0011	0100	0101	0110	0111	
Least Significant 4 Bits	Binary	Hexadecimal	0	1	2	3	4	5	6	7	
		0000	0	Symbols for Controlling Computers (Omission)		SP	0	@	P	`	p
		0001	1		!	1	A	Q	a	q	
		0010	2		"	2	B	R	b	r	
		0011	3		#	3	C	S	c	s	
		0100	4		\$	4	D	T	d	t	
		0101	5		%	5	E	U	e	u	
		0110	6		&	6	F	V	f	v	
		0111	7		'	7	G	W	g	w	
		1000	8		(	8	H	X	h	x
		1001	9		)	9	I	Y	i	y
		1010	A		*	:	J	Z	j	z	
		1011	B		+	;	K	[	k	{
		1100	C		,	<	L	¥	l	|	
		1101	D		-	=	M	]	m	}
		1110	E		.	>	N	^	n	~	
	1111	F	/		?	O	_	o	DEL		

[1] What is the character code for "a" in binary?

.....

[2] What is the symbol corresponding to the character code "00111110₍₂₎"?

.....

[3] What is the symbol corresponding to the character code "5C₍₁₆₎"?

.....

[4] What is the character string corresponding to the character code "486172696E657A756D69₍₁₆₎"?

.....

(4) Calculate the following data size.

[1] The data size when "Welcome" is entered in half-width using Shift JIS code.

[2] The data size when is (Programming) entered in full-width using Shift JIS code.

(5) Choose the shape data of characters corresponding to character codes from the options A to D below.

- A) JIS B) Font C) Environment-dependent characters D) Emoji

Exercise

1- Cover the Point section on page 60 with a red sheet and test yourself by writing the items in order in your notebook.

2- Answer the following questions.

(1) Answer the following questions.

[1] What is the term for a unique numerical value assigned to each character, symbol, etc.?
.....

[2] How many types of characters can be represented with 1 byte?
.....

[3] What is the term for representing a string with character codes?
.....

[4] What is the term for a design that corresponds to a character code and shares the same characteristics?
.....

(2) Briefly explain the characteristics of the character code system ASCII
.....

(3) Use the character code table below to answer the following questions.

		Most Significant 4 Bits									
		Binary	0000	0001	0010	0011	0100	0101	0110	0111	
Least Significant 4 Bits	Binary	Hexadecimal	0	1	2	3	4	5	6	7	
		0000	0	Symbols for Controlling Computers (Omission)		SP	0	@	P	`	p
		0001	1			!	1	A	Q	a	q
		0010	2			"	2	B	R	b	r
		0011	3			#	3	C	S	c	s
		0100	4			\$	4	D	T	d	t
		0101	5			%	5	E	U	e	u
		0110	6			&	6	F	V	f	v
		0111	7			'	7	G	W	g	w
		1000	8			(	8	H	X	h	x
		1001	9			)	9	I	Y	i	y
		1010	A			*	:	J	Z	j	z
		1011	B			+	;	K	[	k	{
		1100	C			,	<	L	¥	l	|
		1101	D			-	=	M	]	m	}
		1110	E			.	>	N	^	n	~
	1111	F	/			?	O	_	o	DEL	

[1] What is the character code for "Y" in binary?

.....

[2] What is the character corresponding to the character code "01101111₍₂₎"?

.....

[3] What is the character corresponding to the character code "72₍₁₆₎"?

.....

[4] What is the character string corresponding to the character code "5468616E6B596F7521₍₁₆₎"?

.....

(4) Calculate the following data size.

[1] The data size when "Happy Birthday" is entered in half-width using Shift JIS code.

.....

[2] The data size when "90" is entered in full-width using Shift JIS code.

.....

6-5 Numerical Calculations [1]

Point!

Addition and Subtraction of Binary Numbers

Addition and subtraction in binary numbers are performed digit by digit, just like in decimal numbers. (1) Binary addition: In binary addition, the place value carries over by one position when the sum reaches 2.

$$\begin{array}{r}
 1 1_{(2)} \\
 + 1 0 1_{(2)} \\
 \hline
 {}^5 1 1 1 0_{(2)}
 \end{array}$$

1 Carry

When two 1s are added together, a carry of 1 is generated to the next higher digit.

(2) Binary subtraction : In binary subtraction, when the minuend is insufficient, a value of 2 is borrowed from the next higher digit.

$$0_{(2)} - 0_{(2)} = ({}^0 0_{(2)}), 1_{(2)} - 0_{(2)} = ({}^1 1_{(2)}), 1_{(2)} - 1_{(2)} = ({}^0 0_{(2)}), 10_{(2)} - 1_{(2)} = ({}^0 1_{(2)})$$

<Example> Subtraction of binary numbers $1010_{(2)} - 0110_{(2)}$

$$\begin{array}{r}
 \cancel{1} 0 1 _{(2)} \\
 - 0 1 1 _{(2)} \\
 \hline
 {}^{10} 0 1 0 _{(2)}
 \end{array}$$

Borrow

When 1 is borrowed from the higher digit, it becomes two 1s in the lower digit.

Warm Up

Perform the following binary calculations.

(1) $0101_{(2)} + 1010_{(2)}$

(2) $1011_{(2)} + 0011_{(2)}$

(3) $1011_{(2)} - 0101_{(2)}$

(4) $1101_{(2)} - 1010_{(2)}$

Explanation

(1)

$$\begin{array}{r} 0101_{(2)} \\ + 1010_{(2)} \\ \hline 1111_{(2)} \end{array}$$

Therefore, $\underline{1111}_{(2)}$

(2)

$$\begin{array}{r} 1011_{(2)} \\ + 0011_{(2)} \\ \hline 1110_{(2)} \end{array}$$

Therefore, $\underline{1110}_{(2)}$

Carry

(3)

$$\begin{array}{r} 1011_{(2)} \\ - 0101_{(2)} \\ \hline 0110_{(2)} \end{array}$$

Therefore, $\underline{0110}_{(2)}$

Borrow

(4)

$$\begin{array}{r} 1101_{(2)} \\ - 1010_{(2)} \\ \hline 0011_{(2)} \end{array}$$

Therefore, $\underline{0011}_{(2)}$

Borrow

Try

Perform the following binary calculations.

(1) $0101_{(2)} + 0110_{(2)}$

.....

(2) $1101_{(2)} + 0010_{(2)}$

.....

(3) $1101_{(2)} - 0010_{(2)}$

.....

(4) $10100101_{(2)}$

.....

Exercise

1 Cover the Point section on page 64 with a red sheet and test yourself by writing the items in order in your notebook.

.....

2) Perform the following binary calculations.

(1) $0011_{(2)} + 1100_{(2)}$

.....

(2) $1001_{(2)} + 0101_{(2)}$

.....

(3) $0111_{(2)} + 0001_{(2)}$

.....

(4) $1010_{(2)} + 0101_{(2)}$

.....

(5) $1101_{(2)} - 1100_{(2)}$

.....

(6) $1011_{(2)} - 0110_{(2)}$

.....

(7) $1001_{(2)} - 0110_{(2)}$

.....

(8) $1010_{(2)} - 1010_{(2)}$

.....

6-6 Numerical Calculations [2]

Point!

1) Representation of Negative Numbers Using Complements

(**Complement**): The smallest number which, when added to a given natural number, produces a carry to the next higher digit. Complements are used for representing negative numbers in computers.

[1] (**10's complement**): In decimal, the smallest number which, when added, produces a carry to the next higher digit.

<Examples> The 10's complement of 71 is (**29**), and the 10's complement of 635 is (**365**).

[2] (**2's complement**): In binary, the smallest number which, when added, produces a carry to the next higher digit

<How to calculate the 2's complement>

For each digit of the original binary number, invert 0s to 1s and 1s to 0s, then add 1 at the end to mechanically obtain the result.

<Example> The 2's complement of 0101(2)

By inverting each digit from 0 to 1 and from 1 to 0, it becomes (**1010** (2)).

Finally, by adding 1, it becomes (**1011** (2)).

2) Subtraction Using Complements

A computer uses subtraction by performing addition with complements.

<Subtraction process>

- 1) Find the (**complement**) of the subtrahend.
- 2) Use the complement to perform (**addition**).
- 3) Ignore the leading digits of the calculation result and provide the answer.

<Example 1>

Subtraction of "8 - 6" in decimal

- 1) The 10's complement of the decimal number 6 is (¹⁰4)
- 2) $8 - 6 \Rightarrow 8$ (¹¹+ 4)
= (¹²12)
- 3) Ignoring the leading digit, (¹³2) ☹️

<Example 2>

Subtraction of "1000₍₂₎ - 0111₍₂₎" in binary

- 1) The 2's complement of the binary number 0111₍₂₎ is (¹⁴1001₍₂₎)
- 2) $1000_{(2)} - 0111_{(2)} \Rightarrow 1000_{(2)}$ (¹⁵+ 1001₍₂₎)
= (¹⁶10001₍₂₎)
- 3) Ignoring the leading digit, (¹⁷0001₍₂₎) ☹️

Warm Up

Answer the following questions.

(1) What is the complement of the following binary number?

[1] $1001_{(2)}$ [2] $0100_{(2)}$

(2) Use complements to perform the following binary subtractions.

[1] $1100_{(2)} - 0111_{(2)}$ [2] $1110_{(2)} - 1001_{(2)}$

Explanation

(1) [1] By inverting each digit from 0 to 1 and from 1 to 0, it becomes $0110_{(2)}$.

Finally, by adding 1, it becomes $0111_{(2)}$.

[2] By inverting each digit from 0 to 1 and from 1 to 0, it becomes $1011_{(2)}$.

Finally, by adding 1, it becomes $1100_{(2)}$. Adding 1 causes a place value to carry over.

(2) [1] The complement of the binary number $0111_{(2)}$ is $1001_{(2)}$, so

$$1100_{(2)} - 0111_{(2)} \Rightarrow 1100_{(2)} + 1001_{(2)} = 10101_{(2)}$$

By ignoring the leading digit, $0101_{(2)}$

[2] The complement of the binary number $1001_{(2)}$ is $0111_{(2)}$, therefore,

$$1110_{(2)} - 1001_{(2)} \Rightarrow 1110_{(2)} + 0111_{(2)} = 10101_{(2)}$$

By ignoring the leading digit, $0101_{(2)}$

Try

Answer the following questions.

(1) What is the complement of the following binary number?

[1] 0101₍₂₎ [2] 1101₍₂₎ [3] 10110001₍₂₎ [4] 01001100₍₂₎

(2) Use complements to perform the following binary subtractions.

[1] 1101₍₂₎ – 0110₍₂₎ [2] 1010₍₂₎ – 01112₍₂₎ [3] 1101₍₂₎ – 1010₍₂₎

Exercise

1) Cover the Point! section on page 66 with a red sheet and test yourself by writing the items in order in your notebook.

2) Answer the following questions.

(1) What is the complement of the following binary number?

[1] 0111₍₂₎ [2] 1011₍₂₎ [3] 10011011₍₂₎ [4] 11000110₍₂₎

(2) Use complements to perform the following binary subtractions.

[1] 1010₍₂₎ – 0110₍₂₎ [2] 1011₍₂₎ - 1001₍₂₎ [3] 1100₍₂₎ – 0010₍₂₎

6-7 Digitalization of Sound

Point!

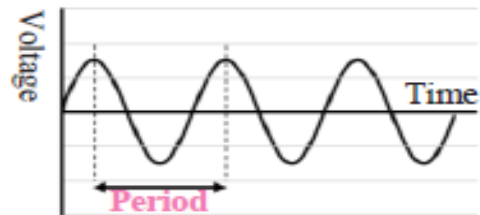
Sound

(1) Sound: A phenomenon transmitted through the vibration of air. Waveform (analog) data.

- For audio data on CDs, etc., sound is converted into (digital) data.

(2) (Frequency): The number of waves contained in one second the unit is ("hertz") [Symbol: (Hz)].

(3) ("Period"): The time it takes for one wave to propagate. The unit is (seconds).



2) Digitalization of Sound

(1) (Pulse Code Modulation (PCM) method): A method for digitizing audio analog data.

Convert sound information into binary code.

<Steps for digitizing sound using the PCM method>

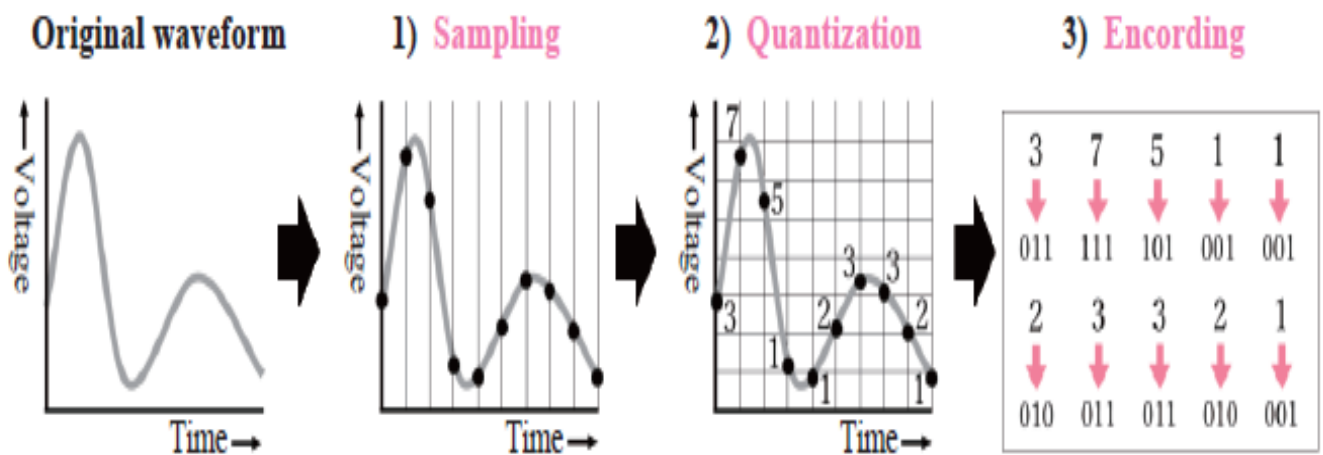
1) (Sampling): The horizontal axis (time) is divided at regular intervals, and the wave height (voltage strength) is extracted. The extracted points are referred to as (sample points).

- (Sampling period): The time interval used to divide when sampling.
- (Sampling frequency): The number of samples taken per second.

2) (Quantization): The vertical axis (voltage) is divided at regular intervals, and the wave heights obtained from sampling are converted to the nearest values on the vertical scale.

- (Quantization bit depth): This determines the number of levels into which the range is divided during quantization.

3) (Encoding): Express the quantized values in binary form.



(2) Digitization and Data Volume

As the sampling frequency and the quantization bit depth (**increase**), the sound becomes closer to the original analog waveform. This causes the sound quality to (**improve**); however, the amount of data also ("**increases**").

(3) (**Sampling theorem**): If the sampling frequency exceeds (**twice**) the highest frequency contained in the original analog waveform, the waveform of the original analog signal can be accurately reconstructed from the digitized data.

3- Amount of Sound Data

(1) Channels: The number of signals used when transmitting sound. A method of playback using a single signal is called (**monaural**), and a method of playback using two different signals is called (**stereo**).

(2) How to Calculate the Amount of Audio Data

Data amount [bits] per second = (**Sampling frequency x Quantization bit depth x Number of channels**)

Warm Up

Answer the following questions.

(1) Choose the one appropriate procedure for digitizing an analog sound signal from the options. A to D.

- A) Sampling → Quantization → Encoding B) Encoding → Quantization → Sampling
C) Quantization → Sampling → Encoding D) Quantization → Encoding → Sampling

(2) Calculate the data amount for 1 second in kilobytes (KB) when digitizing music at a sampling frequency of 44,100 Hz, a quantization bit depth of 16 bits, and in 2-Channel stereo. However, assume that 1 KB = 1,000 B, and round off to the nearest whole number.

(3) Calculate the data amount for 1 minute in megabytes (MB) when digitizing music at a sampling frequency of 44.1 kHz, a quantization bit depth of 24 bits, and in 2-channel stereo. However, assume that 1 KB = 1,000 B, and 1 MB = 1,000 KB, and round off to the nearest whole number

Explanation

(1) A

(2) Data amount [bits] per second = Sampling frequency x Quantization bit depth x Number of channels
Therefore, the amount of data per second is $44,100 \text{ [Hz]} \times 16 \text{ [bits]} \times 2 \text{ [channels]} = 1,411,200 \text{ [bits]}$
Since 1 B = 8 bits, $1,411,200 \text{ [bits]} \div 8 = 176,400 \text{ [B]}$

1 KB = 1,000 B, so $176,400 \text{ [B]} \div 1,000 = 176.4 \approx 176 \text{ [KB]}$ 176 KB

(3) $44.1 \text{ kHz} = 44.1 \times 1,000 = 44,100 \text{ Hz}$, and since 2 minutes = 120 seconds, the data amount per minute is $44,100 \text{ [Hz]} \times 24 \text{ [bits]} \times 2 \text{ [channels]} \times 60 \text{ [seconds]} = 127,008,000 \text{ [bits]}$

Since 1 B = 8 bits, $127,008,000 \text{ [bits]} \div 8 = 15,876,000 \text{ [B]}$.

1 KB = 1,000 B, 1 GB = 1,000 MB, therefore, $15,876,000 \text{ [B]} = 15,876 \text{ [KB]} \approx 16 \text{ [MB]}$ 16 MB

Try

1- Answer the following questions.

(1) Choose the term that best fits into the blanks [1] to [10] in the following sentences from the options A to M below, and answer using the letters.

Sound is a phenomenon that is transmitted through the vibrations of air. The number of waves contained in one second is called ([1]) and is expressed in units of ([2]). The time it takes for one wave to propagate is called the ([3]), and it is expressed in seconds. These vibrations are [4]) data. In contrast, sound information stored on DVDs, CDs, etc. is ([5]) data. Next, follow these steps to convert the data from ([4]) to ([5]).

First, the process of dividing sound waves at regular time intervals and extracting the amplitude values (voltage) for each interval is called ([6]). Next, divide the vertical axis (voltage) at regular intervals and determine the step values. This is called ([7]), and the component that determines the quantization levels is called ([8]). Typically, with n bits, there are 2^n levels. Finally, ([9]) refers to the representation of values obtained through ([7]) in binary form. The method of converting information such as sound into binary codes by replacing numerical values in binary with two different voltage levels (high and low) is called the ([10]) method.

- A) Encoding B) Sampling C) Quantization D) Frequency E) Period
F) Analog G) Digital H) Sampling period I) Quantization bit depth
J) PCM K) MIDI L) Hertz M) Second

(2) Choose the one that enables waveform restoration closest to the original analog signal when digitizing an analog audio signal from the options A to D.

- A- Increase the sampling frequency and increase the quantization bit depth.
B- Increase the sampling frequency and decrease the quantization bit depth.
C- Decrease the sampling frequency and increase the quantization bit depth.
D- Decrease the sampling frequency and decrease the quantization bit depth.

2) Answer the following questions. In these questions, assume that 1 KB = 1,000 B, and 1 MB = 1,000 KB.

- (1) What is the data amount for 1 second in kilobytes (KB) when digitizing music at a sampling frequency of 44,100 Hz, a quantization bit depth of 16 bits, and in 1- Channel monaural? Round off to the nearest whole number in your answer.
- (2) What is the data amount for 1 minute in KB when digitizing music at a sampling frequency of 192 kHz, a quantization bit depth of 24 bits, and in 2-channel stereo?
- (3) What is the data amount for 3 minutes in MB when digitizing music at a sampling frequency of 44.1 kHz, a quantization bit depth of 16 bits, and in 2-channel stereo? If the length of one song is 3 minutes, approximately how many songs can be stored on a 650 MB CD? Round off to the nearest whole number in your answer.

Exercise

1) Cover the Point! section on pages 68 and 69 with a red sheet and test yourself by writing the items in order in your notebook.

2) Answer the following questions.

(1) Choose the term that best fits into the blanks [1] to [6] in the following sentences from the options A to I below, and answer using the letters.

Sound is analog data in waveforms that are transmitted through the vibration of air. The process of capturing sound waveforms on a computer begins with segmenting the waveforms at regular time intervals. This process is called ([1]). The number of partitions per second is called the ([1]) frequency. Next, convert and approximate the segmented wave heights into a continuous bar graph. This process is called [2]). At this time, the value indicating how many levels the numbers are expressed in is called ([3]). Finally, perform ([4]), which uses Os and Is to express the value in binary after ([2]). This method of converting sound into digital data is called ([5]).

In the case of digitizing sound, digital data converted from analog data will approximate the original waveform more closely if the ([1]) frequency is higher. Furthermore, the greater the ([3]), the more accurately the waveform can be represented numerically. However, as a result, the amount of data becomes ([6]).

- | | | | | |
|-------------------|-----------------------------|----------------|---------------|-----------|
| A Encoding | B Sampling | C Quantization | D Larger | E Smaller |
| F Sampling period | G Quantization
bit depth | H PCM method | I MIDI format | |

(2) The following statements A to D are about the sampling frequency and the number of quantization levels. Mark "o" if the statement is correct, and "x" if it is incorrect.

A- Sampling frequency refers to the number of times sampling occurs in one second

B- The greater the number of levels during quantization, the larger the amount of data becomes.

C- If you want to approximate the original analog waveform more closely, it is effective to increase the sampling frequency and reduce the number of levels during quantization.

D- If the maximum frequency of the original analog waveform is 40 Hz, you should digitize it with a sampling frequency greater than 80 Hz.

3) Answer the following questions. In these questions, assume that 1 KB = 1,000 B, and 1 MB = 1,000 KB. (1) What is the data amount for 10 seconds in kilobytes (KB) when digitizing music at a sampling frequency of 44,100 Hz, a quantization bit depth of 16 bits, and in 1-channel monaural?

.....

(2) What is the data amount for 1 minute in MB when digitizing music at a sampling frequency of 96 kHz, a quantization bit depth of 24 bits, and in 2-channel stereo? Round off to the nearest whole number in your answer.

.....

(3) What is the data amount for 1 minute in MB when digitizing music at a sampling frequency of 44.1 kHz, a quantization bit depth of 16 bits, and in 2-channel stereo? What is the maximum length of audio, in minutes, that can be recorded on a 512 MB flash memory? Round off to the nearest whole number in your answer.

.....

6-8 Digitization of Images

Point!

1- Digitization of Images

(1) (**Pixel**): The smallest unit that composes an image.

A digital image is represented by an arrangement of pixels.

(2) Procedure for Digitization of Images

Images captured by digital cameras or image scanners are digitized and imported into a computer through the following process.

1) (**Sampling**): The image is divided into pixels, and the representative brightness is extracted.

• (**Resolution**): The degree of fineness of pixels when sampling.

The unit of resolution is ("**dpi**").

It is sometimes expressed as vertical pixels x horizontal pixels.

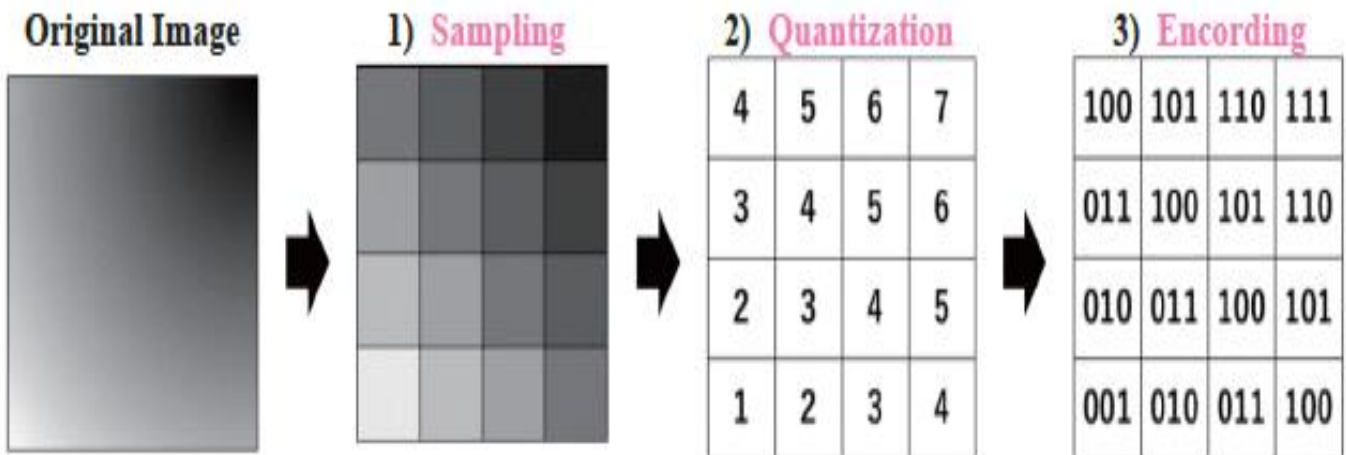
2) (**Quantization**): Converts the brightness of each pixel into numerical values divided into several levels.

• (**Gradation**): The level value that represents the intensity of color per pixel.

The gradation is determined by the number of bits allocated to each pixel.

<**Example**> At 256 gradients (8 bits), it represents 256 levels from 0 to 255.

3) (**Encoding**): Expressing quantized values in binary numbers (0 and 1).



(3) Digitization and Data Volume

[1] Data amount of an image [bits]

=(Number of pixels [vertical pixels \times horizontal pixels] \times Number of bits for color information)

[2] The (higher) the values of resolution and gradation, the smoother the image obtained and the image quality (improves), but the amount of data ("increases").

(4) Raster Format and Vector Format

[1] (Raster format): An arrangement of pixels used to represent text or shapes. It appears jagged when enlarged (this appearance is called ("jaggies")). Images are drawn using (painting software).

[2] (Vector format): A representation that includes information about coordinates of points composing the image, as well as the angles and thickness of the lines connecting them. Images are drawn using (drawing software).

2- Color Representation

- (1) (Three primary colors of light): The three colors of red, green, and blue. When these colors of light are mixed, the brightness increases and approaches ("white).
- (2) (Three primary colors of pigment): The three colors of cyan, magenta, and yellow. Mixing these colors will darken them and bring them closer to (black).
- (3) (Additive color mixing): A method of representing colors by combining the three primary colors of light. Used in televisions and computer displays.
- (4) (Subtractive color mixing): A method of representing colors by combining the three primary colors of pigment. Used in color printers.
- (5) (24-bit full color): Each color of red, green, and blue is represented in 256 levels
($2^8 = 256$ bits) \times 3=24 bits.

Warm Up

Answer the following questions.

(1) Rearrange the following steps A to C in the order of converting an image into digital data.

- A- Replace the brightness levels of each region with integer values according to a fixed rule.
- B- Divide the image into evenly spaced grid sections.
- C- Represent integers in binary.

(2) Choose all statements that correctly describe the digital representation of images from the options A to D, and answer using the letters.

- A- The raster format appears as having noticeably jagged edges when the image is enlarged.
- B- The raster format is suitable for expressing images with clear contours, such as logos.
- C- Vector format represents images by incorporating information such as the coordinates of points and the thickness of lines.
- D- Painting software is used to create vector graphics.

(3) What is the data amount of a 24-bit full-color image with a resolution of 1,280 x 720 pixels in megabytes? For this question, assume that 1 KB = 1,000 B and 1 MB = 1,000 KB, and round your answer to two decimal places.

Explanation

(1) B → A → C

(2) A, C

(3) The amount of data in the image is.

$$1,280 \times 720 \times 24 \text{ [bits]} = 22,118,400 \text{ [bits]}$$

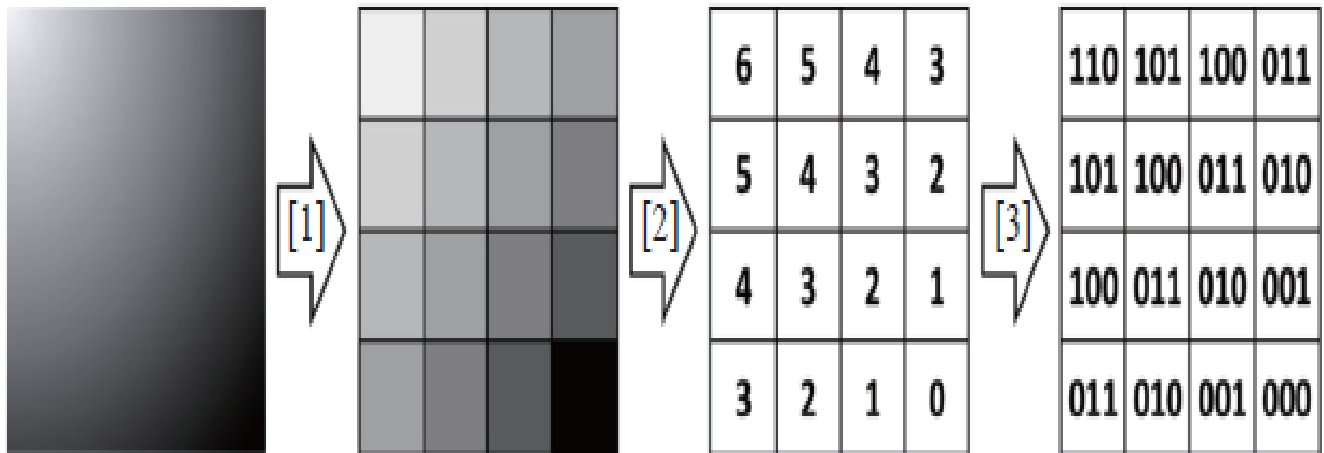
Since 1 B equals 8 bits, $22,118,400 \div 8 = 2,764,800 \text{ [B]}$.

1 KB = 1,000 B, 1 MB = 1,000 KB, therefore,

$$2,764,800 \text{ [B]} = 1,000 \times 1,000 \times 2.7648 \text{ [MB]} \approx 2.76 \text{ [MB]} \quad \underline{2.76 \text{ MB}}$$

Try

1- The following diagram illustrates the process of converting a monochrome image into digital data. Choose the appropriate operations for steps [1] to [3] from [Group A], and then choose the name of each operation from [Group B]. Answer using the numbers.



[Group A] A- Replace the brightness levels of each region with integer values according to a fixed rule.

B- Divide the image into evenly spaced grid sections.

C- Represent integers in binary.

[Group B] A- Quantization

B- Encoding

C- Sampling

2- Answer the following questions.

(1) Complete the following sentences by filling in the blanks [1] and [2] with the appropriate term and number.

To represent colors, a computer display uses a combination of dots in red, green, and blue. These are known as the ([1]). The intensity of each of the primary colors is expressed in gradations. When representing one color with 8 bits, there are ([2]) gradients.

2- Complete the following sentences by filling in the blanks [1] and [2] with the appropriate terms.

Images processed by computers can be divided into two formats: the ([1]) format, which treats the image as a collection of tiny dots, and the ([2]) format, which uses a combination of mathematical expressions to represent the coordinates of points, lines and surfaces connecting them, and color information

3- Choose one statement that is incorrect as an explanation of the digital representation of images from the options A to D.

- A- The unit dpi represents the degree of pixel density.
- B- The number of gradations depends on the number of bits allocated per pixel.
- C- The smaller the resolution and gradation values, the smoother the image obtained.
- D- Gradation indicates the number of steps or levels of color or brightness.

3) Answer the following questions. In these questions, assume that 1 KB = 1,000 B, and 1 MB = 1,000 KB.

(1) What is the data amount of an image in kilobytes with a resolution of 800 x 600 pixels, where each pixel has 8 bits?

.....

(2) What is the data amount of a 24-bit full-color image with a resolution of 720 x 480 pixels in megabytes? Round your answer to two decimal places.

.....

(3) What is the data amount of a 24-bit full-color image with a resolution of $3,820 \times 2,160$ pixels in megabytes? Round your answer to two decimal places.

.....

Exercise

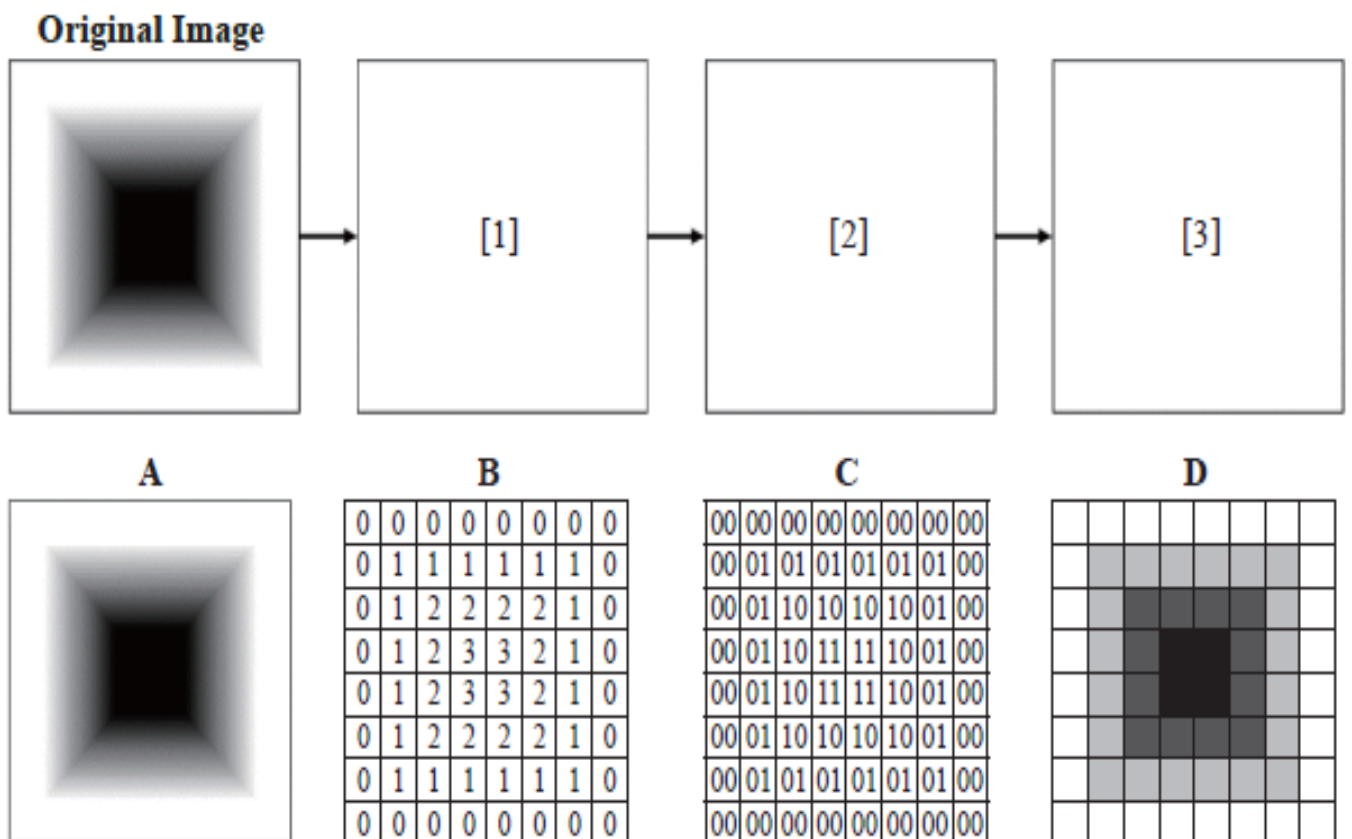
1- Cover the Point! section on pages 72 and 73 with a red sheet and test yourself by writing the items in order in your notebook.

2- Answer the following questions.

(1) Choose the correct flow for digitizing an image captured by a digital camera from the options A to D, and answer using the letter.

- A- Quantization → Encoding → Sampling B- Quantization → Sampling → Encoding
 C- Encoding → Quantization → Sampling D- Sampling → Quantization → Encoding

(2) The following diagram illustrates the process of converting the original image into digital data. Choose the diagram that best fits into the blanks [1] to [3] from the options A to D, and answer using the letters.



3- Choose the term that best fits into the blanks [1] to [3] in the following sentences from the options A to D below.

In color printers, a variety of colors are expressed by combining the three colors of cyan, magenta, and yellow, which are the ([1]). When these colors are mixed together, they approach the color [2]). On the other hand, computer displays represent all colors by combining red, green, and blue, which are the ([3]).

A- Three primary colors of light

B- Three primary colors of pigment

C- White

D- Black

4- Answer the following questions. In these questions, assume that 1 KB = 1,000 B, and 1 MB = 1,000 KB.

(1) What is the data amount of an image in kilobytes with a resolution of 1,080 x 720 pixels, where each pixel has 8 bits? Round your answer to the nearest whole number.

(2) What is the data amount of a 24-bit full-color image with a resolution of 320 x 480 pixels in kilobytes? Round your answer to the nearest whole number.

(3) What is the data amount of a 24-bit full-color image with a resolution of 1,920 x 1,080 pixels in megabytes? Round your answer to two decimal places.

6-9 Digital Representation and Compression Technology for Videos

Point!

1- Mechanism of Videos

- (1) (**Video**): An electronic medium that creates the illusion of movement by displaying a series of still images in succession. It utilizes the (**afterimage phenomenon**), which occurs due to the characteristics of human vision.
- (2) (**Frame**): Each still image that composes a video.
- (3) (**Frame rate**): The number of frames displayed per second. The unit is (*fps).
The ("**higher**") the frame rate number, the smoother the video will appear, and the (**larger**) the data size will become.

(4) How to Calculate the Amount of Video Data

Amount of video data = (Amount of image data [B] × Frame rate [fps] × Time [seconds])

2- Data Compression

- (1) (**Compression**): A process of reducing the amount of data as much as possible while preserving the content of the data.
- (2) (**Decompression**): A process of restoring compressed data to its original state. (3)
- (3) (**Compression ratio**): The extent to which data has been compressed.

$$\text{Compression ratio [\%]} = \frac{(\text{Amount of data after compression})}{(\text{Original amount of data})} \times 100$$

(4) Lossless Compression and Lossy Compression

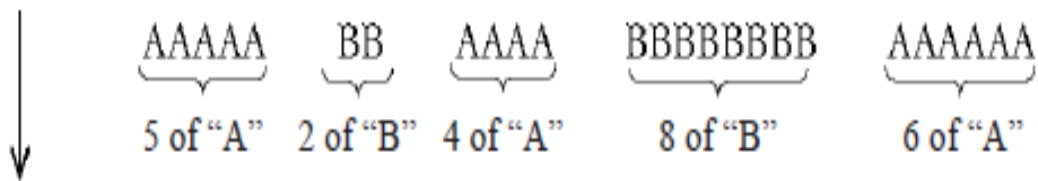
- [1] (**Lossless compression**): A compression method that allows for the complete restoration of the original data from the compressed data. Used for compressing information such as text or program data.

[2] (**Lossy compression**): A compression method in which the original data cannot be restored from the compressed data. Lossy compression is used for compressing audio, images, and video files in a way that humans do not perceive a significant difference, even if those files cannot be perfectly restored to their original form.

3- Main Types of Lossless Compression

(1) (**Run-length encoding**): A compression method that replaces sequences of the same consecutive symbols with a numerical value indicating the length of the sequence. It is effective when there are many consecutive identical symbols.

<Example> Before compression: "AAAAABBAAAABBBBBBBBBAAAAAA" (25 characters)



After compression: (¹⁷A5B2A4B8A6) (10 characters)

The compression ratio is (¹⁸ $\frac{10}{25} \times 100$) = (¹⁹40 [%]).

(2) (**Huffman coding**): A compression method that assigns shorter bit sequences to characters with higher frequencies of occurrence, and longer bit sequences to those with lower frequencies.

Warm Up

Answer the following questions.

(1) [1] What is the data size, in megabytes, of a 10-second uncompressed video at 30 fps, where each frame is a 24-bit full-color still image with a resolution of 500 x 200 pixels? For this question, assume that 1 KB = 1,000 B and 1 MB = 1,000 KB.

.....
.....

[2] Video [1] was converted into a compressed video file using a certain compression method, resulting in a file size of 30 MB. What is the compression ratio in this conversion? Round your answer to the nearest whole number and provide the answer as an integer.

.....
.....

(2) Consider how to represent an image using pixels. In the case of the diagram on the right, the 25 pixels in the 5 x 5 grid are read one by one from the top-left, row by row, moving to the right. If a pixel is black, write "B"; if it is white, write "W". This results in the sequence:

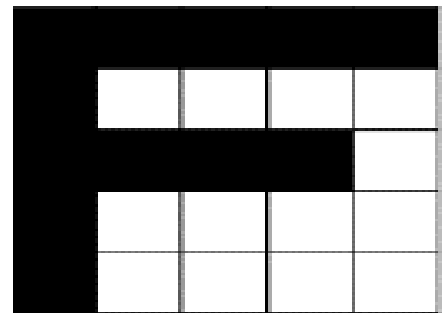
"BBBBBBWWWWBBBBWBWWWBWWWW".

Next, by representing consecutive characters "B" or "W" of length n (where m

is an integer of 2 or more) as "Bn" or "Wn", the sequence can be compressed to

"B6W4B4WBW4BW4". Using the same method with another 5 x 5 grid, what is the alphabet letter represented by the following compressed data?

"B4WBW3B5WBW4BW4"



Explanation

(1) [1] The amount of data per frame is,

$$500 \times 200 \times 24 \text{ [bits]} = 2,400,000 \text{ [bits]}$$

$$\text{Since } 1 \text{ B} = 8 \text{ bits, } 2,400,000 \text{ [bits]} \div 8 = 300,000 \text{ [B]}$$

The amount of data of a 10-second video at 30 fps is as follows:

$$300,000 \text{ [B]} \times 30 \text{ [fps]} \times 10 \text{ [seconds]} = 90,000,000 \text{ [B]}$$

1 KB = 1,000 B, 1 MB = 1,000 KB, therefore,

$$90,000,000 \text{ [B]} \div 1,000 \div 1,000 = 90 \text{ [MB]} \quad 90 \text{ MB}$$

$$[2] \text{ Compression ratio [\%]} = \frac{\text{Amount of data after compression}}{\text{Original amount of data}} \times 100,$$

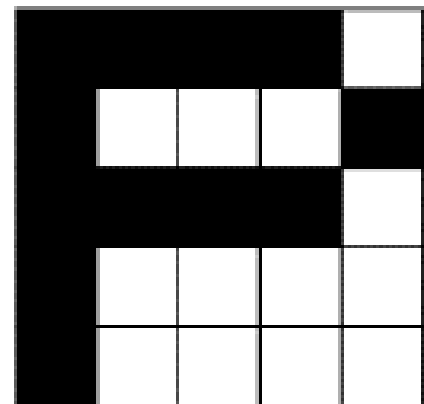
$$\text{resulting in } \frac{30}{90} \times 100 = 33.3\cdots \text{ [\%]} \quad \underline{33\%}$$

(2) Expanding the pre-compressed data

"B4WBW3B5WBW4BW4" yields

"BBBBWBWWWBBBBBWBWWWBWWW".

If you fill in a 5 x 5 grid one pixel at a time from the top-left, row by row to the right, coloring black for "B" and white for "W", you will get the image shown on the right. Therefore, P



Try

1- Answer the following questions. For these questions, assume that 1 KB = 1,000 B and 1 MB = 1,000 KB. (1) Complete the following sentences by filling in the blanks [1] and [5] with the appropriate terms.

A video is a continuous display of still images. By displaying a series of gradually changing images, the phenomenon of ([1]) creates the illusion of movement for humans. The individual still images that make up a video are called ([2]), and the number of ([2]) displayed on the screen per second is referred to as the ([3]). The [4] the ([3]), the smoother the motion in the video appears. However, the amount of data of videos can become ([5]).

(2) What is the data size, in megabytes, of a 1-minute video at 30 fps, where each frame is a 24-bit full-color still image with a resolution of 640 x 360 pixels? Assume that the video is uncompressed. Round the amount of data to the nearest whole number and provide the answer as an integer.

2 -Answer the following questions.

(1) For the following statements A to D about data compression, mark "o" if the statement is appropriate, and "x" if it is inappropriate.

- A- Lossless compression is a method that improves compression efficiency by allowing slight changes to the data, such as removing components that are less noticeable to humans.
- B- Decompression is a process of restoring compressed data to its original state.
- C- Data compressed using lossy compression does not result in exactly the same content as the original uncompressed data.
- D- Data compressed using lossless compression will be exactly the same as the original data after being decompressed.

(2) When 21 MB of compressed data was decompressed, it expanded to 50 MB. What is the compression. ratio of this file?

3- Answer the following questions.

(1) Consider how to represent an image using pixels. In the case of the diagram on the right, the 25 pixels in the 5 x 5 grid are read one by one from the top-left, row by row, moving to the right. If a pixel is black, write "B"; if it is white, write "W". This results in the sequence:

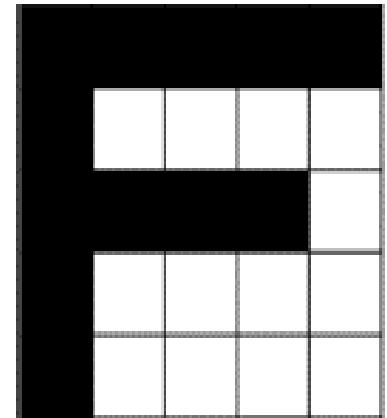
"BBBBBBWWWWBBBBWBWWWWBWWWW".

Next, by representing consecutive characters "B" or "W" of length n (where n is

an integer of 2 or more) as "Bn" or "Wn", the sequence can be compressed to

"B6W4B4WBW4BW4". Using the same method with another 5 x 5 grid, what is the alphabet letter represented by the following compressed data?

"BW3B2W3B7W3B2W3B"



(2) What is the term for the compression method that represents repeated data by listing the data and the number of consecutive occurrences, as shown in (1)?

Choose one from the options A to D, and answer using the letter.

A- Huffman coding

B- Codec

C- Run-length encoding

D- LZ encoding

Exercise

1- Cover the Point! section on page 76 with a red sheet and test yourself by writing the items in order in your notebook.

2- Answer the following questions. For these questions, assume that 1 KB = 1,000 B and 1 MB = 1,000 KB. (1) For the following statements A to D about video mechanisms, mark "o" if the statement is appropriate, and "x" if it is inappropriate.

A- Videos create the illusion of movement by displaying a series of still images in rapid succession, leveraging the afterimage phenomenon. In reality, the images themselves are not moving.

B- Each individual still image that composes a video is called a frame.

C- The number of frames displayed per second is called the frame rate. The lower the frame rate, the smoother the video appears.

D- When recording a video, if the resolution and frame rate settings are the same, the amount of data of a video recorded for 1 second and a video recorded for 60 seconds does not vary.

(2) What is the data size, in megabytes, of a 1-second video at 60 fps, where each frame is a 24-bit full-color still image with a resolution of $1,920 \times 1,080$ pixels? Assume that the video is uncompressed, and round your answer to one decimal place.

3- For the terms that fit in the blanks [1] to [3] in the following sentences, if the compression is lossless, answer with A; if the compression is lossy, answer with B.

There are two main methods for compressing data. A compression method that allows the original data to be completely restored from the compressed data when decompressed is called ([1]). A compression method that does not allow for the complete restoration of the original data is called ([2]). For data such as images and videos, where the compressed data does not need to be perfectly restored and humans do not perceive a significant difference, ([3]) is used.

Answer the following questions.

(1) Consider how to represent an image using pixels. In the case of the diagram on the

right, the 25 pixels in the 5 x 5 grid are read one by one from the top-left, row by row, moving to the right. If a pixel is black, write "B"; if it is white, write "W". This results in the sequence:

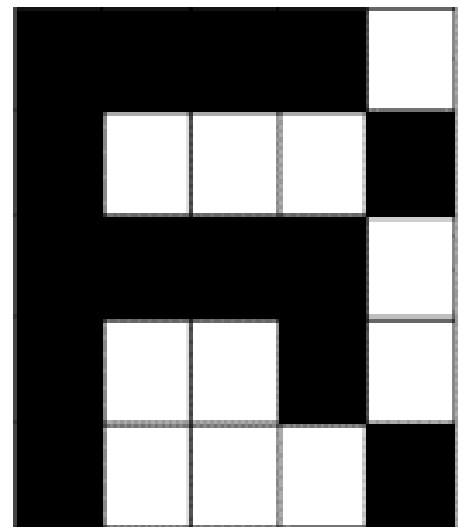
"BBBBWBWWBBBBBWBWBWBWWB".

When "B" or "W" appears consecutively n times (where n is an integer greater than or equal to 2), they can be written as "Bn" or "Wn". Using this method, the

sequence can be compressed as "B4WBW3B5WBW2BWBW3B". Using the same method with another

5 x 5 grid, what is the alphabet letter represented by the following compressed data? "BW3BWBWBW3BW4BW4BW2"

(2) What is the term for the compression method that represents repeated data by listing the data and the number of consecutive occurrences, as shown in (1)?



6-10 Information Design

Point!

1- Information Design

(1) (**Information design**): The process of organizing and creatively expressing information according to its purpose, thereby ensuring that the intended message is correctly conveyed to the target audience.

(2) Information Design Methods

[1] (**Abstraction**): Conveying the intended information simply from within a large amount of data.

- (**Pictogram**): A pictorial symbol designed for the purpose of conveying information without using words. It is used for information signs at stations and airports.
- (**Icon**): A representation of a program's content on a computer or smartphone depicted through images or illustrations.



[2] (**Visualization**): Visually representing information to make it more understandable.

<Examples> Tables, graphs, etc.

[3] (**Structuring**): Organizing and expressing information clearly by arranging it according to relationships, connections, levels, stages, order, etc.

<Examples>> Hierarchical menus on web pages, department store floor maps, etc.

2- Design Techniques for Ease of Understanding

(1) (**User interface (UI)**): A system for transferring information between humans and devices

<Examples> Voice input, touch panel, keyboard, etc.

[1] (**CUI**): A user interface where a device is operated by entering commands via a keyboard.

[2] (**GUI**): A user interface that allows users to issue commands in an intuitive and easy-to-understand way using icons and buttons.

(2) (**User experience (UX)**): The experience or emotional impact that users gain from interacting with a product or service.

(3) (**Affordance**): Actions or operations that can be performed on an object.

(4) (**Signifier**): Cues that prompt users to take action.

(5) (**Usability**): A measure used to indicate how easy and understandable it is for users.

(6) (**Accessibility**): The ease of access to information and services for a wide range of people.

(7) (**Universal design**): Design that is thoughtfully created with the intention that all people, regardless of age, language, nationality, or physical ability, can use it without difficulty.

3- Organizing and Classifying Information

(**LATCH method**): A principle for organizing information and presenting it in a way that is easy for users to understand. Information is organized and classified according to the following five criteria.

- **L**ocation: Classification based on physical location
- **A**lphabet: Classification based on alphabetical or syllabary order.
- **T**ime: A classification based on the sequence of events in terms of time.
- **C**ategory: A classification based on the differences between things, used as a criterion to distinguish realms.
- **H**ierarchy: Classification based on quantitative changes such as size, level, etc.

Warm Up

Answer the following questions.

(1) Choose the most appropriate example of visualization as a method used in information design from the options A to D below, and answer using the letter.

- A- Pictograms for each classroom were created to guide people around the school building.
- B- A web page to introduce the school was created. The page was organized with menus for each hierarchy.
- C- The survey results were compiled into tables and graphs.
- D- Text summarizing multiple matters is presented in bullet points.

(2) Choose the term that best fits into the blanks [1] and [2] in the following sentences from the options A to D below, and answer using the letters.

Current computers widely use ([1]), which allows users to manipulate graphically displayed information, such as icons, with a mouse or their finger. On the other hand, early computers used [2]), which was a method for conveying commands by inputting characters from a keyboard

A- CUI

B- GUI

C- VUI

D- NUI

(3) What is the term for a design that is thoughtfully created in advance to allow all individuals, regardless of nationality, gender, age, or physical ability, to use it without difficulty? Choose one from the options A to D below, and answer using the letter.

A- Usability

B- Universal design

C- Signifier

D- User interface

Explanation

(1) A is an example of abstraction, B of structuring, C of visualization, and D of structuring. Therefore, C

(2) [1]: B [2]: A

(3) B

Try

1- Answer the following questions.

(1) Choose the term that best fits into the blanks [1] to [3] in the following sentences from the options: A to E below, and answer using the letters.

Methods of information design include the following.

([1]): A method for discerning the overall picture and clearly organizing the relationships between elements.

[2]): A method for visually representing information.

[3]): A method for extracting only the necessary elements from a large amount of information.

A- Specification B- Abstraction C- Visualization D- Materialization E- Structuring

(2) Choose the most appropriate example of abstraction as a method used in information design from the options A to D below, and answer using the letter.

A- Pictograms for each classroom were created to guide people around the school building.

B- A web page to introduce the school was created. The page was organized with menus for each hierarchy.

C- The survey results were compiled into tables and graphs.

D- Text summarizing multiple matters is presented in bullet points.

(3) Choose one term that represents a pictorial symbol that conveys information by abstracting the intended message without using text from the options A to D below, and answer using the letter.

A- Usability

B- Affordance

C- Signifier

D- Pictogram

2- Answer the following questions.

(1) Choose the term that best fits into the blanks [1] and [2] in the following sentences from the options A to D below, and answer using the letters.

The experience that users gain through products or services is referred to as ([1]). The aim is not just to achieve ease of use, but also to achieve a sense of comfort. For that purpose, it is necessary to simplify the [2]) that people use to operate devices and screens, choose colors with consideration for the fact that different people perceive colors differently, and add textual information.

A- GUI

B- CUI

C- UX

D- UI

(2) Choose the term that best fits into the blanks: [1] to [3] in the following sentences from the options A to F below, and answer using the letters.

Regardless of the level of advancement for functions offered by a computer, those functions cannot be effectively applied in real life if they are difficult to use. The ease of use of such devices is referred to as |([1]), and ([1]) varies depending on the user. On the other hand, ease of use for a wide range of people, regardless of their abilities or conditions, is referred to as ([2]). The term ([3]) refers to design that enables ease of use for everyone, regardless of age, language, nationality, or physical ability.

A- Accessibility

B- Usability

C- Affordance

D- Universal design

E- User interface

F- Barrier-free

Exercise

1- Cover the Point! section on pages 115 and 116 with a red sheet and test yourself by writing the items in order in your notebook.

2- Answer the following questions.

[1] Choose the most appropriate explanation of visualization as a method used in information design from the options A to D below, and answer using the letter.

- A- Extracting only the necessary elements from a large amount of information.
- B- Discerning the overall picture and clearly organizing the relationships between elements.
- C- Expressing the information you want to convey in a simple manner using diagrams or illustrations.
- D- Representing information visually.

[2] Choose all the appropriate examples of structure as a method used in information design from the options A to D below, and answer using the letters.

- A- A web page to introduce the school was created. The page was organized with menus for each hierarchy.
- B- The survey results were summarized into a graph to convey information in an easy-to- understand manner.
- C- Expressed a warning to the other party through illustrations without using text.
- D- A list was compiled to summarize the events of a particular day.

(2) What is the term for symbols used in public facilities like train stations and airports to visually convey attention or information to others, as shown in the diagram on the right?



Answer the following questions.

(1) Choose the term that best fits into the blanks [1] to [3] in the following sentences from the options A to D below, and answer using the letters.

[1]: A system for transferring information between humans and devices.

[2]: (1) through text. Operate everything from the keyboard.

[3]: (1) through visuals. Intuitive operation is possible using devices like a mouse.

A- GUI

B- CUI

C- UX

D- UI

(2) Choose the most appropriate explanation of a signifier from the options A to D below, and answer using the letter.

A- A measure used to indicate how easy and understandable it is for users.

B- Design that is thoughtfully created with the assumption that everyone can use it without difficulty.

C -A state that is easily accessible to a wide range of people.

D- Cues that prompt users to take action.

7-1 Computer Configuration

Point!

The Five Major Components of a Computer

(1) (**Hardware**): Devices such as the main computer unit and peripheral devices.

(2) Peripheral devices: Devices used by connecting them to a computer.

<Examples> Keyboard, mouse, display, printer, etc.

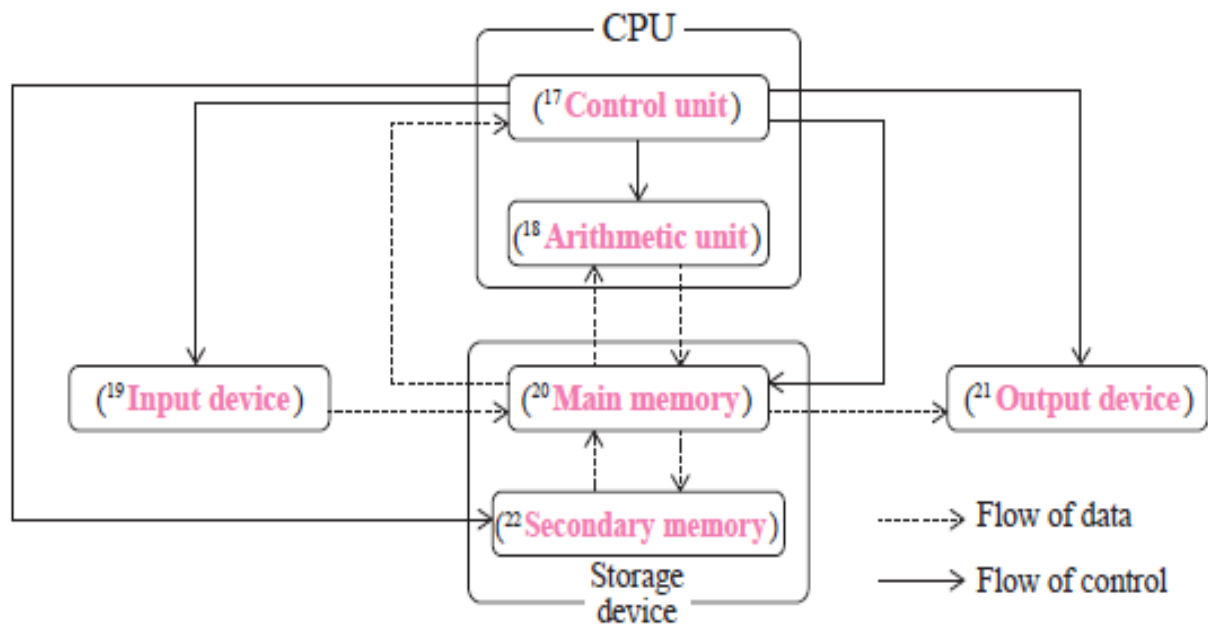
(3) The five major components of a computer: A computer is comprised of the following five components: (**the control unit**), (**the arithmetic unit**), (**the memory unit**), (**the input unit**), and (**the output unit**).

- The control unit and arithmetic unit together are referred to as the (**CPU (central processing unit)**).
- Storage devices are divided into (**main memory**), which temporarily stores programs and data, and (**secondary memory**), which is used for long-term storage.

<Roles of the Five Major Components of a Computer>

Five major components		Role	Example of major component
Control unit	CPU	Executes a computer's (¹⁰ instructions) and issues (¹¹ commands) to each function.	CPU
Arithmetic unit		Performs (¹² calculations).	
Storage device	Main memory device (Memory)	(¹³ Temporarily) stores programs, data, etc.	Main memory
	Secondary memory (Storage)	For (¹⁴ long-term) storage of programs and data.	Hard disk, SSD, USB memory
Input device		(¹⁵ Inputs) information from external sources.	Keyboard, mouse, scanner
Output device		(¹⁶ Outputs) information outside of the computer.	Display, printer

<Relationship of the Five Major Components of a Computer>



(4) **Interface**: A component that mediates the exchange of information. It is used for connecting the main computer and peripheral devices.

[1] **USB**: The most widely used interface for computer peripheral devices.

Compatible with printers, keyboards, and external hard drives.

[2] **HDMI**: A communication standard that allows video, audio, and other data to be transmitted through a single cable.

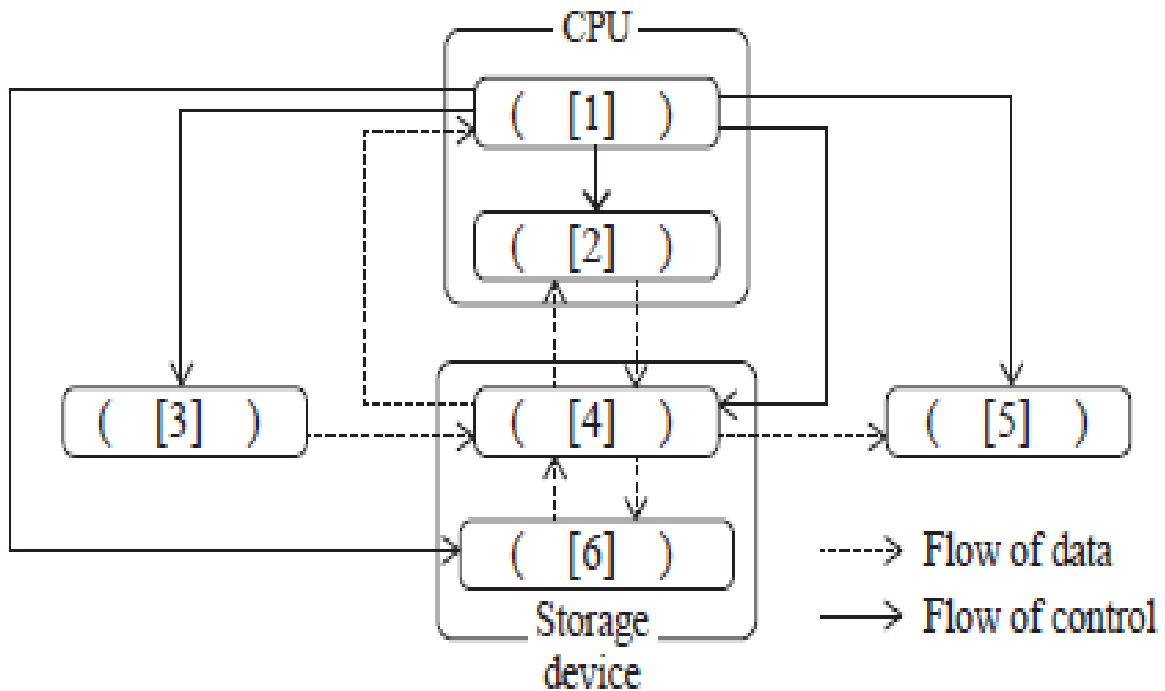
Compatible with digital televisions and audio equipment.

[3] **Ethernet**: A communication standard used in wired LANs at home, the office, etc. Compatible with devices such as hubs and routers.

Warm Up

Answer the following questions.

(1) The following diagram represents the relationship between computer components. Choose the appropriate device name that best fits into the blanks [1] to [6] from the options A to F, and answer using the letters.



A- Input device

B- Output device

C- Control unit

D -Arithmetic unit

E- Main memory device

F- Secondary memory

(2) Choose all of the following options from A to H that are output devices, and answer using the letters.

A- Memory

B- Display

C- SSD

D- Mouse

E- Keyboard

F- Printer

G- Hard disk

H- USB memory

Explanation

(1)

[1] Control unit, because the flow of control is directed towards all devices. C

[2] Among the components of the CPU, [1] is the control unit; therefore, the arithmetic unit. D

[3] The starting point of the data flow; therefore, the input device. A

[4] Among storage devices, this is identified as the main memory because data flows directly into it from the input device. E

[5] Marks the end of the data flow; therefore, an output device. B

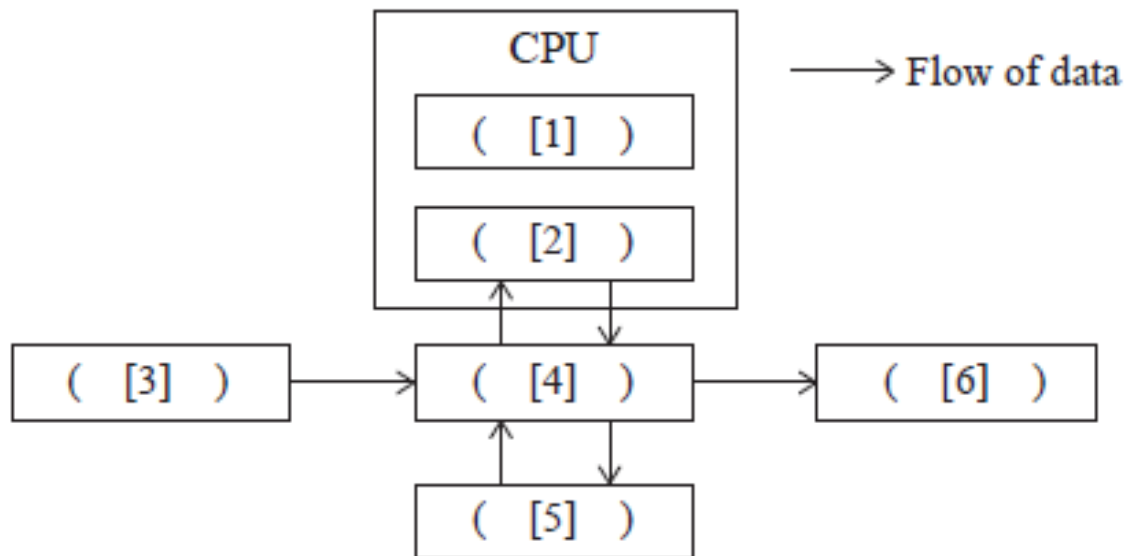
[6] Among storage devices, [4] is the main memory, therefore, the secondary memory. F

(2) B, F

Try

Answer the following questions.

(1) The following diagram represents the relationship between computer components. Choose the appropriate device name that best fits into the blanks [1] to [6] from the options A to F, and answer using the letters. Note that the order of blanks [1] and [2] does not matter.



A- Input device

B- Output device

C- Control unit

D- Arithmetic unit

E- Main memory device

F- Secondary memory

(2) Choose all computer components or peripheral devices corresponding to the following [1] to [5] from the options A to I below, and answer using the letters.

[1] Arithmetic unit, control unit [2] Main memory device [3] Secondary memory

[4] Input device

[5] Output device

A- Memory

B- Display

C- SSD

D- Mouse

E- Keyboard

F- Printer

G- Hard disk

H USB memory

I- CPU

(3) Choose the term that best fits into the blanks [1] and [2] in the following sentences from the options A to D below, and answer using the letters.

[1] is called the main memory and exchanges data directly with the CPU. [2] is also called secondary memory and serves the role of storing large amounts of data.

A- Memory

B- Hardware

C- Interface

D- Storage

(4) What is the interface described by each of the following [1] to [3]?

[1] An interface that connects devices to output video and audio through a single cable.

[2] The most commonly used interface for computer peripheral devices.

[3] Communication standard used for wired LANs in homes, offices, etc.

Exercise

1- Cover the Point! section on pages 123 and 124 with a red sheet and test yourself by writing the items in order in your notebook.

2- Answer the following questions.

(1) Choose the most appropriate explanation of the control unit, which is one of the five major components of a computer from the options A to D below, and answer using the letter.

A- It is a device that performs calculations.

B- It is a device that executes a computer's instructions and issues commands to each function.

C- It is a device for temporarily storing programs and data.

D- It is a device for inputting information from external sources.

(2) Choose the names of the devices that correspond to computer devices and peripheral devices [1] to [5] from the options A to E below, and answer using the letters.

[1] Display [2] HDD [3] Keyboard

[4] CPU [5] Main memory

A- Input device B- Output device C- Control unit, arithmetic unit

D- Main memory device E- Secondary memory

(3) Choose all the peripheral devices from the options A to F, and answer using the letters.

A- Display B- SSD C- Memory

D- CPU E- Keyboard F- USB memory

(4) Choose one correct statement regarding interfaces from the options A to D below, and answer using the letter.

- A- Devices that are not the computer itself but are used by connecting to a computer.
- B- Devices such as the computer itself and peripheral devices.
- C- Devices for temporarily storing programs and data.
- D- A component that mediates the exchange of information. It is used for connecting the main computer and peripheral devices.

(5) Choose the corresponding interface for each of the following peripheral devices [1] to [3] from the options A to D, and answer using the letters.

[1] Keyboard

[2] Router

[3] Audio equipment

A- Ethernet

B- HDMI

C- SSD

D- USB

7-2 Computer Software

Point!

Hardware and Software

(1) Hardware: Devices such as the main computer unit and peripheral devices.

<Examples> CPU, memory, storage, etc.

(2) (Software): Programs and data that operate on hardware.

[1] (System software): Software necessary for operating the hardware.

[2] (Operating system (OS)): A type of system software responsible for the

basic functions of a computer. An OS has management functions such as task management, memory management, and file management.

<Examples> Windows, macOS, Android OS, etc.

[3] (Application software): Software that operates on top of system software. Also

known as application software.

<Examples> Word processing software, spreadsheet software, etc.

(3) (Device driver): A program that controls communication between a connected

device and software on a computer. Also known simply as a

"driver"

Warm Up

For the following statements A to D about an OS, mark "o" if the statement is appropriate, and "x" if it is inappropriate.

- A- Software used to perform specific tasks.
- B- Smartphones do not come equipped with an OS.
- C- A type of system software essential for operating the hardware.
- D- Application software cannot run without system software.

Explanation

A: An explanation about application software. Therefore, x

B: Smartphones are equipped with an OS. For example, iPhones are equipped with iOS, while Android phones run on Android OS. Therefore, x

C: An OS is a type of system software responsible for the basic functions of a computer. Therefore, o

D: Application software is software that operates on top of system software.

Therefore,

Try

Answer the following questions.

(1) Complete the following sentences by filling in the blanks [1] to [3] with the appropriate terms.

Types of software include ([1]) software and ([2]) software. ([1]) software includes ([3]). In the case of computers, examples are Windows and macOS. Additionally, ([2]) software includes word processing software and spreadsheet software.

(2) What is the term for software that is used to control and operate devices connected to a computer?

(3) For the following statements A to D, answer with "a" if the statement is about operating systems or "b" if the statement is about application software.

- A- A program executed on a computer that is designed for a specific purpose.
- B- A program that controls software and hardware on a computer system
- C- Includes word processing software and spreadsheet software.
- D- Included in the system software.

Exercise

1- Cover the Point! section on pages 131 and 132 with a red sheet and test yourself by writing the items in order in your notebook.

2- Answer the following questions.

(1) Choose all the devices and software corresponding to the following [1] to [3] from the options A to F below, and answer using the letters.

[1] Operating system

[2] Hardware

[3] Application software

A- Memory

B- Spreadsheet Software

C- Windows

D- macOS

E- CPU

F- Document processing software

(2) Choose one correct statement regarding device drivers from the options A to D below, and answer using the letter.

A- A type of system software. Examples include, Windows, macOS, etc.

B- Also referred to as application software.

C- A program that controls communication between the devices connected to a computer and the software.

D- The software necessary for operating hardware.

7-3 Logic Circuits

Point!

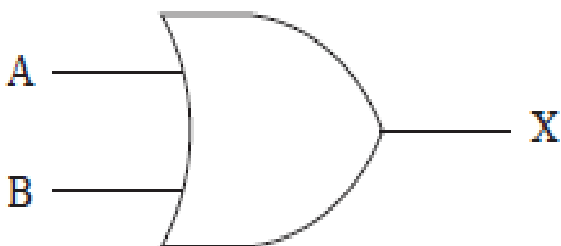
1- Logic Circuits

- (1) (**Logical operations**): Operations performed using combinations of the numbers 0 and 1. In computers, "1" is processed as true and "0" as false.
- (2) (**Logic circuit**): A circuit designed to perform logical operations.
- (3) (**Truth table**): A table that shows all possible combinations of inputs and outputs for a logic circuit.
- (4) (**AND gate (logical conjunction circuit)**): A circuit that outputs 1 only when all inputs are 1.



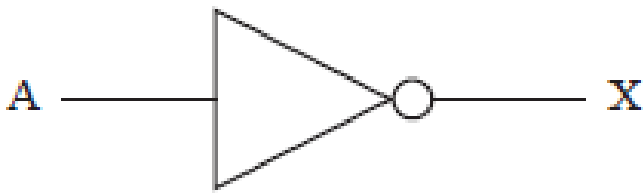
Input		Output
A	B	X
0	0	0
0	1	0
1	0	0
1	1	1

- (5) (**OR gate (logical disjunction circuit)**): A circuit that outputs 1 if at least one of the inputs is 1.



Input		Output
A	B	X
0	0	0
0	1	1
1	0	1
1	1	1

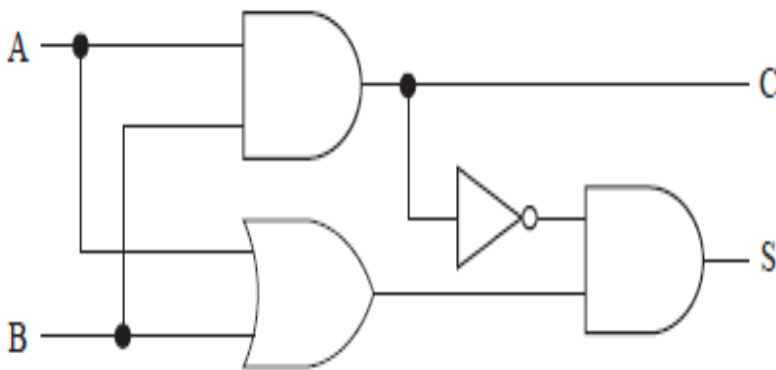
(6) (NOT circuit (inverter circuit)): A circuit that outputs the opposite result of the input.



Input	Output
A	X
0	1
1	0

2- Half Adder Circuit and Full Adder Circuit

(1) (Half adder circuit): A circuit representing the addition of single-digit numbers, composed of AND, OR, and NOT gates.



Input		Output	
A	B	C	S
0	0	0	0
0	1	0	1
1	0	0	1
1	1	1	0

(2) (Full adder circuit): A circuit that considers carry from the lower bit and carry to the higher bit.

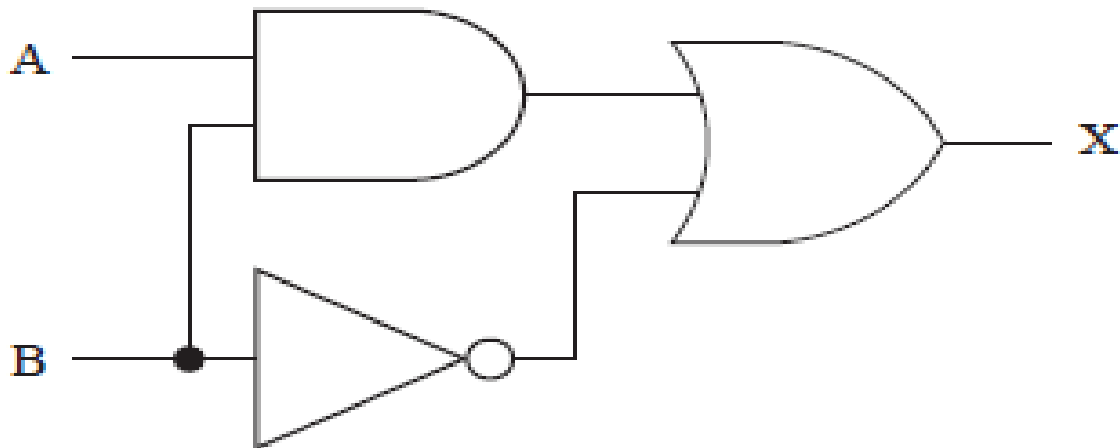
Warm Up

Answer the following questions.

(1) Name the following logic circuit and create a truth table.



(2) A circuit was created by combining logic circuits as shown in the following diagram. In this case, create a truth table for inputs A, B, and output X



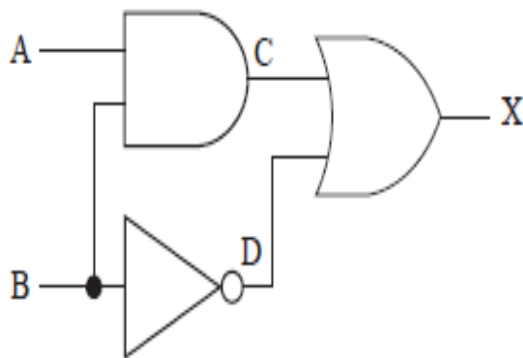
Explanation

(1) AND Circuit (logical conjunction circuit).

An AND circuit is a circuit that outputs 1 only when all inputs are 1. Therefore, the truth table is as follows.

Input		Output
A	B	X
0	0	0
0	1	0
1	0	0
1	1	1

(2) Create and analyze the truth table for each circuit.



A	B	C	D	X
0	0	0	1	1
0	1	0	0	0
1	0	0	1	1
1	1	1	0	1

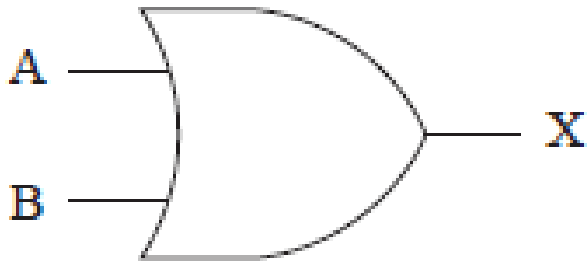
Therefore, the truth table is as follows.

Input		Output
A	B	X
0	0	1
0	1	0
1	0	1
1	1	1

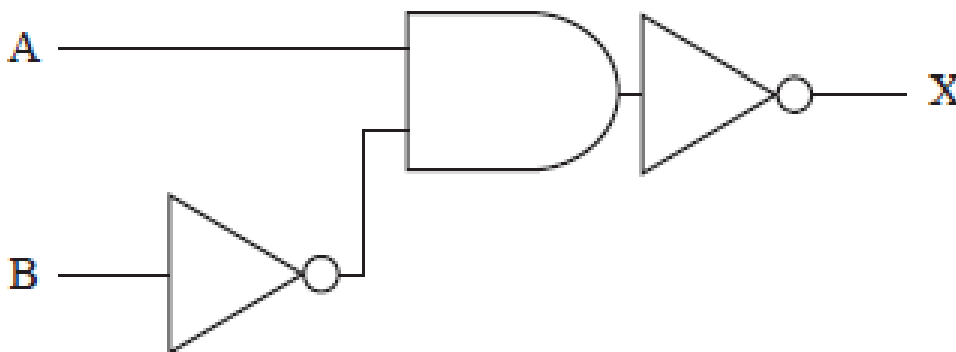
Try

Answer the following questions.

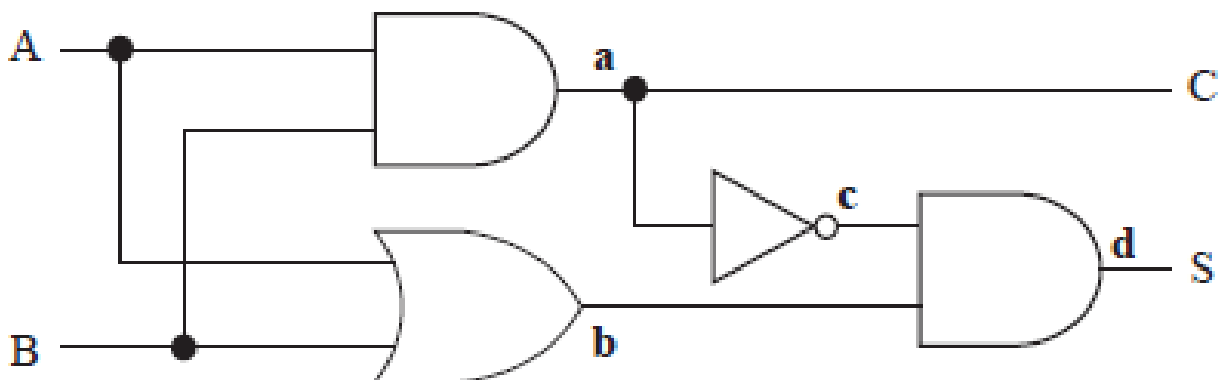
(1) Name the following logic circuit and create a truth table.



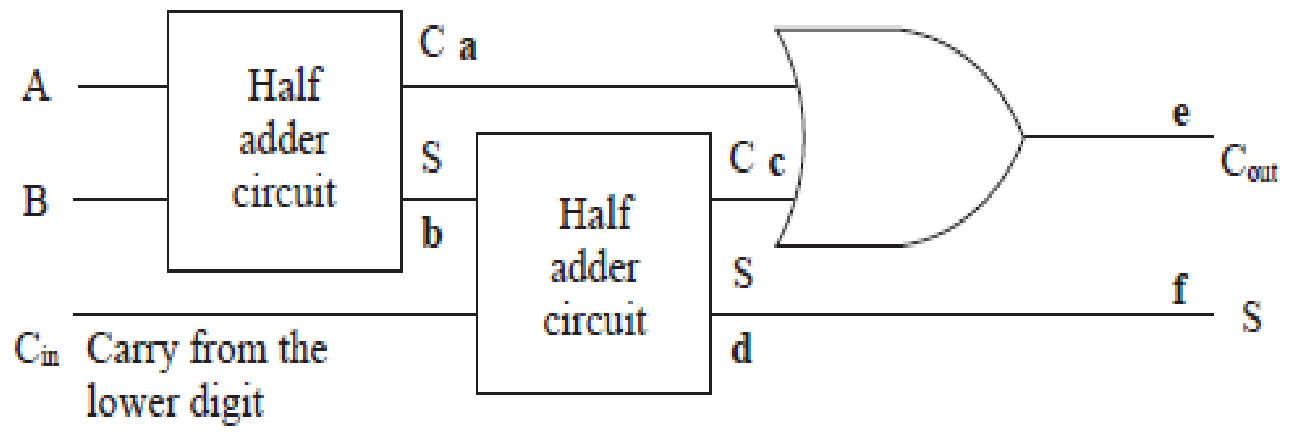
(2) A circuit was created by combining logic circuits as shown in the following diagram. In this case, create a truth table for inputs A, B, and output X.



(3) In the following half adder circuit, determine the values of each output a to d when input A is 0 and input B is



(4) In the following full adder circuit, determine the values of each output a to f when input A is 1, input B is 1, and input C₁, is 0.

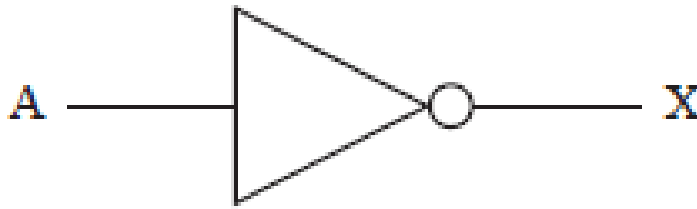


Exercise

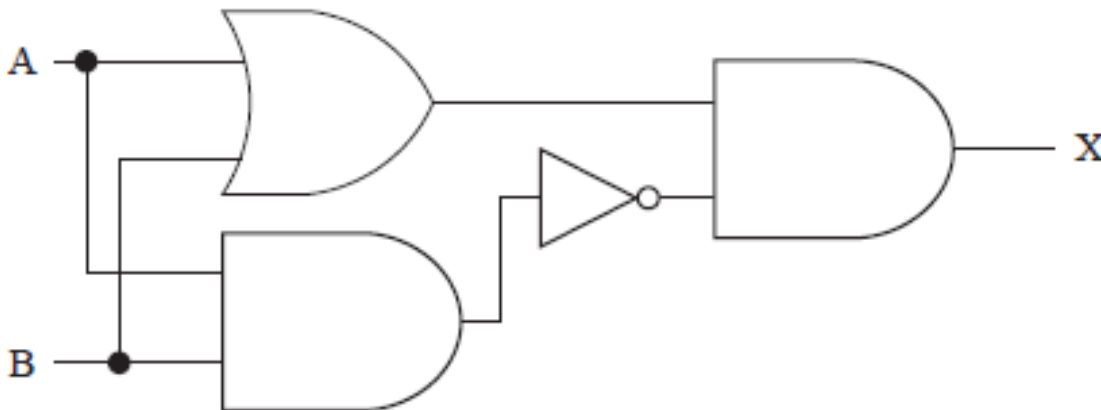
1- Cover the Point! section on pages 135 and 136 with a red sheet and test yourself by writing the items in order in your notebook.

2- Answer the following questions.

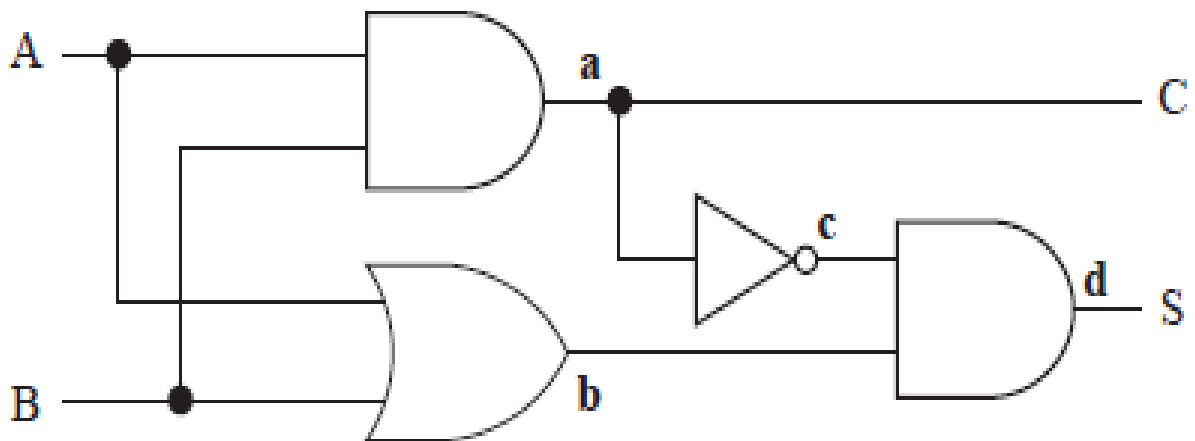
(1) Name the following logic circuit and create a truth table.



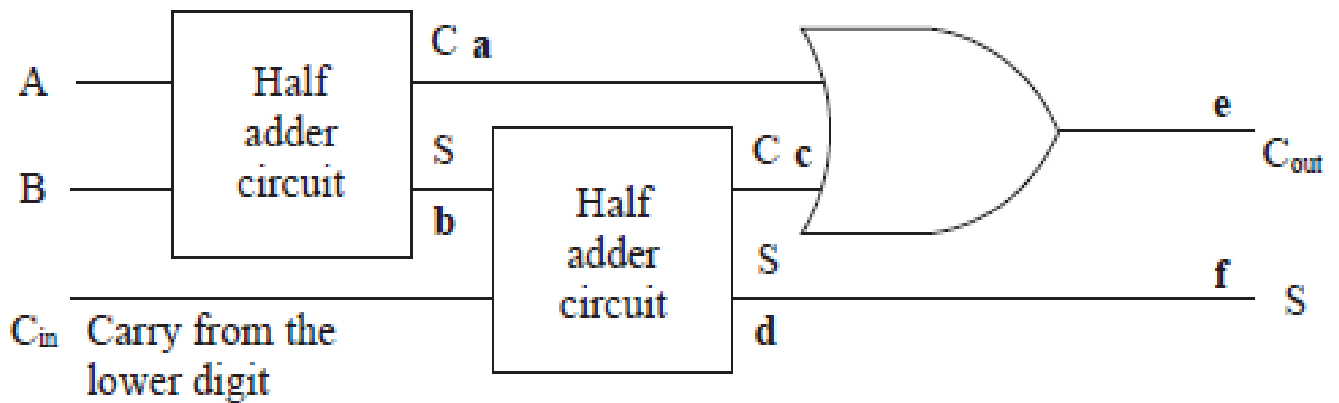
(2) A circuit was created by combining logic circuits as shown in the following diagram. In this case, create a truth table for inputs A, B, and output X.



(3) In the following half adder circuit, determine the values of each output a to d



(4) In the following full adder circuit, determine the values of each output a to f when input A is 1, input B is 0, and input C_i is 1.



تطبيق



مذكرات جاهزة للطباعة

لتحميل الملفات التعليمية مجاناً للمعلم والطالب

مذكرات وملازم / مراجعات وملخصات / امتحانات / كتب الوزارة /
أدلة المعلم / دفاتر التحضير / سجلات مدرسية / أوراق تأسيس

امسح الكود بموبايلك علشان تقدر تثبت التطبيق
وتقدر ف أي وقت تحمّل ال نفسك فيه ببلاش
هيفغنيك عن البحث والجروبات والقنوات الكثيرة



تطبيق الموبايل لتحميل الملفات