

Markscheme

November 2021

**Information technology
in a global society**

Standard level

Paper 1

16 pages

© International Baccalaureate Organization 2021

All rights reserved. No part of this product may be reproduced in any form or by any electronic or mechanical means, including information storage and retrieval systems, without the prior written permission from the IB. Additionally, the license tied with this product prohibits use of any selected files or extracts from this product. Use by third parties, including but not limited to publishers, private teachers, tutoring or study services, preparatory schools, vendors operating curriculum mapping services or teacher resource digital platforms and app developers, whether fee-covered or not, is prohibited and is a criminal offense.

More information on how to request written permission in the form of a license can be obtained from <https://ibo.org/become-an-ib-school/ib-publishing/licensing/applying-for-a-license/>.

© Organisation du Baccalauréat International 2021

Tous droits réservés. Aucune partie de ce produit ne peut être reproduite sous quelque forme ni par quelque moyen que ce soit, électronique ou mécanique, y compris des systèmes de stockage et de récupération d'informations, sans l'autorisation écrite préalable de l'IB. De plus, la licence associée à ce produit interdit toute utilisation de tout fichier ou extrait sélectionné dans ce produit. L'utilisation par des tiers, y compris, sans toutefois s'y limiter, des éditeurs, des professeurs particuliers, des services de tutorat ou d'aide aux études, des établissements de préparation à l'enseignement supérieur, des fournisseurs de services de planification des programmes d'études, des gestionnaires de plateformes pédagogiques en ligne, et des développeurs d'applications, moyennant paiement ou non, est interdite et constitue une infraction pénale.

Pour plus d'informations sur la procédure à suivre pour obtenir une autorisation écrite sous la forme d'une licence, rendez-vous à l'adresse <https://ibo.org/become-an-ib-school/ib-publishing/licensing/applying-for-a-license/>.

© Organización del Bachillerato Internacional, 2021

Todos los derechos reservados. No se podrá reproducir ninguna parte de este producto de ninguna forma ni por ningún medio electrónico o mecánico, incluidos los sistemas de almacenamiento y recuperación de información, sin la previa autorización por escrito del IB. Además, la licencia vinculada a este producto prohíbe el uso de todo archivo o fragmento seleccionado de este producto. El uso por parte de terceros —lo que incluye, a título enunciativo, editoriales, profesores particulares, servicios de apoyo académico o ayuda para el estudio, colegios preparatorios, desarrolladores de aplicaciones y entidades que presten servicios de planificación curricular u ofrezcan recursos para docentes mediante plataformas digitales—, ya sea incluido en tasas o no, está prohibido y constituye un delito.

En este enlace encontrará más información sobre cómo solicitar una autorización por escrito en forma de licencia: <https://ibo.org/become-an-ib-school/ib-publishing/licensing/applying-for-a-license/>.

Critical Thinking – explanation, analysis and evaluation

These trigger words often signal critical thinking. The bold words are the key terms in the various criteria.

Explanation – *Because, as a result of, due to, therefore, consequently, for example*

Analysis – *Furthermore, additionally, however, but, conversely, likewise, in addition, on the other hand, whereas*

Evaluation – *My opinion, overall, although, despite, on balance, weighing up*

Examiners should be aware that in some cases, candidates may take a different approach, which if appropriate should be rewarded. If in doubt, check with your team leader.

In the case of an “identify” question read all answers and mark positively up to the maximum marks. Disregard incorrect answers. In all other cases where a question asks for a certain number of facts eg “describe two kinds”, mark the **first two** correct answers. This could include two descriptions, one description and one identification, or two identifications.

It should be recognized that, given time constraints, answers for part (c) questions are likely to include a much narrower range of issues and concepts than identified in the markband. There is no “correct” answer. Examiners must be prepared to award full marks to answers which synthesize and evaluate even if they do not examine all the stimulus material.

1. Accessing online media

- (a) (i) Identify **two** hardware devices that Rajesh could use to view his internet protocol television (IPTV) channels. [2]

Answers may include:

- Smart TV.
- Mobile phone/cellphone.
- Tablets.
- PC/laptop.
- IPTV box (such as an Amazon Fire stick, Apple TV, etc).

Award [1] for identifying each hardware device Rajesh could use to view his IPTV channels, up to a maximum of [2].

Do not accept monitor or television.

- (ii) Identify **two** characteristics of an IP address. [2]

Answers may include:

- An address assigned to a computer/device (it must be implicit or explicit in the answer that the device is connected to a network/the Internet).
- Identifies a device.
- It can be used to identify a physical location.
- It is either 32 bits or 128 bits (IP v4 or IP v6).
- It can be static or dynamic, may be changed.

Award [1] for each characteristic of an IP address identified, up to a maximum of [2].

- (iii) Rajesh is downloading a film for offline viewing. The download speed is 80 mbps.

Calculate the amount of data, in megabytes (MB), that will be downloaded in 10 minutes. [2]

Answers may include:

- Convert 80 mbps to MB/s = $80/8 = 10 \text{ MB/s}$
- Calculation of $10 \text{ MB} \times 60 \text{ (sec)} \times 10 \text{ (min)} = 6000 \text{ MB}$

Award [1] for conversion from megabit to megabyte.

Award [2] for correct answer (if the conversion/calculation process is not shown, award it only if with correct unit).

- (b) (i) Explain why Rajesh downloaded the films rather than streaming them when he was travelling.

[4]

Answers may include:

- Films can be played offline / no internet connection is needed to play downloaded films / device connects to the source file and downloads to the hard drive.
- The downloaded files can be transferred to other devices.
- The film quality is intact.
- The downloaded files can be viewed in countries with restricted internet access.
- Streaming depends on the internet bandwidth, which may fluctuate.
- There may be film pauses due to buffering, especially with slow internet connections when streaming.

Marks	Level descriptor
[0]	No knowledge or understanding of ITGS issues and concepts. No use of appropriate ITGS terminology.
[1–2]	A limited response that indicates very little understanding of the reasons why downloading a video would be preferable to streaming it. Uses little or no appropriate ITGS terminology.
[3–4]	An explanation of the reasons why downloading a video would be preferable to streaming it. There is the appropriate use ITGS terminology.

- (ii) Rajesh has been told that subscribing to an internet protocol television (IPTV) service may compromise his anonymity.

Distinguish between anonymity and privacy.

[2]

Answers may include:

- Anonymity is knowing what activities are being carried out but not knowing who is carrying them out.
- Privacy is knowing who the person carrying out the activities may be but not knowing what these activities are.

Award [1] for each appropriate statement that distinguishes anonymity from privacy, up to a maximum of [2].

- (c) To what extent is it acceptable for Rajesh to use services like a virtual private network (VPN) to access content that may be blocked in the country he is visiting?

[8]

Answers may include:

Reasons why Rajesh could use services like a VPN:

- The service is legitimate and cannot be accessed by any other means.
- Rajesh may believe that the blocking of the service is unlawful / inappropriate / the degree of censorship is draconian.
- There may be technical advantages of using a service like a VPN.
- Through a VPN, Rajesh can browse the web in complete anonymity.
- Rajesh may find media access through a VPN more economical compared with subscribing to the same services in a different country.

Reasons why Rajesh should not use services like a VPN:

- Rajesh should abide by the laws of the country and by circumventing the laws may place himself at risk.
- The content may be deemed to be inappropriate in the host country and has been blocked for religious / security / political reasons.
- The use of a VPN may reduce the speed of downloading or streaming.
- Rajesh may not be able to download or stream films despite having a subscription to a VPN because a few broadcasting apps use anti-VPN technology to restrict content outside a specific region.

In part (c) of this question it is expected there will be a balance in the ITGS terminology between IT technical terminology and the terminology related to social and ethical impacts.

Please see generic markband on page 16.

2. Singapore shipping

- (a) (i) Identify **two** reasons why a spreadsheet would be used to store the information in **Figure 2**. [2]

Answers may include:

- A spreadsheet may require minimal training / is easier to setup.
- Inbuilt functions and formulae can be applied on data, it can perform calculations.
- Data can be arranged in a specific order, *eg* in ascending order of Shipment_Date.
- Graphs/charts can be created to summarize large amounts of data.
- Users may use dropdown menus for an item from the list, *eg* Destination column.
- To organize data in a clear manner.

Award [1] for identifying each reason why a spreadsheet has been used to store this information, up to a maximum of [2].

- (ii) State the formula to calculate the total number of containers used in Column C. [1]

Answers may include:

- =SUM(C2:C15)
- =SUMA(C2:C15)
- =ADD(C2:C15)
- =C2 + C3 + C4 ++C15

Award [1] for any one of the above.

N.B. Do not accept responses without =.

Accept the range starting from B1, *eg* =SUM(C1:C15).

- (iii) State the data type for the column headed **Shipment_Date** (column B). [1]

Answers may include:

- Date / Long Date / Short Date.

- (iv) Outline **one** reason why *SingShip* would use mail merge when producing letters for customers to advise them about their shipments. [2]

Answers may include:

- Mail merge combines the functionality of word-processing software with that of a spreadsheet...
- ...which is a far more efficient process than individually creating a document for each recipient.
- There is less chance of error if the data is stored once and then merged.
- *ShipSing* can use mail merge to create personalized letters for customers by adding spreadsheet data to the template.
- The customized letters can be generated at once for printing / emailing, saving time and effort.

Award [1] for identifying a reason why SingShip would use mail merge when producing letters for customers and [1] for a development of that reason, up to a maximum of [2].

- (b) (i) Distinguish between data validation and data verification. [2]

Answers may include:

- Data validation is about checking the input data to ensure it conforms with the data requirements of the system to avoid data errors. Data validation rules (or check routines) are used to ensure the validity (mostly correctness and meaningfulness) of data.
- Data verification is a way of ensuring the user types what they intend, to ensure they do not make a mistake when inputting data, eg double data entry.

Award [1] for each reason that clearly differentiates between data validation and data verification, up to a maximum of [2].

The product development life cycle (PDLC) was used to develop the database for *SingShip*.

- (ii) Explain **one** advantage for *SingShip* of using a development methodology, such as the product development life cycle (PDLC). [2]

Answers may include:

- Uses a recognized development process.
- Has a series of predefined stages.
- These stages can be allocated to different teams.
- Allows for concurrent working / agile or waterfall methodologies if appropriate.
- Clear roles and responsibilities among analysts, project managers, designers, developers and business analysts.
- Clearly defined inputs and outputs from one step to the next.

Award [1] for identifying a reason why SingShip would use a development methodology such as the product development life cycle (PDLC) and [1] for a development of that reason, up to a maximum of [2].

- (iii) Explain **one** disadvantage for *SingShip* of using a development methodology, such as the product development life cycle (PDLC). [2]

Answers may include:

- May be too rigid.
- ...which may lead to an increased development time.
- It may add a lot of overheads and costs.
- It may be difficult sometimes to define everything before seeing it / requirements may change frequently.

Award [1] for identifying a reason why SingShip would not use a development methodology such as the product development life cycle (PDLC) and [1] for a development of that reason, up to a maximum of [2].

- (c) The head of IT at *SingShip* has recommended that all the information stored by the company in various spreadsheets should be integrated into a single relational database.

Evaluate this decision.

[8]

Advantages of using a relational database:

- Data will only need to be entered once, so problems linked to data redundancy and update anomalies can be removed.
- Use of the database will reduce the amount of time *SingShip* will spend managing or updating data.
- Using a database allows reports to be produced, modified and used more easily than in a spreadsheet.
- Database applications can be shared among many users simultaneously.
- The database administrator may configure different access permissions for different users ensuring security of data.
- Cost efficiency – Despite the initial setup cost, the use of the database may save time in the long run, resulting in a more cost-effective solution.

Disadvantages of using a relational database:

- Substantial hardware and software may require *SingShip* additional start-up costs.
- More expense to hire IT experts to set up and manage the database.
- Data migration from legacy system/spreadsheet to database may not be straightforward, as these systems may not be fully compatible.
- The database may be more complex for employees to understand compared to spreadsheets.
- Employees may require training to use it.
- Database doesn't provide direct ways to generate graphs/charts in the way a spreadsheet does.

In part (c) of this question it is expected there will be a balance in the ITGS terminology between IT technical terminology and the terminology related to social and ethical impacts.

Please see generic markband on page 16.

3. Smart farming

- (a) (i) Identify **two** zip file formats. [2]

Answers may include:

- ZIP
- RAR
- JAR
- WAR
- Open Document Format for Office applications (ODF)

Award [1] for each zip file format identified, up to a maximum of [2].

Do not accept the name of a program (Winzip, Winrar, etc.)

- (ii) Identify **two** characteristics of Bluetooth. [2]

Answers may include:

- A short-range communication technology to connect to devices.
- Allows wireless connections between devices.
- Allows interconnection between devices.
- Uses short-range radio frequency (RF).
- Intended to replace communication that uses cabling.
- Used for building PANs (Personal Area Networks).

Award [1] for each characteristic of Bluetooth identified up to [2].

- (iii) Identify **two** types of data collected by the sensors in the data logger. [2]

Answers may include:

- temperature
- humidity
- wind speed
- climate
- rainfall
- hours of sunlight
- soil moisture content (%)
- pH of the soil.

Award [1] for each type of collected data identified, up to a maximum of [2].

- (b) (i) Explain **one** advantage of using lossless compression to send the data to the university. [2]

Answers may include:

- Lossless compression will not result in the loss of quality of the data sent, so the receiver can reconstruct the original data.
- This will ensure that any vital information is not lost or compromised.

Award [1] for identifying a reason why lossless compression would be used to send the information and [1] for a development of that reason, up to a maximum of [2].

- (ii) Explain **one** disadvantage of using lossless compression to send the data to the university. [2]

Answers may include:

- Lossless compression will take longer to be sent due to large file size – this compression technique cannot achieve high level of compression like lossy compression.
- In countries / situations where there is inadequate bandwidth, this will slow down the transmission of the data.

Award [1] for identifying a disadvantage of the data being sent using lossless compression and [1] for a development of that reason, up to a maximum of [2].

- (iii) Explain why protocols are used when data is sent from one computer to another. [2]

Answers may include:

- Agreed set of rules.
- This allows each device to communicate.
- Enables secure communication.
- Covers authentication, error detection and correction.
- Helps in tracing the source of message.
- Is cross platform.
- Ensures reliable transmission of data.

Award [1] for identifying why a protocol such as TCP/IP is used for the communication of data and [1] for a development of that reason, up to a maximum of [2].

- (c) The scientists who developed the app have received many complaints from farmers who have been unable to use it. They are considering two options:
- Making the existing system more user friendly.
 - Educating the farmers to use the existing system.

Evaluate these two options.

[8]

Answers may include:

Advantages of making the system more user friendly:

- May reduce development costs, as the work can be carried out at the university.
- May only require minimal adjustments to the interface.
- Can probably be done in the short term, so will have a more immediate impact.
- Will require little or no training of farmers, so cheaper than providing training, which may involve the development of online training sites or require farmers to travel to a college.
- May require less testing before the improved interface is introduced.
- Farmers may wish to use it.

Disadvantages of making the system more user friendly:

- Farmers may not like the change.
- It could be costly.

Advantages of educating the farmers to use the existing system:

- Will provide a longer-term solution that will be beneficial over a longer period.
- May provide other benefits, as farmers become more tech savvy.
- May give farmers a greater ownership of the initiative.

Disadvantages of educating the farmers to use the existing system:

- Farmers may not like the process of training.
- Farmers may have difficulty in learning.

In part (c) of this question it is expected there will be a balance in the ITGS terminology between IT technical terminology and the terminology related to social and ethical impacts.

Please see generic markband on page 16.

4. Human genome research

- (a) (i) State the role of a primary key in a relational database table. **[1]**

Answers may include:

- A primary key provides a unique identifier for each record in a table.

Award [1] for correctly stating the role of a primary key.

- (ii) State the role of a foreign key in a relational database. **[1]**

Answers may include:

- A foreign key acts as a reference between two tables / creates a link between them.

Award [1] for correctly stating the role of a Foreign Key.

- (iii) Identify **two** reasons why a relational database, rather than a flat-file database, is used to store the data for *MediResearch*. **[2]**

Answers may include:

- Removes update anomalies / updates are easier, as data is only stored once.
- Removes the risk of data redundancy.
- Reduces storage requirements.

Award [1] for identifying each reason why a relational database is used to store the data for MediResearch, up to a maximum of [2].

- (iv) Identify **two** features of data mining. **[2]**

Answers may include:

- The practice of interrogating (large) databases.
- To uncover patterns in the data that would not normally be apparent.

Award [1] for each characteristic of data mining identified, up to a maximum of [2].

- (b) *MediResearch* is looking to expand access to the genome data it holds by sharing it with other companies.

Explain **three** strategies that *MediResearch* could use to ensure the security of the genome data.

[6]

Answers may include:

- Using additional authentication processes, such as a PIN or a text/SMS...
- ...which will mean a second device is required for authentication to take place.

- Setting different levels of access so only specified employees have access to the most sensitive data...
- ...meaning less likelihood of this sensitive data being accessed.

- Designing the database so that the most sensitive data is placed in a table that only specified employees have access to...
- ...reducing the likelihood of this sensitive data being accessed.

- Encryption on the stored data....
- ... will ensure only users or devices who are authorised can access the stored data.

- VPN/Encryption when transferring the data to other companies...
- ... ensure that if data is intercepted it is not compromised.

- Creating policies/agreements between parties...
- ... which will dictate the way the data can be shared and used.

Award **[1]** for identifying each policy and **[1]** for a development of the policy identified, up to a maximum of **[3]**.

Mark as **[2]** + **[2]** + **[2]**.

- (c) The chief executive officer of *MediResearch* is considering using cloud-based storage to store the genome data.

Discuss whether *MediResearch* should move to cloud-based storage.

[8]

Answers may include:

Advantages of cloud-based storage:

- No need for them to invest in storage infrastructure on site.
- Data security will be provided by the company responsible for the cloud-based storage.
- Data back-up facilities will be provided by the company responsible for the cloud-based storage.
- Collaborating and sharing genome data with other data companies or external scientists will be more convenient.
- Accessibility: Having the data on the cloud will enable the *MediResearch* scientists to work remotely using an internet connection.
- Scalability: *MediResearch* can expand or reduce storage capacity subscription on a needs basis.

Disadvantages of cloud-based storage:

- The data may be managed by a third party, which could cause issues linked to its use.
- *MediResearch* may feel that data security may be more easily compromised.
- The company will have to ensure that they have enough internet bandwidth for data accessibility.
- Storing data in the cloud may sometimes be difficult – *MediResearch's* existing data management may not integrate well with the cloud vendor's system.
- Considering the nature and sensitivity of the genome data held by *MediResearch*, the government policies of the country where the cloud storage unit is placed may influence the way data is stored/used or shared.

In part (c) of this question it is expected there will be a balance in the ITGS terminology between IT technical terminology and the terminology related to social and ethical impacts.

Please see generic markband on page 16.

SL and HL paper 1 part (c) and HL paper 3 question 3 markband

Marks	Level descriptor
No marks	<ul style="list-style-type: none"> ● A response with no knowledge or understanding of the relevant ITGS issues and concepts. ● A response that includes no appropriate ITGS terminology.
Basic 1–2 marks	<ul style="list-style-type: none"> ● A response with minimal knowledge and understanding of the relevant ITGS issues and concepts. ● A response that includes minimal use of appropriate ITGS terminology. ● A response that has no evidence of judgments and/or conclusions. ● No reference is made to the scenario in the stimulus material in the response. ● The response may be no more than a list.
Adequate 3–4 marks	<ul style="list-style-type: none"> ● A descriptive response with limited knowledge and/or understanding of the relevant ITGS issues and/or concepts. ● A response that includes limited use of appropriate ITGS terminology. ● A response that has evidence of conclusions and/or judgments that are no more than unsubstantiated statements. The analysis underpinning them may also be partial or unbalanced. ● Implicit references are made to the scenario in the stimulus material in the response.
Competent 5–6 marks	<ul style="list-style-type: none"> ● A response with knowledge and understanding of the relevant ITGS issues and/or concepts. ● A response that uses ITGS terminology appropriately in places. ● A response that includes conclusions and/or judgments that have limited support and are underpinned by a balanced analysis. ● Explicit references to the scenario in the stimulus material are made at places in the response.
Proficient 7–8 marks	<ul style="list-style-type: none"> ● A response with a detailed knowledge and understanding of the relevant ITGS issues and/or concepts. ● A response that uses ITGS terminology appropriately throughout. ● A response that includes conclusions and/or judgments that are well supported and underpinned by a balanced analysis. ● Explicit references are made appropriately to the scenario in the stimulus material throughout the response.