Markscheme

May 2022

Information technology in a global society

Standard level

Paper 1

17 pages

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.   Medical data shared in online apps

Note to examiners:
- All part (a) and (b) questions are marked using ticks and annotations where appropriate.
- Part (c) is marked using a markband. Use annotations and text comments to provide a rationale behind the marks you awarded. **Do not use ticks**.

(a)   (i)   Define the term *privacy*.   **[2]**

Answers may include:
- knowing who somebody is...
- … but not knowing what activities they are carrying out.

- having control over one's personal information
- … such as the ability of individuals/groups to determine when, how and to what extent their personal information is shared with others (Guide p.21).

Award [1] for identifying privacy and [1] for an additional comment.

(ii)   Identify **two** ways the smartwatch and cellphone (mobile phone) could use to communicate with each other.   **[2]**

Answers may include:
- Bluetooth.
- WiFi
- Near fild communication (NFC).

Award [1] for identifying each way that the smart watch and the mobile phone could use to communicate with each other up to [2].

(iii)   State the domain name.   **[1]**

yourhealthwatch.com

Note to examiners: accept www.yourhealthwatch.com

(iv)   State the protocol used in the URL.   **[1]**

https / hypertext transfer protocol secure

(b) (i) The team developing the smartwatch app followed the project development life cycle (PDLC).

Explain why end-users should be involved in the development of products such as the smartwatch app. **[3]**

Answers may include:
- End-users are able to provide an insight into how a product may function
- … which may not be possible to obtain from in-house testing (alpha testing)
- … as this may not expose the product to the range of situations it may be expected to function in
- … and could be considered to be beta testing
- … will make end-product more marketable / desirable to the end-user.

- End-user testing can take place in the customer's environment.
- … allowing them to use the program under normal conditions
- … which may allow them to find 'bugs' / features which need improving / discover new features and suggest these to the developers
- … which may lead to making the end-users more likely to use the finished product as they are involved in its development.

Award [1] for identifying a reason why end-users should be involved in the development of products such as the smartwatch app and [1] for each subsequent development of that reason up to [3].

Note to examiners: the development of one idea with two additional points that develop it.

(ii) Explain why a feasibility study would be used in the development of products such as the smartwatch app. **[3]**

Answers may include:
- Feasibility studies can provide the parameters for the development of a product.
- This may provide / set constraints that the developers can work within.
- … and may prevent the development going in directions that may prove to be unsustainable.
- Determine the technical viability.
- Determine the economic viability.
- Determine how much time the project may take.

Award [1] for identifying a reason why a feasibility study would be used in the development of products such as the smartwatch app and [1] for each subsequent development of that reason up to [3].

Note to examiners: the development of one idea with two additional points that develop it.

(c)   Many people use smartwatches to monitor their vital signs and manage their
        health.

        To what extent should an individual use a smartwatch to manage their health?   **[8]**

        Answers may include:
        Advantages:
        - Patients will be able to keep abreast of their vital signs / medical condition
          24/7.
        - This can lead to them having less need to go to the doctors or to use valuable
          health resources if the condition is not serious.
        - All the historical data may be captured.
        - The data will be more comprehensive than if it is only collected in a
          consultation with a doctor.
        - Which may mean it is easier to spot trends / abnormalities.
        - Might allow users to better manage illnesses which can be controlled, like
          diabetes and high blood pressure.
        - Allows users to maintain a healthy lifestyle as their vital signs can show the
          benefits of healthy activity e.g., exercise, good sleep, eating well etc.

        Disadvantages:
        - The app might suggest treatments which are not appropriate if the user's
          symptoms do not match the 'average' symptoms for a particular condition.
        - Users of the smartwatch may become fixated by it, which could have negative
          effects (white coat syndrome).
        - May be unreliable - may be lost or damaged or experience software bugs
          which make them unreliable.
        - Technology in a smart watch may not provide accurate enough readings for
          medical use.
        - The user may not want to use the watch because they are worried about what
          might happen to the data which the watch generates i.e. could be sold to or
          shared with third parties / used against them by insurance companies or
          potential employers etc.

        *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 17.

2. Investigation of ocean disasters

Note to examiners:
- All part (a) questions and part (b)(i) are marked using ticks and annotations where appropriate.
- Part (b)(ii) and the part (c) questions are marked using a markband. Use annotations and text comments to provide a rationale behind the marks you awarded. **Do not use ticks**.

(a)   The voyage data recorder (VDR) records weather conditions during a voyage.

    (i)   Identify **two** sensors that may be used to detect data about the weather conditions. **[2]**

    Answers may include:
- (Atmospheric) pressure
- Temperature
- Wind (speed/direction)
- Humidity
- Rain / precipitation / water level (BOD)
- Sunlight

    Award [1] for identifying each sensor that may be used to detect data about weather conditions up to a maximum of [2].

    (ii)   State the primary key in the Ship table in **Figure 3**. **[1]**

    Ship_ID

    (iii)   State the relationship between the Ship table and Accident table in **Figure 3**. **[1]**

    One – many

    (iv)   Outline **one** advantage of using a relational database rather than a flat-file database. **[2]**

    Answers may include:
- Any item of data is only entered once.
- … which eliminates redundant data.

- Removing redundant data
- … reduces the amount of storage space needed for the database.
- … reduces the chance of an error occurring.

- Normalization
- … reduces the chance of anomalies (*eg* update / deletion / insertion).

- Improves security of the data
- … as different permissions can be added to different tables.

    Award [1] for identifying an advantage of a relational database rather than a flat-file database and [1] for a development of that reason up to [2].

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

Answers may include:
- Data validation is the process of ensuring the data entered is valid (clean, correct and useful) using computer based rules (*e.g.* presence check, length check, type check, range check *etc*).
- Data verification is the process of checking what has been entered is correct compared to the original (integrity) or by entering the data twice and comparing the instances of the data entry.

Award [1] for a definition of data validation.
Award [1] for a definition of data verification.

(ii) The MADAS system uses data visualization.

Explain why data visualization is used by the MADAS system. **[4]**

Answers may include:
- Visualization is story telling with images, graphs and charts.
- It uses mathematical operations to model events.
- This enables complex data to be presented in a way that can be easily understood.
- This allows the easy identification of trends
- … to make connections between operations and results
- … to identify future problems which may arise / predict accidents.

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 why data visualization is used by the MADAS system.
	Uses little or no appropriate ITGS terminology.
	No reference is made to the scenario.
3–4	An explanation of why data visualization is used by the MADAS system.
	There is appropriate ITGS terminology throughout the response.
	Explicit and relevant references are made to the scenario.

(c)   To what extent can the use of simulations like the MADAS system help prevent
       future accidents?   **[8]**

       Answers may include:

       Advantages:
       - There is a lot of data and if this is put together usefully then the causes of the
         accident can be better understood.
       - Understanding the accident will mean that mitigation strategies can be
         developed.
       - If the simulation was part of a training program then the simulations could be
         used to teach future boat pilots how to avoid the same kind of accidents.
       - Cheaper to run a situation through a simulation to see what will happen than
         to wait for it to happen in real life.
       - The information from the model and simulation may allow the authorities to
         make changes to the regulations.
       - "What if" simulation can be easily run to observe the effects of changes in
         behaviour or conditions.

       Disadvantages:
       - Simulations are only as accurate as the data which is given to them. GIGO.
       - Simulations might be biased because they have been created by a particular
         organisation / company.
       - Simulations are not the real thing so even if a person has trained on a
         simulation, there is no guarantee that this will mean they will know what to do
         if facing a possible accident.
       - Too many variables to account for and it is unclear which of these might have
         made the accident worse or better.

       *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 17.

3.   Schools told not to use cloud computing software applications

Note to examiners:
*   All part (a) and (b) questions are marked using ticks and annotations where appropriate.
*   Part (c) is marked using a markband. Use annotations and text comments to provide a rationale behind the marks you awarded. **Do not use ticks**.

(a)   (i)   Identify **two** types of cloud computing software applications that students might use at school.   **[2]**

Answers may include:
*   Word processor: Google Docs / Microsoft Word.
*   Spreadsheet: Google Sheets / Microsoft Excel.
*   Email: Gmail / MS Outlook.
*   Presentation: Google Slides / MS PowerPoint.
*   Web site design: Google Sites.
*   Calendars: Google Calendar.
*   Online forms: Google Forms / MS Forms.
*   Collaboration tools: Microsoft Teams / Google Classroom.
*   Storage apps: Microsoft OneDrive / Google Drive
*   Video Communication: Zoom, Skype, Teams, Meet etc.
*   Learning Management Systems: Blackboard/ Moodle / Powerschool / Canvas / Schoology etc.

Award [1] for identifying each application up to [2].

Note to examiners:
DO NOT accept Microsoft Office / Office 365 / Google Workspace / Gsuite as these are mentioned in the stimulus materials on the question paper.

(ii)   If the schools in Hesse can no longer use cloud computing software applications, they will need to store their data on a local file server and access it through a local area network (LAN).

Identify **two** ways in which data could be secured if the school stored it locally.   **[2]**

Answers may include:
*   Different levels of access
*   Login (username and password / biometrics)
*   Firewalls, proxy server
*   Encryption
*   Audit trails
*   Anti-virus / anti-malware software
*   Physical security of the servers

Award [1] for identifying each way the data can be stored securely up to [2].

(iii)   The change from cloud computing software applications may require the school to change the type of licence they need to purchase.

Identify **two** types of licence that the school could purchase to allow them to install and run software applications on their local area network (LAN).   **[2]**

Answers may include:
- Site / school
- Concurrent
- Multi user
- Single user
- Educational licence
- Volume Licence

*Award **[1]** for identifying each licence type up to **[2]**.*

(b)   The European Union's (EU) General Data Protection Regulation (GDPR) governs data protection and privacy in the EU. Its regulations give users certain rights in terms of their data.

Explain **three** principles that should be included in data protection regulations such as GDPR.   **[6]**

Answers may include:
- The right to know who has access to my data
- … and for the purposes it is being used for.

- The level of security used to protect the data
- … so only appropriate users of the data have access.

- The purpose that the data will be used for
- … will it be shared with third parties.

- Data will not be processed without informed consent from the owner
- … unless there is a legal requirement to process the data

- Requires that the holder of the data controller provides information to the data subject
- … in a concise, transparent, intelligible and easily accessible form, using clear and plain language.

- The data subject has the right to be forgotten
- … so data can be deleted after it has served its required purpose.

- Data should be stored on a server within the same country or within a country with similar data protection legislation in place.
- … so that the owner of the data is sure that its security remains protected.

*Award **[1]** for identifying a principle that should be included in data regulation principles such as GDPR and **[1]** for a development up to **[2]**.*

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

(c) A new school has opened in Switzerland and its IT Manager is considering two options:
- **Option 1:** Using a local client–server network.
- **Option 2:** Using a cloud-based service.

Evaluate the implications of these two options for the IT Manager. **[8]**

Answers may include:
Option 1:
Advantages
- The management of the client-server network can be carried out in-house which will mean the way in which the network is set up can be tailored to the school's needs.
- There will be fewer costs to external agencies for the upkeep of the network i.e. there is no monthly fee / subscription fees etc. Which will need to be managed by the IT Manager.
- The IT Manager will have complete knowledge about where their data is held.
- A client-server network allows in-house control of backup and security (this could be argued from both sides depending on the competency of the IT staff).

Disadvantages
- The hardware costs for network infrastructure as well as software licencing costs will need to be paid by the school and managed by the IT manager.
- IT manager will need to employ staff who can manage the network and maintain the hardware or arrange for this to be outsourced.

Option 2:
Advantages
- The management of the client-server network can be carried out remotely by the cloud service provider which will mean that IT Manager will not have to carry out a number of tasks linked to the maintenance of the network.
- The cloud-based provider will provide backing up facilities as part of the service so the IT Manager will not have to address this issue.
- The cloud-based provider will be able to provide up to date versions of software and services more efficiently than the IT Manager who may have to buy them in after carrying out due diligence.

Disadvantages
- Increasing the storage capacity of the network would be easily done by requesting this from the cloud service provider. No addition hardware or infrastructure will be required.
- There will still be a need to have some hardware and software on site (for example print servers) which will need to be purchased and maintained by the IT manager.

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 17.

4. **China's social credit scheme**

Note to examiners:
- All part (a) and (b) questions are marked using ticks and annotations where appropriate.
- Part (c) is marked using a markband. Use annotations and text comments to provide a rationale behind the marks you awarded. **Do not use ticks**.

(a) (i) Define the term *resolution*. **[2]**

Answers may include:
- Quality of an image
- Number of dots per inch.
- May be measured in DPI or pixels.
- Number of dots in an image.

Award [1] for identifying each characteristic of the resolution of an image up to [2].

(ii) Identify **two** types of image file. **[2]**

Answers may include:
- jpg / jpeg
- tiff
- png
- bmp / bitmap
- gif

Award [1] for identifying each file type up to [2].

(iii) Distinguish between authentication **and** authorization. **[2]**

Answers may include:
- Authentication – confirming the identity of a person/the person is who they say they are.
- Authorization – determining the user's access levels to computer resources.

Award [1] for a definition of authentication.
Award [1] for a definition of authorization.

(b)　(i)　Other governments are considering setting up similar systems that will use facial recognition to gather information about the behaviour of its citizens.

Explain why the development of a requirements specification is important in the development of a new facial recognition system.　　　　**[3]**

Answers may include:
- Sets out the key decisions that need to be made about the nature of the solution.
- Identifies the potential challenges in the implementation of the facial recognition system.
- Provides a list of goals/benefits/challenges.
- Provides some indication of what may be required in a feasible solution such as hardware and software requirements.
- Helps to estimate budgets to have a proper solution implementation based on the requirements.
- Reduces chance of errors.
- Reduces the need for redesigns – therefore saving money.
- Gives a list of functional requirements against which the final system can be tested.

Award [1] for identifying a reason why the development of a requirements specification is important and [1] for each subsequent development of that reason up to [2].

(ii)　Explain why using high-resolution images could be a challenge to the implementation of a facial recognition system.　　　　**[3]**

Answers may include:
- High resolution images may require a longer transfer time.
- Which will require computers with high specifications to be processed in a timely manner.
- May require considerable storage space.
- May require lossy compression to transfer them quickly which may lead to a reduction in the quality / usefulness of the image.

Award [1] for identifying a reason why having images with a higher resolution could be a challenge to the implementation of a facial recognition system and [1] for each subsequent development of that reason up to [2].

(c) Discuss the advantages **and** disadvantages of a government using a facial recognition system to monitor the behaviour of its citizens. **[8]**

Answers may include:
Advantages:
- May improve people's behaviour as they will know they are being watched.
- May stop crime before it happens meaning fewer people in jail or in court. Similar to a speeding camera but for people.
- Might need fewer police to patrol and put themselves in danger.
- Could help to improve the physical environment by catching those who litter / responsible for polluting the environment.
- Could allow people to be more accurately identified leading to fewer false accusations/prosecutions.
- Allows the government to track and apprehend criminals i.e., makes society safer as criminals are caught.

Disadvantages:
- Feeling of being watched will be bad for morale of population.
- May lead to a distrust in the government.
- Might be punished incorrectly (or rewarded incorrectly) if the facial recognition fails.
- Criminals might just find other ways of committing crime (like wearing masks or avoiding the cameras).
- People wear masks (against pollution) or hats which cover their faces (when it is very cold), won't be recognised that easily.
- Invasion of privacy as people are never able to not be under surveillance.
- May take up considerable resources in developing and maintaining the data and hardware.
- Facial recognition is not that accurate so there might be many false positives.

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 17.

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

Marks	Level descriptor
No marks	• 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	• 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	• 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	• 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	• 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.