Diploma Programme
Programme du diplôme
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Markscheme

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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 explanations, 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. Parents "cyber-spying" on their children

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

(a) (i) Identify **two** features of spyware. **[2]**

Answers may include:
- spyware collects data/information about a person, such as internet surfing habits, passwords, log in details, monitors keystrokes / keylogger, accesses data stored on the device
- spyware is hidden from the user/is anonymous - the user is not aware of its presence (hence the name: it is like a spy) and has not given consent
- spyware can have different functions
  - some spyware only collects data and monitors what the user does
  - others can install additional software
  - start controlling the computer (for example hijacking the modem, controlling the camera etc.)
  - can weaken the computer security by disabling firewalls and antivirus software
  - can detect when the user is engaged in suspicious activity
  - can access the content of emails sent and received
- spyware can take different forms such as adware or trojan horses
- spyware is usually regarded as malicious and harmful, but not always, for example when used by law enforcement and security/intelligence agencies
- spyware is installed on a user's computer without their knowledge.

Note to examiners: The question stem does not make a clear distinction between "spyware" and "monitoring software". The terms should therefore be regarded as equivalent/synonymous in candidates' responses.

Award ***[1]*** *for identifying each feature of spyware up to a maximum of* ***[2]****.*

(ii) Identify the steps taken by a GPS device to determine its location. **[4]**

Answers may include:
- GPS device gets signal from the first satellite
- uses radio signals
- GPS device calculates how far it is this first satellite (based on how long it took for the signal to travel)
- GPS device does the same for 2-3 (or more) other satellites (minimum total number is 3 satellites. At least 4 satellites are required for accurate location.)
- GPS device calculates the distance from the 3 or more satellites (called triangulation)
- GPS device uses this calculation to determine the latitude, longitude and altitude of its current position
- GPS device takes this location information and displays it on map files stored in its memory.

Award ***[1]*** *for identifying each step taken by a GPS device to determine its location up to a maximum of* ***[4]****.*

(b) The developers of Qustodio decided to use automated keyword detection to monitor for signs of cyber-bullying.

Analyse this decision. **[6]**

Answers may include:

Advantages of using automated keyword detection

- the suspicious message could be stopped even before it appears on the child's device
- automated keyword detection is immediate and can instantaneously draw parents' attention to suspicious messages and their authors
- there is no need for parents to read through all the messages
- the system may help discourage children who know they are being monitored from sending suspicious messages.

Disadvantages of using automated keyword detection

- some terms may be wrongly detected as sign of cyberbullying when in fact they are innocuous in context
- some people may use alternative spelling or leetspeak to go around this issue, for example "I8u" for "I hate you". Teenage language evolves more rapidly than the software could incorporate new keywords
- cyberbullying is not just about words but also tone, style, intention, sarcasm, which automated keyword detection could not spot
- not all cyberbullying is carried out through text (e.g. image-based) so a keyword detector would not be effective in these cases
- the software might only be able to detect keywords in certain commonly-spoken languages.

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 topic or the reason is not clear. Uses little or no appropriate ITGS terminology. No reference is made to the scenario in the stimulus material. The response is theoretical.*
3–4	*A description that is unbalanced or a partial analysis of the issues related to the use automated keyword detection to monitor for signs of cyberbullying. There is some use of appropriate ITGS terminology in the response.*
5–6	*A balanced and detailed analysis of the relative advantages and disadvantages of the use automated keyword detection to monitor for signs of cyberbullying. Explicit and relevant references are made to the scenario in the stimulus material. There is appropriate ITGS terminology throughout the response.*

(c) To what extent is it acceptable for parents to use apps such as Qustodio and TeenSafe to monitor their child's online activities? **[8]**

Answers may include:

Reasons why it is acceptable

- parents may want to control the contents of websites that their child is going to access
- parents may be worried about who contacts their child online and what messages they exchange/gives parents a sense of relief of knowing what their child is up to
- parents are responsible for the safety and wellbeing of their child and feel it is their duty, as parents, to monitor their child's online activities
- parents pay for the mobile devices, in most cases, so they feel that have the right to know how, when and for what purpose the devices are used.

Reasons why it is not acceptable

- children have a right to privacy, which these apps refute and deny
- the use of apps could involve data being sent to the app developers which potentially introduces new privacy issues
- children may not know that their parents monitor their messages and online activities, which can be detrimental to trust and honesty within the family
- there is no consent: the children may not be asked whether they agree or not
- younger children may need to be protected, but teenagers may feel they have a right to exchange messages in all confidentiality with other people, without their parents spying on them.

Marking note: Do not accept references to hacking. The question is about the acceptability of parents monitoring their child's online activities

Please see generic markband information sheet on page 19.

2. Braille keyboards

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

(a) (i) Identify **two** features of American Standard Code for Information Interchange (ASCII). **[2]**

Answers may include:
- ASCII is the standard system to encode and represent English characters as numbers, (for example, upper case L is 76
- ASCII code numerically represents alphabet letters, but also signs such as "%" or "@" or even some actions such as "backspace" or "delete"
- ASCII is a simple "raw" format that any computer can understand (plain text, no formatting)
- the standard ASCII character set uses 7 bits for each character (though some non-English letters and graphic symbols use 8 bits)
- ASCII has 128 characters (each character is assigned a number from 0 – 127 *e.g.* L is 760.

Award ***[1]*** *for identifying each feature of ASCII up to a maximum of* ***[2]****.*

(ii) Describe **two** methods that Umair could have used to gather data from visually impaired people during the development of his system. **[4]**

Answers may include:

One-to-one interviews
Umair could have spoken with visually impaired people, individually, asking them about their experience or about their own particular needs from a Braille keyboard. At the very beginning of the development of his system, this could have helped him define and refine the specification, as they are the target users.

Focus groups
Umair could have spoken with a small group of visually impaired people, asking them to test and compare different versions of the overlay he was producing, discussing their advantages and advantages at the same time, encouraging them to share ideas and speak with one another.

Surveys
Umair could have carried out some quantitative research, with questionnaires in Braille, asking questions to a number of visually impaired people in order to collect data from a larger sample, more representative of the population of visually impaired people who may be the end users of his Braille keyboard.

Direct observation
Umair could have visited a place where visually impaired individuals use the system to observe how it is used, how it can be improved and make notes on what features would be appropriate for the new system. In other words, observe people using a braille keyboard

*Award **[1]** for identifying each method Umair could have used to gather data from visually impaired people during the development of his system and **[1]** for description of that method up to a maximum of **[2].***

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

(b) Umair has decided to release his Braille software as open source software, rather than proprietary software.

Explain why Umair took this decision. **[6]**

Answers may include:

- Umair seems more motivated by "doing good" and helping visually impaired people than by making a profit
- the software could be gradually and freely improved by other experts, for example creating versions in different languages
- open source community is more active than a company's helpdesk, offering accessible and timely support
- the software may evolve/update more rapidly than if it was a commercial product
- the time taken to register the software and gain patents may lead to other software developers creating similar software that would reduce the impact of Umair's software if it became proprietary
- open source software is generally supplied free of charge making it more accessible to a wider range of people (e.g. schools, charities, people on low incomes etc.)
- open source software can be published under one of the Creative Common licenses, which are free to use. Proprietary software may require more complex and costly methods (e.g. patenting) to protect Umair's intellectual property rights.

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 topic or the reason is not clear. Uses little or no appropriate ITGS terminology. No reference is made to the scenario in the stimulus material. The response is theoretical.*
3–4	*A description or partial explanation of why Umair released his software as open source software. There is some use of appropriate ITGS terminology in the response.*
5–6	*A comprehensive explanation of why Umair released his software as open source software. Explicit and relevant references are made to the scenario in the stimulus material. There is appropriate ITGS terminology throughout the response.*

(c) Umair has two options:
- Option 1: he could continue to develop his software and Braille keyboard by using crowdfunding.
- Option 2: he could sell the intellectual property rights to *AssistivIT*, a large company that develops software.

Evaluate these **two** options. **[8]**

Answers may include:

Reasons for Umair continuing to develop the software for his Braille keyboard using crowdfunding
- the Braille keyboard and associated software is very much Umair's vision and he may not want to relinquish control of it as he may have an emotional attachment to the software
- using crowdfunding would allow Umair to remain true to his principles such as using open source software
- Umair may be able to develop working relationships with other like-minded individuals who may be willing to fund his development work without him having to change his vision
- the use of crowd funding may lead to a relatively cheap product which may help to reduce the digital divide between sighted and visually impaired people
- crowdsourcing may enable more rapid development of the software and overlay
- Umair would lose any revenue from the software
- AssistivIT may increase the price of the software and make it inaccessible to many of the potential customers Umair was intending his low-tech solution for.

Reasons for Umair selling the IP for his software and keyboard to *AssistivIT*
- Umair may have gone as far as he can with developing the software and overlay and
  may realise that investing any more of his time and money in the venture will bring little additional benefits
- developments in both hardware and software may lead to solutions of a similar standard being developed more cheaply than Umair will be able to
- Umair may realise that his strengths lie in the development of innovate solutions rather than selling them, so he may have to accept that his head must rule his heart
- Umair may see the payment from *AssistivIT* as funding to start his next initiative
- *AssistivIT* will be able to provide reliable ongoing funds (e.g. for development / maintenance)
- *AssistivIT may have a larger development team that can develop the software more rapidly than Umair would be able to do so alone*.

Note to examiners: The bullet points above concentrate mostly on positive reasons for each decision. Examiners should give credit for valid reasons expressed as negatives.

Please see generic markband information sheet on page 19.

3. Hurricane warning systems

Note to examiners:
- *All part (a) questions are marked using ticks and annotations where appropriate.*
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(a) (i) Identify **two** file types that could be used for the image in **Figure 3**, which shows the potential tracks of Hurricane Irma. **[2]**

Answers may include:
- JPG/JPEG
- PNG
- TIFF
- GIF
- BMP

Accept video formats such as

- Mp4
- Mov
- Avi
- Wmv
- Flv

Award ***[1]*** *for identifying each file type that could be used to show the potential tracks of Hurricane Irma up to a maximum of* ***[2]****.*

(ii) Outline the difference between data and information. **[2]**

Answers may include:
- "data" is simply a list of facts or figures/raw data
- "information" is "data" which has a context/has been processed/analysed.

Award ***[1]*** *for a definition of either data and information, and* ***[1]*** *for a definition of the other up to a maximum of* ***[2]****.*

(iii) Outline why visualization is used to present data. **[2]**

Answers may include:
- visualization presents the data in a form that is easily understandable such as images and charts
- therefore, it can be presented to audiences who may not have the specialist knowledge required to understand the information in its raw form/aids the prediction of future events

- visualization may synthesise the data
- so it can be presented in a simplified, yet understandable, manner.

Award ***[1]*** *for identifying a reason why visualisation is used and* ***[1]*** *for a development of that reason up to a maximum of* ***[2]****.*

(b) (i) Distinguish between a model and a simulation. **[2]**

Answers may include:
- a model is a simplified version of reality/a program to replicate a real-life system
- a simulation is the operation of the model over time/uses a model to study a real-world system under certain conditions/allows the variables within the model to be changed over time and a series of "what-if" scenarios can be run to see the effects of these changes.

*Award **[1]** for a definition of either a model or a simulation and **[1]** for a definition of both up to a maximum of **[2]**.*

(ii) Different weather variables such as wind speed and temperature need to be collected in order to predict the track of a hurricane. Wind speed data is sampled more frequently than temperature data in a hurricane.

Explain **one** reason why wind speed data would be sampled more frequently than temperature data in a hurricane. **[2]**

Answers may include:
- the faster a variable such as wind changes
- the more frequently it must be sampled.

- wind speed is the critical and rapidly changing variable in the hurricane
- therefore, it needs to be sampled as regularly as possible to be able to monitor the possible trends

- sampling the wind speed frequently
- enables the track of the hurricane and its effects to be predicted more accurately.

- temperature data does not change as rapidly as wind speed
- therefore the sample rate can be lower.

*Award **[1]** for identifying each reason why wind speed data would be sampled more frequently than temperature data in a hurricane and **[1]** for a development of that reason up to a maximum of **[2].***

(iii) Explain why the data collected about Hurricane Irma was not encrypted prior to being transmitted. **[2]**

Answers may include:

- the data being collected is not sensitive in nature
- therefore, there is no need to encrypt the data as a data breach would not cause an issue

- as data encryption is not a necessary measure
- the IT requirements to ensure the transmission of data are reduced so resources can be allocated elsewhere.

- not encrypting /decrypting the data will speed up processing
- in a time-critical scenario.

- not encrypting the data makes it immediately available to the wider scientific community
- which allows them to improve their hurricane models.

*Award **[1]** for identifying a reason why the data being collected about the hurricane does not need to be encrypted and **[1]** for a development of that reason up to a maximum of **[2]**.*

(c) *Panasonic* does not make its PWS model available to governments, as the company says that doing so would compromise its commercial interests.

Discuss whether governments should make private companies such as *Panasonic* share their data. **[8]**

Answers may include:

It is acceptable for governments to make private companies such as *Panasonic* share their data

- with its PWS, *Panasonic* has proved better than the American and European models at predicting the path of Hurricane Irma, so *Panasonic* should share its data, not only to help the government, but also to help people, rather than keeping vital information private and confidential
- hurricanes may have devastating consequences for people and property, so in such a situation of crisis, the government should have the power and the right to access any data, even private data, that can save life
- there is no issue of individual/personal privacy or confidentiality, so this is not a case where the government would infringe on people's rights or liberty.

It is not acceptable for governments to make private companies such as *Panasonic* share their data

- *Panasonic* has invested a lot of money and other resources (such as engineers' time) to develop its PWS model, so it is not fair towards the owners, shareholders and even workers that suddenly the government gets access for free to all the data collected by *Panasonic*
- if governments believe they should use data from aircraft and similar sources, like *Panasonic*, they should develop such programmes of weather predictions, rather than relying on weather balloons
- as a principle, governments should respect the private nature of data that belongs to independent companies, otherwise this could open the gate to many other cases in scientific research (*eg* with pharmaceutical drugs) where the governments overstep their boundaries and their rights
- if the data from the company is incorrect and there are serious repercussions as a result, who is accountable?

Please see generic markband information sheet on page 19.

4. Electronic voting (e-voting)

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

(a) (i) Other than font size, identify two features of the GUI that could be customized so that it is accessible for all voters, including people with physical, sensory and other challenges. **[2]**

Answers may include:
- colour scheme, especially contrast in colour (*eg* white text on black background, or dark blue text on pastel background)
- simple and unambiguous language
- use of images, visuals or logos (eg for politicians or political parties)
- icons / menus for commands to select the candidate
- text to speech / audio instructions
- voice commands
- screen magnification (e.g. being able to magnify part of the screen)
- language options for those persons who are voting and require an alternative language.

Award ***[1]*** *for identifying each aspect of the GUI that could be customised, up to a maximum of* ***[2]****.*

(ii) Identify **two** features of authentication. **[2]**

Answers may include:
- authentication is about verifying the identity of the user: it intends to prove that you are the person you claim to be
- authentication can be done by using a range of methods such as username/password/PIN/biometric feature *etc*
- authentication is preceded by identification: identification is about giving one's identity, but authentication goes further – it provides more evidence to confirm this
- authentication is usually followed by authorization: once your identity is confirmed, you then have access to some actions
- information provided by the user is compared with information stored in a user database.

Award ***[1]*** *for identifying each feature of authentication up to a maximum of* ***[2]****.*

(iii) Identify **two** features of encryption. **[2]**

Answers may include:
- encryption is the process of coding a message so that only authorized parties can decode it and read it
- encryption is made possible by an encryption algorithm (cipher) generating ciphertext that needs to be decrypted (using a key) before it can be read
- the two main types of encryption are "symmetric" (the encryption and decryption keys are the same) and "public/private key" (only the receiver has the decryption key).

Award ***[1]*** *for identifying each feature of encryption up to a maximum of* ***[2]****.*

(b) Elections using e-voting in countries such as Finland will create significant amounts of personal data. The government of Finland will have to ensure it has appropriate policies for the **collection**, **storage** and **sharing** of the data.

Explain why it is important to have an appropriate policy for the **collection**, **storage** and **sharing** of the data from e-voting elections. **[6]**

Answers may include:

Collection of data
- policy – data must be collected anonymously
- explanation – so that nobody should be able to find out what someone voted

- policy – the voter's ID must be accurately recorded
- explanation – so nobody can vote more than once.

*Award **[1]** for identifying an appropriate policy for the collection of the data and **[1]** for an explanation for why it is appropriate up to a maximum of **[2]**.*

Storage of data
- policy – data must be stored for x number of years
- explanation – in case of a need one day to check the data, or do research on it

- policy – data must be stored securely (i.e. encrypted, database server in a secure location etc.)
- explanation – the data could be accessed illegally and altered.

- policy – data must be backed-up
- explanation – loss of data during the election would have serious consequences for the electoral process

*Award **[1]** for identifying an appropriate policy for the storage of the data and **[1]** for an explanation for why it is appropriate up to a maximum of **[2]**.*

Sharing of data
- policy – the data should not be shared with the private sector, and only to organisations in the public sector, for the purpose of research
- explanation – so that there is no commercial value to the data which may be perceived as being an unethical use of data

- policy – shared data must not be linked to a voter's ID
- explanation – this could violate the voter's privacy.

*Award **[1]** for identifying an appropriate policy for the sharing of the data and **[1]** for an explanation for why it is appropriate up to a maximum of **[2]**.*

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

(c) Evaluate the advantages and disadvantages of e-voting. **[8]**

Answers may include:

Advantages of e-voting

- some voters may like to interact with such technology, which may result in more people voting, especially younger people
- some voters may like the fact that the GUI can be adjusted for easier reading, unlike printed ballot papers
- voting may take less time than with a paper ballot
- counting votes may be faster and more reliable, as it is done electronically, without the risk of human error when counting thousands of ballot papers
- the system of identification and authorisation could reduce the risk of fraud
- the government will be able to analyse voting outcomes (e.g. demographics of how votes were cast).

Disadvantages of e-voting

- some voters may not trust that their vote will be anonymised and remain confidential
- some voters may not know how to use the e-voting system and need to be trained
- some people may believe that the system is rigged and that the EVMs have been dishonestly programmed
- it may be expensive and difficult to put in place, if all polling stations must be equipped with EVMs
- if there is any electronic glitch, the system will lose credibility, and so will the results
- the system may be open to hacking, or accusations of hacking such as in the US 2016 elections.

Please see generic markband information sheet on page 19.

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.*