Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

November 2020

Information technology in a global society

Standard level

Paper 1

19 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. E-voting

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) State the primary key in the Voter table in **Figure 2**. **[1]**

VoterID

*Award **[1]** for stating VoterID.*

(ii) Identify **one** foreign key in the Votes table in **Figure 2**. **[1]**

Answers may include:
- VoterID
- CandidateID

*Award **[1]** for identifying the foreign key up to a maximum of **[1]**.*

(iii) Identify the data type that would be used in the Gender field in **Figure 2**. **[1]**

Answers may include:
- Text
- String

(iv) State the relationship between the Candidate table and the Votes table. **[1]**

One – Many

(v) Outline why a drop-down list would be used for the Party field in the Candidate table. **[2]**

Answers may include:
- Provides a set number of possible options.
- To remove the likelihood of data input errors.
- They conserve screen space, other alternatives such as radio button or checkbox may require all possible options to be displayed taking more screen space.
- Faster data entry.

*Award **[1]** for identifying why a drop-down list would be used for the Party field and **[1]** for a development of that point up to a maximum of **[2]**.*

(b) A number of individuals and groups were consulted during the design of the e-voting system to enable designers to create an intuitive interface for it.

Analyse questionnaires and interviews as methods of data collection to gather this information from these individuals and groups. **[6]**

Answers may include:

Questionnaires:

- Provide a mechanism to get responses from a large number of people.
- Provide a mechanism to obtain quantitative answers. These answers are relatively easy/quick to analyse.
- Less labour intensive than using interviews.
- Poorly designed questions, for example the overuse or lack of closed questions, can yield almost meaningless information.
- Respondents may sometimes misunderstand or misinterpret questions; it will be very hard to correct these mistakes and collect missing data in a second round.
- Questionnaires do not have time constraints; respondents can take their time to complete the questionnaire in their own time.
- Questionnaires safeguard respondents' anonymity, which allows for complete invisibility, maximizing comfort for those answering.

Interviews:

- Provide information that may be more detailed than that obtained from a questionnaire.
- Require skillful interviewers to be able to take advantage of the face-to-face interactions.
- If the skillset of the interviewees is appropriate, the qualitative data may be used to provide more substantial conclusions than relying solely, or largely, on quantitative data.
- Can be very time consuming: setting up, interviewing, transcribing, analysing, feedback, reporting.
- Not all respondents may be comfortable taking part in interviews and may feel nervous, especially when it is being recorded.

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, unbalanced or partial analysis of the appropriateness of the use of questionnaires and interviews. References, implicit and/or explicit, are made to the scenario in the stimulus material There is some use of appropriate ITGS terminology in the response.*
5–6	*A balanced and detailed analysis of the appropriateness of the use of questionnaires and interviews. Explicit and relevant references are made to the scenario in the stimulus material. There is appropriate ITGS terminology throughout the response.*

(c) Some states are planning to return to a paper-based voting system, where voters put a cross (*X*) in the column next to the party of their choice.

Discuss whether these states should retain e-voting or return to a paper-based voting system. **[8]**

Answers may include:

Advantages of retaining e-voting:

- The collection of the votes is more straightforward if the voting form is online.
- Voters will have the flexibility to cast their votes from any location using online voting.
- The results of the election can be reported more quickly.
- More in-depth analysis of the voting patterns may occur, which may help political parties target voters during subsequent elections.
- Electronic voting machines with touch screens are proven to be advantageous for physically challenged people.
- Electronic voting machines can also come with audio support to assist visually impaired voters. In such cases, the visually challenged person can cast their vote without any problem.
- Electronic voting machines allow people with disabilities to cast truly anonymous ballots and ensure them equitable rights.
- A long-term decrease in expenses. Conducting a large-scale election can be a costly prospect, primarily because of labour costs.
- More convenient to transport e-voting machines than ballot papers and boxes.

Disadvantages of retaining e-voting:

- The biggest concern about electronic voting is hacking: there is always the risk that someone without authorization would be able to access and alter the results of an election. This could be done either in-person, by physically tampering with the voting machines, or remotely, if the system transmits any kind of data over the internet.
- A hurdle for implementing widespread e-voting is the high upfront cost of installation. While electronic voting can be a cost-saving measure in the long term, the cost of setting it up may be a prohibitive factor. Costs include the servers, voting machines, maintenance and installation, testing the infrastructure, and securing the premises.
- E-voting machines may require power backup, which may be a challenge, especially in remote locations.
- Technical supervisors/staff may be required at the site of e-voting to deal with technical glitches.

Advantages of reverting to paper voting:

- The cost of implementing the technology may not be cost effective.
- There are concerns about the e-voting system being hacked or fraudulent activities linked to the voting.
- Some people prefer the human element of paper voting.
- No technical training required for voters: they can mark their preference on a paper ballot and drop it into the ballot box.
- Even people with low literacy levels can easily use a paper ballot.
- No technical training is required for election officers deployed at the polling booths: no electronic capturing devices are in use.

- Paper ballots are more secure – tampering is not possible due to a physical record of votes.
- The paper ballot is effective in reducing fake and bogus votes, as the software of electronic voting machines can be manipulated with malware, which can be used to tamper with the election results.
- Statistically relevant auditing can serve as a tool to detect or deter malfunction or fraud.
- In the instance where a candidate is entitled to a recount, a full hand recount of paper ballots can determine the accurate or final results.

Disadvantages of reverting to paper voting:

- Printing of ballots ahead of time and setting them in order is a difficult task. Printing of ballots is done district-wise, making the task even more complex.
- The voter may accidentally mark two boxes on the same ballot or may not mark the choice correctly. The computer software can prevent this happening.
- With traditional paper methods, ballots must be collected from various polling locations and consolidated at a central location before a team of individuals sifts through them manually. This process is very time consuming, leading to a significant delay in the announcement of election results.
- In a paper ballot, physically challenged people may have difficulty casting their votes in private.
- The requirement to go to a polling location continues to drive down voter turnout. Some people don’t have time to take off work, don’t live close to a polling location, or just can’t be bothered.

Please see generic markbands on page 19.

2. BYOD at Xingu Academy

(a) (i) Identify **two** pieces of information that would be used to identify a device on the IT network. **[2]**

Answers may include:
- MAC address
- IP address
- User's credentials, such as username
- Computer name

*Award **[1]** for identifying each piece of information the IT department would use to identify the device on the IT network, up to a maximum of **[2]**.*

(ii) Identify the steps used by speech-to-text software. **[4]**

Answers may include:
- A student speaks a word / microphone used to capture voice.
- The software converts the analog word to digital sound.
- The software converts sound to text based on a database of sounds.
- The word is matched (against the words in a database) to see if it is a valid word.
- If the word is found in the database.
- A word is presented on screen.
- If the word is not found in the database.
- A wrong word / the closest match / software makes a suggestion / an error message appears.

*Award **[1]** for identifying each step that the text-to-speech software uses up to a maximum of **[4]**.*

(b) Digital citizenship is included in Xingu Academy's IT acceptable-use policy.

Explain why it is important that students at Xingu Academy are both competent users of digital technologies **and** good digital citizens. **[6]**

Reasons for being competent users of digital technologies:

- To be able to use digital technologies to support their learning.
- To be able to use software tools appropriately to maximize their efficiency.
- To develop a set of transferable skills they can take beyond school.
- To be able to access a wide range of online resources.
- In order to take responsibility for their personal devices – ensure they are in working order and keep hardware and data secure. In a BYOD school, technicians may not be able to support all these diverse devices

Reasons for being good digital citizens:

- Understand that being able to use the digital technologies is not sufficient to ensure the opportunities they bring are harnessed.
- Appreciates that a number of ethical decisions occur when interactions with the digital technologies occur.
- Accept that they should be responsible for their actions when interacting with digital technologies and that some actions could have potentially negative consequences, such as employers judging prospective students by their social media profiles. So, it is important to teach students how to create online personas that project a positive and constructive image.
- See the need for good digital citizenship as no more than an extension of their own physical citizenship.
- Accept that the boundary between digital and physical citizenship can be blurred and ensure that these dual roles can be reconciled.
- Students must respect other users and be aware of the impacts of irresponsible online behavior, *eg* cyber-bullying.
- Students need to be aware of legal issues – illegally downloading games/music, crimes such as hacking/identity theft. Illegal games/hacking tools could be brought to school on their own devices.
- Students require digital literacy to wisely use the vast amount of information on the internet.
- Students need to understand that there is a digital divide – within the school/community/world – that may be accentuated at a BYOD school where some students own the latest technology. Children could put pressure on parents to buy newer devices.
- Students need to be aware of digital health issues – good ergonomics, risks of internet/game addiction.
- Students need to be aware of the need to protect their data using passwords/backup.

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 it is important that students at Xingu Academy are both competent users of digital technologies **and** good digital citizens. References, implicit and/or explicit, are made to the scenario in the stimulus material There is some use of appropriate ITGS terminology in the respo44nse.*
5–6	*An explanation of why it is important that students at Xingu Academy are both competent users of digital technologies **and** good digital citizens. Explicit and relevant references are made to the scenario in the stimulus material. There is appropriate ITGS terminology throughout the response.*

(c) Discuss whether Xingu Academy should become a bring-your-own-device (BYOD) school. **[8]**

Answers may include:

Reasons why Xingu Academy should become a bring-your-own-device (BYOD) school:

- There will be a significant reduction in the cost of IT hardware that can be passed on to other teachers and learning needs (such as more staff).
- The IT support team may not need to be so large, but will need to support a wide range of devices, including the latest technology as well as old technology.
- Students may find that they do not have to learn the software used by the school as they have similar (or better) software installed on their device.
- Students are already familiar and comfortable using their own technology so they can focus on the lesson.
- Students can choose their own device type, more comfortable learning on certain devices.
- Students' personal mobile devices tend to be more cutting-edge, so schools can more easily stay up to date with technology – but this could present problems (digital divide/technical support).
- With BYOD, students are more likely to continue learning outside of school hours.
- Students will be more organized with all their notes and assignments all in one place (as opposed to having them on different computers and devices in different places at school and home).
- Students can store their data on their own personal devices, so Xingu Academy is not responsible for data storage.
- BYOD allows opportunities for more personalized learning where students can excel at their own pace.

Reasons why Xingu Academy should not become a bring-your-own-device (BYOD) school:

- Some teachers may not be comfortable with the new BYOD approach and may see it as technology for technology's sake.
- Some teachers may not be familiar with the software on a student's device.
- The school network may not have the capacity to deal with the increased number of devices on the network.
- Some students will be advantaged, as they can afford much better devices than others, some may not be able to bring in a device – children may put pressure on their parents to upgrade their devices to keep up with their friends. Digital divide issues.
- Teachers may find it harder to monitor a student's digital behaviour.
- Some schools monitor students' screens – this will raise issues if monitoring software must be installed on students' personal devices.
- The IT support team may have to install network peripherals, such as printers, onto to the students' devices.
- The increased levels of access may lead to security concerns.
- Students bringing in their own devices to school may increase the possibility of theft.
- Applications may not be universal across all platforms, making it difficult for teachers to assist.
- There may be more work for the IT department if they must support students' personal devices.
- Students sometimes may forget to bring their device or charge it.

Please see generic markbands on page 19.

3. Clouds under the sea

(a) (i) Identify **two** characteristics of cloud computing. **[2]**

Answers may include:
- On-demand / measured service.
- Based on a network of linked servers.
- Multi-tenancy and resource pooling.
- Rapid elasticity and scalability.
- Broad network access.
- Pay-as-you-go.
- Easy maintenance.
- Low down time.
- Higher level of security, hard to breach.
- Accessible from multiple devices.
- Accessed via the internet.

*Award **[1]** for identifying characteristics of cloud computing, up to a maximum of **[2]**.*

(ii) Servers used in cloud computing hold considerable amounts of data.

Identify **two** forms of backup that could be used for the data on these servers. **[2]**

Answers may include:
- Duplicate/alternative versions
- Disk-to-cloud backup / Multi-location backup
- Disk-to-disk backup

*Award **[1]** for identifying each form of back-up that could be used for the data on these servers, up to a maximum of **[2]**.*

(iii) A user is downloading a ZIP (zipped file) from cloud storage.

The ZIP file is 0.6 GB in size and the bandwidth speed is 8 mbps.

Calculate the total time it will take to download the ZIP file.

Note: 1 GB=1000 MB. **[2]**

Bandwidth = 8 (mbps) / 8 = 1 (MB)

Download time = 600 / 1 seconds or 10 minutes.

*Award **[1]** for correct conversion of mbps to MB (ie, divide by 8)*
*Award **[1]** for correct answer.*

(b) (i) Compression software can be used to speed up the upload and download of files.

The ZIP file recently downloaded from the cloud-based server contained a number of images and videos.

Explain why lossy compression techniques would be used for the images that have been downloaded from cloud storage. **[2]**

Answers may include:
- The image may not be used for printing.
- Therefore, the quality/resolution of the image does not need to be as high if it is only to be viewed on screen.
- Due to significantly reduced file size, downloading images from cloud storage will be fast and will consume less internet bandwidth.

*Award **[1]** for identifying why lossy compression techniques would be used for the images and **[1]** for a development of that point, up to a maximum of **[2]**.*

(ii) Explain why lossless compression techniques would be used for the videos that have been downloaded from cloud storage. **[2]**

Answers may include:
- The quality of the decompressed video would need to be exactly the same as the pre-compressed version.
- Because the use of lossy compression techniques could lead to critical parts of the video being lost.
- Reduced file size without losing the quality of the video.

*Award **[1]** for identifying why lossless compression techniques would be used for the videos and **[1]** for a development of that point, up to a maximum of **[2]**.*

(iii) Cloud storage providers are responsible for protecting the privacy and anonymity of the individuals whose data is held on their servers.

Distinguish between privacy and anonymity. **[2]**

Answers may include:
- Privacy is knowing who the person is, but not knowing what they are doing / privacy is a concept describing activities that one keeps entirely to themselves, or to a limited group of people.
- Anonymity is knowing what a person may be doing, but not being able to identify the person.

*Award **[1]** for identifying each difference between privacy and anonymity, up to a maximum of **[2]**.*

Note:** It is acceptable to correctly define each term for **[2].

(c) Evaluate Microsoft's decision to build data centres on the seabed. **[8]**

Answers may include:

Reasons why Microsoft should build data centres on the seabed:

- The water surrounding the data centre can be used to cool it.
- The percentage of the world's water used for this purpose is almost infinitesimally small, so there is going to be almost no environmental effect.
- They can be hidden and will not be unsightly.
- They may not take up valuable sites on land that could be used for housing.
- They are likely to need less maintenance.
- The underwater data centers will take relatively less time compared to land constructions.

Reasons why Microsoft should not build data centres on the seabed:

- The technology has existed for 10 years, but there has been no commercial development of these data centres – why is this the case?
- The data centres may need to be backed up terrestrially, so it may not be as environmentally friendly as suggested.
- Maintenance will be more difficult.
- The data centres may have an impact on local ecosystems e.g. heat from the plants / chemicals leaching from the equipment.
- The cables to the data centres may be damaged by ships.
- Seabed data centres may be significantly more expensive than land-based ones.
- Finding efficient ways of delivering backup power suppliers to an underwater site may be problematic.

Please see generic markbands on page 19.

4. The role of portable digital devices in health

(a) (i) Identify **two** vital signs that can be recorded by Jaime's sport watch. **[2]**

Answers may include:
- Heart rate / pulse.
- Blood pressure.
- Blood oxygen level / oxygen saturation.
- Respiration rate.
- Body temperature.

*Award **[1]** for identifying each vital sign, up to a maximum of **[2]**.*

(ii) Describe the steps that the GPS receiver in Jaime's sport watch uses to show the routes of his training runs. **[4]**

Answers may include:
- The GPS receiver receives data from satellites that circle the earth, tracking the location of the runner as he moves.
- The GPS receiver receives information about the orbits of each satellite (so it knows where each satellite will be at any given moment).
- The GPS receiver calculates how far away from each satellite it is and therefore where it is on the surface of the earth.
- It measures the distance to each satellite by calculating the amount of time it takes to receive its signal.
- Once the GPS receiver has a minimum of three satellites in its fix, it can calculate its position on earth.
- It uses a process of trilateration.
- With two satellites in its fix, a GPS receiver can calculate its latitude and longitude (2D fix).
- With three satellites in its fix, a GPS receiver can calculate its latitude, longitude and altitude (3D fix).
- With four or more satellites in range, the GPS receiver can compensate for time differences between the receiver's clock and the satellites' clocks.
- Using the location data, the route can be displayed on a map (GIS software).

*Award **[1]** for identifying each step that global positioning systems (GPS) follow to give an accurate location, up to maximum of **[4]**.*

(b) Jaime has decided to share his personal health information with researchers at the University of Sierra Nevada (USN).

Analyse Jaime's decision to share his personal health information with the University of Sierra Nevada (USN). **[6]**

Reasons for sharing his personal health information:

- The university may have access to data analytics tools that can interrogate his personal health information and give him feedback on his health/fitness.
- The university may be able to provide additional health-related information.
- The university may be able to analyse Jaime's data against other and/or larger data sets.
- Jaime may accept that his data is "out there" already so there is no harm in re-sharing it.
- Jaime may wish to contribute towards research at USN.

Reasons for not sharing his personal health information:

- There may be no way of knowing which other third parties the university is sharing Jaime's data with.
- The university may impose conditions that may mean the data is not used for the purposes it was intended.
- Once the data is shared, it is hard to guarantee that is deleted when it is no longer needed.
- Patient privacy is a concern. Is data anonymized and does the university have sufficient security measures in place?

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, unbalanced or partial analysis of whether it is appropriate for Jaime to share his personal health information. References, implicit and/or explicit, are made to the scenario in the stimulus material There is some use of appropriate ITGS terminology in the response.*
5–6	*A balanced and detailed analysis of whether it is appropriate for Jaime to share his personal health information. Explicit and relevant references are made to the scenario in the stimulus material. There is appropriate ITGS terminology throughout the response.*

(c) The development of mobile health apps has changed the way citizens manage their own health and wellbeing.

Discuss whether citizens such as Jaime should rely only on the advice of a health app to manage their own health and wellbeing. **[8]**

Answers may include:

Reasons why citizens such as Jaime should only rely on the recommendations of the health app:

- The health app may be more consistent in its advice than a human doctor.
- The health app will not be influenced by the patient during the consultation / will be completely objective.
- The health app may lead to savings (for the user of the app) so that other treatments that are currently not available may become possible as money is freed up / health app may be more cost effective for the user than visiting a specialist.
- The health app is available 24/7.
- It is convenient, the app is available immediately and Jaime would not have to visit a doctor or sports scientist to get advice.
- The information from the app is available immediately without any delays.
- The health app can be updated almost instantaneously, whereas doctors would have to attend courses to ensure new procedures, *etc*, are explained.
- App is available in any location so could, for example, be used on holiday and the information and advice would still be available.

Reasons why citizens such as Jaime should not rely only on the recommendations of the health app:

- The health app may be based on a generic profile and not have sufficient background data to make a more meaningful diagnosis than a human.
- The users may not trust the health app due to reliability and integrity issues.
- The quality of the data being collected may be poor and the advice might not be appropriate.
- Negative results could result in anxiety or cause Jaime to overexert himself in order to follow the advice of the app.

Please see generic markbands 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.*