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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. Smart lamp posts

(a) (i) Identify **two** sensors the smart lamp posts could use. **[2]**

Answers may include:
- Temperature / Wind Speed / Atmospheric pressure.
- Air quality (ozone/particles/gases such as carbon monoxide).
- Proximity/infra-red.
- Movement.
- Audio / Sound.
- Light Sensors.
- Speed.

*Award **[1]** for identifying each sensor the smart lampposts could use up to **[2]**.*

(ii) Outline **one** reason why encryption is used to transmit the data from the smart lamp posts to the data centre. **[2]**

Answers may include:
- Avoids unauthorized users to access the data.
- Because it converts the text to an ineligible text.

- Ensure sensitive data has appropriate levels of security.
- Protect people's privacy.

*Award **[1]** for identifying a reason why encryption is used to transmit the data from the smart lamppost to the data centre and **[1]** for a development of that reason up to **[2]**.*

(iii) Outline **one** reason the Hong Kong authorities are using cloud computing to store the data collected by the lamp posts. **[2]**

Answers may include:

- Maintenance is carried out by the cloud computing provider.
- So there should be no downtime.

- Security issues are the concern of the provider.
- So the Government does not need to allocate resources, beyond those of sub-contracting the work to the provider.

- Accessibility anywhere, with any device.
- This ensures everyone uses up-to-date information to make any data analysis.

- Cost savings
- Hong Kong authorities no longer required to have your own server, cables, network switches, backup generators, redundant routers.

- Centralized data security / data loss prevention
- Security policies and data backups are centralized in the cloud providers' data centers.

- Scalability and flexibility.
- The Hong Kong authorities can quickly scale resources and storage up.

*Award **[1]** for each reason why the Hong Kong authorities are using cloud computing identified and [1] for a development of that reason up to **[2]**.*

(b) Explain **three** technical requirements that will need to be met to enable the smart lamp post system to function effectively. **[6]**

Note to examiners: This part (b) should be marked with ticks.

Answers may include:

- There is sufficient bandwidth.
- So data can be transferred without excessive latency / so it can be used in real time.

- There is sufficient technical support/expertise.
- So the system can be maintained.

- There are sufficient data storage facilities available.
- So all of the data collected can be stored.

- The hardware needs to be durable.
- So it can function in all conditions.

- Infrastructure needs to be resilient.
- So it is able to cope in adverse conditions.

*Award **[1]** for identifying a technical requirement that will need to be met to enable the smart lamppost system to function effectively and **[1]** for a development of that reason up to **[2]**.*

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

(c) To what extent will the introduction of smart lamp posts lead to an improvement in the environmental conditions within a city? **[8]**

Note for Examiners: (Answers should be related to environmental conditions and not general benefits and concerns).

Answers may include:
Benefits include:

- The data collected can be used to manage the traffic levels in the city.
- It can allow the authorities to act if dangerous levels of pollution or temperatures are detected.
- It can be used to turn on/off the street lights as necessary depending on the ambient conditions rather than using a pre-programmed approach.
- To turn on street lights when people are in their vicinity (energy saving).
- To build up patterns of pollution, traffic levels etc over time to develop more sustainable long term solutions.

Concerns include: (Do not accept obsolescence of smart lamp posts)

- Improvements to the environmental conditions may be minimal and may not justify the costs of developing the smart lamppost system / there may need to be a more citywide approach to resolving the environmental problems.
- The information may not resolve the problem, but merely relocate the problem to areas where smart lampposts have not been installed.
- There could be high costs of installation and maintenance.
- There may be concerns about surveillance, or that the authorities are gathering more data than they claim.

Note for examiners:
Answers should refer to environmental conditions, not general conditions.

Please see generic markband on page 18.

2. No more snow days

(a) (i) Identify **two** types of software required for distance learning. **[2]**

Answers may include:
- Video conferencing/ Communication software (Teams, Google Meet, Zoom, etc).
- LMS examples (Moodle, Blackboard, etc.).
- Online collaborative office automation tools (MS Office, Google Docs).

*Award **[1]** for identifying each type of software required for distance learning up to **[2]**.*

(ii) Identify **two** reasons why a school would introduce an acceptable use policy. **[2]**

Answers may include:
- To encourage students and staff to use the school's IT facilities appropriately / establish a code of conduct.
- To make students and staff aware of possible sanctions for failing to use the school's IT facilities appropriately / add a disclaimer if student use is inappropriate.
- Students and staff need to sign that they are aware that the school may be monitoring their network use.
- The school needs to protect the network from security breaches so needs to inform staff and students about security issues.

*Award **[1]** for identifying each reason **or** example for an acceptable use policy (AUP) up to **[2]**.*

(iii) Outline **one** advantage for users if a school introduces a virtual private network (VPN). **[2]**

Answers may include:
Accessibility
- Allows users to access their personal files on the school server.
- Which means they can work seamlessly between home and school / Access to school-approved digital resources that would otherwise be blocked due to location.

Security
- Data and communications protection
- Data is encrypted.

*Award **[1]** for identifying an advantage for the staff if the school introduces a VPN and **[1]** for a development of that reason up to **[2]**.*

(b) Two strategies for distance learning are using synchronous teaching and asynchronous teaching.

Analyse these strategies. **[6]**

*Note to examiners: This part (b) should **NOT** be marked with ticks.*

Answers may include:

Advantages of synchronous learning

- Teachers and students gather at the same time and interact in “real time”.
- Allows for students to receive real time feedback from teachers and vice versa which may be more effective than asynchronous exchanges.
- Creates schedule allowing for students to allocate their time.
- Is the most efficient use of resources (time wise).
- Synchronous learning is more time efficient for the teacher who can answer questions during class – with asynchronous learning teachers would have to respond to individual questions posted from students.

Disadvantages of Synchronous Learning

- It is more difficult to review the material again if the teacher did not share it with the students.
- Distraction of students by having other tabs or web pages open.
- Dependence on a good Internet connection.
- Child protection concerns.
- Dependence on the skills of the teacher and students in the use of technologies.

Advantages of asynchronous learning

- Students accessing class materials during different hours and from different locations / more convenient.
- Allows students to use a more flexible schedule permitting them to work on several or different subjects during different times of the day.
- Students can learn at their own pace.
- May benefit students who prefer less face to face interactions.
- Teachers can benefit from a more flexible schedule e.g. post worksheets at night ready for the next day.

Disadvantages of Asynchronous learning

- Not following the instructions/content and skipping directly to the activity.
- Requirement of responsibility and organization on the part of the student.
- Social disconnection with classmates.

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 limited analysis of the advantages and disadvantages of synchronous and asynchronous learning. There is some use of appropriate ITGS terminology in the response.
[5–6]	A balanced analysis that addresses the advantages and disadvantages of synchronous and asynchronous learning. Explicit and relevant references are made to the scenario in the stimulus material. There is appropriate ITGS terminology throughout the response.

(c) Many schools are considering moving to a one-to-one mobile device programme where each student has access to one device. Two options for implementing a one-to-one mobile device programme are:
- schools owning devices that are issued to students
- students owning their own devices and using them in the school (also called a bring-your-own-device (BYOD) policy).

Evaluate these options **[8]**

Answers may include:

Advantages of schools owning the laptops that are issued to students
- All laptops will be configured identically and will be network ready.
- May reduce cyberthreats compared to the students using their own laptops.
- This will mean that maintaining the laptops will be more straight forward for the IT Support Team.
- It will prevent students who cannot afford laptops / or laptops having a specification that does not allow them to use the software on the school network.
- If a laptop fails, it can be replaced more easily, the student will not lose valuable learning time.
- May prevent students from using smartphones as a substitute for a laptop, particularly if they cannot afford both.
- Students may include the most up to date software whereas schools may have older versions that they upgrade on three year cycles.
- Students can also have games loaded on their personal laptops so these distractions would be avoided if the school provided laptops which prevented the student loading executable files.

Advantages of students owning their own devices
- May be considerably cheaper for the school as the school does not have to purchase the laptops.
- There may be less involvement of the IT Support Team as the laptops will be configured by the student.
- Students may be more careful / less likely to mistreat the laptop as it is theirs rather than the schools.
- If the school uses cloud based services the quality of the laptop may not be as critical for performance.
- Students will have familiarity with their laptop and will not need to relearn how to use a different device.
- Students may be more productive as they have more confidence in using their laptop.
- May increase continuity of learning, for example if they have come from a different school prior to commencing the DP

Please see generic markband on page 18.

3. Digital documentation

(a) (i) State the primary key in the Citizen table in **Figure 3**. **[1]**

- IdentID

(ii) State the relationship between the Licenses and Driving_License tables in **Figure 3**. **[1]**

- One to many

(iii) Outline **one** advantage of using a relational database instead of a flat file database to store the data collected by the government. **[2]**

Answers may include:
- It is easier to update data as they are stored in a single location.
- Whereas multiple records would each have to be updated individually.

- Greater accuracy / consistency and less time spent in updating data.
- Data is stored once so there is no danger of storing different versions of data and is quicker.

- Reduces redundancy (repeated data).
- Whereas multiple repetitions of the same data can lead to errors.

- Saves storage space.
- Whereas multiple repetitions of the same data occupy more space.

*Award **[1]** for identifying an advantage of using a single relational database to store the data collected by the government and **[1]** for a development of that reason up to **[2]**.*

(iv) Describe the difference between identification and authentication. **[2]**

Answers may include:
- Identification is saying who you are / uniquely a user of a system or an application that is running in the system.
- Authentication confirms you are who you claim to be / verifying the identity.

*Award **[1]** for difference between identification and authentication described up to **[2]**.*

(b) The development of digital services will require policies for the collection, storage and sharing of data.

Explain how a government and the developers of its digital systems can ensure that the privacy of citizens is not compromised when data is collected, stored **and** shared. **[6]**

Note to examiners: This part (b) should be marked with ticks.

Answers may include:

Collection

- To ensure that only the information of patients who have consented to the use of their data is collected.
- Or that they have a way to 'opt-out' of their data being used if they have concerns about their privacy being compromised.

- Citizens are aware of what data is being collected.
- So can make an informed decision whether to opt in or opt out.

*Award **[1]** for identifying a way how government and developers of the digital systems can ensure that the privacy of the citizens is not compromised when data is collected and **[1]** for a development of that way up to **[2]**.*

Storage

- Explicitly state to the citizens how long their data will be stored.
- And this will comply with the law / will not be longer than necessary.

- Restricted access to data storage
- Security levels for data access based on user roles.

*Award **[1]** for identifying a way how government and developers of the digital systems can ensure that the privacy of the citizens is not compromised when data is stored and **[1]** for a development of that way up to **[2]**.*

Sharing

- Data about a citizen is only shared with their consent.
- And the sharing of the data does not break any data sharing guidelines / regulations / laws.
- Ensure data is shared securely.
- Passwords/encryption/authentication required to access them.

*Award **[1]** for identifying a way how government and developers of the digital systems can ensure that the privacy of the citizens is not compromised when data is shared and **[1]** for a development of that way up to **[2]**.*

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

(c) Discuss the advantages **and** disadvantages for the citizens of a country if the government moves its services online. **[8]**

Answers may include:

Advantages
- Reduces the requirement for paper documentation (preventing loss).
- Allows citizens to have their information on multiple devices.
- Reduces the requirement for a citizen to authenticate themselves multiple times.
- Everything is in one place, so the same data can be used for multiple purposes.
- Data may be easier to access.

Disadvantages
- May exclude certain individuals or groups (digital divide).
- May lead to a citizen's personal data being more easily shared / mined.
- Will rely on an internet connection.
- May not be cost effective, do the benefits outweigh the costs?
- May result in privacy concerns for individuals and/or citizens groups.
- May increase security concerns as data is centralised.

Please see generic markband on page 18.

4. Workforce monitoring

(a) The URL for *SaskWater* is: https//www.saskwater.com/index

(i) State the protocol. **[1]**

- https / https:// / Hypertext transfer protocol secure

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

- saskwater.com / www.saskwater.com

(iii) State the formula used to calculate the total number of alerts sent. **[1]**

- =SUM(E2:E6) *Do not accept ; only :*
- =SUM(E2;E3;E4;E5;E6) / = E2+E3+E4+E5+E6
- =SUMA(E2 + E3 + E4 + E5 + E6) *Even though not the best formula, still works and provides the same answer*

(iv) State the EmployeeID that would appear in the second row of the spreadsheet if the alerts were sorted in descending order. **[1]**

- Emp8754

(v) Identify **two other** ways in which *SaskWater* could monitor its staff. **[2]**

Answers may include:
- Keystroke monitoring.
- Video surveillance.
- E-mail monitoring.
- Location monitoring.
- Scheduled meetings.
- Web content monitoring.
- Activity monitoring.
- Revision of objectives/projects completed
- Live screen capture.

*Award **[1]** for each other way SaskWater can monitor staff up to **[2]**.*

(b) (i) Distinguish between the way monitoring software and spyware gather information. **[2]**

Answers may include:
- Monitoring software is software that is used to gather information about a computer user with the knowledge of the person who is being monitored.
- Spyware is the installation of software that gathers data about a computer user without their knowledge.

*Award **[1]** for each difference between the way monitoring software and spyware gather information up to **[2]**.*

(ii) Explain **two** reasons why a spreadsheet was chosen to store and manage the information about alerts. **[4]**

Note to examiners: This part (b) should be marked with ticks.

Answers may include:
- Easy to produce graphs.
- As many managers may want information that is visual rather than in columns/tables.

- Allows the data to be manipulated.
- So data can be sorted, filtered etc.

- So SaskWater will not need to give additional training to managers to enable them to process the data provided / Easy to implement predictive calculation formulas.
- Unlike more sophisticated software packages such as databases.

- Spreadsheet software such as Excel comes with standard software packages.
- Which means SaskWater may not need to purchase additional software.

*Award **[1]** for identifying a reason why a spreadsheet has been chosen to process or share the information about alerts and **[1]** for a development of that reason up to **[2]**.*

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

(c) To what extent is it acceptable for employers to use monitoring software on their employees' work laptops. **[8]**

Answers may include:

Reasons why it is acceptable

- Employers want to ensure employees are on task
- Employers may be worried about lack of supervision of employees working at home and worry that employees may not be utilising their time appropriately.
- Employers provide work devices, so they feel that have the right to know how, when and for what purpose the devices are used.
- Employers have the legal right to monitor employees electronically on company-provided devices and across their networks as long as they have a legitimate business reason and obtain employees' consent.
- Monitoring software has no impact on laptop processing or in employee performance.

Reasons why it is not acceptable

- Might be expensive to implement and deploy.
- It may break the bond of trust between the employer and the employees.
- Employees may see this as a type of surveillance.
- Data may be sent to the developers of the software that may lead to sensitive commercial information being shared.
- If there is no consent from the employees / the monitoring software is imposed.
- It may lead to employees finding workarounds to circumvent the monitoring software.
- The monitoring software may collect significant quantities of data that may not be possible to process.

Please see generic markband on page 18.

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.