ib Diploma Programme
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Markscheme

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Information technology in a global society

Higher level and standard level

Paper 2

International Baccalaureate
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Using assessment criteria for external assessment

For external assessment, a number of assessment criteria have been identified. Each assessment criterion has level descriptors describing specific levels of achievement, together with an appropriate range of marks. The level descriptors concentrate on positive achievement, although for the lower levels failure to achieve may be included in the description.

Examiners must judge the externally assessed work at SL and at HL against the four criteria (A–D) using the level descriptors.

- The same assessment criteria are provided for SL and HL.

- The aim is to find, for each criterion, the descriptor that conveys most accurately the level attained by the candidate, using the best-fit model. A best-fit approach means that compensation should be made when a piece of work matches different aspects of a criterion at different levels. The mark awarded should be one that most fairly reflects the balance of achievement against the criterion. It is not necessary for every single aspect of a level descriptor to be met for that mark to be awarded.

- When assessing a candidate's work, examiners should read the level descriptors for each criterion until they reach a descriptor that most appropriately describes the level of the work being assessed. If a piece of work seems to fall between two descriptors, both descriptors should be read again and the one that more appropriately describes the candidate's work should be chosen.

- Where there are two or more marks available within a level, examiners should award the upper marks if the candidate's work demonstrates the qualities described to a great extent. Examiners should award the lower marks if the candidate's work demonstrates the qualities described to a lesser extent.

- Only whole numbers should be recorded; partial marks, that is fractions and decimals, are not acceptable.

- Examiners should not think in terms of a pass or fail boundary, but should concentrate on identifying the appropriate descriptor for each assessment criterion.

- The highest level descriptors do not imply faultless performance but should be achievable by a candidate. Examiners should not hesitate to use the extremes if they are appropriate descriptions of the work being assessed.

- A candidate who attains a high level of achievement in relation to one criterion will not necessarily attain high levels of achievement in relation to the other criteria. Similarly, a candidate who attains a low level of achievement for one criterion will not necessarily attain low achievement levels for the other criteria. Examiners should not assume that the overall assessment of the candidates will produce any particular distribution of marks.

- The assessment criteria must be made available to candidates prior to sitting the examination.

Theme: Business and employment

Criterion A — The issue and stakeholder(s) **[4]**

1. (a) Describe **one** social/ethical concern related to the IT system in the article.

    [1]: for identification of the concern (which does not have to be explicitly named).

    [2]: there needs to be an explicit description of the impact/result/consequences/effect/outcome on the hotel owner, staff, providers of the Digital Key or guests.

    Social/ethical concerns may include the following:
    - reliability – the digital key may not work because an error was made during generation, and it may prove even harder to gain access to the room if no hotel staff are on duty
    - reliability - if the system has faults and problems the reputation of the Digital Key providers would be damaged
    - surveillance – data stored about the use of the digital key may be used to monitor activities of guests
    - privacy – data collected and stored in the cloud, could be used by staff or hackers who profit from using the information
    - security – unauthorized access to the digital key could mean that others could gain access to the room and steal a guest's possessions
    - people and machines – loss of personalized service: guests may no longer receive a warm welcome and may prefer to stay elsewhere
    - digital divide – not all guests will want to use this technology and it may make their stay more stressful/not all guests will have smart phones
    - authenticity – it will be difficult to determine who is staying at the hotel as it may not be the person placing the booking who is staying at the hotel
    - data integrity, hackers can enter the database and modify the information of the guests to benefit others and harm those who initially made the reservation.

(b) Describe the relationship of **one** primary stakeholder to the IT system in the article.

[1]: Who – identification of the stakeholder.

*[2]: **What** are they doing with the IT system and **Where** in the IT system (technical part).*

Primary stakeholders may include the following:
- hotel owner/hotel staff – uses the key generator app/digital keys to issue keys to guests, needs to fix if code does not work, may find their job is deskilled or is not needed
- guests – download Digital Key app to receive the digital key code in order to open the door of their room.
- cleaners – can access the Digital Key app to determine which rooms to clean and when
- Digital Key providers – gain profits and increase reputation, the more that hotels use their app.

Marks	Level descriptor
0	The response does not reach a standard described by the descriptors below.
1	Either an appropriate social/ethical concern **or** the relationship of **one** primary stakeholder to the IT system in the article is identified.
2	Either an appropriate social/ethical concern **or** the relationship of **one** primary stakeholder to the IT system in the article is described **or** both are identified.
3	Either an appropriate social/ethical concern **or** the relationship of **one** primary stakeholder to the IT system in the article is described; the other is identified.
4	Both an appropriate social/ethical concern **and** the relationship of **one** primary stakeholder to the IT system in the article are described.

Criterion B — The IT concepts and processes   **[6]**

2.   (a)   Describe, step-by-step, how the IT system works.
IT system: Digital keys and hotel room booking.

There are two main stages:

1- Make the reservation, including obtaining the digital key

2 -the use of digital keys to open the door.

Each stage has a number of steps.

Answer must mention / relate both stages although only the step-by-step detail of one of them is developed.

[1]: the student can show some understanding of the process, but not in a step-by-step approach, using the information in the article and possibly missing some steps or a stage.

[2]: The student can provide a logical description step by step using the information in the article but lacks some details. Does not include other developments. The best fit if it contains developments / information beyond the article, but not step by step.

[3]: the student can provide a step-by-step description that can be detailed. It must contain at least two technical developments beyond the article.

[4]: at least four technical developments beyond the article.

Answers provided in the article include the following:
- Guests make a booking through the hotel website or other hotel booking sites
- the Digital Key app generates the digital key, based on dates and duration of the booking
- after credit card payment is approved, guests receive the link to Digital Key app
- guests download Digital Key app to get the location of their rooms
- all bookings and customer information is stored in the cloud
- guests who arrive without a booking at the hotel can use the computer at the front desk to do so and get access to Digital Key app
- Digital Key consists of two parts – hardware for the door and an app for the key generator
- guests hold their phone with the digital key close to the lock (up to 5 ft/1.5 meters) and the door opens
- Report about room occupancy and check-in time
- Production of a detailed report on the room usage
- Access by cleaners to booking information through the housekeeping function
- Guest receives booking confirmation via e-mail/SMS with a link to Digital Key's app.

Answers with additional information to that in the article may include the following:

- during the set-up, the hotel needs to install the hardware on the doors and configure each door so that it is uniquely identified with the room number
- each door has its own unique algorithm used by the APP to create the digital code (similar to a one-time pin used by banks but lasts the duration of the stay)
- the Digital Keys app uses an algorithm to create a unique code for each booking
- guests need to log on and register with the website or hotel booking site, entering personal details such as mobile phone number and email address
- an Interactive calendar is used to select dates of check in/out
- the guest's requested dates are matched against a database and a suitable room is selected based on these dates and the number of occupants
- rooms can be selected at the time of booking or can be allocated depending on chosen room type
- Digital Key apps downloaded and installed - one operation
- an email template is used to include the welcome message, map, location of the cottage and the digital key
- guest opens the Digital Key app on their phones to display the digital key, which is held against the room door
- Digital Keys use wireless technologies such as Bluetooth or NFC communication to transmit the code stored in the smart phone to the door
- the app reads the digital key and compares it to the code stored in the door. If the digital keys algorithm matches that of the door, then the latch on the door is unlocked
- when the phone is tapped on the door, the digital key looks up the code and checks it against the time and date of the booking stored in the cloud
- if the current time is earlier than the checkout time the door is unlocked
- Use of Digital Key is recorded in the hotel system, cloud or local Digital Key storage in hotel
- Data stored in the cloud can be used by the management to view room usage
- Data is stored in a cloud-based database as long as they mention database and not cloud only.
- Booking site is protected using SSL.

(b)   Explain the relationship between the IT system and the social/ethical concern described in **Criterion A**.

Explaining the link between the concern and specific parts, or whole, of the IT system means the student must include how and why the concern has arisen from the use of the IT system. The naming of the concern identified in Criterion A may be implicit.

Q2(b) clearly asks for a link to Q1(a), but the link only needs to be generic – eg for a specific security concern described in Q1(a), then in Q2(b) the student can explain a security weaknesses without reference to the specific concern in Q1(a). If the concern addressed in Q2(a) is completely different from that in Q1(a) a link cannot be made and hence [0].
Q2(b) can also be related back to Q1(b) where the who and what and where of the IT system usage are described.

[1]: if the student identifies the relationship between the concern and the IT system. This may be a repeat/rewording, of the response to Q1(a) or lack of detail for the how and why.

[2]: how and why the concern can happen must be described in technical IT and ITGS terms: eg privacy: responses need to specify how (technical) the data can be accessed (similar to some of the steps for Q2(a)) and why it has been allowed to be accessed (eg lack of privacy settings).

Answers may include the following:
- reliability:
    – the digital key may not work (what) because an error was made during the key generation (why), wrong door lock could have been assigned to wrong room (how)
    – guest cannot display the digital key on the phone(what) because the phone has no battery (why; how is implicit-forgot to charge phone)
    – guest cannot open the door (what) as digital key cannot confirm the date/time (why) due to transmission error between hotel website and app (how)
    – guest cannot display the digital key on the phone (what) because the Internet is down (why) due to a problem with the server/router (how)
- surveillance – movement and patterns of behavior of guests/hotel staff can be determined (what) if a suitable analysis software (how) is used to access logs of the digital key
- privacy – data collected and stored in the cloud, could be used by staff or hackers if password access to data or reports is weak or online security is weak
- security – unauthorized access to the digital key could mean that others could gain access to the room – if the phone is lost or a digital key reader is positioned near the room
- loss of personalized service – online-check ins remove the need for guests to meet face to face with hotel staff because check in is done online and keys don't need to be issued
- digital divide – not all guests will want to be able to use this technology not everyone has a smart phone or knows how to use one
- authenticity – bookings can be made online with a credit card – this person is authenticated, but bookings can be forwarded by text or email to those actually staying in the room due to lack of proper authentication features.

Candidates are expected to make reference to the relevant stakeholders, information technologies, data and processes. Candidates will be expected to refer to "how the IT system works" using appropriate IT terminology.

Marks	Level descriptor
0	The response does not reach a standard described by the descriptors below.
1–2	There is little or no understanding of the step-by-step process of how the IT system works and does not go beyond the information in the article. The major components of the IT system are identified using minimal technical IT terminology.
3–4	There is a description of the step-by-step process of how the IT system works that goes beyond the information in the article. Most of the major components of the IT system are identified using some technical IT terminology. The relationship between the IT system referred to in the article and the concern presented in criterion A is identified, with some use of ITGS terminology.
5–6	There is a detailed description of the step-by-step process that shows a clear understanding of how the IT system works that goes beyond the information in the article. The major components of the IT system are identified using appropriate technical IT terminology. The relationship between the IT system referred to in the article and the concern presented in criterion A is explained using appropriate ITGS terminology.

Criterion C — The impact of the social/ethical issue(s) on stakeholders [8]

3. Evaluate the impact of the social/ethical issues on the relevant stakeholders.

   Marking is to be done holistically focusing on determining the correct markband and then the level in the markband using the guidelines attached to each markband. Best fit is often needed as some responses have qualities that appear in two markbands. And best fit within a markband is also often needed.

   Impact = result/consequence/effect/outcome on stakeholder – positive and negative

   The evaluation should focus on the overall impact on all the stakeholders mentioned discussing the balance between the positive and negative impacts. E.g. overall, which stakeholder is impacted the most/least, which impacts are worse/better than the others.

   At least two stakeholders are required for entrance into the top markband – in this case perhaps the hotel owner/staff; guest of the hotel; digital key APP developers/providers.

   Lower markband:
   [1]: one or two impacts identified - named and lacks details of impact.

   [2]: more than two impacts described of either type – positive or negative.

   Middle markband:
   [3]: analysis by structure – division into groups eg positive/negatives and/or various Stakeholders.

   [4]: at least one negative and one positive impact for at least two stakeholders in order to provide a partially balanced analysis in the top markband. Only one stakeholder analysed or unbalanced analysis maximum of [4], eg the impacts on the hotel owner only or negative impacts only.

   *[5]: must include **some linking analytical connections** (between positive/negatives, various stakeholders, various issues) and/or and **added evaluative comments** about the implications for stakeholders.*

   Upper markband:
   *[6]: fully analysed and evaluated. Significant analytical connections and evaluation comments **require clear evidence of additional thinking beyond descriptions and structure** throughout the response. Fully analysed means at least two positive and two negative impacts for at least two stakeholders.*

   [7–8]: a conclusion backed by direct reference to the impacts described is needed and not just a repetition or summary – it needs to be argued based on the evidence.

Answers may include the following:

Hotel Owner (Daniel)

Positive Impacts
- cost savings –not having to pay staff to supervise the check in desk
- cost savings – no need to handle physical keys, which need handing in and out, if lost, need to be replaced or locks changed which is expensive.
- improved reputation due to modernization
- able to offer more efficient check-in services as housekeeping will be able to use the app to plan their cleaning automatically without being directed
- Daniel can analyse guest behavior and offer additional services based on their behavior
- the hotel may be more profitable due to improved check-in services
- Daniel can work from home as he can generate the digital key using the owner's app
- may attract more overseas/business guests who require fast 24/7 check-in.

Negative Impacts
- reliability – if the key system fails, there is no way to get into the room and the digital key provider would need to come out to fix the problem
- digital divide – may lose customers who do not own smart phones
- authenticity of guests staying – it will be harder to control the number of guests in a room or to know who is physically staying in each room
- breach of key security could lead to a loss of reputation for the hotel
- loss of personalized service may mean that feedback about room stay is not obtained and staff miss the opportunity to sell upcoming hotel promotions.
- guests may not know the exact time of checkout on a day so could overstay (however if they leave the room, after check-out time, they will not be able to regain entry)
- cleaners may not benefit from those checking out earlier than the agreed time.
- may be harder to charge guests who check out after the official checkout time.
- is expensive to set up and change the locks of all hotel rooms and cottages
- authenticity – bookings can be made online with a credit card – this person is authenticated, but bookings can be forwarded by text or email to those actually staying in the room.

Guests

Positive Impacts
- more convenient as no need to carry around a separate key and can use existing phone
- saves time as no need to queue at the check-in or check-out counter to collect your key
- can check in and out at any time of day
- can remain anonymous, as guest staying may not be the person doing the booking. If membership schemes are offered – then discounts can easily be shared amongst friends.

Negative Impacts
- reliability – may be an issue if the guest's phone runs out of battery or the key cannot determine the date and time and they cannot enter the room
- international tourists may not have internet access for the country they are visiting and may not be able to retrieve the SMS or open the app
- surveillance – guests may not like the fact that the hotel is able to monitor their movements in and out of their room
- unauthorized access to the digital key could mean that others could enter the room and steal their possessions
- privacy – data collected and stored in the cloud, could be used by staff or hackers if password access to data or reports is weak or online security is weak
- loss of personalized service – guests may not feel as comfortable, may know less about the facilities and local events/promotions
- digital divide – may add to the stress of a holiday if guests have problems using these technologies
- if they leave the room and forget to take their phone they will not be able to get back into their room
- a second guest in the room cannot unlock the door unless he has the phone of the person who made the booking.

Digital Key Providers

Positive Impacts
- gain profits and increased reputation, the more that hotels use their facilities
- use of keys can be increased beyond hotels to business, hospitals and schools if guests have a good experience with it.

Negative Impacts
- may be held responsible for any thefts caused by digital key security breaches
- loss of reputation when key does not work or bad use of keys
- costs in repairs/hardware lock replacements may be high if hardware is not reliable
- integration of key system with other online booking systems costs more money to develop.

Marks	Level descriptor
0	The response does not reach a standard described by the descriptors below.
1–2	The impact of the social/ethical issues on stakeholders is described but not evaluated. Material is either copied directly from the article or implicit references are made to it.
3–5	The impact of the social/ethical issues on stakeholders is partially analysed, with some evaluative comment. Explicit references to the information in the article are partially developed in the response. There is some use of appropriate ITGS terminology.
6–8	The impact of the social/ethical issues on stakeholders is fully analysed and evaluated. Explicit, well developed references to information in the article are made appropriately throughout the response. There is use of appropriate ITGS terminology.

Criterion D — A solution to a problem arising from the article **[8]**

4. Evaluate **one** possible solution that addresses at least **one** problem identified in **Criterion C**.

   *Problem must be specified here, but if this is not done here, it must be one of the impacts/problems identified in Criterion C. The **one** solution may refer to any of the problems. Mark the first solution only.*

   If the evaluation does not provide any additional information to that in the article, the candidate will be awarded a maximum of [2].

   Lower markband:
   [1]: solution is identified.

   [2]: solution is described (what, who, where) and the link to article may be implicit, which could be a general description eg general policy description similar to that found in a textbook.

   Middle markband:
   [3]: the solution is applied to the problem directly and not generally – how and why it solves the problem (first positive evaluation). The solution must be feasible and can be applied to the problem, even if not good "quality".

   [4–5]: at least one positive evaluation and at least one negative evaluation is required. Best fit if description is limited.

   Upper markband:
   *[6]: fully evaluated strengths and weaknesses requires a balance of at least two positive and two negative evaluations with details of each one. A further development of **this solution** may involve the solving of more than one problem.*

   [7–8]: concluding paragraph directly referencing the evaluations. Students may propose future developments in response to the evaluations, such as solution/s to the negative evaluations, as part of the conclusion – best fit applies if included instead of discussion of evaluations.

   Best fit also applies if a student has not fully described the solution or provided the minimum four evaluations.

   Solutions to other problems (for example, Q.1a) are accepted if they are within the context of the article.

Answers may include the following:

Reliability solutions:
- phone charging stations in the lobby or corridors with charging cables to borrow
- back up keys *eg* keypads on the doors so that code can be manually entered.

Security and privacy solution:
- improved security on cloud storage of booking system
- users and access rights configured to restrict access for different users
- app provides an area to store digital keys and uses biometric or manual passwords to restrict access
- in room features where users have to authenticate themselves to use room facilities *eg* lights/entertainment systems
- encrypt the data in the cloud storage
- cameras to monitor the hotel if phone stolen or the key stolen/copied
- encryption to ensure the safe transmission of the data
- VPN - Encrypts the transmissions between user and the cloud.

Reliability/Digital Divide/Lack of internet access solution:
- offer a reduced service at the check in for guests who still wish to check in with staff assistance or are facing technical issues
- a cheap smart phone to be borrowed – each room is equipped with a cheap smart phone with the hotel website and limited functions.

Guest Authentication
- digital Key app need user authentication (username-password / Biometric) etc, before generating key/unlocking door.

Controlling number of guests
- issue Digital key based on number of guests.

Surveillance
- terms and conditions/policies that inform guests about the use of personal data/information.

Marks	Level descriptor
0	The response does not reach a standard described by the descriptors below.
1–2	**One** feasible solution to at least **one** problem is proposed and described. No evaluative comment is offered. Material is either copied directly from the article or implicit references are made to it.
3–5	**One** appropriate solution to at least **one** problem is proposed and partially evaluated. The response contains explicit references to information in the article that are partially developed. There is some use of appropriate ITGS terminology.
6–8	**One** appropriate solution to at least **one** problem is proposed and fully evaluated, addressing both its strengths and potential weaknesses. Areas for future development may also be identified. Explicit, fully developed references to the information in the article are made appropriately throughout the response. There is use of appropriate ITGS terminology.