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Markscheme

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Information technology in a global society

Higher and standard level

Paper 2

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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*

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 employee, client, or Chief Technical Officer.*

Accept reasonable answers related to the concerns listed below, bearing in mind different scenarios related to remote access to the *E&A* company network, such as, but not limited to:
- *E&A* employees using the company laptop
- if *E&A* employees are using VPN to connect to *E&A* network.
- if *E&A* employees are using cloud services to access *E&A* network
- if *E&A* employees are using a hotspot / dongle / aircard / 3G or 4G source
- concerns related to working at a client's office, such as having to login to the client's network.

Social/ethical concerns may include the following:

Security/Privacy concerns
- Unauthorized access to private data may be possible, as the *E&A* network or the employee's network may not be secure.
- *E&A* employees may not be able to access the network and retrieve the necessary files at the client's office because of its network settings.
- Unauthorized access to private data may be possible during data transfer between the *E&A* network and the laptop.
- Remote access may involve a third party and therefore be more susceptible to abuse by hackers.
- Weak authentication requirements could lead to unauthorized access to company data.
- Personal data of employees/clients can be accessed /without permission

Reliability concerns
- Low bandwidth at a client's office or home will slow down work/may make it impossible to use some software or download large files.
- Viruses or failure of laptop – the employee may not be able to rectify the problem and cannot access files.
- Unable to access the *E&A* network from a client's office so work cannot be completed.
- Employees may lose work if there is not an appropriate backup mechanism when working at a client's office or home.

Policies
- Employee awareness of issues linked to accessing the *E&A* network when working at a client's office or home – if a laptop screen is unlocked when visiting a client, anyone could access the company network and files.

(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:
- *E&A* managers, who must provide a laptop to their employees to access E&A network from their client's office.
- Employees of *E&A*, who need to access the company network and/or specialized software outside the Head Office.
- Chief Technical Officer (CTO) / management at *E&A*, who have to find a solution to access the *E&A* network off site.
- Clients who must allow *E&A* employees to access their company network by logging in through the client's WiFi/network.
- Clients use the IT system to work with the employees of E&A to review the designs and then produce their products.

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: Remote access to (implies; and use of files/software on) the *E&A*
          company network.

          [1]: the student may show some understanding of the process but not in a step by step approach – using the information in the article and possibly some steps missing.

          [2]: the student is able to provide a logical, step-by-step account using the information in the article but lacks some details. It must contain at least two major steps from the article. No developments present. Best fit if contains developments/information beyond the article but not in step by step.

          [3]: the student is able to provide a step-by-step account which may be detailed. It must contain at least two technical developments beyond the article in two of the major steps.

          [4]: at least four technical developments beyond the article, in two or more of the major steps.

          Accept reasonable answers related to the steps in different scenarios related to the remote access to the E&A network, such as, but not limited to:
- E&A employees using the company laptop
- if E&A employees are using VPN to connect to E&A network.
- if E&A employees are using cloud services to access E&A network
- if E&A employees are using a hotspot / a dongle / aircard / 3G or 4G source
- Concerns related to employees working at a client's office, such as having to log into a client's network.

          Answers provided in the article include the following:
- Employees have a laptop.
- *E&A* has a company network.
- There is partial access to the *E&A* network – the article only states that employees store PDF versions of the designs. It does not indicate how these are loaded onto the laptop.
- Designs are saved in PDF for clients.
- *E&A* uses specialized design software to develop its projects.
- Changes requested by the clients must be updated on *E&A* network.
- Employees may have problems to connect at client's offices.

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

Cloud storage is not permitted by itself as the Article specifically states the files are stored on the E&A network.
Cloud storage is permitted if it is accessed through the E&A network, for example, the E&A One Drive / Google Drive / other cloud storage.

Stage 1 – the employee accessing their laptop
- Login to laptop requires providing a username and password.
- Additional authentication may be used, such as biometrics, texts, SMS.

Stage 2 – connection to E&A network
- Authentication may be required to a client's WiFi / network.
- Create a hotspot.
- Use a dongle / air card / 3G or 4G source.
- Remote desktop connection.

Stage 3 – authentication on the E&A network
- Once logged into their laptops, employees may need additional authentication to login to the *E&A* network, *e.g.* biometrics/ID and password/additional authentication step/2 way verification/challenge question
- User credentials will be matched to a record in the database to validate details.

Stage 4 – access to files and specialized software
- Accessing, saving and downloading files on the E&A network.
- Starting (may need authentication) and operating the specialised software - including access to files.
- Automatic authentication for software as logged into E&A network.

(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 weakness 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 employee may not be able to connect to the E&A file server due to bandwidth issues.
- The employee may not be able to connect to the E&A file server due to login issues/firewalls/ports being closed/security settings
- Files may not be accessible due to the laptop being damaged/infected with virus/not support specialized software
- Version control as information may be located in a number of places ie laptops and server
- Version control between server and laptop may be a problem
- Continuing transferring of information between devices could lead to the hardware becoming corrupted.

Security / **Authentication** / **Privacy**
- Unauthorized access may be possible as the client's or employees network may not be secure.
- Unauthorized access may be possible during file transfer between the server and the laptop if encryption is not sufficiently strong.
- *E&A* employees may not be able to access the network at the client's office because of its network safety settings.
- *Theft of personal / corporate data due to weak security protocols leading to privacy breach.*
- Accidental/deliberate leak of personal data due to oversight or by a disgruntled employee.

Backup policies
- Employees may lose work as backing up the files may not be possible when working at a client's office.

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.

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.

At least two stakeholders are required for entrance into the top markband – in this case perhaps the employee and the client(s).

[1]: one or two impacts identified.

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

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

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

*[6]: Fully analysed and evaluated. Significant analytical connections and evaluation comments **require clear evidence of additional thinking beyond descriptions and structure.***

[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:

The focus of the response can be on either working from home benefits and issues, as well as the issues and benefits from working with the E&A system including the files and design software. The working from home focus may include more positive and negatives than are included here.

E&A managers

Positive impacts
- May engender a culture of trust and autonomy for employees.
- Provide a better service to clients as they will not need to come to *E&A* Head Office.
- Better service to clients as employees have flexible working hours.
- No need to invest in more licenses of CAD software.
- More control of the changes made on client's design as updates on CAD files can only be done at the Head Office and may require pre-authorization from *E&A* managers.
- Control of client's final designs.
- Less risk of having CAD files corrupted or hacked as they are not tampered online.

Negative impacts
- Not being able to directly supervise employees.
- May require upgrading of laptops to support specialized software.
- May require more licenses of specialized software if it is to be loaded on employee's laptops.
- Concerns that trade secrets may be compromised as employees may be off the network and unable to be monitored.
- Security issues if the company network is compromised.
- Extra training may be needed for employees to use remote access/understand security issues/backup work and ensure version control.
- Cost to train employees to be able to work remotely.
- Must provide employees with reliable Internet connection off-site such as high-speed bandwidth plans, investments on a dongle / air card / 3G or 4G source.
- Risk of not having the latest version of client's design if employees fail in updating client's design files.

E&A employees

Positive impacts
- Cost savings as no commuting costs.
- Able to work more flexibly.
- May engender a culture of trust and autonomy for employees.
- Being near to clients help focus on clients projects and needs.
- Easier to do their jobs as they can access all the company files/don't need to carry all the files with them.

Negative impacts
- Lack of collaboration with colleagues, not getting expert advice / not harnessing the benefits of collective intelligence.
- May lead to more work being carried out at inconvenient times.
- May not feel confident in dealing with IT issues remotely – remote access will be more complicated than accessing pdf files on the laptop.
- Isolation as not having the support of more experienced colleagues.
- May not be able to access the resources due to bandwidth issues / authentication/ firewall issues at home/client's network.
- Having to update changes made on the PDF versions on the client's design at *E&A* file network.
- Having to go through multiple authentication steps to reach *E&A* network (authenticate to log on: laptop; client's network/WiFi and on *E&A* network).
- Frustration to have to work on a PDF version of the designs.
- Frustration of not having access to the specialized software thus not being able to make changes to the design in real time.

Clients

Positive impacts
- Convenience, the *E&A* employee can come to their home / site to see the project for real.
- Secure as the designs are being viewed in a private space.
- Not having to commute to *E&A* head office to discuss their projects.
- Confidence that their building designs are safe as *E&A*'s network controls access to client's final designs and they are not tampered online.

Negative impacts
- Home/client's network may not be able to access the *E&A* file server.
- Not having broad bandwidth may hinder communication/access to *E&A* network.
- Not having access to multiple *E&A* employees to brainstorm projects.
- Frustration at not being able to view changes to the design in real time.
- Having to share their private or office network/WiFi sharing password/authentication details.

Chief Technical Officer (CTO)

Positive impacts
- May only be required to work on laptops when necessary.
- May free up internal bandwidth within the *E&A* Head Office.

Negative impacts
- Might need to give extra technical support to employees working remotely from home or at clients' offices.
- Employees may expect technical support at home after hours/weekends.
- Lack of f2f contact with employees may mean that problems escalate unnecessarily.
- Security issues may increase the workload
- Having to authorize all laptops to access *E&A* network, dealing with connection problems at client's office, and making sure that the changes requested by the clients are updated on the CAD software and on *E&A* network.

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.

   [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.

   [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.

   [6]: fully evaluated strengths and weaknesses requires a balance of at least two positive and two negative evaluations.

   [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.

Answers may include the following:

VPN solution:
- Access to bespoke software / company resources.
- Secure backup.
- Real-time synchronization of data.
- More reliable than cloud based.
- Set-up can be customized to meet the requirements of the *E&A* IT Department.
- Reassurance of feeling as if you are in the office, same environment, same "view" of the files.
- Most expensive and technical solution.

Cloud-based solutions:
- Secure backup, but less than VPN.
- Many document types are not editable due to the need of specialized software.
- Cheaper than a VPN.
- Who owns the data, and who has access to the data.
- Setup is more generic, more straight forward.
- May have functionality that may is possible in a VPN such as alerts.

Upgrade of the E&A laptop:
- Will provide access to bespoke software / company resources.
- Will not be affected by potential connectivity issues if an external Internet access is provided by the company such as a dongle / air card / 3G or 4G source.
- As the files are on a local device they will run/render more quickly using a VPN or cloud-based approach.
- More secure than cloud-based files as no third parties are involved.
- Cheaper than VPN and no third parties involved as with cloud-based solution.

Non-technical solution:
- Policies to backup laptops and changes made while meeting with client.
- Education/training of employees to work remotely.
- Training to adapt to new way of working (isolated rather than communal).
- Cheapest solution.

Connectivity solutions:
- Provide high bandwidth through dongle / aircard / 3G or 4G source so that employees do not depend on clients Internet connection.
- Provide top-notch laptops that can support *E&A* specialized software.
- Provide employees with updated anti-virus software.

Security / authentication solutions:
- Invest in strong authentication requirements, such as biometrics.

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

It is likely that solutions may integrate different aspects of the different solutions identified. If the integrated solution is coherent candidates must not be penalised.

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.