

Markscheme

May 2016

**Information technology
in a global society**

Higher level and standard level

Paper 2

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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: Home and leisure

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 runners, cyclists Kiku Co or their rival companies.

Social/ethical concerns may include the following:

Reliability issues:

- reliability of app and/or GPS system may affect accuracy of training data/accuracy of the training data collected
- accuracy/reliability of the data displayed live on the app – recorded accurately (line 8).

Privacy issues:

- privacy issues for users who have data stored on website – who has access and how much data do they have access to which can be used for...?
- ability of third parties to create website accounts and view routes, locations, team associations *etc* of users
- geo-locating of users at a specific place and time. Possible loss of anonymity/identification of user – people know where you are and at what time
- possible prediction of future location (eg if user regularly uses the same route or is taking part in a team challenge over several routes)
- possible conflict of privacy/user policies between Kiku and other companies with whom they share data
- sharing of data on social networking sites may allow a third party to gather further information about a user that could be used for malicious purposes
- targeted advertising from third parties such as Facebook and Twitter
- use of data by third party companies – no mention of how data is being used.

Security issues – privacy and security issues overlap for impacts and should be awarded marks; a consequence of a breach of privacy can result in a security issue for the person, eg can access home location and then harm them.

But in Q2(b) the security or privacy IT must be addressed appropriately

Security issues:

- data stored on the device may not be secure. Mobile device can be stolen or compromised (exposing the stored data to a malicious party). Access to the stored data may allow a third party to determine home location, patterns of movement *etc*
- data may not be secure while being uploaded from device to website
- data can be intercepted in transmission between device and website, allowing a third party to determine home location, patterns of movement *etc*.

(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:

- Kiku users who use the IT system to gather training data and upload it to their accounts or who purchase items marketed on its website
- Kiku App developers/owners/company that are responsible for allowing rival company to add their users to Kiku website without proper privacy policies and/or privacy setting; or who are responsible for the IT systems that allow the data to be uploaded and plotted on maps/used to calculate badges etc
- rival companies work with Kiku website to share data between their apps
- third parties (eg criminals) who may create a Kiku account and view uploaded data/access the mobile device/intercept the data in transmission in order to identify and/or locate the user, the user’s home location or the user’s patterns of movement.

Note: the IT system is GPS geolocation app that uses mobile device, not a dedicated fitness device.

A general reference to Kiku is not enough for the IT system requirement. It needs to be more specific about the app and/or the website.

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: GPS-based geolocation.

*Three major steps include: **access** (downloading app, registering), **storage/use** (recording geolocation data, calculations, storage on device or website) and **output/sharing** (on screen, through website, through twitter, facebook, email).*

[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. 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 and two of the major steps.

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

GPS and 3/4G connections are different technologies – GPS is for tracking and 3/4G is used to connect to the Internet. If there is confusion mark positively and award the higher mark for either technology described.

Answers provided in the article include the following:

access (downloading app, registering):

- users can access their accounts via website, see previous data (line 9)
- users can choose photographs and create usernames that include personal details eg username GrahamD (line 25).

storage/use (recording geolocation data, calculations, storage on device or website):

- Kiku uses the built-in GPS of the user's mobile device to record geo-location data (line 3)
- data is stored on the mobile device (line 4)
- data is uploaded automatically to the user's account on the Kiku website (line 4)
- Kiku uses this data to calculate the start and finish times of the session, the total time taken and the overall distance covered (line 5)
- Kiku continuously records the location of the device (line 7)
- Kiku calculates challenge winners and adds digital badges to profiles (line 14).

output/sharing (on screen, through website, through twitter, Facebook, email):

- the exact route taken by the user can be displayed on an interactive map, both on the device and on the Kiku website. This implies it is displayed live on the device? (line 7–8)
- users can share data via email or social media (Facebook, twitter) (line 9).

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

access (downloading app, registering):

- users need to download the app from an app store and install the app
- user needs to register their account with Kiku including a password to log in
- app asks user permission to collect user's location
- once registered the user needs to activate the app and log on.

storage/use (recording geolocation data, calculations, storage on device or website):

- each GPS satellite transmits a continuous stream of time-stamped data
- the GPS receiver on the mobile device receives data from least four satellites (accept three, as it is possible)
- the GPS receiver calculates out distance to each satellite (using the time delay between the time the data was transmitted by the satellite and the time the data was received by the device)
- the GPS receiver contains a database (almanac) that contains orbital path data for each satellite
- the almanac is periodically updated by corrected data (ephemeris) sent by the satellites
- by knowing where the satellites are at any moment in time (calculated from almanac data) and the distance to each satellite (calculated from the time taken for the satellite signal to reach the device), the device can calculate its position on the surface of the earth using trilateration (accept triangulation)
- the app stores that position in a database on the device in the form of time-stamped geo-location data
- device continuously repeats this process, storing each new position as a record in the database
- uploaded data is stored in a database/server on the Kiku website
- using the time-stamped geo-location data, the device and/or website can calculate the start and finish time of the training session, the distance covered, the speed of travel throughout the session and the route followed
- data stored on the device and/or the Kiku website can be displayed as a point on a map (maps either stored on the device or retrieved from the internet)
- timestamps and position data uploaded to website can be used to calculate speed, distance covered, progress in challenges *etc.*

output/sharing (on screen, through website, through twitter, facebook, email):

- position data gathered during a training session is sent to the website using any available internet connection (*eg 3/4G while the user is training, or over Wi-Fi once a connection is available*)
- users can add routes, goals, to their social media profiles as automatic posts
- personal goals can be automatically shared via social media
- shared routes can be downloaded by others and used offline.

- (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 – weakness with the technical).*

Answers may include the following:

Reliability issues:

- app crash may not be noticed by user as the phone may be in a pouch while doing activity (how); due to poorly tested updates or programming (why) or
- app crashes may result in data loss, as when the app is not functioning, it is not able to collect and record the data; due to poorly tested updates or programming (why)
- GPS signals may be obscured or distorted by buildings or geographical features leading to inaccurate or incomplete storage of route information (how); signals may not always be able to transmit through the density/type of some materials (why)
- runs out of power as has not been charged before the trip, or device is old and does not hold its charge.

Privacy issues:

- inadequate control over authentication and permissions on website may lead to users' personal data being viewed by others who have accounts with the Kiku website (how); program and security/privacy have not been designed properly – intentionally or unintentionally (why)
- access to stored route information may allow user to be located at a specific place and time (if it is live updating could also provide actual position) (how); because of live updating and sharing of data on website or SNS (why)
- tendency of users to create accounts with names that contain personal details and/or uploaded profile photographs may lead to loss of anonymity/identification of user, particularly if this is combined with information from social networking sites used to share Kiku route data (how), due to the willingness of users to show their sporting achievements and the share settings of their SNS have allowed easy access to happen (why)
- if users of other services have their data shared with Kiku, differing privacy policies may result in those users' data being shared with third parties without their explicit consent/knowledge; different laws and policies apply in different countries of where the apps are being developed or the country the website is being hosted; or the different companies have different policies as they are in different countries with different laws (why).

Security issues:

- if mobile device is stolen or compromised, access to data stored on the device may allow third party to determine user's home location, patterns of movement *etc*; due to no passcode on device or easy to guess passcodes (why)
- if data is intercepted during transmission between device it may allow a third party to determine home location, patterns of movement *etc* (how); weak/lack of encryption during data transmission (why)
- if the Kiku app is live updating this provides the location of the person on the website and potentially puts them at risk (how); users may be in remote/isolated locations eg parks, jungle areas and on their own; poor privacy settings on SNS gives access to unwanted parties (why)
- psychological Issues – addiction – the use of apps can be addictive and have a psychological impact on users – regular recording of activities can become an addiction or be overly competitive amongst friends, the need to reach a certain target every day or to beat a friend everyday as this information is being shared (how); the ease of being able to record and track fitness activity and compare performance from week to week or from person to person (why).

Candidates are expected to make reference of 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	<p>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.</p> <p>The major components of the IT system are identified using minimal technical IT terminology.</p>
3–4	<p>There is a description of the step-by-step process of how the IT system works that goes beyond the information in the article.</p> <p>Most of the major components of the IT system are identified using some technical IT terminology.</p> <p>The relationship between the IT system referred to in the article and the concern presented in criterion A is identified, with the some use of ITGS terminology.</p>
5–6	<p>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.</p> <p>The major components of the IT system are identified using appropriate technical IT terminology.</p> <p>The relationship between the IT system referred to in the article and the concern presented in criterion A is explained using appropriate ITGS terminology.</p>

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 runner/cyclist, app developers/company, and one other eg the users of rival companies, third parties.

Markband 1 - 2

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.
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Lower end - one or two impacts identified.

Upper end - more than two impacts described of either type – positive or negative.

Markband 3 - 5

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.
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Lower end - analysis by structure; division into groups eg positive/negatives and/or various stakeholders.

Middle - 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 the runner/cyclist only or negative impacts only.

Upper end - must include **some linking analytical connections** (between positive/negatives, various stakeholders, various issues) and/or and **added evaluative comments** about the implications for stakeholders.

Markband 6 - 8

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.
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Lower end - fully analysed and evaluated. Significant analytical connections and evaluation comments **require clear evidence of additional thinking beyond descriptions and structure.**

Middle and upper end - 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:

User (cyclist, runner)

Positive Impacts

- Kiku users – motivated to do more sport as their performance can be viewed and shared by others
- app may have recommended challenges can help train users in their sport eg recommended routes and distances to train for a marathon
- can purchase items marketed on its website with a discount
- fitness/Sporting performance may be linked to health insurance companies with reduced health insurance premiums

Negative impacts:

Reliability issues:

- app crash and/or inaccurate recording of position of device during use may result in failure to store training data. This may affect completion of challenges, progress of team, loss of discount “prizes”
- inaccurate or incomplete data or data loss could affect training programmes and impact on the success of competitive athletes
- could also mean that reusing routes is not possible and attempts to do so could get users lost or off track
- ability to locate a user while on route eg in case of injury or bike fault, could mean that they are not in the expected location

Privacy issues:

- exposure of data may allow a third party to build-up detailed information about the user from the Kiku website and by aggregating data from the Kiku website and other websites (eg social networking sites) used to share data/route information – User may have limited ability to control who sees this data
- detailed route information (eg with start and finish times, dates, locations etc) may allow a third party to predict patterns of movement. This may expose the user to risk of being stalked/assaulted or have their home/property attacked as the attacker would be able to predict when they were not at home
- if live update to website then provides actual location of user putting them at risk of assault etc
- if the users start the app at their home location, third parties (eg criminals) may be able to deduce that location from the route information displayed on the website and/or stored on the device itself. This may lead to theft of property from home location etc

Security issues:

- theft of device or compromised device may expose detailed user data to a third party
- interception of data during transmission may expose details of routes/locations to third parties
- unauthorized access to database on the website may expose detailed user information to third parties.

Psychological issues:

- users may become addicted to their app/performance which may have a negative psychological impact if targets are not met

Kiku Company/Developers

Positive Impacts

- by sharing info on SNS and adding third party data Kiku will be more popular and more people will join; more companies will sponsor/advert on Kiku.

Negative impacts

- reliability issues: app crashes and unreliable data will affect Kiku reputation and if not resolved, users may prefer to use other rival company apps
- privacy issues: are responsible for allowing rival company to add their users to Kiku website without proper privacy policies and/or privacy setting. Time and money may need to be spent to hire staff to develop appropriate policies and necessary security measures to protect the company and users
- they could be held responsible for negative consequences by third parties eg assault, theft and be sued
- security issues: the ease that a third party could gain access to user data via unsecured phone, through transmission or on the webserver, may mean software developers will need to solve this problem which will cost time and money to develop

Rival companies work with Kiku website to share data between their apps

Positive Impacts

- sharing of data, may be lead to advertising deals or two way sharing which could direct network traffic to the rival company.

Negative impacts

- users of rival company may switch to Kiku apps if performance is better and the company will lose users, be less popular in the market.

Third parties (eg criminals)

Positive Impacts

- who may create a Kiku account and view uploaded data/access the mobile device/intercept the data in transmission in order to identify and/or locate the user, the user's home location or the user's patterns of movement – data is easily available with little work – will gain financially from thefts.

Negative impacts

- if the app is not reliable, data may not be accurate and wrong homes targeted resulting with users being at home or not having bikes *etc.*

Reliability issues

- app crash and/or inaccurate recording of position of device during use may result in failure to store training data. This may affect completion of challenges, progress of team, loss of discount “prizes”. Inaccurate or incomplete data or data loss could affect training programmes and impact on the success of competitive athletes; could also mean that reusing routes is not possible and attempts to do so could get users lost or off track. Ability to locate a user while on route eg in case of injury or bike fault, could mean that they are not in the expected location.

Privacy issues

- exposure of data may allow a third party to build-up detailed information about the user from the Kiku website and by aggregating data from the Kiku website and other websites (eg social networking sites) used to share data/route information
- user may have limited ability to control who sees what data
- detailed route information (eg with start and finish times, dates, locations etc) may allow a third party to predict patterns of movement. This may expose the user to risk of being stalked/assaulted or have their home/property attacked as the attacker would be able to predict when they were not at home
- If live update to website then provides actual location of user putting them at risk of assault etc
- if the users start the app at their home location, third parties (eg criminals) may be able to deduce that location from the route information displayed on the website and/or stored on the device itself. This may lead to theft of property from home location etc
- other companies who share their users’ data with Kiku may find that privacy policies are in conflict. May expose companies to liability of complaints/prosecution by their users. Users may find they are targeted by third party companies for email, spam etc

Security issues

- theft of device or compromised device may expose detailed user data to a
- third party
- interception of data during transmission may expose details of routes/locations to third parties
- unauthorized access to database on the website may expose detailed user information to third parties.

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.

Markband 1 - 2

1–2	<p>One feasible solution to at least one problem is proposed and described.</p> <p>No evaluative comment is offered. Material is either copied directly from the article or implicit references are made to it.</p>
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Lower end - solution is identified.

Upper end - 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.

Markband 3 - 5

3–5	<p>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.</p>
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Lower end - 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”.

Middle to upper end - at least one more positive evaluation and at least one negative evaluation is required. Best fit if description is limited.

Markband 6 - 8

6–8	<p>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.</p>
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Lower end - fully evaluated strengths and weaknesses requires a balance of at least two positive and two negative evaluations.

Middle to upper end - 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:

Reliability issues:

- Kiku provides regular updates of app to address stability issues across different devices and reduce frequency of app crash
- app crash during use causes a warning sound/vibration of device to maximize chances of user noticing crash
- poor GPS signal compensated for by app automatically switching to or including other location information (eg location determined by Wi-Fi and/or mobile phone network positioning).

Privacy issues:

- user can set permissions to control who can view stored profile information on website (eg public/private/other group members only)
- user can opt to reduce route information displayed to others (eg simply overall distance and elapsed time rather than full time/location information) to minimize possibility of patterns of movement being built-up over time
- user can set some stored routes as “private” or restrict access to other group members only
- user can make membership of groups private or invisible
- user can register home location with the app on the mobile device. App will not store any location information if device is within a certain radius of home location
- user can register home location with website (in addition to or instead of storing it in the app itself). Any route data within a certain radius of that location is not displayed by default to reduce the chances of a third party determining user’s home address or location
- automatic delay of recording until at least 500 m from starting point – car or home
- Kiku and/or other companies update their privacy policies where users have their data shared with Kiku – option to opt-out of sharing and/or control who has access to data to reduce possibility of targeted advertisements etc.

Security issues:

- Kiku adds user authentication to the app (eg password/PIN/finger-scan) required to access data stored on device
- Kiku uses encrypted storage of data on device and/or website (authentication method acts as decryption key)
- Kiku uses secure data transfer between device and website (eg HTTPS/SSL).

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

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.
