M17/3/ITGSX/BP2/ENG/TZ0/XX/M

Markscheme

May 2017

Information technology in a global society

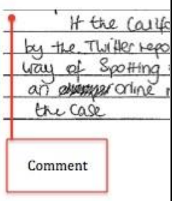
Higher level and standard level

Paper 2

20 pages

The following are the annotations available to use when marking responses.

Annotation	Explanation	Comment	Short cut
✓	Correct point	Use for identify, state, outline, describe	Alt+0
✗	Incorrect point	Use for identify, state, outline, describe	
BOD	Benefit of the doubt	Answer is close enough to give some credit, indicates that you see some merit in it.	
NBOD	No benefit of doubt	Not quite enough to earn any credit.	
SEEN	Seen	Indicates that the text has been noted, but no credit has been given, or used on a blank page to ensure that RM Assessor and/or staff in Cardiff know that you have seen the page	
OC	Off course	Content not relevant to the question.	Alt+8
TV	Too vague	Point is unclear, or not specific enough to answer the question.	Alt+1
REP	Repetition	Repeats a point previously made, not necessarily worded in the same way.	Alt+2
REF	Reference	This is used to indicate a reference to the stimulus material, article or the Case Study (Paper 2 or Paper 3)	Alt+3
D	Description	Candidate has added descriptive information to an initial idea that has been named or identified.	Alt+4
A+	Analysis / Explanation	Candidate has explained **why** something occurs, or why it is important to the point s/he is making, or described the consequences of a policy/action/use of IT.	Alt+5
B+	Balanced argument involving detailed analysis	Use in the examiner’s comments at the end of extended response questions. Balanced arguments involving detailed analysis can occur within paragraphs as well as at the end of the response. Often, a transition word to link/compare ideas, such as “however” or “on the other hand” is used. Can also be structured analysis of ideas, *eg* good vs bad, for X and against X.	Alt+6
EVAL	Evaluation – beyond the ideas presented to reach a conclusion or overall comment.	Use only if **evaluation is supported**, not just stated. Note that evaluation can occur in the body of an extended response as an evaluative comment about an idea as well as at the end in the conclusion. Fully evaluated requires a well-supported conclusion. Evaluation and detailed analysis can overlap when evaluation is within a paragraph.	Alt+7
O	Opinion	Use only if opinion is supported, not just stated. Note that opinion can occur in the body of an extended response as well as at the end.	Alt+9

▭	Dynamic, Horizontal	Indicates a valid point that the student will need to support in an extended response.	
〰	Dynamic, Horizontal Wavy	Used for incorrect statements/phrase	
⌇	Dynamic, Vertical Wavy	Indicates that the candidate has veered off course, i.e. either by not answering the question that is asked or has moved in a direction unrelated to the question. Can also use OC annotation	
 it the Calif by the Twitter repo way of Spotting an ~~answer~~ online the case Comment	Text box with extended vertical line.	Used to mark and comment on a block of writing that makes a valid point. Note that the text box and the vertical line are connected.	
Text box	Insert comments	Used for comments at the end of questions where the mark needs to be JUSTIFIED. Often with AO2 command terms – EXPLAIN. ALWAYS with AO3 command terms – EVALUATE, JUSTIFY, TO WHAT EXTENT, and DISCUSS.	

You **must** make sure you have looked at all pages. Please put the SEEN annotation on any blank page, to indicate that you have seen it.

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, in contrast, as a consequence, similarly*
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.

Themes: Business and employment, home and leisure, politics and government

Introduction
The technology does not involve the use of the internet to operate and use the drone. Internet may be used later to upload videos to cloud or sync. Responses that identify WiFi as internet should be assessed with care, as WiFi can carry the internet but not only the internet. WiFi is a channel of communication only. Bluetooth is a very short distance channel and not appropriate for this article.

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 may not be explicitly named or incorrectly named or vaguely named).

__[2]__: there needs to be an explicit description of the impact / result / consequences / effect / outcome.

If more than one concern is identified, e.g. privacy and security, look at 2b and award marks for the concern that will give the candidates the highest mark across this question and 2b.

The description needs to reference the IT system in the article.

If two __different__ concerns are raised, since the question specifies __one__ concern hence only mark the first; except if commonly linked.

Social/ethical concerns may include:

- loss of privacy for drone user and/or members of the public due to intercepting the video streamed from the drone and misusing it (*eg* publishing captured video/using it to plan or commit crimes) or dropping drugs/guns/etc into prisons)
- security concerns, such as the drone being taken over or disabled by third parties
- safety concerns where drones are used inappropriately or recklessly (*eg* near airports, over forest fires, above crowded areas such as sporting fixtures)
- privacy concerns over the use of drones for surveillance by individuals or government departments
- loss of privacy if members of the public are filmed, without their knowledge or permission, and the video is published (*eg* on social media)
- reliability where the limited range of WiFi may mean that drone may fly out of WiFi range and then out of control presenting a risk to public and loss of the drone
- reliability and accuracy of GPS particularly in built up areas due to canyon effect of buildings/structures shrouding the GPS signal
- digital citizenship where the use of small civilian drones as a weapon and surveillance tool in terrorist events (Syria and Iraq)
- policies such as where local governments can set restrictions on the operation of the drone and easy access means that some people may be unaware that they are operating the drone illegally (in Dubai, it is illegal to fly drones without permission from the authorities concerned). Civilian/leisure user of drones can be fined/jailed (they may be unaware of the policies of government depending on size/type/purpose/features/range of drones)
- inappropriate surveillance by government/police, misuse by people to monitor neighbours,

- criminals can use it to better understand a locality to plan a crime, and to see if anyone is at home, where guards are, *etc*
- people and machines where drones may be prone to misuse because of range of possibilities/features this device has to offer, type of misuse needs to be specifically identified but not necessarily fully described.

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

Describe means to include who, what and where but not how and why for full marks.

[1]*: Who – identification of the stakeholder.*

[2]*: Where – the use of the IT system (technical part) AND What are they doing with the IT system.*

Primary stakeholders may include:

- drone owner who operates the drone and receives the video shot by the drone's camera; not just flying the drone
- members of the public who are observed/filmed by the drone's camera or directly affected by the drone, *eg* closure of airport
- government departments such as the fire service whose work may be impeded by incorrect use of the drone by operators
- government departments such as the police who use drones for crime fighting or intelligence gathering
- government departments who are responsible for regulating the use of drones and setting rules for their use
- third parties who may intercept the video or take control of the drone
- commercial enterprises such as filmmakers, retailers or construction companies who use the drones themselves or data/video gathered by drones for business activities
- companies responsible for developing the drone hardware/software and who have a responsibility to ensure its security and reliability
- a third party put at risk by the reliability of the WIFI signal/GPS signal, *etc*, and the drone crashes and does damage
- anyone illegally using the drone – *eg* terrorism, criminal activity (transport of guns, drugs, *etc*), illegal surveillance.

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]

Before marking, please review how the GPS satellites are used by the GPS software in the mobile device and the drone (triangulation). Basically, the GPS satellites only send a signal that is received and processed by the device – there is no communication back to the GPS satellite. Ignore incorrect GPS steps but award marks for steps such as those indicated in the following link: www8.garmin.com/aboutGPS/

2. (a) Describe, step-by-step, how the IT system works.
IT system: use of smartphones, WiFi, GPS positioning and video streaming to operate drones.

Many of the responses will not fit neatly into a mark descriptor, so best fit will need to be applied.

The major steps are the use of the ***four components*** *of the IT system: smartphone, WiFi, GPS positioning and video streaming.*

[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 (at least* ***three*** *major components are required.*

[3]*: the student is able to provide a step-by-step account which contains significant details, and which includes some information beyond the article (at least* ***two*** *technical developments) and includes at least* ***three*** *major components.*

[4]*: at least* ***four*** *technical developments and all major components in* ***detail****.*

Answers provided in the article include:

- an app is installed on the drone operator's GPS-enabled phone already
- GPS-enabled smartphone connects to the drone using WiFi
- drone pinpoints its position using GPS
- drone streams video back to the smartphone
- user uses streamed video and GPS data to see where the drone is
- user can send GPS coordinates to the drone, causing the drone to fly to that point
- drone has a GPS receiver enabled automatically
- drone can operate autonomously with preset GPS coordinates.

NB: *Setting up the phone and the drone are covered in the article, so no development marks for installing app or activating GPS and WiFi.*

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

- WiFi connection is made by specifying the drone’s unique SSID in the smartphone app
- both the smartphone and the drone use GPS satellites to trilaterate (accept triangulate) their position
- drone continuously sends GPS coordinates of its current position back to the smartphone
- smartphone displays the position of both the user and the drone on a map streamed from the internet or downloaded to the device
- user can control the drone using onscreen controls provided by the smartphone app
- use and outline of features displayed on the smartphone such as: overlaid maps, information about yaw, pitch, altitude, artificial horizon, battery life, GPS signal strength indicator, WiFi signal strength indicator, emergency landing button, *etc*
- user can control the drone using a handset or controller connected to the phone (or a specialized handset/joystick by itself)
- drone can be controlled by sending GPS coordinates from the smartphone to the drone, the drone calculates a flightpath from its current location to the location specified by the coordinates and flies to that point
- the drone can have a “return to home” setting added, where it returns to a point if the WiFi connection is lost (this can happen if the drone is used beyond the normal range or in a different city
- real time video gathered by the drone’s camera is transmitted to the smartphone in compressed format via the WiFi connection
- the smartphone is paired with the drone by selecting the drone from the list of available devices
- user can choose the speed and height of the drone using controls on smartphone
- user can instruct the drone to hover at a certain point and capture video footage
- encryption of video stream and control instructions
- real time viewing/streaming of camera video – this is different from real time control
- video is recorded and stored in camera/smartphone and may be in cloud
- drone may require authentication, such as a 4-8 digit number, to be operated
- password and username NOT awarded marks if just stated; needs to be explained how it is used to link to the drone
- password and username for the phone is NOT a development; and downloading the drone app is NOT a development.

(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) may refer to material from 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, or 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/OR ITGS terms – eg privacy concern: responses need to specify HOW (technical) the data can be accessed (eg interception of the WiFi signal) (similar to some of the steps for Q2(a)) AND WHY it has been allowed to be accessed (eg lack of encryption of the WiFi signal)*

Answers may include:

- **How** – Loss of privacy due to intercepting the video streamed from the drone. **Why** – The WiFi connection may be insecure or the data may be intercepted during transmission.
- **How** – Surveillance of people using the drone. **Why** – People may not be aware that they are being observed/recorded by the drone. It is difficult for someone on the ground to know whether the camera is filming them or not as there is no visual or audible warning from the drone that filming is taking place.
- **How** – Surveillance of property using the drone/using the stored video to aid criminal activities such as HD video and zoom function giving a detailed picture. **Why** – Exact location details obtained or shared via the internet for criminal purposes.
- **How** – Privacy concerns arising from publishing recorded video on social media. **Why** – Social media do not screen the uploads.
- **How** – Security concerns, such as the drone being taken over or disabled by third parties/streamed video being intercepted and used for purposes other than those intended by the drone owner. **Why** – Lack of WiFi security.
- **How** – Safety concerns where drones are used inappropriately (*eg* near airports, over forest fires, overcrowded areas such as sporting fixtures). **Why** – Lack of regulations.
- **How** – Loss of privacy. **Why** – People are not aware that they are being recorded by the drone – HD video footage/zoom function – along with location/time details – can easily identify an individual being at a certain place at a certain time.
- **How** – Loss of connectivity/signal due to limited WiFi range or interference. **Why** – Operators may not be aware of the range of the WiFi they are using or the potential risk of interference causing a loss of control. Transmitter in the drone and phone have limited output, other operators maybe on similar frequencies, often requiring line of sight transmission. Also batteries may run out.

- **How** – Inappropriate use of drone in terrorist actions. **Why** – The small size, mobility, low cost and ease of use, making drones a simple, improvised weapon or surveillance tool.
- **How** – GPS signal loss occurs in built up areas or due to rainfade. **Why** – Low power of the GPS signal can be absorbed by structures and other features, impacting on the accuracy and reliability of the positioning systems.
- **How** – Recklessly flying over forbidden areas, *eg* privacy concern. **Why** consciously or unknowingly not following regulations.

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 the 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.

The FINAL evaluation/conclusion 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.*

Marks	Level descriptor
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.

***Lower end**: One or two impacts **identified** – this is a low threshold.*
*Upper end: At least **three** impacts **described** of either type – positive or negative.*

*A list of impacts with no clear structure and descriptions only – max **[2]**.*

Marks	Level descriptor
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.

***Lower end**: Analysis by **structure** – division into groups, eg positive/negatives and/or various stakeholders/issues.*
***Middle**: At least **one** negative and **one** positive balanced impact for at least **each of two** stakeholders/issues.*
***Upper end**: Must include **some** linking analytical connections (between positive/negatives, various stakeholders, various issues**) and/or** added evaluative comments about the implications for stakeholders.*

*Only **one** stakeholder analysed or **unbalanced** analysis (ie only negative or positive impacts): maximum of **[4]**.*

Marks	Level descriptor
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.

*Entry to this markband requires at least **three** impacts (balance of negative and positive) for **each** of **two or more** stakeholders in order to provide a balanced set of impacts for the conclusion.*

***Lower end**: Fully analysed and evaluated. **Significant** analytical connections and evaluation comments means **consistent** evidence of additional thinking, beyond descriptions and structure, **throughout** the various stakeholders/issues impact descriptions.*
***Middle to upper end]**: A conclusion backed by direct reference to the impacts described is needed and NOT just a repetition or summary or unsupported opinion – it needs to be **argued based** on the evidence.*

Answers may include:

Loss of privacy due to intercepting/misusing the video streamed from the drone

- drone users may be filming sensitive/private actions or property – *eg* private activities or views that would not be visible from ground level. Third parties who gain unauthorized access to the video footage may use it inappropriately. If a drone also can record audio this has privacy implications for people whose conversations are recorded accidentally or without their knowledge
- drone users operating the drone for professional purposes (*eg* journalism/ film making) may suffer risks or loss of revenue due to their work being stolen and published/used by unauthorized people or may be put at risk if video is intercepted by the authorities
- third parties may not be aware that they are being filmed by the drone – may result in actions/activities that were intended to be private being recorded and published (*eg* celebrities/public figures may have drone video leaked to the press or posted online)
- captured video may be used to blackmail third parties with images being shared on social media
- property and premises may be filmed from vantage points that are not visible/accessible from ground level. Video may be used to plan/assist in crimes such as burglary (*eg* by revealing who is in the property, what entrance points there may be *etc*).

Security concerns such as the drone being taken over or disabled by third parties

- drone itself may be stolen/the phone containing the video footage could be stolen – implications of access to the video
- drone may be used to endanger people on the ground due to loss of control/ deliberate intent by the third party to crash the drone or endanger people.

Safety concerns where drones are used inappropriately (*eg* near airports, over forest fires, overcrowded areas such as sporting fixtures)

- drone owners may not be aware of the regulations, or choose not to follow them as they feel they have little chance of being caught.

Inappropriate use of the drone may

- impede the work of emergency services (*eg* fire services unable to fly over forest fires due to presence of drone); may result in costs to the emergency services through diverting flights or costs to the public due to lack of ability of the services to respond effectively to an emergency situation
- cause a dangerous situation near airports; aircraft may be at risk of collision with drone and possible life-threatening damage (*eg* drone getting sucked into an aircraft engine); may result in flights being delayed/diverted
- the drone may be operating within restricted airspace – inexperienced or unqualified drone operator may not be aware of restrictions
- disrupt sporting fixtures or outdoor events; progress of the event may be held up by the presence of a drone; possibility of drones crashing into crowds and causing injury; possibility of drone causing an accident by obstructing or distracting people participating in the event
- may be used as an improvised weapon or surveillance device by terrorist groups
- may be used as a mechanism for illegal activities (delivering drugs/weapons etc to restricted areas).

Reliability

- endangering people could also relate to the reliability of the hardware/software
- reliability of user input, *eg* wrong GPS coordinates sent to drone/wrong height or speed entered
- endangering people and risking loss of the drone by limited range of the WiFi signal
- reliability of the GPS signal impacting on the accuracy of the drones operation.

Business and Employment

- loss of jobs as drones take over the delivery of goods.

Drones may

- permit inspection of areas that would be inaccessible/hazardous for humans to enter
- allow film makers to include aerial shots without the expense of hiring an aircraft/pilot
- be used by commercial enterprises such as travel agents/property developers to capture footage for advertising purposes
- allow monitoring of construction sites *etc* to check on progress and work safety
- individuals may use drones to record family activities/holidays for later enjoyment
- individuals may use drones as source of entertainment and fun
- be used in sporting competitions like drone racing (there is a professional drone racing league)
- used for rapid survey and surveillance of disaster zones (Kaikoura earthquake)
- retailers can use drones to deliver goods to customers
- timely delivery of goods due to overcoming road congestions.

Sample Conclusion:
Overall the impact of the use of drones will be positive because the uses of drones and their impact will increase as I explained above. **However**, some uses of drones can have negative impacts linked to them as I explained above. But these negative impacts were often due to the deliberate actions of the users of the drones, and these users are in a minority. **Also**, as the drone technology improves the negative impacts will lessen; and as regulations and laws are put in place by governments the negative impacts will also lessen. **However**, as I will show in the next question, where I will discuss one solution in detail, these solutions are not fool proof.

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 in the space provided, 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. No penalty if the problem is not stated. The space is to help the candidate focus on the task.

*Mark the **FIRST** solution only.*
Some solutions may have multiple parts, eg security arrangements, and each part must not be a different type of solution (otherwise it is a second solution and not marked – use your judgement here).

Marks	Level descriptor
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.

***[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, general description of how encryption works like in a textbook.*

Marks	Level descriptor
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.

***[3]**: the solution is applied to the specific 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]**: one EXTRA evaluation, positive or negative, receives **[4]** marks. At least ONE extra POSITIVE, other than the applied evaluation of the solution, **and** ONE NEGATIVE evaluation, hence balance, is required for **[5]** marks.*

Evaluation must be more than an identification.

*Unbalanced (only negative or positive) is a maximum of **[4]**.*

Marks	Level descriptor
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.

***[6]**: fully evaluated strengths and weaknesses requires a balance of at least TWO positive and TWO negative evaluations (**including** the first positive evaluation).*
***[7–8]**: concluding paragraph directly referencing the evaluations to reach a balanced conclusion as to the effectiveness of the solution.*

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.

***Warning:** some students do not realise that WiFi is a radio signal and propose solutions that replace it. But Bluetooth and infrared are not suitable replacements; but they can be marked if later rejected as part of the evaluations. Securing the WiFi with encryption or different protocols are viable solutions. Refer to:*
https://www.forbes.com/sites/gregorymcneal/2016/10/19/key-questions-about-securing-drones-from-hackers/#497cfeba33f3

Answers may include:

Solutions to the problem of loss of privacy for drone user due to intercepting the video streamed from the drone

- secure the WiFi/encrypted connection. Companies who manufacture drones could be required to include secure WiFi connections between the drone and the controller, preventing data interception. Companies may be unwilling to do this unless obliged to as it would incur extra development costs. If new drones were required to have secure WiFi this would not solve the problem for existing drones unless a recall of drones for upgrading the system was made
- provide mandatory training/certification for drone owners on correct use of the drones and awareness of the regulations for privacy
- increased security – encryption requires increased processing and therefore potential cost and cost of software/hardware development

Do not accept VPN as a version of encryption.

*Award **[1]** for ID of encryption as part of the VPN but the second mark for the details is not to be awarded. The technology available in the drone and smartphone cannot support VPN.*

Solutions to the problem of loss of privacy for third parties through publishing captured video/using it to commit crimes

- require drones to be fitted with a flashing light/LED to warn users when the camera is pointing in their direction
- strengthen and update privacy laws to include specific sections related to drones
- require all drone users to register their drones. This would only work if there was a way of identifying the drone itself while in use – *eg* a visible serial number on the drone (similar to the number on other aircraft) or a unique identification code transmitted by the drone on a known frequency

- automatic tracking of drones – include extra software for real time and after use transmission of movements (students need to specify how the tracking will happen and the data transmitted; a mention of tracking is only 1 mark for an identification as it lacks details).

Solutions to the problem of security concerns such as the drone being taken over or disabled by third parties

- secure the WiFi connection (see commentary above)
- fit drones with ability to change WiFi frequency if the main channel was jammed.

Solutions to the unemployment from drone use.

- retrain as operators, maintenance, other appropriate solutions.

Solutions to the problem of safety concerns where drones are used inappropriately (*eg* near airports, over forest fires, overcrowded areas such as sporting fixtures)

- make all drone owners register their drones so that they can be more easily identified
- draft more explicit regulations and penalties for not following them
- provide mandatory training/certification for drone owners on correct use of the drones and awareness of the regulations
- use WiFi jammers near airports or at the scene of emergencies to prevent drones from operating in the vicinity
- use “geo-fencing”: Marking certain areas as “forbidden” via their GPS coordinates as and make drones download that data by law – drones will not cross into the marked areas even if the user instructs them to
- regulations could include a policy on height
- regulations may be different for government, commercial or personal use of drones.

Solutions safety concerns due to loss of WiFi/GPS signal

- setting return to home points (factor if return home is in a different town, drone attempts to fly home)
- using a handset that the phone plugs into and boost the signal strength (potential health and safety risk with increased transmission strength)
- include a signal strength measure in the transmission to the device and set alarms at threshold points
- program a descend and hover function when signal lost (most high-end drones like the DJI phantoms already have this) (drone could descend out of sight and be lost from the operator’s view)
- use of enhanced GPS using terrestrial waypoints and markers to improve accuracy of GPS and reduce reliance on GPS Satellites.

*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.