

Markscheme

May 2017

Information technology
in a global society

Higher level







Paper 1




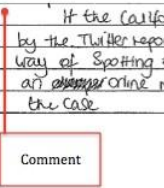
28 pages

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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	
	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	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		Alt+8
	Too vague	Point is unclear, or not specific enough to answer the question.	Alt+1
	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, e.g. 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	
	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*

Evaluation - *My opinion, overall, although, despite, on balance, weighing up*

Examiners should be aware that in some cases, candidates may take a different approach, which if appropriate should be rewarded. If in doubt, check with your team leader.

In the case of an “identify” question read all answers and mark positively up to the maximum marks. Disregard incorrect answers. In all other cases where a question asks for a certain number of facts eg “describe two kinds”, mark the **first two** correct answers. This could include two descriptions, one description and one identification, or two identifications.

It should be recognized that, given time constraints, answers for part (c) questions are likely to include a much narrower range of issues and concepts than identified in the markband. There is no “correct” answer. Examiners must be prepared to award full marks to answers which synthesize and evaluate even if they do not examine all the stimulus material.

Section A

1. Airport luggage control

Note to examiners.

- All part a questions are marked using ticks and annotations where appropriate
- Part b and part c are marked using markbands. Use annotations and text comments to provide a rationale behind the marks you awarded. **Do not use ticks.**

(a) The barcode allows the airport's luggage control system to access a database containing information about each piece of luggage.

(i) Identify **two** pieces of information about the luggage that may be obtained from this database. [2]

Answers may include:

- destination
- passenger name/surname
- weight of the bag
- route of the complete journey (eg point of departure / transfers)
- flight information (flight number, airline).

NB: Do not accept simply “journey” – sufficient detail must be given.

Award [1] for identifying each piece of information about the luggage that may be obtained from this database up to maximum of [2].

(ii) Identify the steps taken by the luggage control system to decide which conveyor belt to choose when a bag reaches a junction between two conveyor belts. [4]

Answers may include:

- barcode reader reads barcode of bag arriving junction
- system looks for code/finds code in the database
- system retrieves the flight number (accept destination of the flight) that the bag needs to be delivered to from the record associated with that code
- system also retrieves data identifying which conveyor has been assigned to deliver bags for that flight number
- if the new conveyor has been assigned to the same flight number as the bag, the bag is pushed onto the new conveyor
- if not then the bag continues on the original conveyor.

NB: Responses must make reference to the IT system(s) involved.

Award [1] for identifying each of the steps taken by the system to decide if a bag is pushed to a different conveyor or not when arriving at a junction up to maximum of [4].

- (b) Analyse the decision by some airports to attach radio frequency identification (RFID) tags to luggage when it is checked in by the passenger, instead of barcode paper printed tags.

[6]

Answers may include:

Advantages of barcodes on printed tags

- tags have information that is visible and readable by people
- workers may re-route luggage if needed as information is readable
- printing may be cheaper than RFID tags.

Disadvantages of barcodes on printed tags

- barcodes need to be in the line of sight with the barcode reading device
- paper tags may get dirty or broken
- papers with barcodes may not deliver the information if they are damaged (and paper tags are easily damaged)
- barcode tags more labour intensive – need to be printed and physically attached by airport staff.

Advantages of RFID tags

- can be read by RFID reader from a greater distance/no need to have tag in line with reader
- RFID tags can have more information than a set of numbers in a barcode
- can be reused (if returned – or by frequent flyers)
- are read at a faster rate than barcodes
- may not get damaged with handling as easy as paper tags
- RFID are read/write devices – information may be added along the way
- RFID tags more secure – can be encrypted
- more than one tag can respond at the same time – (so bags hidden under other bags would still be detected etc).

Disadvantages of RFID tags

- more expensive
- if system fails then there may not be information on tag readable by a person/ possible delays in baggage processing
- possible that they are read by unauthorized users
- used tags are more difficult to destroy/deactivate than paper barcodes/ discarded tags pose a potential privacy issue for the traveller.

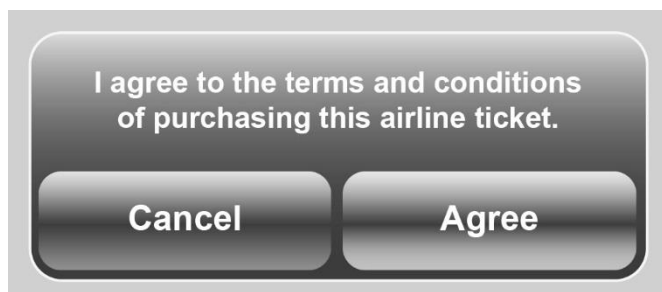
[0]: No knowledge or understanding of ITGS issues and concepts. No use of appropriate ITGS terminology.

[1–2]: A limited response that demonstrates minimal knowledge and understanding of the use of barcodes / RFID tags and uses little or no appropriate ITGS terminology.

[3–4]: A partial analysis, either lacking detail or balance, that demonstrates some knowledge and understanding of the use of barcodes / RFID tags. Some relevant examples from the scenario are used within the response. There is some use of appropriate ITGS terminology in the response.

[5–6]: A balanced and detailed analysis of the issue which demonstrates thorough knowledge and understanding of the use of barcodes / RFID tags. Relevant examples from the scenario are used throughout the response. There is appropriate ITGS terminology throughout the response.

- (c) Airlines have databases that contain data about passengers when tickets are booked. This data includes travel dates, itineraries, contact details, passport details and passengers' home addresses. When passengers purchase a ticket online from an airline company, they have to accept the airline's terms and conditions by clicking "Agree" (see **Figure 2**).



Within these terms and conditions, it states that the airline may receive a request to share this data with the government of the country to which the passenger is flying.

Discuss whether airlines should share the passenger's data with the government of the country to which they are flying.

[8]

Answers may include:

- airlines or passengers may see sharing this information as unethical or a breach of privacy which may raise wider issues and affect their business or business model
- airlines may feel that if passengers are aware that the airline sharing their data they may decide not to use the airline and opt for one that does not have data sharing agreements
- sharing passenger data might help protect countries from terrorist attacks or other criminal activities (eg passengers may be on a "watch-list" in the destination country)
- sharing passenger data may allow governments to respond more effectively if the passenger needs to be traced/contacted urgently during their stay in the country
- governments can track and analyze tourism data for planning workforce, infrastructure etc
- will the additional time and effort the airline spends on highlighting this data sharing agreement be cost effective? In other words, do passengers need to know, or are passengers likely to care?
- airlines may feel that passengers may not be concerned about their data being shared, or they may just accept that this will happen as it is "out there", regardless of whether they agree with it or not
- if airlines group together they could form associations that can set policies about what data should be shared/should not be shared with governments which may make passengers feel more confident about the confidentiality of their data
- governments may require that airlines make this data sharing available and part of the ticket purchasing process, so the decision may be effectively made for the airline.

Please see generic markband information sheet on page 28.

2. Apurimac Health Centre

Note to examiners.

- All part a questions are marked using ticks and annotations where appropriate
- Part b and part c are marked using markbands. Use annotations and text comments to provide a rationale behind the marks you awarded. **Do not use ticks.**

(a) All computers have input and output devices.

(i) Identify **one** input device.

[1]

Answers may include:

- keyboard
- mouse
- camera/video camera/webcam
- microphone
- scanner
- touch-screen
- accelerometers
- joystick/gaming controller
- optical character reader/barcode reader/magnetic stripe reader.

NB: If candidates suggest a valid input device not listed here please check with your team leader before awarding marks.

Award [1] for identifying input device up to maximum of [1].

(ii) In addition to a printer, identify **one** output device.

[1]

Answers may include:

- screen/monitor (accept TV, SmartTV, etc)
- speaker/loudspeaker
- projector
- plotter.

NB: If candidates suggest a valid output device not listed here please check with your team leader before awarding marks.

Award [1] for identifying output device up to maximum of [1].

(iii) Identify **one** characteristic of random access memory (RAM).

[1]

Answers may include:

- temporary storage area
- volatile memory – it is erased when the computer is turned off,
- work area for running programs including the operating system, application programs and data
- the type of memory that can be written to and read by the processor and other devices
- memory locations can be accessed directly/in any order.

Award [1] for identifying each characteristic of random access memory (RAM) up to maximum of [1].

- (iv) Identify **one** activity carried out by the health centre that would be easier to do with spreadsheet software.

[1]

Answers may include:

- budget for the centre
- inventory of medicines
- keep a list of patients' visits
- staff wages
- producing graphs/charts (eg patients presenting different symptoms/ ailments, etc).

NB: Do not accept responses that simply state “store patient records”.

Award [1] for identifying each activity carried out by the health centre that would be easier to do with a spreadsheet software using the computers up to maximum of [1].

- (v) Identify **two** characteristics of an internet service provider (ISP).

[2]

Answers may include:

- company that may also provide access to email
- will provide an Internet plan, for a fee, to give the user access to the internet
- may provide additional features (eg antis spam)
- web hosting
- assigns bandwidth/data transfer limits to customers
- may offer support/help services to customers
- may track and store customer usage history (eg websites visited, etc)
- may provide hardware to users (eg modems/routers/WAPs)
- provides users with an IP address
- ISP provides/acts as a gateway for packet transfer/forwarding packets.

NB: Do not accept simply “connects to the internet” without any identification of a characteristic (eg a plan/subscription package, etc).

Award [1] for identifying each characteristic of an internet service provider (ISP) up to maximum of [2].

- (b) Medical students in Peru must spend six months training in rural areas during their medical studies. Apurimac Health Centre has been selected by the medical school in Cusco as a place to send students for training every year.

Analyse the impact on the medical student of spending six months training in a health centre with limited Internet access.

[6]

Answers may include:

- students will need to ask a local doctor or rely on their knowledge from school/ will not be able to research on the Internet when in doubt/will not be able to collaborate with online with experts
- may feel frustrated and not do the job properly
- medical students may want to take their own IT devices (phones with internet access plans, computers, tablets), which could lead to different issues such as those linked to security, patient's data privacy and the use of different platforms
- will not have facilities such as teleconferencing with experts (eg for guidance during a difficult medical procedure)
- will not have access to fast results (eg if a patient sees a specialist in Cusco results would need to be posted back to Apurimac)
- limited access might result in less distractions (eg social media) and greater focus on work
- may help students become more able to cope with similar situations met later on in their careers.

[0]: *No knowledge or understanding of ITGS issues and concepts. No use of appropriate ITGS terminology.*

[1–2]: *A limited response that demonstrates minimal knowledge and understanding of the impact.*

[3–4]: *A partial analysis, either lacking detail or balance, that demonstrates some knowledge and understanding of the impact on medical students. Some relevant examples from the scenario are used within the response. There is some use of appropriate ITGS terminology in the response.*

[5–6]: *A balanced and detailed analysis of the issue which demonstrates thorough knowledge and understanding of the impact. Relevant examples from the scenario are used throughout the response. There is appropriate ITGS terminology throughout the response.*

- (c) Juan has a limited budget and has two options:
- install a network and pay for an Internet connection, or
 - spend the money on training the doctors to use the IT system, acquiring modern software and installing diagnostic tools on the standalone computers.
- Evaluate these **two** options. [8]

Answers may include:

Advantages of installing a network and internet connection

- computers in the network can share resources (hard disk for files, printers)
- doctors with an internet connection can do research when needed
- doctors can consult other doctors not in the area and share images/share test results
- software can be installed on the network and shared (if license allows it)
- doctors will have access to online training in IT and in their professional capacity
- doctors can backup data to the cloud to guard against data loss if computers are damaged/stolen
- internet access may include WiFi (allowing doctors to use personal devices/expand the network beyond the six desktop computers).

Disadvantages of installing a network and internet connection

- installing a network might require bringing an IT expert to install it
- appoint a network administrator
- if the network is down lack of skills/funds may mean patient records are inaccessible
- connection to the internet may increase the risk of malware infecting computers/risk of unauthorised access. Centre may need to install and maintain anti-virus software/firewall, *etc.*

Advantages of standalone computers: IT training for doctors, acquiring modern software, installing diagnostic tools

- patients may be treated more effectively with doctors receiving constant IT training
- modern resources may help doctors do their job better and the centre's patients will benefit from these improvements directly
- IT training will improve the use of computers – better service to patients (record keeping, follow ups)
- less skills required to manage standalones
- if one computer is down it will not impact the others/other computers can still be used.

Disadvantages of standalone computers: IT training for doctors, acquiring modern software, installing diagnostic tools

- software needs to be installed in every computer (licencing) or only in some and this might be a difficulty
- all the disadvantages of lack of collaboration with experts in other places/online resources
- may need to employ trained staff to maintain/configure the stand-alone computers.
- data held on computers may become unreliable (*eg* data updated on one computer may not be updated on another).

Please see generic markband information sheet on page 28.

3. Updating the Wisconsin High School (WHS) database

Note to examiners.

- All part a questions are marked using ticks and annotations where appropriate
- Part b and part c are marked using markbands. Use annotations and text comments to provide a rationale behind the marks you awarded. **Do not use ticks.**

- (a) (i) Identify **two** ways of preventing parents from making mistakes when entering data on the online form.

[2]

Answers may include:

- drop down list
- data validation rules
- range check
- data type check
- presence check
- character check/format check
- double-entry of data (data verification)
- check-box added to the data entry form for the parent to confirm that all the data entered is correct.

Award [1] for identifying each way parents can be prevented from making mistakes when entering data on the form up to maximum of [2].

- (ii) Identify **two** characteristics of a relational database.

[2]

Answers may include:

- two or more tables in the database are linked/joined using key fields
- a defined relationship between at least two tables within the database
- a relational database prevents redundancy as fields may be coded and related to a table that has the complete information
- it is faster to enter information into a relational database as codes may be used
- less storage space is used and long fields (for descriptions) may be replaced by codes from a related table
- less mistakes are made when entering data as entering a code is shorter than a complete description (less room for mistakes)
- data independence.

Award [1] for identifying each characteristic of a relational database up to maximum of [2].

- (iii) The school wants to consult a lawyer about the documentation that would be needed to send students to France during the summer holidays. They would like to search the database to find a parent who is a lawyer and has French as their mother-tongue (first language).

Outline the query that could be used to search for this information.

[2]

Answers may include:

- (List all parents) WHERE mother-tongue = "French" and profession = "lawyer".

NB: The WHERE and AND conditions do not need to be capitalized.

Candidates may use other terms that clearly imply the same conditions.

Use professional judgement for the parameters of the search in each of the two fields. If in doubt, check with your team leader before awarding marks.

Award [1] for identifying a condition:

- WHERE condition
- AND condition

Award [1] for identifying a parameter:

- mother tongue = "French"
- profession = "lawyer".

Maximum of [2] for the question.

- (b) The developers of ColegiumWise may accept requests from clients such as schools for additions or changes to the system. The developers send out system upgrades and updated user manuals on a regular basis with the changes that have been requested by the schools and other clients.

Explain **three** different ways the upgraded version of ColegiumWise could be tested before it is sent to the schools and other clients.

[6]

Answers may include:

- MIS is tested by the development team (in-house or alpha testing – system). Accept responses that detail specific tests, eg regression testing, unit testing, testing the correct operation of validation rules, etc
- MIS is sent to a small number of schools and they are asked to try the new options (pilot/prototype, a part of agile development)
- a "test version" or "beta release" version of the MIS is made available that users may try and send comments on what they find (beta testing).

NB: Candidates may detail the testing of more than one validation rule. Award marks for each different valid test explained.

Award [1] for identifying a way the system with the additions or changes may be tested before they send the upgraded version to the schools and [1] for a development of the way identified up to a maximum of [2].

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

- (c) ColegiumWise has several key functions that cannot be changed. The contract with the developers of ColegiumWise is due to expire in 2018 and the administrators at WHS have two options:
- continue with ColegiumWise, knowing that it will not have the specific functions required by the school
 - not renew the contract and develop their own school management information system (MIS) for the school.

Evaluate these options.

[8]

Answers may include:

Renew the contract

- the ColegiumWise system is ready and can be used immediately as they have been doing
- users are already familiar with the system and won't require any retraining
- support provided by the ColegiumWise provider
- changes requested by other schools (clients) may be useful to the school (client) as well
- school may have to pay a costly licence while the system is being used
- school may need to adapt some features they wish to include to what is offered by the software
- some changes requested may take too long to be implemented
- there will be further need for additional features over time so it is likely that the current MIS will become increasingly limited in the future
- the school may have to include data in the database which they don't need but the system requires (which wastes their time).

Create their own

- the system will be created to cover the school's exact needs (if possible)
- the system may be adapted to changes that are introduced over time
- a team will have to be appointed for the development of the system
- the in-house system may take a long time to be created
- the school (IT team) has the responsibility of the functionality of the system
- the school (IT team) has the responsibility for the security of the stored data
- new staff may need to be hired as current staff may not have sufficient expertise to develop and support the system
- there may be additional requirements for hardware to run the new system
- may involve more costs for development and training
- migrating data from the existing (ColegiumWise) system to the new system may cause issues (eg data loss, incompatible formats, data types, etc).

Please see generic markband information sheet on page 28.

Section B

4. Artificial intelligence (AI) and Cyber-bullying

Note to examiners.

- All part a questions are marked using ticks and annotations where appropriate
- Part b and part c are marked using markbands. Use annotations and text comments to provide a rationale behind the marks you awarded. **Do not use ticks.**

- (a) (i) Identify **two** characteristics of machine learning. [2]

Answers may include:

- uses neural networks or decision trees to find patterns in sets of training data
- can use pattern recognition
- requires large quantities of data
- uses an iterative process *ie* looks at one set of data, extracts characteristics, then another set and another *etc*
- requires significant computer power
- computer program that can teach itself to grow and change when exposed to new data.

Award [1] for identifying each characteristic of machine learning up to a maximum of [2].

- (ii) Apart from recognizing bullying, identify **two** uses of pattern recognition. [2]

Answers may include:

- face identification as in Facebook
- fingerprint identification
- optical character recognition
- voice recognition
- identifying an object from its shape/object detection
- identifying a pattern in a dataset (*ie* patterns in credit card payments, identifying SPAM email, analysing data about the game *etc*).

*Do accept an example that fits into one of the above categories.
Do not accept bullying.*

Award [1] for identifying each use of pattern recognition in addition to recognizing bullying up to maximum of [2].

- (iii) *Riot Games* collected examples of behaviour that players had reported as abusive. A committee decided which examples were actually abusive.

Outline **one** limitation of collecting data in this way. [2]

Answers may include:

- some players who had experienced abuse may not have complained, so the sample may not represent a full range of player experience
- time consuming because all complaints need to be read and judged.

Award [1] for identifying a limitation and an additional mark for a brief explanation of it.

(b) The new system has been implemented in phases, starting with the instant feedback system.

(i) Explain **one** reason why *Riot Games* decided to use a phased changeover when introducing the new system to the game. [2]

Answers may include:

- they can test each phase sequentially so they can refine it before introducing the next phase
- the players have time to adjust to the new system step by step
- change, even positive change, is often rejected, this process reduces potential dissatisfaction of the players with new ideas
- *Riot Games'* staff can be trained gradually.

Award [1] for identifying a reason why Riot Games decided to use a phased changeover when introducing the new system to the game and [1] for a development of the impact identified up to a maximum of [2].

(ii) *Riot Games* has been happy to share both its data and best practices for controlling abusive behaviour with the wider gaming industry.

Explain **one** benefit of this decision. [2]

Answers may include:

- sharing best practices will help other game companies control abusive behavior in their games
- more people will work with the data and/or implement the practices. This opens up the possibility of new ideas being generated that will improve the software for everyone
- researchers, for example psychologists who study gamers, will have access to more data. More data may enable them to discover new patterns and better understanding of the gamers who act in an abusive manner.

Award [1] for identifying a reason why Riot Games has been very open about sharing their data and their best practices for controlling abusive behaviour with the wider gaming industry and [1] for a development of the reason identified up to a maximum of [2].

(iii) Explain **one** reason why *Riot Games* chose to ask the end-users to decide what should be considered as abusive behavior. [2]

Answers may include:

- allowed them to gather a very large quantity of data. More data provides a foundation for better analysis (increases the reliability of the data)
- end users are directly affected, so their judgments as to what is offensive are critical
- involving end users gives them the sense that their ideas are being listened to so they are more likely to support the solution that results.

Award [1] for identifying a reason why Riot Games chose to ask the end users to decide what would be considered as abusive behaviour and [1] for a development of the impact identified up to a maximum of [2].

- (c) While *Riot Games* is using artificial intelligence algorithms to improve game behaviour, similar algorithms could be used to evaluate the performance of employees, such as speed of service, body language, and so on. For example, the interactions between employees and customers in a coffee shop could be recorded and analysed to evaluate employee behaviour.

Discuss the impact on the employees of the coffee shop of their managers using artificial intelligence algorithms to evaluate their performance.

[8]

Answers may include:

- both good employees and poor employees could be identified – impacts could include better training of employees, firing of employees whose behavior does not improve, recognition or pay raise for good employees
- inefficient employee work patterns could be identified, *ie* poor interaction of employees doing various jobs, poor communication skills – impact could be analysis and subsequent changes in employee work patterns (must address impact of changing patterns on employees)
- improved employee efficiency could lead to customers experiencing better service which may increase tips for employees
- relationships between employees and managers could either improve or degenerate depending on how this system is used (development must focus on the impact on the employee, not the manager)
- employees can get feedback on their performance – impact is that they can improve based on the feedback
- some employees may feel uncomfortable or stressed by being under surveillance – may impact their work performance, cause employee burnout, or lower morale.

Please see generic markband information sheet on page 28.

5. Japan’s robot hotel

Note to examiners.

- All part a questions are marked using ticks and annotations where appropriate
- Part b and part c are marked using markbands. Use annotations and text comments to provide a rationale behind the marks you awarded. **Do not use ticks.**

- (a) (i) Identify the steps used by the facial recognition software to control access to the hotel rooms. [4]

Answers may include:

- the image of the guest is captured, *ie* with a camera
- the image is stored in a database
- the room number of the guest is added to the database
- the software measures key features of the face (distance between the eyes, width of the nose, *etc*)
- this information is stored in the database
- the software accesses the room details of the guest
- when the guest wants to enter the room, the software matches the guest’s face with the one stored in the database
- if they match, the guest can enter the room number held in the database.

Award [1] for identifying each step used by the facial recognition software to control access to the hotel rooms up to maximum of [4].

- (ii) Identify **two** characteristics of a “natural language”. [2]

Answers may include:

- develops naturally through human use *ie* affected by human biology, social groups
- used by humans to communicate with one another
- different from artificial or constructed languages, *ie* computer programming, Klingon.

Award [1] for identifying each characteristic of a “natural language” up to maximum of [2].

(b) Guests are understandably concerned about what happens when something goes wrong. One day at the hotel Ms Kuragawa, the human manager, received the following incident report (a list of problems in the hotel) when she began her work shift:

- a room service robot has lost power on its way back from a delivery
- two guests have discovered that their luggage was taken to the wrong room
- the dinosaur robot that checks people in began repeating itself and had to be shut down, so there are now only two clerks to check people in
- the Tulip robot in room 104 has stopped working.

Incidents are given priority ratings of low, normal, high or very high. Ms Kuragawa must give a priority rating to each incident.

Explain **three** criteria that she can use to determine the priority of these incidents.

[6]

Answers may include:

- criterion: does the incident affect the core business?
- and reason why the incident affects the core business

- criterion: does the incident affect more than n users?
- and reason why the number of users makes the incident a priority

- criterion: does the incident affect the image/reputation of the business (such as hotel rating/cost)?
- and reason why the image/reputation of the business may be affected

- criterion: the occurrence of the incident is intermittent
- and reason why an intermittent problem may be more serious than one that happens, but does not seem to resolve itself/not possible to predict what staff resources are needed to resolve the incident

- criterion: the time required to complete the repair
- and reason why the particular incident needs a speedy resolution (or not)

- criterion: what is the impact on guests if the problem is not resolved
- and reason whether the incident is potentially a priority to resolve

- criterion: if a human is harmed
- and reason: any harm to a human being will negatively affect the reputation of the hotel/any harm to a human being is a serious issue.

Award [1] for each criterion identified and [1] for the explanation of that criterion up to a maximum of [2].

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

Award a maximum of [6] for the answer.

- (c) Several other hotels are experimenting with robots that can check guests in, deliver room service and store bags.

Discuss the impact of using robots instead of human beings to provide services to guests in hotels.

[8]

Answers may include:

Advantages

- robots can make repetitive tasks more efficient
- robots can be better at remembering guest preferences
- robots that deliver room service don't need to be tipped
- will save costs of hiring more staff
- tech savvy visitors will enjoy this type of service
- can free hotel staff to take care of more complex tasks
- younger customers may prefer robots
- can eliminate long lines as people check in
- robots are less intrusive than humans when delivering room service
- fewer health and safety issues, *eg* lifting heavy loads, cleaning up after guests
- robot responses may be limited so they can't answer complex questions/unusual requests for example when guests check in
- robots have greater memory than humans so they can deliver some services more efficiently and accurately than humans, *ie* checking in/out, checking bags, *etc*
- robots can be programmed to speak multiple languages (as in the Hen-nat Hotel).

Disadvantages

- robots cannot provide personalized services such as special food orders
- they are unlikely to be used in high-end hotels where people expect customized service
- robots can malfunction or not perform the required action
- robots need maintenance. The hotel will have to provide tech support itself or purchase it from the robot's manufacturer
- hotels will need to have staff to help the guests with the robots
- guests, particularly older guests, may prefer "the human touch", *ie* uncomfortable with robots
- there may be reliability issues for example a robot breaks down whilst delivering room service
- the robot may not speak or understand the customer's language. Discussion might include the robot's inability to communicate as a human would to compensate for this issue, *ie* it won't use gestures
- robots will take human jobs. Discussions should include description/analysis of the impact on society.

Please see generic markband information sheet on page 28.

6. Self-driving trucks

Note to examiners.

- All part a questions are marked using ticks and annotations where appropriate
- Part b and part c are marked using markbands. Use annotations and text comments to provide a rationale behind the marks you awarded. **Do not use ticks.**

- (a) (i) Identify **two** sensors required by these trucks. [2]

Answers may include:

- camera
- radar (infrared/microwave)
- LIDAR
- ultrasonic (accept sonar)
- laser

Do not accept motion sensor. Too vague.

Award [1] for identifying each sensor these trucks will require up to maximum of [2].

- (ii) Identify **two** characteristics of an algorithm. [2]

Answers may include:

- a step by step process for solving a problem or performing an operation
- each step must be precise, *ie* unambiguous
- can be a computer program, a recipe, *etc*
- can be written in both natural language and programming language
- algorithms have a finite number of steps.

Award [1] for identifying each characteristics of an algorithm up to maximum of [2].

- (iii) Identify **two** situations in addition to roads in cities where the self-driving trucks may not be able to operate safely without a human driver. [2]

Answers may include:

- anything that's unexpected or random – this answer requires an example such as flat tire, shift in load, emergency vehicle appears
- inclement weather
- map connected to the GPS is incorrect
- badly maintained highways
- parking lots/car parks are full of obstacles including other vehicles.

Do not accept city streets, as that is already in the stem.

Award [1] for identifying each situation in which the trucks may not be able to operate safely without a human driver up to maximum of [2].

- (b) (i) Explain **one** reason why the software that controls these trucks needs to use pattern recognition. [2]

Answers may include:

- to recognize road signs/traffic lights to know what action to take
- to recognize people to avoid hitting them
- to recognize markings on road in order to stay within its lane.

Award [1] for identifying a reason why the software that controls these trucks needs to use pattern recognition and [1] for a development of the impact identified up to a maximum of [2].

- (ii) Mr Mahoney has asked the project management team to undertake a feasibility study.

Explain why undertaking a feasibility study will help Mr Mahoney decide whether to go ahead with the purchase. [4]

Answers may include:

- examines the cost of the trucks vs the potential benefits *ie* cost-benefit analysis
- determines if the problems that his current vehicles have would be remedied by the new trucks. How urgent are these problems? Is there another solution?
- explores the effect on the drivers *ie* will they be comfortable driving these trucks. Will they resist change? How will their working environment change? Will the effects on drivers be positive or negative for the company?
- how soon could the change to these trucks occur? What would be the best time to make such a changeover?
- to determine any training requirements for drivers who work in these new trucks. How much will training cost? How will it be done? How much time will be needed?

[0]: *No knowledge or understanding of ITGS issues and concepts. No use of appropriate ITGS terminology.*

[1]: *A limited response that indicates very little understanding of the functions of a feasibility study. Uses little or no appropriate ITGS terminology. No reference is made to the scenario in the stimulus material.*

[2–3]: *A description or partial analysis with limited knowledge and/or understanding of the functions of a feasibility study. Some use of appropriate terminology relating to the topic. Some reference is made to the scenario in the stimulus material.*

[4]: *A thorough analysis with a detailed knowledge and understanding functions of a feasibility study. An examination that uses appropriate ITGS terminology. Explicit and relevant references are made to the scenario in the stimulus material.*

- (c) To what extent would changing his 75 trucks to self-driving trucks benefit Mr Mahoney's company?

[8]

Answers may include:

Benefits

- safety – avoids the problem of driver error because drivers are sleepy, 90% of truck accident are due to driver error
- frees the driver from the monotonous part of truck driving
- more fuel efficient
- reduces pollution
- currently there is a shortage of truck drivers in the US and Europe and it will get worse. This addresses that problem
- there will still be drivers in the trucks
- a faster trip - a truck can drive 24/7 (however if there is an accompanying driver he will need some stops).

Disadvantages

- cost of replacing the trucks may be prohibitive
- legal problems may arise if there's an accident involving the trucks
- drivers might become too dependent on the system, so they don't react quickly enough when human intervention is needed
- drivers might use the system in situations where it shouldn't be used. Could be dangerous
- insurance companies might be reluctant to insure this new technology
- technical support will be needed to keep the trucks running properly. This could be costly
- additional costs due to training of drivers.

Please see generic markband information sheet on page 28.

7. Saving elephants from poaching

Note to examiners.

- All part a questions are marked using ticks and annotations where appropriate
- Part b and part c are marked using markbands. Use annotations and text comments to provide a rationale behind the marks you awarded. **Do not use ticks.**

(a) Alpha testing and beta testing were used during the development of PAWS.

- (i) Identify **two** characteristics of alpha testing. [2]

Answers may include:

- testing of new software done toward the end of the development process
- main goal is to refine the quality of the product by fixing bugs/problems before they affect the final product
- generally done “in house” ie not by users who don’t work for the company
- usually done by a group that is not part of the design team
- determines if the software is ready for beta testing.

Award [1] for identifying each characteristics of alpha testing up to maximum of [2].

- (ii) Identify **two** characteristics of beta testing. [2]

Answers may include:

- last test of new hardware or software prior to release
- main goal is to refine the product by fixing bugs/problems not found in alpha testing
- done by external stakeholders/users rather than “in house”
- carried out in a real environment/real world testing
- performed after alpha testing.

Award [1] for identifying each characteristics of beta testing up to maximum of [2].

- (iii) Identify **two** characteristics of artificial intelligence. [2]

Answers may include:

- capable of learning based on prior knowledge
- able to learn preferences and behaviours
- able to make decisions
- recognizes regularities/patterns in data
- the simulation of human intelligence by machines.

Note: do not accept pattern recognition as that is in the stem.

Award [1] for identifying each characteristic of artificial intelligence up to a maximum of [2].

- (b) The developers used the agile project development methodology rather than the waterfall project development methodology to develop PAWS.

Explain why the developers have decided to use an agile project development methodology.

[6]

Advantages of agile:

- more flexible than waterfall – programmer can make changes as it is developed/ project priorities are re-evaluated on a continuing basis
- may lead to cost savings as potential errors in PAWS may be identified and eliminated at an early stage of development
- beneficial for small teams with rapidly changing requirements as poaching patterns, research into poaching patterns or poaching legislation in the countries may change / vary
- iterative in nature so can respond to challenges that occur during development so is able to incorporate new features/ideas as PAWS develops
- training is “just-in-time” and on-going
- may lead to faster development compared with waterfall method
- may allow the development team to return to an earlier stage such as creating a second prototype if deemed necessary.

[0]: No knowledge or understanding of ITGS issues and concepts. No use of appropriate ITGS terminology.

[1]: A limited response that indicates very little understanding of the functions of agile development methodologies. Uses little or no appropriate ITGS terminology. No reference is made to the scenario in the stimulus material.

[2–3]: A description or partial analysis with limited knowledge and/or understanding of the functions of agile development methodologies. Some use of appropriate terminology relating to the topic. Some reference is made to the scenario in the stimulus material.

[4]: A thorough analysis with a detailed knowledge and understanding functions of agile development methodologies. An examination that uses appropriate ITGS terminology. Explicit and relevant references are made to the scenario in the stimulus material.

- (c) In the future the use of PAWS will be extended to cover all of sub-Saharan Africa, and will be run from a control centre that communicates where it thinks poachers might be active to the rangers who are patrolling these areas.

To what extent can the implementation of PAWS assist in reducing the poaching of African elephants?

[8]

Answers may include:

- random patrols can help catch more poachers
- predicting poacher's future actions will make them more vulnerable to capture
- as PAWS develops new insights, new approaches to dealing with poachers may emerge
- PAWS may lead to greater efficiencies in the search for poachers and therefore a reduction in poaching
- the involvement of countries such as the USA may raise the profile of elephant poaching and governments and NGOs may divert additional funds to reducing poaching so PAWS may be a catalyst for change
- the effectiveness of PAWS will be based on a number of external factors that are outside the control of the AI software such as the competence of the rangers
- the AI software may be constantly playing "catch-up" with the poachers so it is going to be one step behind the poachers
- the security measures used by PAWS may be vulnerable to hackers who may be able to sell this information on to the poachers rendering PAWS ineffectual, may lead to the ambushing of rangers
- the movements of the elephants may be less predictable than the computer models that attempt to model it so PAWS may have limited effectiveness
- there may not be enough data available from this wider area for patterns of elephant movement to be determined with any degree of confidence
- the use of PAWS across many geographical boundaries may make it become a generic software rather than be flexible enough to address the needs of individual countries
- the use of PAWS across many geographical boundaries may increase the cost of the software as it will have to be adapted to a wider area
- rangers will need to be trained in the use of PAWS thus increasing the costs of the program
- the software may lead to administrators trusting the algorithms in the software rather than the judgement of the rangers.

Please see generic markband information sheet on page 28.

SL and HL paper 1 part (c) and HL paper 3 question 3 markband

Marks	Level descriptor
No marks	<ul style="list-style-type: none"> • <i>A response with no knowledge or understanding of the relevant ITGS issues and concepts.</i> • <i>A response that includes no appropriate ITGS terminology.</i>
Basic 1–2 marks	<ul style="list-style-type: none"> • <i>A response with minimal knowledge and understanding of the relevant ITGS issues and concepts.</i> • <i>A response that includes minimal use of appropriate ITGS terminology.</i> • <i>A response that has no evidence of judgments and/or conclusions.</i> • <i>No reference is made to the scenario in the stimulus material in the response.</i> • <i>The response may be no more than a list.</i>
Adequate 3–4 marks	<ul style="list-style-type: none"> • <i>A descriptive response with limited knowledge and/or understanding of the relevant ITGS issues and/or concepts.</i> • <i>A response that includes limited use of appropriate ITGS terminology.</i> • <i>A response that has evidence of conclusions and/or judgments that are no more than unsubstantiated statements. The analysis underpinning them may also be partial or unbalanced.</i> • <i>Implicit references are made to the scenario in the stimulus material in the response.</i>
Competent 5–6 marks	<ul style="list-style-type: none"> • <i>A response with knowledge and understanding of the relevant ITGS issues and/or concepts.</i> • <i>A response that uses ITGS terminology appropriately in places.</i> • <i>A response that includes conclusions and/or judgments that have limited support and are underpinned by a balanced analysis.</i> • <i>Explicit references to the scenario in the stimulus material are made at places in the response.</i>
Proficient 7–8 marks	<ul style="list-style-type: none"> • <i>A response with a detailed knowledge and understanding of the relevant ITGS issues and/or concepts.</i> • <i>A response that uses ITGS terminology appropriately throughout.</i> • <i>A response that includes conclusions and/or judgments that are well supported and underpinned by a balanced analysis.</i> • <i>Explicit references are made appropriately to the scenario in the stimulus material throughout the response.</i>