

# Markscheme

November 2017

**Information technology  
in a global society**

**Standard level**

**Paper 1**

20 pages

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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.

## 1. Voice biometrics technology in banking

*Note to examiners.*

- All part a and b questions are marked using ticks and annotations where appropriate
- Part c is 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** forms of biometric identification other than voice.

[2]

*Answers may include:*

- DNA
- iris
- retina
- facial
- fingerprint
- hand / palm print
- gait
- odour
- ear
- signature
- keystroke.

*Do not accept “eye recognition” – this is too vague. Iris or retina is required for marks.*

*Award [1] for identifying each form of biometric identification up to a maximum of [2].*

(ii) Identify the steps used by the voiceprint biometric technology to authenticate a customer calling *CBR Bank*.

[4]

*Answers may include:*

- biometric voice feature is initially recorded
- voice is converted from analogue to digital
- voice is stored in database together with other personal information
- voice is re-scanned when person needs to be authenticated over the phone
- voice is matched with information in database
- if a match then it is authenticated
- if no match then the customer is asked to repeat the phrase and is rejected after a certain number of attempts.

*Award [1] for identifying each of the steps used to authenticate a customer calling *CBR Bank* up to a maximum of [4].*

- (b) *CBR Bank* holds a large amount of information on its customers. Some customers are concerned about the security, privacy **and** anonymity of their data.

For **each** of the concerns above, explain **one** policy that *CBR Bank* could use to address the concerns of its customers.

[6]

*Answers may include:*

**Security:**

- user access to data is limited to authorized personnel – to ensure data is secure during storage
- username and password access is implemented – to ensure data is secure during storage
- a password policy is implemented (*eg* minimum length, mix of characters, changed after a given number of days *etc*)
- two factor / two-step authentication is implemented (*eg* one-time password/PIN to a mobile phone, code generating device supplied by the bank, confirmation email *etc*)
- data is encrypted – to ensure data is secure during transmission
- a firewall is used to protect the bank's server
- bank servers are kept updated with the latest software / security patches
- bank employees are prohibited from accessing customer data on personal devices / devices outside the company network – to ensure that all devices are protected by the bank's security measures.

**Privacy:**

- customers are informed to specify how the data may be used – if/how it may be shared with third parties
- only authorized personnel will have access to bank database – not all employees will be able to view data.

**Anonymity:**

- ensure the customer's anonymity is maintained – when data is shared with third parties, the data that could give the identity of a customer must be detached
- reports are kept anonymous – reports cannot allow individuals to be identified.

**N.B.:** *the response requires an explanation of a policy and not a discussion of the problems themselves. There must be a policy for **each** kind of concern: security, privacy and anonymity and reason(s).*

*Award [1] for identifying a policy that CBR Bank could use to address the security, privacy and anonymity concerns of its customers and [1] for a development of the policy identified up to a maximum of [2].*

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

- (c) The chief executive officer (CEO) of *CBR Bank*, Alice McEwan, said in a recent interview, “*CBR Bank* will be replacing all passwords, PINs and personal verification questions for our online banking and mobile banking with voice biometric recognition.”

Discuss whether the changes proposed by Alice are beneficial for **both** *CBR Bank*’s customers and *CBR Bank*’s IT support.

[8]

*Answers may include:*

**For customers:**

**Advantages of replacing passwords with biometric voice recognition:**

- don’t have to remember a password or PIN code
- more secure as voice characteristics are unique
- verification time is within a few seconds
- harder for others to hack online banking with biometric voice recognition
- some customers may have physical conditions that make entering PINs/passwords difficult – voice recognition will avoid having to type.

**Disadvantages of replacing passwords with biometric voice recognition:**

- voice recognition system may not accept foreign accents, or range of voices
- illness (such as a cold) can change a person’s voice, making identification difficult
- a person’s voice can be easily recorded and used for unauthorized access
- someone with very similar voices (*eg* a member of the same family) may be able to gain access to the bank account.

**For IT support:**

**Advantages of replacing passwords with biometric voice recognition:**

- more secure, less likely to be hacked – less problems for IT staff to deal with
- easy to record by customers themselves – no IT staff required to setup
- IT staff do not have to deal with lost password/PIN.

**Disadvantages of replacing passwords with biometric voice recognition:**

- voice recognition system may not accept particular accents – customers cannot access their online banking and will need support
- a person’s voice can be easily recorded and used for unauthorized access – customers may complain of unauthorized access, IT staff will have to investigate hacked accounts
- illness (such as a cold) can change a person’s voice, making identification difficult – a greater number of customers might need to call support to access their own account
- when the new system is implemented, *CBR*’s IT support could be overwhelmed with overlooked bugs *etc*
- audio files / biometric templates will require more storage space than passwords / PINs – this may make backing-up data more time consuming / require IT support to increase available storage space *etc*
- Initial implementation of the new system may require additional IT support staff
- IT support staff may face an increased workload (*eg* if the old system initially has to run parallel to the new system).

***Please see generic markband information sheet on page 22.***

## 2. Goal-line technology in football (soccer)

*Note to examiners.*

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

(a) (i) Define the term *resolution*.

[2]

*Answers may include:*

- the density of the pixels in the image / the number of dots, or pixels, used to create or display an image
- the sharpness and clarity of an image
- higher resolution means that more pixels are used to create the image
- describes the detail in a picture
- is measured in pixels per inch (ppi) or dots per inch (dpi)
- used to describe monitors, printers, and bit-mapped graphic images.

*Award [1] for identifying each appropriate statement up to a maximum of [2].*

(ii) Using the following assumptions:

- 1 pixel is made of 24 bits
- 1 kilobyte (KB) = 1000 bytes
- 1 megabyte (MB) = 1000 KB

Calculate in megabytes (MB) the storage requirements for an image size of 2000 pixels by 4000 pixels.

[2]

- Image size = 8 000 000 pixels
- Images size = 8 000 000 \* 24 bits
- = 192 000 000 bits
- = 192 000 000 / 8 bytes
- = 24 000 000 bytes
- = 24 MB

*Award [1] for converting bits to bytes correctly or using the correct logic and missing out this conversion.*

*Award [2] for the correct answer.*

- (iii) The system records the ball's flight path into a database.

Identify **two** fields that would be found in the goal-line technology database. **[2]**

*Answers may include:*

- the coordinates of the sensors
- time of the event
- position of ball (triangulation)
- height / elevation of the ball
- speed of the ball
- line of sight to the goal-line (angle)
- images of ball
- camera number
- camera location
- a Boolean / Yes-No field to record if the ball crossed the line or not
- which goal line the ball went over.

*Award **[1]** for identifying each appropriate field that would be found in the goal-line technology database up to a maximum of **[2]**.*



- (b) The goal-line technology is capable of collecting vast quantities of data. To make this manageable three policies are needed: for the collection, storage **and** sharing of data.

Explain how **each** of these **three** policies could be implemented so that the quantity of data is manageable.

[6]

*Answers may include:*

**Collection:**

- data would only be collected when the ball is within several meters of the goal-line – this would reduce the amount of data collected
- the cameras can create lower resolution images
- after the flight path of the ball is calculated, the original images of the ball are not saved.

**Storage:**

- data would only be stored for a finite period of time – this would reduce the amount of storage space required
- access to stored data would be limited – only authorized individuals will have access to the vast amount of data – data not shared with third party, unless authorized
- data would only be stored if there was a need to store it – for example it may refer to controversial decisions or those that may be used to set a precedent
- data will be stored in compressed form to minimise storage space required
- use of storage capacity regularly / continuously reviewed to ensure adequate storage is always available.

**Sharing:**

- data would only be shared with specified organizations who would not be able to share it with third parties – (*ie* controlling access to the data)
- the amount of data shared would be limited to the minimum necessary (*eg* the image of the ball crossing the line, the relevant statistical data about the goal *etc*) in order to make the amount of data manageable.
- access to data would be limited to authorized personnel – to the minimum amount of data necessary for their position.
- exporting/sending images using lossy compression to reduce the size of images.

*Award [1] for identifying the policy and [1] for a development of the policy identified that makes a feasible proposal about how the quantity of data held is manageable up to a maximum of [2].*

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

- (c) Many sports have introduced technology to assist officials with their decision-making at critical moments. These include whether to award a goal in football, whether a shot in tennis is in, or whether a sprinter has made a false start.

To what extent do the advantages of introducing technology in sport outweigh the disadvantages?

[8]

*Answers may include:*

- should ensure the correct decision is made by the officials
- reduce the burden on the officials so they know any critical decisions are being checked during the game
- can be used where the human eye is unable to detect whether the critical event has taken place or not (eg a false start)
- installation costs and ongoing costs of the technology will be high so it may only be found at certain venues
- time consuming – too much time could be taken when showing replays / stopping the game to review the data from the cameras
- may require changes to the equipment that may have unintended results
- the algorithms within the software may not be a 100% accurate
- the technology may not be 100% reliable
- the role of the official is reduced considerably and is subservient to the technology
- the human element, getting decisions wrong, is part of the game.

***Please see generic markband information sheet on page 22.***

### 3. Social media and political tension

*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) In addition to providing access to the Internet, identify **two** functions of an internet service provider (ISP). [2]

*Answers may include:*

- provides an IP address
- provides various bandwidth options
- email accounts
- customer service
- spam filtering
- domain registration
- web hosting
- blocking sites
- firewall
- parental controls
- VPN
- set-up / installation (eg for new customers)
- routing data / data packets
- load balancing
- provide DNS servers
- provide anti-virus protection / software
- control the amount of data transfer / data usage allowed
- provide cloud storage services.

*Award [1] for identifying each characteristic of an internet service provider up to a maximum of [2].*

- (ii) Identify **two** characteristics of a proxy server. [2]

*Answers may include:*

- acts as a gateway between the local network computer and a larger network (such as the internet)
- provide increased performance and security
- can be hardware or software
- connecting through a proxy server can slow down the connection
- changes the IP address used to access websites
- allows users to access websites banned/blocked in their home country or by organisations (eg employers)
- allows users to keep their location information private
- allows users to appear to be accessing the internet from the country the proxy server is located in.

*Award [1] for identifying each characteristic of a proxy server up to a maximum of [2].*

- (iii) Identify **two** ways that the government could have determined the identity of the person responsible for posting the offending images on the social media. [2]

*Answers may include:*

- IP address
- MAC address
- unique serial number
- personal identifying data stored on the device and included with the photo (eg in the photo's EXIF metadata)
- GPS location data stored with the photo.

*Information from the social media provider*

- login credentials to the social media account (eg username).

**N.B.:** *Some students may take the alternative perspective that the identity of the person cannot be determined, only the device, for the same reasons as above.*

*Award [1] for identifying each way that a government can determine the identity of the person responsible for posting the offending images on the social media up to a maximum of [2].*

- (b) Many schools block access to social networking websites such as *Twitter*, *Facebook* and YouTube. However, other schools are investigating two different options:
- monitoring the network to view what websites the students are viewing, or
  - giving different ages of students different levels of access to social media sites.

Analyse these **two** options.

[6]

*Answers may include:*

**Monitoring the network:**

- prevent cyberbullying – keep students safe
- teach student responsibility – digital citizenship
- protect students from sharing inappropriate information and images about themselves
- identifies any inappropriate content that students can access on these sites
- gather information for future policies for the use (or not) of social media
- students of all ages would have access to the same websites, regardless of age – younger students could have access to inappropriate content for their age
- privacy of students – school would have access to see what the students are viewing.

**Giving different ages different levels of access:**

- some websites have age restrictions – should only be accessed if age appropriate
- younger students should not be exposed to some content that is acceptable for older students
- schools have responsibility to ensure the use of the network is appropriate to various ages
- younger students may not be able to differentiate between true intentions of online friendships
- older students need to learn responsible digital citizenship and take responsibility for their actions
- awareness of the benefits and drawbacks of social media sites is gathered as the student matures
- blocking sites by age could cause issues – block content that is needed by older students
- granting different levels of access may be more cost effective than implementing an ongoing monitoring system.

Marks	Level descriptor
0	No knowledge or understanding of ITGS issues and concepts. No use of appropriate ITGS terminology.
1–2	A limited response that indicates very little understanding of the topic or the reason is not clear. Uses little or no appropriate ITGS terminology. No reference is made to the scenario in the stimulus material. The response is theoretical.
3–4	A description, unbalanced or partial analysis of whether network monitoring or providing different access levels is appropriate within a school. There is some use of appropriate ITGS terminology in the response.
5–6	A balanced and detailed analysis of whether network monitoring or providing different access levels is appropriate within a school. Explicit and relevant references are made to the scenario in the stimulus material. There is appropriate ITGS terminology throughout the response.

- (c) Many citizens have raised concerns about the surveillance of their web browsing history or censorship of selected websites by their national government.

To what extent is it appropriate for national governments to use surveillance and censorship to control citizens' access to websites?

[8]

*Answers may include:*

**Reasons that surveillance and censorship to control citizens' access to websites is acceptable:**

- can keep children from being victims of cyberbullying, sex trafficking and pornography
- can control/monitor various illegal activities
- helps strengthen national security with laws against hacking and impose large fines and punishments
- can lessen the incidence of identity theft
- governments may be best informed to determine what may, or may not, be appropriate for their citizens.

**Reasons that surveillance and censorship to control citizens' access to websites is not acceptable:**

- removes citizens' freedom of expression
- can be used to keep relevant information from citizens
- it can be expensive for the government or may require too many resources for the benefits it brings
- may accidentally block sites that should not be blocked
- knowledge is power
- can be used to identify people who oppose the government.

***Please see generic markband information sheet on page 22.***

#### 4. Sports watches used in physical education lessons

*Note to examiners.*

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

- (a) (i) Apart from heart rate, identify **two** possible vital signs that could be recorded by the sports watch. [2]

*Answers may include:*

- blood sugar / glucose levels
- blood pressure
- oxygen levels
- body temperature
- hydration levels
- ECG / pulse rate / heart rate
- stress levels
- sleep patterns
- calories burned
- body fat
- respiratory rate/breathing rate.

**N.B.:** In the context of an ITGS course it is not expected that candidates know the medical definition of a “vital sign”.

Should **not** be accepted as they are measurements to do with the activities, not the students:

- calories
- steps taken
- distance tracking
- speed.

Award **[1]** for identifying each vital sign that could be monitored by the teachers up to a maximum of **[2]**.



- (ii) At the start of each lesson the student is asked to set their maximum heart rate on the watch to  $220 \text{ bpm} - \text{their age}$ ; so in the case of a 15-year-old it would be  $220 \text{ bpm} - 15 = 205 \text{ bpm}$ .

Identify the steps used by the software in the sports watch to encourage students not to exceed their maximum heart rate.

**[4]**

*Answers may include:*

- device takes the measurement of the student's heart rate
- data is converted from analog signals to digital data / analysed by the device
- heart rate value is compared with the "normal" value stored in device for student
- if value is outside accepted range, then signal / alert is sent
- if value is inside accepted range, then no signal / alert is sent
- device waits for next time interval to take new measurement.

*Award **[1]** for identifying each of the steps used by the sports watch to ensure that students stay within their recommended heart rate zone up to a maximum of **[4]**.*

- (b) (i) Explain **one** advantage for the student of using these monitoring devices. [2]

*Answers may include:*

- can act as a personal coach for the student – motivate students to be more active, help keep students within healthy range
- recording of activity levels and frequency – can motivate students to reach healthy goals, be more active
- device can easily store information and it is emailed to the students – students can keep a copy on file to follow their progress – no need to write it down
- students can evaluate their personal fitness such as cardiovascular system – this may lead to early notification of health issues.

*Award [1] for identifying an advantage for the student of using these monitoring devices and [1] for a development of the policy identified up to a maximum of [2].*

- (ii) Explain **one** advantage for the teacher if their students are using these monitoring devices. [2]

*Answers may include:*

- personalized learning – teachers can modify lessons according to students' fitness level and needs
- determining grades – results are recorded and teachers can use this data to create grades
- motivating students – students may work harder in class if they are motivated to work harder and improve their fitness
- avoid risks associated with extreme exercise – monitoring students' vital signs can help prevent excessive exercise, or indicate health problems in advance
- teachers can monitor the students heart rates without stopping the activity the students are doing
- data from the watch may be more accurate than manually checking heart rates – gives the teacher more reliable data.

*Award [1] for identifying an advantage for the teacher if their students are using these monitoring devices and [1] for a development of the policy identified up to a maximum of [2].*

- (iii) Explain why the reliability of the sports watches may be a concern for the teachers.

[2]

*Answers may include:*

- recorded results may be inconsistent – this would make it difficult to determine if a student is improving or not – would also make it difficult to determine if there is a health issue
- may push students' limits too far if data is incorrect – students may overexert themselves if the device does not indicate they are over their heart rate limit
- student progress may not be accurate – teachers may think the students are improving and grade them accordingly
- data may not be received by teacher – due to network issues
- student's watch may malfunction – if it is not working this may delay the lesson – hardware is not reliable
- students might find a way to fool the watch into recording activities when none are taking place (eg swinging an arm rapidly to simulate running) - teachers would get unreliable data
- teachers are concerned that a summary of unreliable results may be sent to students' parents and cause them to worry.

*Award [1] for identifying a reason why the reliability of the sports watches may be a concern for the teachers and [1] for a development of the reason identified up to a maximum of [2].*

- (c) The Principal at Collège Earlet has been discussing arrangements for sharing data from the students' watches with a third party, *Fitness World*.

Discuss whether the Principal at Collège Earlet should agree to share data that has been collected by the students' watches with *Fitness World*.

[8]

*Answers may include:*

**Reasons for sharing the data with *Fitness World*:**

- can do further analysis of student performance
- can provide data that can help improve performance of overall population
- can benchmark student with other students from other schools
- may motivate students to do better if they know data is shared
- company may provide other resources to the school if they share data
- students may be able to upload their data to the *Fitness World* site and communicate with students from other schools who use the same watches
- students may be invited to take part in regional or national competitions (eg if they perform well compared to students from other schools).

**Reasons for not sharing the data with *Fitness World*:**

- students may be under 18 and data sharing may be inappropriate, unethical or illegal
- privacy of student data may be compromised
- security of data – could be stolen or shared without permission
- could put pressure on students if data is being shared, or compared with others
- school policies may not allow student information to be shared with third party.

***Please see generic markband information sheet on page 22.***

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

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