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# **Information Technology in a Global Society**

## **Higher level and standard level**

**Specimen papers 1, 2 and 3**

**For first examinations in 2016**

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**Information technology in a global society**  
**Higher level**  
**Paper 1**

SPECIMEN PAPER

2 hours 15 minutes

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**Instructions to candidates**

- Do not open this examination paper until instructed to do so.
- Section A: answer two questions.
- Section B: answer one question.
- Each question is worth **[20 marks]**.
- The maximum mark for this examination paper is **[60 marks]**.

## Section A

Answer **two** questions. Each question is worth **[20 marks]**.

### 1. BodyGuardian

The BodyGuardian is a lightweight, wearable and wireless body sensor. This technology allows patients to remain active and independent while their health is being monitored with a simple sensor that is in contact with their skin.

**Figure 1: The BodyGuardian device**



[Source: [www.mayoclinic.org](http://www.mayoclinic.org)]

The BodyGuardian system consists of the BodyGuardian device and a smartphone with the BodyGuardian app\* installed. The smartphone connects to the cloud-based service mHealth using a 3G cell/mobile phone network.

Doctors are able to access their patient's data via mHealth using a mobile device. They can also set different limits for each patient, allowing for personalized alerts.

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\* app: application software, typically a small, specialized program downloaded onto mobile devices; apps can also run on the internet, on a computer, on a cell/mobile phone or other electronic device.

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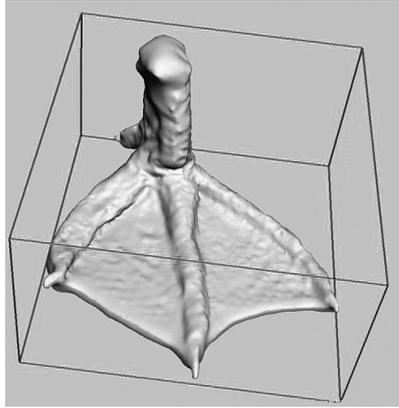
**(Question 1 continued)**

- (a) (i) Identify **two** health indicators that could be measured by the BodyGuardian device. [2]
- (ii) Identify **four** steps taken by the software to decide if a health indicator measurement needs to be sent to a doctor for a decision. [4]
- (b) The managers of mHealth are investigating the nature of passwords used by doctors to access patient information. The two options being investigated are:
- the doctor creates a password that does not need to be changed
  - the mHealth system requires doctors to create a strong password that must be changed every 40 days.
- Analyse these **two** options. [6]
- (c) As part of the development of the BodyGuardian device, it is being tested in clinical trials by doctors and patients.
- Discuss the implications for doctors and patients of trialling the BodyGuardian device before it is sold publicly. [8]

## 2. 3D printing

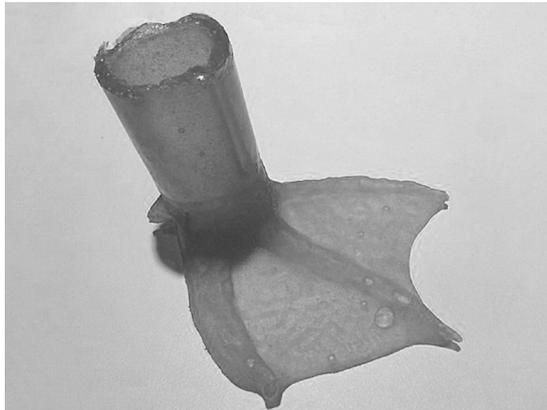
Charlie is a duck who was born with only one foot. His owner took pictures of another duck's foot from different angles and was able to use 3D printer technology to produce a new plastic foot for him.

**Figure 2: Computer-generated image of a duck's foot**



[Source: <http://mashable.com>]

**Figure 3: Charlie's new plastic foot**



[Source: [www.dailymail.co.uk](http://www.dailymail.co.uk)]

**(This question continues on the following page)**

(Question 2 continued)

**Figure 4: A 3D printer**



[Source: <http://cubify.com>]

A 3D printer, like the one shown in **Figure 4** creates an object by adding plastic layer by layer until it is complete.

Inspired by Charlie’s story, Alejandro Toys has created a company that uses a computer with a 3D printer and software to produce plastic toys for children.

Alejandro Toys has found out that some software will allow them to input 2D images into the 3D printer software so that they can be converted into a 3D object. They are considering either to use open source software or to purchase proprietary software.

- (a) (i) Identify **two** ways that a 2D image file can be input into the 3D printer software. [2]
- (ii) Identify **four** of the steps required to produce Charlie’s replacement foot. [4]
- (b) Analyse Alejandro Toys’s decision to either use open source software or to purchase proprietary software to produce the company’s 3D toys. [6]
- (c) It is now possible to use a 3D printer to print a large range of products in addition to toys. These include guns, bicycles and human prosthetic limbs. However some governments are concerned about the software for 3D printers being freely available on the internet.  
  
To what extent should governments regulate the access to software for 3D printers? [8]

**Turn over**

**3. Small town book shop moves to computer-based records**

El Hoyo is a small village in the south of Argentina. The local book shop has recently received a number of academic books from a large university in Buenos Aires. The university also sent a computer which has all of the books listed in a spreadsheet.

The table in **Figure 5** shows a small part of the list of books. The complete table has 400 different entries (last entry is in row 401).

Daniela, the shop manager, has been waiting for a computer for a long time. She knows that, with this computer, her staff will provide a faster service when they are searching for specific books.

**Figure 5: Part of the spreadsheet of books**

	A	B	C	D	E	F	G
1	Book title	Number of books	Author	ISBN	Cost in pesos (\$)	Subject area	Subtotal pesos (\$)
2	Flatland: A Romance of Many Dimensions	4	Abbott	978-0486272634	\$200	Mathematics	\$800
3	Exploring Anatomy and Physiology	2	Amerman	978-1617310560	\$148	Natural sciences	\$296
4	Wellness	8	Anspaugh	0-078022509	\$202	Physical education	\$1616
5	Research Strategies: Finding Your Way	3	Badke	978-1491722336	\$169	English	\$507
6	Parent–Child Relations	8	Bigner	978-0135002193	\$213	Psychology	\$1704
7	Ordinary Men: Reserve Police Battalion	4	Browning	978-0060995065	\$187	History	\$748
8	The Earth and its Peoples, Vol II	3	Bulliet	978-0495902881	\$188	History	\$564
9	Lab Book CH251	8	CER	978-0495642152	\$150	Natural sciences	\$1200
10	The Story and its Writer	1	Charters	0-312596243	\$184	English	\$184
11	Environmental Science: A Global Concern	12	Cunning	978-0073383255	\$152	Natural sciences	\$1824
12	Feasting, Fasting	2	Desai	978-0618065820	\$177	English	\$354
13	Reconstructing Gender	1	Disch	978-0073380063	\$182	English	\$182

[Source: adapted from <http://schools.cms.k12.nc.us>]

**(This question continues on the following page)**

**(Question 3 continued)**

- (a) (i) Daniela needs to see the books in alphabetical order, with the “Subject area” sorted from A to Z and then the “Number of books” sorted from largest to smallest.

State the author that would appear in the first row of the sorted spreadsheet using only the books shown in **Figure 5**. [1]

- (ii) State the formula that would be required to add up the cost of all the books in the book store. [1]

- (iii) Daniela now thinks that she should have installed a database for the information about the books. Outline **two** advantages that a database would have over a spreadsheet for the El Hoyo book shop. [4]

- (b) Explain **three** impacts that the new computer system may have for the staff at the book shop. [6]

- (c) El Hoyo receives a large number of tourists during the summer when the fruit festival takes place, but suffers from periods of poor internet connectivity. Daniela has now created a separate area in the book shop that has several computers with free broadband internet access so that tourists can use them to check their emails and find information about the local area.

Evaluate the impacts of this initiative for Daniela as shop manager. [8]

## Section B

Answer **one** question. Each question is worth **[20 marks]**.

### 4. Penrose Airport (United Kingdom) automated baggage system

The automated baggage system designed for Penrose Airport is an example of an IT project failure. When a prototype of the system was switched on for a demonstration, bags became jammed on the conveyer belt, fell off, or airport employees put them on the wrong conveyer belt. As a result, bags were often misrouted, lost or damaged.

An investigation into the failure of the automated baggage system revealed several problems:

- the managers of Penrose Airport kept changing their requirements for the system
- the company that designed and implemented the automated baggage system had never created one of this size before
- the deadline for completion was only two years from the beginning of the project
- the airlines that use Penrose Airport were not included in the early discussions about the project.

The waterfall method of development was used.

The project management team, which was composed of the airport's chief engineer and the senior management team of the firm that built the system, made the key decisions regarding the project. Several lower level managers, who were not directly involved in the decisions, advised the project management team that the project needed four years to complete, not the two years allocated.

**Figure 6: Baggage chaos at Penrose Airport**



[Source: [www.thestar.com](http://www.thestar.com)]

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**(Question 4 continued)**

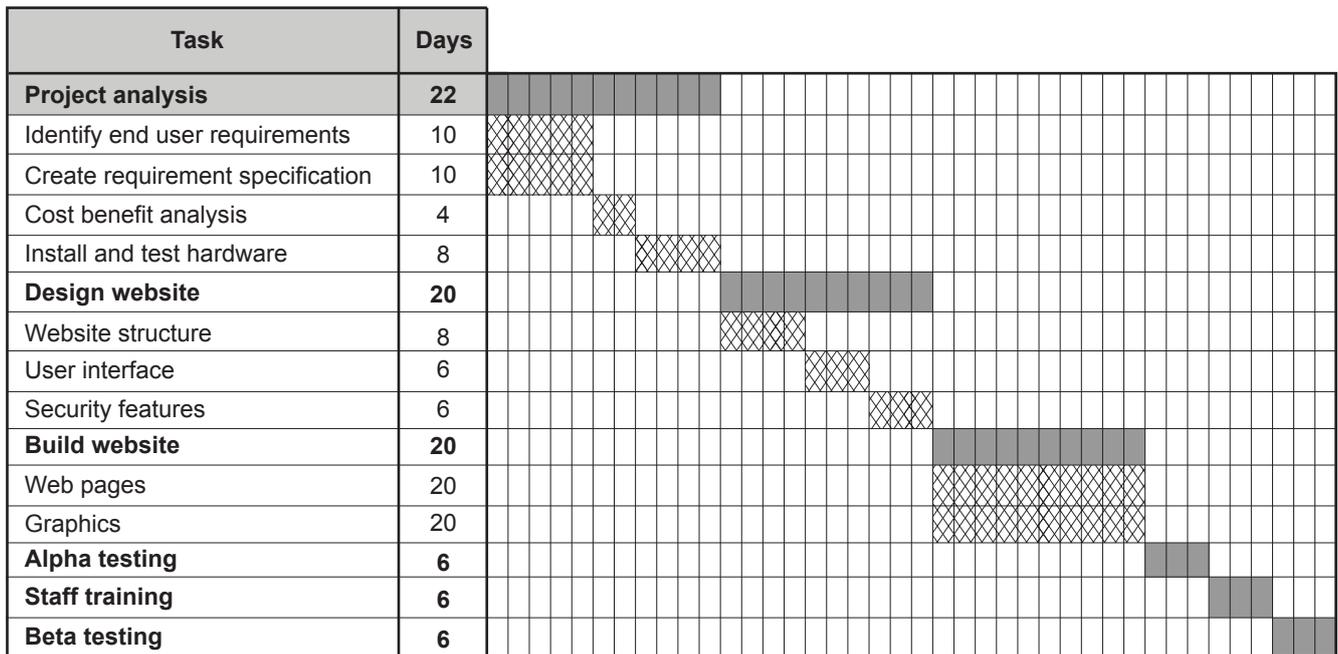
- (a) (i) Identify **two** key stakeholders in this automated baggage system project. [2]
- (ii) Identify **two** characteristics of a “prototype”. [2]
- (iii) Identify **two** types of information that should have been gathered at the beginning of the automated baggage system project. [2]
- (b) Explain **three** reasons why the use of the AGILE system of project development might have prevented the failure of the automated baggage system project. [6]
- (c) To what extent is the success of projects such as the Penrose Airport automated baggage system dependent on the involvement of key stakeholders throughout the development process? [8]

**5. Zunica Chocolates**

Zunica Chocolates sells its products from a number of stores in New Mexico, USA. Sales have grown rapidly in recent years.

Zunica Chocolates has decided to create an e-commerce platform for online sales. This platform needs to be integrated with the company’s current website. Zunica Chocolates has decided to contract the work out to Karlsons, an e-commerce development company. The owner will work with Anna, the project manager at Karlsons, who will design and create the e-commerce platform. She has developed a Gantt chart to schedule and coordinate tasks.

**Figure 7: Gantt chart for the Zunica Chocolates e-commerce platform**



**Key:**  
 Each cell is equivalent to two days.  
 Project phase  
 Project task

- (a) (i) Identify **three** requirements for an e-commerce website in order to be user-friendly. [3]
- (ii) Identify **three** components of a “feasibility study”. [3]
- (b) Explain why Zunica Chocolates uses both alpha testing and beta testing to ensure the functionality of their website. [6]
- (c) To what extent could the use of a Gantt chart such as the one above lead to the successful development of Zunica Chocolates’s website? [8]

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## 6. Telepresence robots

Several students of Fernwood School have to study at home because of serious health issues. The school is considering whether to purchase VGo robots for these students.

The robots stand inside the classroom and have a screen that displays the student's face in real time. The student is able to control the robot in order to see and hear what is happening in the classroom as well as participate in class discussions, group work, and even attend assemblies or join other students in the lunchroom.

The student at home will need a computer with access to the internet to receive the video and sound from the robot. The school will need a Wi-Fi network, because the robot will travel throughout the school just as the student would. The student controls the movement of the robot from their home computer.

At the end of the school day, the student “drives” their robot to a secure area where its battery is charged overnight.

**Figure 8: A VGo robot in a classroom**



[Source: [www.ericsson.com](http://www.ericsson.com)]

**(This question continues on the following page)**

**(Question 6 continued)**

- (a) (i) Identify **two** of the sensors that the robot must have in order to move around the classroom. [2]
- (ii) Outline **two** characteristics that make the VGo different from a fixed video system such as Skype. [4]
- (b) Analyse the impact that using a VGo robot would have on a student who cannot attend school in person. [6]
- (c) Larsson Laboratories, which makes drugs for rare diseases, is considering the use of VGo robots for company communications. The head office is in central Stockholm, with a research laboratory in a nearby town and a production facility in Germany. The VGo robots would be used for meetings and visits to the laboratory and production facility by managers, as well as by workers who are in the office for some of the time, and work from home (telecommute) for the rest.  
  
Discuss the potential effects of the use of VGo robots for Larsson Laboratories. [8]

## 7. Art and expert systems

Harold Cohen, a noted painter, has used his knowledge of drawing and colour to create an expert system called AARON. AARON uses a knowledge base containing information about real-world objects and has a set of rules about how to create works of art. AARON has a robotic arm that it uses to mix colours, draw, paint and, finally, clean its paint pots and paint brushes.

**Figure 9: AARON**



[Source: <http://hackaday.com>]

Cohen also gave AARON machine learning capabilities. All of AARON's works are different from one another and, once the program is running, AARON makes all the decisions about the paintings; for example AARON makes decisions about the components of the paintings.

**Figure 10: AARON follows a set of rules to create works of art**



[Source: <http://prostheticknowledge.tumblr.com>]

AARON's drawings and paintings have been exhibited in a number of museums, including the San Francisco Museum of Modern Art, The Tate, London and the Stedelijk Museum, Amsterdam. According to one art critic, "AARON allows the spontaneously occurring accidents that often give a work of art its character to remain, rather than efficiently cleaning them up".

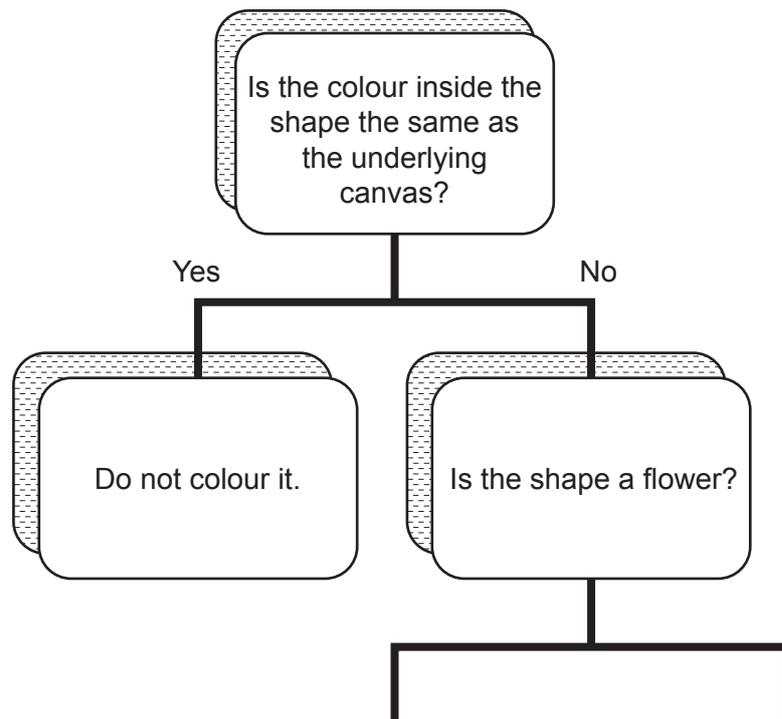
**(This question continues on the following page)**

**(Question 7 continued)**

- (a) AARON, like all expert systems, has a knowledge base and inference engine.
  - (i) Identify **two** possible items that could be included in AARON's knowledge base. [2]
  - (ii) Programs like AARON often contain fuzzy logic. Identify **two** characteristics of fuzzy logic. [2]
  - (iii) Identify **two** characteristics of machine learning. [2]
- (b) (i) AARON needs to select colours for leaves and flowers in each drawing. Once a shape is selected, it must follow these rules:
  - AARON can colour large flowers red
  - AARON can colour small flowers blue
  - if the shape is a leaf, AARON can colour it green
  - if the shape is neither a leaf nor a flower, AARON should not colour it.

Copy and complete the information below to construct a decision tree that AARON could use to colour its drawings. [4]

**Figure 11:**



- (ii) Explain **one** weakness of using a decision tree like this one for AARON. [2]
  - (c) Discuss the museums' decision to list AARON as the artist when exhibiting AARON's paintings and drawings. [8]
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# Markscheme

## Specimen paper

### Information technology in a global society

#### Higher level

#### Paper 1

This markscheme is **confidential** and for the exclusive use of examiners in this examination session.

It is the property of the International Baccalaureate and must **not** be reproduced or distributed to any other person without the authorization of the IB Assessment Centre.

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. BodyGuardian

*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** health indicators that could be measured by the BodyGuardian device. [2]

*Answers may include:*

- body temperature
- respiratory rate
- blood pressure
- sugar levels (blood glucose)
- heart rate/pulse rate
- electrocardiogram (ECG).

*Award [1] for each of the above up to a maximum of [2].*

- (ii) Identify **four** steps taken by the software to decide if a health indicator measurement needs to be sent to a doctor for a decision. [4]

*Answers may include:*

- device takes the measurement
- measurement converted to digital data/ analogue to digital conversion (ADC)
- data sent from BodyGuardian device to smartphone
- patient data is uploaded to mHealth system for analysis
- value is compared with the “normal” value stored in device for patient
- if value is outside accepted range, then signal is sent to doctor for action to be taken
- if value is inside accepted range, then no signal is sent
- device waits for next time interval to take new measurement.

*Consider any four steps in the response.*

*Award [1] for each step up to a maximum of [4].*

- (b) The managers of mHealth are investigating the nature of passwords used by doctors to access patient information. The two options being investigated are:
- the doctor creates a password that does not need to be changed
  - the mHealth system requires doctors to create a strong password that must be changed every 40 days.

Analyse these **two** options.

[6]

*Answers may include:*

- Option: password created by doctor that does not need to be changed
  - familiar for doctor and probably easy for him to remember
  - no need to write it down therefore it will not be found by others
  - others with access to the computer may “guess” it if they know the doctor well
  - if the password is discovered/cracked it can be used for an indefinite time period. the doctor may not be aware that the password has been compromised
  - may allow doctor to access account faster as no need to look-up the password
  - a password that is never changed creates a security problem as people close to doctor may find out the password (*ie* see it, guess it)
  - may not be a strong password
- Option: strong password created by doctors that must be changed every 40 days
  - secure as it may not be related to the doctor – therefore difficult to guess
  - the need of constantly updating the password in mHealth will improve the security as it may be harder to guess
  - may be difficult for doctors to remember which variant of the password they have used
  - doctor may need to keep it written down – therefore it has the risk of being found by others
  - may have difficult characters that may not be in a keyboard of mobile devices.

**[1–2]:** *A limited response that demonstrates minimal knowledge and understanding of the topic and uses little or no appropriate ITGS terminology. Only one of the options is addressed in the response.*

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

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

- (c) As part of the development of the BodyGuardian device, it is being tested in clinical trials by doctors and patients.

Discuss the implications for doctors and patients of trialling the BodyGuardian device before it is sold publicly.

[8]

*Answers may include:*

- may have to do double checks: with and without the device – this will take more time and put the patient under unnecessary stress / may take time from busy doctors
- if doctors/patients discover that incorrect information is being sent from the device they may not trust it / feel uncomfortable about having to use it
- if device works well doctors/patients may advertise it positively, making others more willing to use it
- doctors/patients may need training to use the device
- patients in the trial may feel their health is being more effectively monitored
- patients and/or doctors may provide feedback to improve final device
- patients may need to be assured that security measures have been taken to protect the privacy of their data
- doctors may have an opportunity to learn how to use the device before it is sold publicly.

*In part (c) of this question it is expected there will be a balance in the ITGS terminology between IT technical terminology and the terminology related to social and ethical impacts.*

***Please see generic markband information sheet on page 25.***

## 2. 3D printing

*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 that a 2D image file can be input into the 3D printer software.

**[2]**

*Answers may include:*

- 2D images *imported* imported into the 3D printer software
- 2D images are *opened* by the 3D printer software
- 2D file is converted into a format required by the 3D printer software by another file conversion program.

*Award [1] for each way up to a maximum of [2].*

- (ii) Identify **four** of the steps required to produce Charlie's replacement foot.

**[4]**

*Answers may include:*

- images of the other duck's foot are imported into the 3D printer/modelling software
- the software creates a 3D image/model of the foot from the images
- the 3D image/model is edited to make it the same size as Charlie's foot
- printer is loaded with the type of raw material needed for creating the foot
- the 3D image/model of the foot is sent to the 3D printer
- the 3D printer creates the replacement foot

*Award [1] for each step up to a maximum of [4].*

- (b) Analyse Alejandro Toys’s decision to either use open source software or to purchase proprietary software to produce the company’s 3D toys.

[6]

*Answers may include:*

- open-source software is often free or low-cost, allowing the company to acquire more software within a limited budget / proprietary software may demand a higher level of investment by the company
- open-source software can be changed or customised to suit the company’s requirements – the source code is available for programmers to modify / proprietary software can only be modified by the manufacturer
- open-source software may have “bugs” that have not yet been reported which affect the company’s production (ie may take time to be fixed) / proprietary software manufacturers may release patches/bug-fixes on a regular basis
- open-source software may not have all the options/features needed by the company / proprietary software often has a greater range of options/features
- manufacturers of proprietary software can provide support and assistance to the company / open-source software often has limited support
- using open source software for producing the 3D toys may require hiring more programming staff to upgrade the software

**[1–2]:** *A limited response that demonstrates minimal knowledge and understanding of the topic and uses little or no appropriate ITGS terminology. Only open-source software or proprietary software is explicitly referred to in the response.*

**[3–4]:** *A partial analysis, either lacking detail or balance, that demonstrates some knowledge and understanding of the topic. Some relevant examples are used within the response. There is some use of appropriate ITGS terminology in the response. Both open-source software and proprietary software are explicitly or implicitly referred to in the response.*

**[5–6]:** *A balanced and detailed analysis of the issue which demonstrates thorough knowledge and understanding of the topic. Relevant examples are used throughout the response. There is appropriate ITGS terminology throughout the response. Both open-source software and proprietary software are explicitly referred to in the response.*

- (c) It is now possible to use a 3D printer to print a large range of products in addition to toys. These include guns, bicycles and human prosthetic limbs. However some governments are concerned about the software for 3D printers being freely available on the internet.

To what extent should governments regulate the access to software for 3D printers?

**[8]**

*Answers may include:*

*Regulation of the access to software for 3D printers*

- could aim to ensure good quality of the 3D objects being made. 3D software may allow for sub-standard / faulty 3D objects to be manufactured, creating risks for users
- could aim to prevent the manufacture of artifacts that are only sold with a licence (eg guns). However if similar shapes are needed for other articles, their manufacture may be prevented by mistake Eg: if a certain shape is recognized the software may not allow it to be printed
- could protect manufacturers of copyrighted products. Owners of 3D printers would be prevented from making them
- could prevent owners of 3D printers making their own objects freely, stifling innovation
- could mean an invasion of privacy. It is possible to know what blueprint is being downloaded to which IP address
- to what extent is regulation possible.

*In part (c) of this question it is expected there will be a balance in the ITGS terminology between IT technical terminology and the terminology related to social and ethical impacts.*

***Please see generic markband information sheet on page 25.***

**3. Small town book shop moves to computer-based records**

*Note to examiners.*

- *Part a and part b questions are marked using ticks and annotations where appropriate*
- *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) Daniela needs to see the books in alphabetical order, with the “Subject area” sorted from A to Z and then the “Number of books” sorted from largest to smallest.

State the author that would appear in the first row of the sorted spreadsheet using only the books shown in **Figure 5**. **[1]**

- Badke

*Award [1] for the correct answer shown above.*

- (ii) State the formula that would be required to add up the cost of all the books in the book store. **[1]**

*Answer may include:*

- =SUM(G2:G401)
- =SUMA(G2:G401)
- =ADD(G2:G401)
- = $\Sigma$ (G2:G401). (where xxxx is another valid formula which adds the numbers in cells G2 through G401)
- =G2+G3+...+G401

*Award [1] for any one of the above.*

- (iii) Daniela now thinks that she should have installed a database for the information about the books. Outline **two** advantages that a database would have over a spreadsheet for the El Hoyo book shop.

**[4]**

*Answers may include:*

- queries can be done to select specific records, *ie* English books
- reports can be made (*ie* summary of all the books that have been purchased, labels can be printed to label the books/bookshelves etc.)
- databases may reduce data redundancy and allow for more efficient storage & updating of data than spreadsheets
- a user interface can be included for the book shop staff without much IT knowledge, using spreadsheets may require a greater level of IT capability
- databases allow for data for a large number of books to be stored and accessed without increasing complexity for the user.
- databases allow the field choices to be set so that only certain types of data may be entered (e.g. Type of book, language etc.). Spreadsheets to not have this possibility.
- a database can limit the view of the data for particular users (e.g. Daniela as the shop manager, may be able to view more data than the rest of the staff), a spreadsheet does not have this capability

*Note: If an advantage is generic with no reference to the book shop, a maximum of 1 mark is awarded for identifying the advantage.*

*Award **[1]** for identifying an advantage and an additional **[1]** for an outline for that advantage.*

*Award up to a maximum of **[4]** for the question.*

- (b) Explain **three** impacts that the new computer system may have for the staff at the book shop.

**[6]**

*Answers may include:*

- the salesperson may have to learn/receive training on how to use the computer and software. This may involve additional time commitment.
- the salesperson may request new software applications (ie image editing software to create posters about the books) or hardware (ie barcode scanners) and this may involve costs
- shop owner may now expect the salesperson to perform analysis of sales/inventory
- having a computer may allow the salesperson to perform additional tasks (ie printing of advertisements about new books, mail merged letters, ordering books from their supplier)
- employees work will be easier and faster as they can check directly in the computer if they have a copy of the book
- staff will no longer have to calculate the costs of books manually leading to less errors in charging customers/fewer customer complaints.

*Award **[1]** for each impact identified, and an additional **[1]** for an appropriate explanation of that impact.*

*Award a maximum of **[6]** for the response.*

- (c) El Hoyo receives a large number of tourists during the summer when the fruit festival takes place, but suffers from periods of poor internet connectivity. Daniela has now created a separate area in the book shop that has several computers with free broadband internet access so that tourists can use them to check their emails and find information about the local area.

Evaluate the impacts of this initiative for Daniela as shop manager.

**[8]**

*Answers may include:*

- additional staff with IT expertise may be needed to work in that area if the demand is high installation, maintenance and repairs may be needed if the equipment is used frequently
- antivirus and firewalls may be needed to be installed
- the shop may become a popular place and sales of books may increase
- Daniela's investment may not be cost effective if demand for the bookshop's internet access decreases
- Daniela may need to develop an acceptable use policy
- Daniella may have access to the browser histories on the computers and could use that information to help decide what books to stock
- staff are able to query the book database for specific information (e.g. all of the books written by a certain author, all books which cost less than \$200).

*In part (c) of this question it is expected there will be a balance in the ITGS terminology between IT technical terminology and the terminology related to social and ethical impacts.*

***Please see generic markband information sheet on page 25.***

## Section B

### 4. Penrose Airport (UK) automated baggage system

*Note to examiners.*

- *Part a and part b questions are marked using ticks and annotations where appropriate*
- *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** key stakeholders in this automated baggage system project. [2]

*Answers may include:*

- passengers
- airlines
- airport's chief engineer
- airport's managers
- firm that built the system (or its senior management team)
- system development personnel
- project management team.

*Note: reward a specific member of any team i.e. someone who would be on the project management team, but do NOT reward two members of the same team.*

*Award [1] for each of the points identified above up to a maximum of [2].*

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

*Answers may include:*

- early working model of a system or subsystem
- used to test the system (eg interface, functioning)
- used to demonstrate how the system will work
- used to check whether the systems will meet the target user's requirements.

*Award [1] for each of the points identified above up to a maximum of [2].*

- (iii) Identify **two** types of information that should have been gathered at the beginning of the automated baggage system project. [2]

*Answers may include:*

- amount of baggage the system will need to handle
- maximum size and weight of baggage
- needs of individual airlines
- time parameters *ie* when is the automated baggage system scheduled to open
- number of concourses or gates to be served by the system
- cost estimate.

*Award [1] for each kind of information identified up to a maximum of [2].*

- (b) Explain **three** reasons why the use of the AGILE system of project development might have prevented the failure of the automated baggage system project. **[6]**

*Answers may include:*

- project could be adapted to changing needs of the stakeholders
- the concerns of lower level managers would have been heeded (eg resolving issues early on before they became significant)
- small parts of the system can be tested as they are developed (eg the parts of the baggage system that failed would have been caught early)
- requires stakeholders and developers to work together throughout the process (eg airlines would have communicated requirements throughout the process)
- developers work in teams increasing communication
- deadlines can be adjusted based on concrete information about the current performance of the system.

*Award **[1]** for each reason why the use of the AGILE system of project development might have avoided the failure of the automated baggage system project.*

*Award **[1]** linked to each reason identified for why the use of the AGILE system of project development might have avoided the failure of the automated baggage system project. **[1]** giving a maximum of **[2]** for each reason.*

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

- (c) To what extent is the success of projects such as the Penrose Airport automated baggage system dependent on the involvement of key stakeholders throughout the development process? **[8]**

*Advantages may include:*

- needs of all stakeholders will be taken into account from the beginning/avoids sudden dramatic changes in the project
- key stakeholders will have a clear idea of how the project is progressing
- regular communication with stakeholders ensures that the solution will meet their needs
- affords developers the possibility of working with experts who have detailed knowledge of the system requirement
- enables early recognition of small problems before they become huge problems
- regular communication ensures that necessary resources can be identified and provided.

*Disadvantages may include:*

- if views of some stakeholders are divergent from the rest, the project could fail
- coordination problems, ie between stakeholders, could cause delays in the project
- if there is no centralized control and knowledge, the project could fail
- meetings with stakeholders can be time consuming and/or non-productive.

*In part (c) of this question it is expected there will be a balance in the ITGS terminology between IT technical terminology and the terminology related to social and ethical impacts.*

**Please see generic markband information sheet on page 25.**

## 5. Zunica Chocolates

*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 **three** requirements for an e-commerce website in order to be user-friendly.

**[3]**

*Answers may include:*

- shopping cart
- search box
- login box
- social media links
- payment options
- contact information
- clear presentation of products/services
- use smaller files and images and files to reduce load times
- includes functions to aid the disabled
- included FAQs about transactions, delivery etc.
- allows users to compare products
- easy for users to provide information to the seller ,i.e. financial and shipping information
- offers a wishlist .

*Award **[1]** for each of the points identified above up to a maximum of **[3]**.*

- (ii) Identify **three** components of a “feasibility study”.

**[3]**

*Answers may include:*

- analysis of the likely success of a project
- considers cost
- technical issues
- resources needed
- value to or needs of the stakeholder(s)
- determine estimated date of completion.

*Award **[1]** for each of the points identified above up to a maximum of **[3]**.*

- (b) Explain why Zunica Chocolates uses both alpha testing and beta testing to ensure the functionality of their website.

[6]

<b>Alpha</b>	<b>Beta</b>
First stage of testing, prepares for beta testing.	Occurs when software passes alpha testing.
Tests if software meets design specifications.	Last stage of testing/pre-release.
Normally done by software testers within the company that created the software.	Test by group of "real world" users.
Reveals bugs, crashes, missing features etc.	Some bugs or crashes but features should be complete.
Critical issues are fixed, some features might be changed.	Only important/critical changes are made, new features are not added.
White box testing <i>ie</i> checks internal workings of the software (code).	Black box testing <i>ie</i> tests how it actually performs.

**[1–2]:** A limited response that indicates very little understanding of the topic.

**[3–4]:** A reasonable explanation of how both alpha and beta testing can be used to ensure the success of the project. The answer may be unbalanced and lack appropriate reasoning at the lower end of the band.

**[5–6]:** A clear, detailed explanation of how both alpha and beta testing can be used to ensure the success of the project.

- (c) To what extent could the use of a Gantt chart such as the one above lead to the successful development of Zunica Chocolates's website?

[8]

*Benefits may include:*

- use of a Gantt chart visualizes the process eg helps to maintain organization
- it illustrates which tasks must be completed before the next one can begin
- task can be viewed against a calendar showing start and end dates
- resources required for tasks can be linked to the tasks on the chart.

*Drawbacks may include:*

- it is a linear *ie* step-by-step process so it is very inflexible. Changes are difficult to make
- errors are difficult to correct
- changes could result in significant costs
- chart can be too simplistic *ie* does not provide enough detail for a complex project *ie* this chart leaves out the construction of the database
- it is difficult to show where there is slack time in the project.

*In part (c) of this question it is expected there will be a balance in the ITGS terminology between IT technical terminology and the terminology related to social and ethical impacts.*

**Please see generic markband information sheet on page 25.**

## 6. Telepresence robots

*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** of the sensors that the robot must have in order to move around the classroom.

[2]

*Answers may include:*

- cliff/edge detection
- sensor to detect edge of the wireless network
- sensor to detect battery level
- motion sensor
- proximity sensor (obstacle detection)
- visual sensor.

*Note: do not accept distance sensor or cameras.*

*Award [1] for each sensor identified up to a maximum of [2].*

- (ii) Outline **two** characteristics that make the VGo different from a fixed video system such as Skype.

[4]

*Answers may include:*

- the VGo robot is portable while the video system must be available in every classroom
- the student controls the VGo robot, can move from class to class along with everyone else while a portable video system must be wheeled around by a staff member
- the student controls the VGo while someone in each classroom needs to position the camera
- the student can move around the classroom as if she were physically present but the video system is relatively fixed
- the camera in the VGO system can look all around instead of having a fixed perspective
- student can control the robot from a remote place
- student can zoom in and out to see details or get a better perspective on the room.

*Award [1] for each characteristic that makes the VGo different from a fixed video system such as Skype identified up to a maximum of [2].*

*Award [1] for each expansion of each characteristic identified up to a maximum of [1] giving a maximum of [2].*

*Mark as [2 + 2].*

- (b) Analyse the impact that using a VGo robot would have on a student who cannot attend school in person.

[6]

*Advantages may include:*

- students will be able to participate fully in interactive class discussions/group work/working in pairs so they will have the full educational experience
- students will be able to move from class to class with peers/go to the lunchroom/chat while walking through the halls so they will be able to develop friendships
- student can participate in some extracurricular activities.

*Disadvantages may include:*

- sitting in front of a computer monitor can be tiring for the user
- parents might have privacy concerns about using cameras in class
- if the robot loses power, drops the internet connection or there's a hardware or software failure, the student will not be able to follow the lesson
- The student might play with the robot and get distracted
- Other students in school might make the student using the robot feel uncomfortable
- if the student is not confident or competent at using the VGo, the student's ability to follow the lesson will be reduced

**[1–2]:** *A limited response that indicates very little understanding of the topic.*

**[3–4]:** *A reasonable description of the positive and negative impacts of using the VGo robot in this scenario. The answer may be unbalanced and lack appropriate reasoning at the lower end of the band.*

**[5–6]:** *A balanced and thorough analysis of the positive and negative impacts of using the VGo robot in this scenario.*

- (c) Larsson Laboratories, which makes drugs for rare diseases, is considering the use of VGo robots for company communications. The head office is in central Stockholm, with a research laboratory in a nearby town and a production facility in Germany. The VGo robots would be used for meetings and visits to the laboratory and production facility by managers, as well as by workers who are in the office for some of the time, and work from home (telecommute) for the rest.

Discuss the potential effects of the use of VGo robots for Larsson Laboratories.

[8]

*Advantages may include:*

- the system would allow employees who telecommute to interact with colleagues in the office
- would save the business the costs of travel *ie* transportation, accommodations, meals; especially important for global companies
- employees can gain visual access to remote facilities such as manufacturing facilities, laboratories, *etc*
- employees can be more productive as time will not need to be spent on travel *eg* managers can visit multiple locations in a short period of time
- allows for “walk and talk” or “watercooler” discussions *ie* informal collaboration
- allows direct monitoring and interaction with employees if the supervisor is not physically present
- fewer people physically present means less risk of contamination in the laboratory.

*Disadvantages may include:*

- trust is harder to build when working with telecommunication technologies *eg* personal relationships are often critical in business environments
- bandwidth can be a problem *ie* video requires significant bandwidth. Companies may be limited in the use of robots by cost of bandwidth or may find their networks cannot handle the telepresence robots
- security is a problem because remote control cameras are moving around a financial institution or research laboratory
- the use of the internet to transmit the video opens up the company to breaches of security
- can make employees uncomfortable because they feel as if they're being spied on
- cannot be sure the robot will be controlled by the person who is supposed to be controlling it
- the field of vision of VGo's camera is not as wide as a human's, so it is impossible to have a view of the whole room
- a moving robot may risk expensive equipment or spill chemicals if not controlled correctly by the remote control user.

*In part (c) of this question it is expected there will be a balance in the ITGS terminology between IT technical terminology and the terminology related to social and ethical impacts.*

**Please see generic markband information sheet on page 25.**

## 7. Art and expert systems

*Note to examiners.*

- *Part a and part b questions are marked using ticks and annotations where appropriate*
- *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) AARON, like all expert systems, has a knowledge base and inference engine.

- (i) Identify **two** possible items that could be included in AARON's knowledge base. [2]

*Answers may include:*

- part of a human body
- physical types
- a set of colours to choose from
- basic shapes.

*Award [1] for each item that could be in AARON's knowledge base identified up to a maximum of [2].*

- (ii) Programs like AARON often contain fuzzy logic. Identify **two** characteristics of fuzzy logic. [2]

*Answers may include:*

- based on degrees of truth not “true or false”, eg percentages
- can quantify natural language expressions that state imprecise values, eg hot, warm, cool
- can be used in situations where precise values are not known, eg the temperature in a clothes dryer
- uses the logical values between 0 and 1 ie things can be partly true and partly false at the same time.

*Award [1] for each characteristic identified.*

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

*Answers may include:*

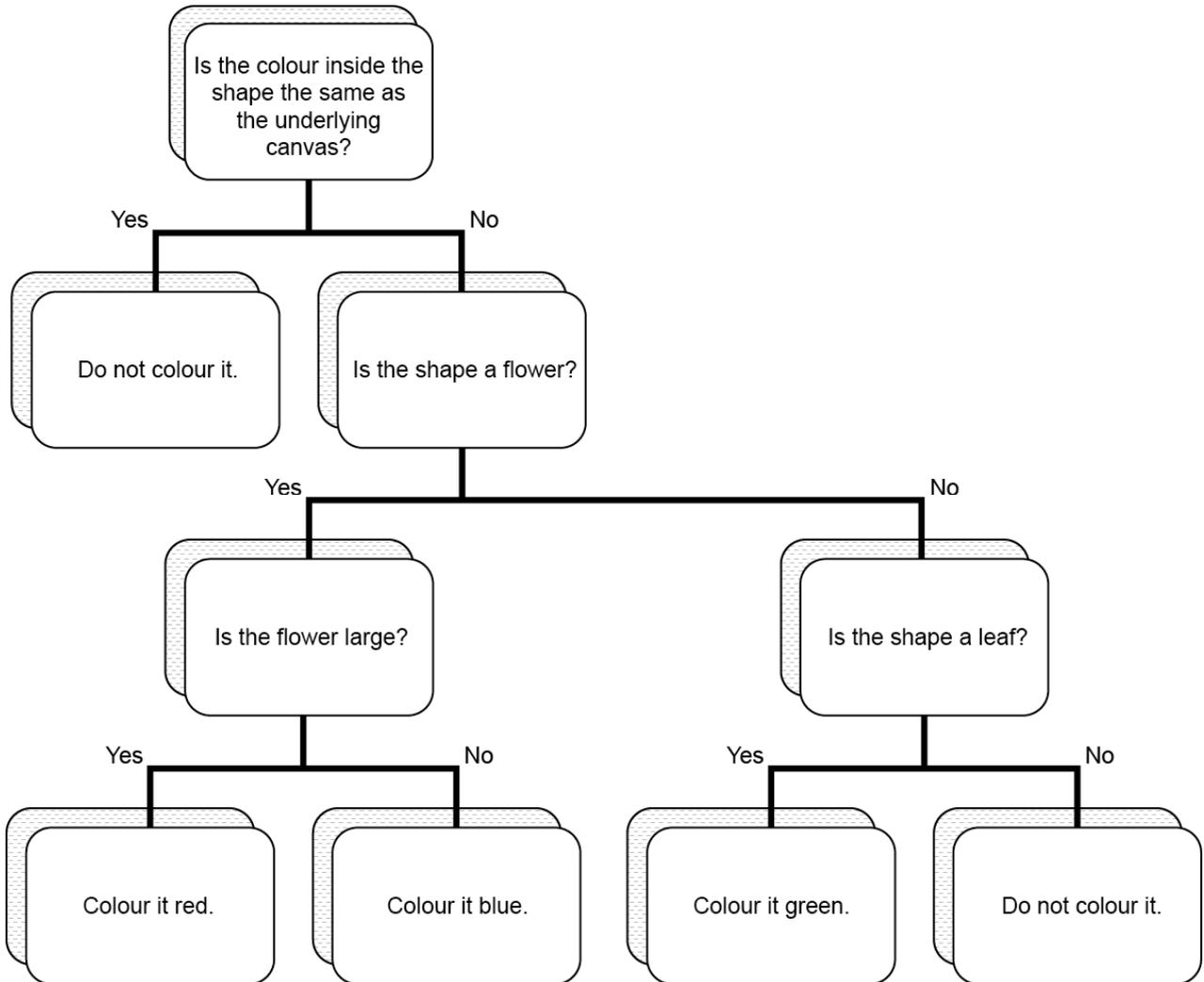
- software learns from data/input
- software can perform new tasks after processing the data
- software can react to new inputs it has not encountered before
- software searches through data for patterns and adjusts accordingly
- an example might be the newsfeed in Facebook/adjusts to the users behaviour.

*Award [1] for each of the characteristics stated above up to a maximum of [2].*

- (b) (i) AARON needs to select colours for leaves and flowers in each drawing. Once a shape is selected, it must follow these rules:
- AARON can colour large flowers red
  - AARON can colour small flowers blue
  - if the shape is a leaf, AARON can colour it green
  - if the shape is neither a leaf nor a flower, AARON should not colour it.

Copy and complete the information below to construct a decision tree that AARON could use to colour its drawings.

[4]



Answers may include:

- Y/N at each decision node
- leads to correct conclusions, bottom line
- exactly four levels
- exactly four terminators
- no false leads.

Any four points, award [1] each up to a maximum of [4].

- (ii) Explain **one** weakness of using a decision tree like this one for AARON. **[2]**

*Answers may include:*

- the decision tree is based on preset parameters which may not address all of the eventualities encountered when AARON is trying to complete a painting
- “flower size: large or small” is ambiguous and relative
- the decision tree is made up of binary choices which are very limited, *ie* only two choices for colour/only flowers vs. leaves. This could be very limiting **OR** could lead to a huge decision tree thus a very slow program
- the decision tree may be influenced by new information as a result of machine learning during the creation of a painting by AARON. This may lead to paintings being created using different inference rules (and not being consistent in the style intended).

*Award [1] for identifying one reason why the use of a decision tree like the one in b(i) for AARON may be considered a weakness.*

*Award [1] for why the use of a decision tree like the one in b(i) for AARON may be considered a weakness. [1] giving a maximum of [2].*

- (c) Discuss the museums' decision to list AARON as the artist when exhibiting AARON's paintings and drawings.

[8]

*Reasons supporting the decision may include:*

- each of AARON's works is unique, *ie* AARON remembers its drawings so it does not repeat itself
- AARON makes all the decisions so it is the artist
- works to be exhibited in museums are judged to be art by the curators, *ie* they are appreciated as fine art
- it is impossible to know what an artist was feeling when she/he created the work of art
- human brains work creatively while we are unconscious, *ie* asleep.

*Reasons against the decision may include:*

- Harold Cohen wrote the program so he is the artist
- AARON cannot experience the world the way a human can so he cannot create art
- AARON is not conscious so it cannot make decisions about the quality of its art
- there can be multiple copies of the program, so there is no individual artist
- AARON can only create images out of the knowledge that Cohen has programmed into it
- real art communicates the emotion/passion of the artist.

*In part (c) of this question it is expected there will be a balance in the ITGS terminology between IT technical terminology and the terminology related to social and ethical impacts.*

***Please see generic markband information sheet on page 25.***

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

<b>Marks</b>	<b>Level descriptor</b>
<b>No marks</b>	<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>
<b>Basic 1–2 marks</b>	<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>
<b>Adequate 3–4 marks</b>	<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>
<b>Competent 5–6 marks</b>	<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>
<b>Proficient 7–8 marks</b>	<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>



**Information technology in a global society**  
**Standard level**  
**Paper 1**

SPECIMEN PAPER

1 hour 30 minutes

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**Instructions to candidates**

- Do not open this examination paper until instructed to do so.
- Answer two questions. Each question is worth **[20 marks]**.
- The maximum mark for this examination paper is **[40 marks]**.

Answer **two** questions. Each question is worth **[20 marks]**.

**1. BodyGuardian**

The BodyGuardian is a lightweight, wearable and wireless body sensor. This technology allows patients to remain active and independent while their health is being monitored with a simple sensor that is in contact with their skin.

**Figure 1: The BodyGuardian device**



[Source: [www.mayoclinic.org](http://www.mayoclinic.org)]

The BodyGuardian system consists of the BodyGuardian device and a smartphone with the BodyGuardian app\* installed. The smartphone connects to the cloud-based service mHealth using a 3G cell/mobile phone network.

Doctors are able to access their patient's data via mHealth using a mobile device. They can also set different limits for each patient, allowing for personalized alerts.

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\* app: application software, typically a small, specialized program downloaded onto mobile devices; apps can also run on the internet, on a computer, on a cell/mobile phone or other electronic device.

**(This question continues on the following page)**

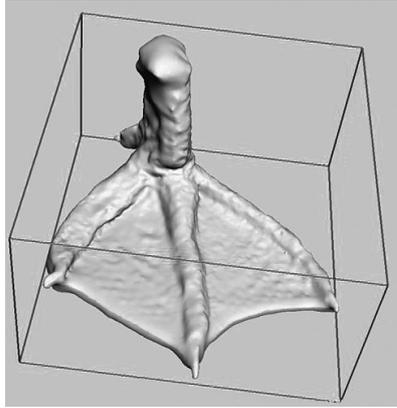
**(Question 1 continued)**

- (a) (i) Identify **two** health indicators that could be measured by the BodyGuardian device. [2]
- (ii) Identify **four** steps taken by the software to decide if a health indicator measurement needs to be sent to a doctor for a decision. [4]
- (b) The managers of mHealth are investigating the nature of passwords used by doctors to access patient information. The two options being investigated are:
- the doctor creates a password that does not need to be changed
  - the mHealth system requires doctors to create a strong password that must be changed every 40 days.
- Analyse these **two** options. [6]
- (c) As part of the development of the BodyGuardian device, it is being tested in clinical trials by doctors and patients.
- Discuss the implications for doctors and patients of trialling the BodyGuardian device before it is sold publicly. [8]

## 2. 3D printing

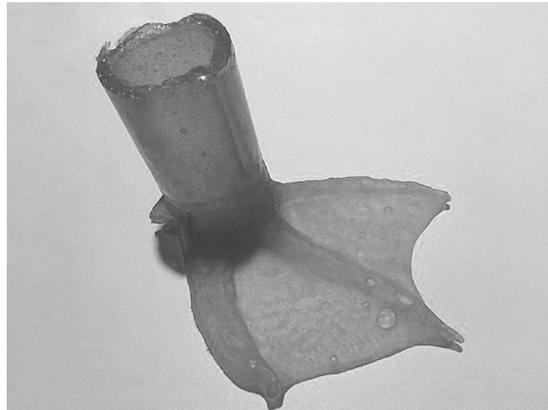
Charlie is a duck who was born with only one foot. His owner took pictures of another duck's foot from different angles and was able to use 3D printer technology to produce a new plastic foot for him.

**Figure 2: Computer-generated image of a duck's foot**



[Source: <http://mashable.com>]

**Figure 3: Charlie's new plastic foot**



[Source: [www.dailymail.co.uk](http://www.dailymail.co.uk)]

**(This question continues on the following page)**

(Question 2 continued)

**Figure 4: A 3D printer**



[Source: <http://cubify.com>]

A 3D printer, like the one shown in **Figure 4** creates an object by adding plastic layer by layer until it is complete.

Inspired by Charlie’s story, Alejandro Toys has created a company that uses a computer with a 3D printer and software to produce plastic toys for children.

Alejandro Toys has found out that some software will allow them to input 2D images into the 3D printer software so that they can be converted into a 3D object. They are considering either to use open source software or to purchase proprietary software.

- (a) (i) Identify **two** ways that a 2D image file can be input into the 3D printer software. [2]
- (ii) Identify **four** of the steps required to produce Charlie’s replacement foot. [4]
- (b) Analyse Alejandro Toys’s decision to either use open source software or to purchase proprietary software to produce the company’s 3D toys. [6]
- (c) It is now possible to use a 3D printer to print a large range of products in addition to toys. These include guns, bicycles and human prosthetic limbs. However some governments are concerned about the software for 3D printers being freely available on the internet.  
  
To what extent should governments regulate the access to software for 3D printers? [8]

**Turn over**

**3. Small town book shop moves to computer-based records**

El Hoyo is a small village in the south of Argentina. The local book shop has recently received a number of academic books from a large university in Buenos Aires. The university also sent a computer which has all of the books listed in a spreadsheet.

The table in **Figure 5** shows a small part of the list of books. The complete table has 400 different entries (last entry is in row 401).

Daniela, the shop manager, has been waiting for a computer for a long time. She knows that, with this computer, her staff will provide a faster service when they are searching for specific books.

**Figure 5: Part of the spreadsheet of books**

	A	B	C	D	E	F	G
1	Book title	Number of books	Author	ISBN	Cost in pesos (\$)	Subject area	Subtotal pesos (\$)
2	Flatland: A Romance of Many Dimensions	4	Abbott	978-0486272634	\$200	Mathematics	\$800
3	Exploring Anatomy and Physiology	2	Amerman	978-1617310560	\$148	Natural sciences	\$296
4	Wellness	8	Anspaugh	0-078022509	\$202	Physical education	\$1616
5	Research Strategies: Finding Your Way	3	Badke	978-1491722336	\$169	English	\$507
6	Parent–Child Relations	8	Bigner	978-0135002193	\$213	Psychology	\$1704
7	Ordinary Men: Reserve Police Battalion	4	Browning	978-0060995065	\$187	History	\$748
8	The Earth and its Peoples, Vol II	3	Bulliet	978-0495902881	\$188	History	\$564
9	Lab Book CH251	8	CER	978-0495642152	\$150	Natural sciences	\$1200
10	The Story and its Writer	1	Charters	0-312596243	\$184	English	\$184
11	Environmental Science: A Global Concern	12	Cunning	978-0073383255	\$152	Natural sciences	\$1824
12	Feasting, Fasting	2	Desai	978-0618065820	\$177	English	\$354
13	Reconstructing Gender	1	Disch	978-0073380063	\$182	English	\$182

[Source: adapted from <http://schools.cms.k12.nc.us>]

**(This question continues on the following page)**

**(Question 3 continued)**

- (a) (i) Daniela needs to see the books in alphabetical order, with the “Subject area” sorted from A to Z and then the “Number of books” sorted from largest to smallest.

State the author that would appear in the first row of the sorted spreadsheet using only the books shown in **Figure 5**. [1]

- (ii) State the formula that would be required to add up the cost of all the books in the book store. [1]

- (iii) Daniela now thinks that she should have installed a database for the information about the books. Outline **two** advantages that a database would have over a spreadsheet for the El Hoyo book shop. [4]

- (b) Explain **three** impacts that the new computer system may have for the staff at the book shop. [6]

- (c) El Hoyo receives a large number of tourists during the summer when the fruit festival takes place, but suffers from periods of poor internet connectivity. Daniela has now created a separate area in the book shop that has several computers with free broadband internet access so that tourists can use them to check their emails and find information about the local area.

Evaluate the impacts of this initiative for Daniela as shop manager. [8]

#### 4. Digital citizenship

After several problematic situations with the use of technology by students and staff, a school decided to adopt “We are Digital Citizens” as its mission statement for the year. This goes beyond limiting access to some resources such as social networking sites and video streaming sites, and instead focuses on using technology inside and outside of school in a responsible way.

The network administrator has also been told to allow the downloading or streaming of videos from the internet. However he has explained to the principal that allowing this would cause issues related to bandwidth, storage and appropriateness of content for high school students.

A working party has been set up, consisting of the network administrator, teachers from different departments and some students. This working party will meet to plan a programme of activities for the next year that will be used to help teachers and students understand what digital citizenship is, and how to promote the responsible use of technology by everybody in the school.

(a) (i) Outline **one** difference between streaming and downloading videos. [2]

(ii) Define the term “bandwidth”. [2]

(iii) The science teacher wants to show to the class a video about polar bears and how they survive living near the north pole.

The size of this video is 3.2 gigabytes (GB) and it is available for download. The teacher will download it in advance to be able to show it to the class without the need for an internet connection.

The school has a bandwidth of 50 megabits per second (Mbps). Calculate how long it will take the teacher to download the video.

Use 1 GB = 1000 megabyte (MB). [2]

(b) At the request of the principal, the network administrator has allowed teachers to download videos. Students are still not allowed to download videos at any time using the school internet.

Analyse the impact this will have on the teachers and the students. [6]

(c) One area that the working party will focus on is the responsible use of the available bandwidth. Some teachers have found that the internet is too slow to allow a class to investigate a topic when students in different classes are using social networking sites.

To what extent can the implementation of the digital citizenship policies ensure the responsible use of technology in the school with respect to sharing the available bandwidth? [8]

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# Markscheme

## Specimen paper

### Information technology in a global society

#### Standard level

#### Paper 1

This markscheme is **confidential** and for the exclusive use of examiners in this examination session.

It is the property of the International Baccalaureate and must **not** be reproduced or distributed to any other person without the authorization of the IB Assessment Centre.

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. BodyGuardian

*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** health indicators that could be measured by the BodyGuardian device. [2]

*Answers may include:*

- body temperature
- respiratory rate
- blood pressure
- sugar levels (blood glucose)
- heart rate/pulse rate
- electrocardiogram (ECG).

*Award [1] for each of the above up to a maximum of [2].*

- (ii) Identify **four** steps taken by the software to decide if a health indicator measurement needs to be sent to a doctor for a decision. [4]

*Answers may include:*

- device takes the measurement
- measurement converted to digital data/ analogue to digital conversion (ADC)
- data sent from BodyGuardian device to smartphone
- patient data is uploaded to mHealth system for analysis
- value is compared with the “normal” value stored in device for patient
- if value is outside accepted range, then signal is sent to doctor for action to be taken
- if value is inside accepted range, then no signal is sent
- device waits for next time interval to take new measurement.

*Consider any four steps in the response.*

*Award [1] for each step up to a maximum of [4].*

- (b) The managers of mHealth are investigating the nature of passwords used by doctors to access patient information. The two options being investigated are:
- the doctor creates a password that does not need to be changed
  - the mHealth system requires doctors to create a strong password that must be changed every 40 days.

Analyse these **two** options.

[6]

*Answers may include:*

- Option: password created by doctor that does not need to be changed
  - familiar for doctor and probably easy for him to remember
  - no need to write it down therefore it will not be found by others
  - others with access to the computer may “guess” it if they know the doctor well
  - if the password is discovered/cracked it can be used for an indefinite time period. the doctor may not be aware that the password has been compromised
  - may allow doctor to access account faster as no need to look-up the password
  - a password that is never changed creates a security problem as people close to doctor may find out the password (*ie* see it, guess it)
  - may not be a strong password
- Option: strong password created by doctors that must be changed every 40 days
  - secure as it may not be related to the doctor – therefore difficult to guess
  - the need of constantly updating the password in mHealth will improve the security as it may be harder to guess
  - may be difficult for doctors to remember which variant of the password they have used
  - doctor may need to keep it written down – therefore it has the risk of being found by others
  - may have difficult characters that may not be in a keyboard of mobile devices.

**[1–2]:** *A limited response that demonstrates minimal knowledge and understanding of the topic and uses little or no appropriate ITGS terminology. Only one of the options is addressed in the response.*

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

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

- (c) As part of the development of the BodyGuardian device, it is being tested in clinical trials by doctors and patients.

Discuss the implications for doctors and patients of trialling the BodyGuardian device before it is sold publicly.

[8]

*Answers may include:*

- may have to do double checks: with and without the device – this will take more time and put the patient under unnecessary stress / may take time from busy doctors
- if doctors/patients discover that incorrect information is being sent from the device they may not trust it / feel uncomfortable about having to use it
- if device works well doctors/patients may advertise it positively, making others more willing to use it
- doctors/patients may need training to use the device
- patients in the trial may feel their health is being more effectively monitored
- patients and/or doctors may provide feedback to improve final device
- patients may need to be assured that security measures have been taken to protect the privacy of their data
- doctors may have an opportunity to learn how to use the device before it is sold publicly.

*In part (c) of this question it is expected there will be a balance in the ITGS terminology between IT technical terminology and the terminology related to social and ethical impacts.*

***Please see generic markband information sheet on page 18.***

## 2. 3D printing

*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 that a 2D image file can be input into the 3D printer software.

**[2]**

*Answers may include:*

- 2D images *imported* imported into the 3D printer software
- 2D images are *opened* by the 3D printer software
- 2D file is converted into a format required by the 3D printer software by another file conversion program.

*Award [1] for each way up to a maximum of [2].*

- (ii) Identify **four** of the steps required to produce Charlie's replacement foot.

**[4]**

*Answers may include:*

- images of the other duck's foot are imported into the 3D printer/modelling software
- the software creates a 3D image/model of the foot from the images
- the 3D image/model is edited to make it the same size as Charlie's foot
- printer is loaded with the type of raw material needed for creating the foot
- the 3D image/model of the foot is sent to the 3D printer
- the 3D printer creates the replacement foot

*Award [1] for each step up to a maximum of [4].*

- (b) Analyse Alejandro Toys’s decision to either use open source software or to purchase proprietary software to produce the company’s 3D toys.

[6]

*Answers may include:*

- open-source software is often free or low-cost, allowing the company to acquire more software within a limited budget / proprietary software may demand a higher level of investment by the company
- open-source software can be changed or customised to suit the company’s requirements – the source code is available for programmers to modify / proprietary software can only be modified by the manufacturer
- open-source software may have “bugs” that have not yet been reported which affect the company’s production (ie may take time to be fixed) / proprietary software manufacturers may release patches/bug-fixes on a regular basis
- open-source software may not have all the options/features needed by the company / proprietary software often has a greater range of options/features
- manufacturers of proprietary software can provide support and assistance to the company / open-source software often has limited support
- using open source software for producing the 3D toys may require hiring more programming staff to upgrade the software

**[1–2]:** *A limited response that demonstrates minimal knowledge and understanding of the topic and uses little or no appropriate ITGS terminology. Only open-source software or proprietary software is explicitly referred to in the response.*

**[3–4]:** *A partial analysis, either lacking detail or balance, that demonstrates some knowledge and understanding of the topic. Some relevant examples are used within the response. There is some use of appropriate ITGS terminology in the response. Both open-source software and proprietary software are explicitly or implicitly referred to in the response.*

**[5–6]:** *A balanced and detailed analysis of the issue which demonstrates thorough knowledge and understanding of the topic. Relevant examples are used throughout the response. There is appropriate ITGS terminology throughout the response. Both open-source software and proprietary software are explicitly referred to in the response.*

- (c) It is now possible to use a 3D printer to print a large range of products in addition to toys. These include guns, bicycles and human prosthetic limbs. However some governments are concerned about the software for 3D printers being freely available on the internet.

To what extent should governments regulate the access to software for 3D printers?

[8]

*Answers may include:*

*Regulation of the access to software for 3D printers*

- could aim to ensure good quality of the 3D objects being made. 3D software may allow for sub-standard / faulty 3D objects to be manufactured, creating risks for users
- could aim to prevent the manufacture of artifacts that are only sold with a licence (eg guns). However if similar shapes are needed for other articles, their manufacture may be prevented by mistake Eg: if a certain shape is recognized the software may not allow it to be printed
- could protect manufacturers of copyrighted products. Owners of 3D printers would be prevented from making them
- could prevent owners of 3D printers making their own objects freely, stifling innovation
- could mean an invasion of privacy. It is possible to know what blueprint is being downloaded to which IP address
- to what extent is regulation possible.

*In part (c) of this question it is expected there will be a balance in the ITGS terminology between IT technical terminology and the terminology related to social and ethical impacts.*

***Please see generic markband information sheet on page 18.***

**3. Small town book shop moves to computer-based records**

*Note to examiners.*

- *Part a and part b questions are marked using ticks and annotations where appropriate*
- *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) Daniela needs to see the books in alphabetical order, with the “Subject area” sorted from A to Z and then the “Number of books” sorted from largest to smallest.

State the author that would appear in the first row of the sorted spreadsheet using only the books shown in **Figure 5**. **[1]**

- Badke

*Award [1] for the correct answer shown above.*

- (ii) State the formula that would be required to add up the cost of all the books in the book store. **[1]**

*Answer may include:*

- =SUM(G2:G401)
- =SUMA(G2:G401)
- =ADD(G2:G401)
- = $\Sigma$ (G2:G401). (where xxxx is another valid formula which adds the numbers in cells G2 through G401)
- =G2+G3+...+G401

*Award [1] for any one of the above.*

- (iii) Daniela now thinks that she should have installed a database for the information about the books. Outline **two** advantages that a database would have over a spreadsheet for the El Hoyo book shop.

**[4]**

*Answers may include:*

- queries can be done to select specific records, *ie* English books
- reports can be made (*ie* summary of all the books that have been purchased, labels can be printed to label the books/bookshelves etc.)
- databases may reduce data redundancy and allow for more efficient storage & updating of data than spreadsheets
- a user interface can be included for the book shop staff without much IT knowledge, using spreadsheets may require a greater level of IT capability
- databases allow for data for a large number of books to be stored and accessed without increasing complexity for the user.
- databases allow the field choices to be set so that only certain types of data may be entered (e.g. Type of book, language etc.). Spreadsheets to not have this possibility.
- a database can limit the view of the data for particular users (e.g. Daniela as the shop manager, may be able to view more data than the rest of the staff), a spreadsheet does not have this capability

*Note: If an advantage is generic with no reference to the book shop, a maximum of 1 mark is awarded for identifying the advantage.*

*Award **[1]** for identifying an advantage and an additional **[1]** for an outline for that advantage.*

*Award up to a maximum of **[4]** for the question.*

- (b) Explain **three** impacts that the new computer system may have for the staff at the book shop.

**[6]**

*Answers may include:*

- the salesperson may have to learn/receive training on how to use the computer and software. This may involve additional time commitment.
- the salesperson may request new software applications (ie image editing software to create posters about the books) or hardware (ie barcode scanners) and this may involve costs
- shop owner may now expect the salesperson to perform analysis of sales/inventory
- having a computer may allow the salesperson to perform additional tasks (ie printing of advertisements about new books, mail merged letters, ordering books from their supplier)
- employees work will be easier and faster as they can check directly in the computer if they have a copy of the book
- staff will no longer have to calculate the costs of books manually leading to less errors in charging customers/fewer customer complaints
- staff are able to query the book database for specific information (e.g. all of the books written by a certain author, all books which cost less than \$200).

*Award **[1]** for each impact identified, and an additional **[1]** for an appropriate explanation of that impact.*

*Award a maximum of **[6]** for the response.*

- (c) El Hoyo receives a large number of tourists during the summer when the fruit festival takes place, but suffers from periods of poor internet connectivity. Daniela has now created a separate area in the book shop that has several computers with free broadband internet access so that tourists can use them to check their emails and find information about the local area.

Evaluate the impacts of this initiative for Daniela as shop manager.

**[8]**

*Answers may include:*

- additional staff with IT expertise may be needed to work in that area if the demand is high installation. Daniela may need to meet additional wage costs
- maintenance and repairs may be needed if the equipment is used frequently, increasing costs to the shop
- website blocking software, antivirus and firewalls may be needed to be installed which may increase costs to the shop
- the shop may become a popular place and sales of books may increase
- Daniela's investment may not be cost effective if demand for the bookshop's internet access decreases
- Daniela may need to develop an acceptable use policy
- Daniella may have access to the browser histories on the computers and could use that information to help decide what books to stock

*Note: Do not award marks for references to staff being able to search faster or more easily for information relating to books. This is stated in the scenario.*

*In part (c) of this question it is expected there will be a balance in the ITGS terminology between IT technical terminology and the terminology related to social and ethical impacts.*

**Please see generic markband information sheet on page 18.**

#### 4. Digital citizenship

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) Outline **one** difference between streaming and downloading videos. **[2]**

*Answers may include:*

- streaming video is content sent in compressed form over the internet and displayed by the viewer in real time / downloaded videos are stored on a local device and played later
- streaming video can start to be played as soon as sufficient data arrives / downloaded videos must finish downloading before they can be played
- streaming video requires a network connection to be maintained throughout the playing / downloaded video can be stored for offline playback
- streaming videos may pause or stutter if the bandwidth/data transfer rate is too low / downloaded videos are more likely to play without interruption from the hard disk
- Download videos occupy storage space on the local device / streaming videos are only stored temporarily while they are being played

*Award [1] for identifying a difference for either streaming or downloading videos with an implied reference to the other.*

*Award up to a maximum of [2] for an outline of a difference between streaming and downloading videos that explicitly refers to both methods of watching videos.*

- (ii) Define the term “bandwidth”. **[2]**

*Answers may include:*

- bandwidth is often used as a synonym for data transfer rate
- amount of data that can be transmitted in a given amount of time
- expressed in bits per second (bit/s) (accept kb/Mb/Gb, accept answers expressed in Bytes).

*Award [1] for a basic comment about bandwidth with [1] for each additional comment up to a maximum of [2].*

- (iii) The science teacher wants to show to the class a video about polar bears and how they survive living near the north pole.

The size of this video is 3.2 gigabytes (GB) and is available for download. The teacher will download it in advance to be able to show it to the class without the need for an internet connection.

The school has a bandwidth of 50 megabits per second (Mbps). Calculate how long it will take the teacher to download the video.

Use 1 GB = 1000 megabyte (MB).

**[2]**

*Answers may include:*

- convert 3.2 Gigabytes to Megabytes –  $3.2 \times 1000 = 3200\text{MB}$
- multiply by 8 to get it into Megabits – 25 600 Mbits
- divide by 50 to get the download time –  $\frac{25\,600}{50} = 512$  seconds,  
or 8 minutes 32 seconds.

*Award [1] for the correct calculation of file size 3200 MB.*

*Award [1] for the correct calculation into time.*

- (b) At the request of the principal, the network administrator has allowed teachers to download videos. Students are still not allowed to download videos at any time using the school internet.

Analyse the impact this will have on the teachers and the students.

**[6]**

*Answers may include:*

- teachers can download a video and save it to use it with class in the future
- teachers may have to stay after school hours if they want to download videos using the school internet as they may not have time to do it during the day
- teachers may have fewer problems with the video in class if it has been downloaded as the internet speed will not affect the playing of the video
- teachers may be better prepared for a lesson
- students may receive the a link to the videos to watch at home before the lesson
- internet speed will not affect the flow of the lesson when watching the video during a lesson
- students may ask for a copy of the video without having to use internet to download it or watch it
- students may resort to downloading study-related videos at home which could incur costs/consumption of bandwidth
- if the video is deleted/removed from the internet the teacher/student will still have a copy to use.

**[1–2]:** *A limited response that demonstrates minimal knowledge and understanding of the impact of downloading videos using the school internet 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 impact of downloading of videos using the school internet. Some relevant examples related to the scenario are used within the response. There is some use of appropriate ITGS terminology in the response. Award a maximum of **[4]** if only the impact on teachers or students are addressed.*

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

- (c) One area that the working party will focus on is the responsible use of the available bandwidth. Some teachers have found that the internet is too slow to allow a class to investigate a topic when students in different classes are using social networking sites.

To what extent can the implementation of the digital citizenship policies ensure the responsible use of technology in the school with respect to sharing the available bandwidth?

[8]

*Answers may include:*

- policies without a previous education campaign /involvement of stakeholders may not work
- teachers/students may feel they can ignore the policies because they do not apply to their situation (e.g. downloading copyrighted videos to use in class because the school has insufficient bandwidth to stream them)
- digital citizenship policies are only as effective to the extent which all the stakeholders in the school community agree to follow them (e.g. students, teachers, parents, administrators etc.)
- the school may need to use technical solutions to support responsible use (e.g. blocking certain social networking sites, monitoring students network activities)

*In part (c) of this question it is expected there will be a balance in the ITGS terminology between IT technical terminology and the terminology related to social and ethical impacts.*

***Please see generic markband information sheet on page 18.***

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

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

**Information technology in a global society  
Higher level and standard level  
Paper 2**

SPECIMEN PAPER

1 hour 15 minutes

**ARTICLE**

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**Instructions to candidates**

- Do not turn over this sheet until instructed to do so.
- This sheet contains the article required for information technology in a global society higher level and standard level paper 2.

## Theme: Student cyber-bullying using social networking sites

### IT system: using computer-based technologies and social networks

According to a recent poll, more than 10% of parents surveyed around the world said their child had been cyber-bullied and nearly 25% knew a child who had been a victim. The most widely reported method of online cyber-bullying is by using social networking sites, such as Facebook.

5 Results from the poll indicated that 32% of parents in India had said that their child had experienced cyber-bullying, followed by 20% in Brazil, 18% in Canada and Saudi Arabia, and 15% in the United States.

10 Billye, in Utah, USA and Olivia, in Wales, UK are two teenagers that have been victims of cyber-bullying through Ask.fm. Ask.fm is a social networking site that is popular with teenagers. The site allows an account holder to send anonymous questions from a cell phone (mobile phone) or laptop to another account holder. Once a response is received, the exchange of messages is posted publicly for anyone to read. Both Billye and Olivia received a constant stream of nasty messages through the site, and felt that they would not survive this cyber-bullying. Cyber-bullying victims suffer from a range of stress-related health problems, including anxiety and depression. In the case of Billye and Olivia, they were able to take control of the situation and overcome the  
15 cyber-bullying. In instances where the cyber-bullies anonymously post in school, school security systems can be used to identify the cyber-bullies.

20 People who cyber-bully are able to terrorize their victims 24/7 by using cell phone apps\* to post directly to social networking sites. The postings can include a range of personal information, photos, or videos intended to hurt or embarrass the victim. The anonymous nature of these websites may also lead bullies to behave even more aggressively than they would in real life.

25 There is considerable evidence that cyber-bullying is a worldwide concern. However children and students often feel helpless when they are trapped in a cyber-bullying situation. Parents are uncertain about how to help their child if they are being bullied via their cell phone services and social networking sites. In some locations, parents of the children who are doing the cyber-bullying may be held accountable for the actions of their children.

30 Teachers and school administrators are often uncertain about what their role and responsibility is regarding cyber-bullying that occurs both inside and outside of the school premises. They are also concerned about how cyber-bullying disrupts the school's positive learning environment and are uncertain about what action they should take. Often it is unclear if laws apply in some instances of cyber-bullying. In other situations new laws have been passed quickly and may be difficult to enforce. However social networking sites do not want to lose their advertisers and customers. They often make claims on their websites that they are addressing issues related to cyber-bullying.

[Source: [www.reuters.com](http://www.reuters.com); [www.ksl.com](http://www.ksl.com); [www.bbc.co.uk](http://www.bbc.co.uk) and [deletecyberbullying.eu](http://deletecyberbullying.eu)]

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\* apps: application software, typically small, specialized programs downloaded onto mobile devices; apps can also run on the internet, on a computer, or on a cell/mobile phone or other electronic device

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**Information technology in a global society**  
**Higher level and standard level**  
**Paper 2**

SPECIMEN PAPER

Candidate session number

1 hour 15 minutes

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**Instructions to candidates**

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Read the article on the accompanying sheet carefully.
- Answer all questions in the boxes provided.
- It is recommended that 15 minutes is spent reading the article before writing the response.
- The maximum mark for this examination paper is **[26 marks]**.















Please **do not** write on this page.

Answers written on this page  
will not be marked.



08EP08

# Markscheme

## Specimen paper

### Information technology in a global society

#### Higher level and standard level

#### Paper 2

This markscheme is **confidential** and for the exclusive use of examiners in this examination session.

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## Using assessment criteria for external assessment

For external assessment, a number of assessment criteria have been identified. Each assessment criterion has level descriptors describing specific levels of achievement, together with an appropriate range of marks. The level descriptors concentrate on positive achievement, although for the lower levels failure to achieve may be included in the description.

Examiners must judge the externally assessed work at SL and at HL against the four criteria (A–D) using the level descriptors.

- The same assessment criteria are provided for SL and HL.
- The aim is to find, for each criterion, the descriptor that conveys most accurately the level attained by the candidate, using the best-fit model. A best-fit approach means that compensation should be made when a piece of work matches different aspects of a criterion at different levels. The mark awarded should be one that most fairly reflects the balance of achievement against the criterion. It is not necessary for every single aspect of a level descriptor to be met for that mark to be awarded.
- When assessing a candidate's work, examiners should read the level descriptors for each criterion until they reach a descriptor that most appropriately describes the level of the work being assessed. If a piece of work seems to fall between two descriptors, both descriptors should be read again and the one that more appropriately describes the candidate's work should be chosen.
- Where there are two or more marks available within a level, examiners should award the upper marks if the candidate's work demonstrates the qualities described to a great extent. Examiners should award the lower marks if the candidate's work demonstrates the qualities described to a lesser extent.
- Only whole numbers should be recorded; partial marks, that is fractions and decimals, are not acceptable.
- Examiners should not think in terms of a pass or fail boundary, but should concentrate on identifying the appropriate descriptor for each assessment criterion.
- The highest level descriptors do not imply faultless performance but should be achievable by a candidate. Examiners should not hesitate to use the extremes if they are appropriate descriptions of the work being assessed.
- A candidate who attains a high level of achievement in relation to one criterion will not necessarily attain high levels of achievement in relation to the other criteria. Similarly, a candidate who attains a low level of achievement for one criterion will not necessarily attain low achievement levels for the other criteria. Examiners should not assume that the overall assessment of the candidates will produce any particular distribution of marks.
- The assessment criteria must be made available to candidates prior to sitting the examination.

## Theme: Student cyber-bullying using social networking sites

### Criterion A — The issue and stakeholder(s)

[4]

1. (a) Describe **one** social/ethical concern related to the IT system in the article.

*The issues are about cyber-bullying and the related concerns which includes anonymity, health/stress problems, privacy and authenticity. There are some specific concerns listed below.*

**[1]:** For identification of the concern, which may not be explicitly named separately or incorrectly named or vaguely named (ie identifying cyber-bullying without describing a related impact/result/consequence/effect/outcome).

**[2]:** The candidate must describe **the impact/result/consequences/effect/outcome** of the concern to obtain **[2]**. If the description does not support the identified concern, award **[1]**. Detailed description not required as it will come into 2b

*If two **linked/overlapping** concerns are identified, eg reliability and integrity, mark the best response and that concern needs to be explained in (2)(b).*

*The description needs to reference the IT system in the article (sometimes candidates will describe the issue and not the concern in context).*

*If two **different** concerns are raised, since the question specifies **one** concern hence only mark the first; except if commonly linked eg security and privacy, anonymity and on-going harassment.*

*Social/ethical concerns may include the following:*

- anonymity – being able to post anonymously on social networking sites giving potential for aggressive behaviour
- on-going harassment – leading to hurt and embarrassment
- privacy (use and sharing of personal information without permission) the unethical use of personal information from a victim with the intent of harassment (if a concern is identified as privacy but described as another concern e.g. anonymity = 1 mark)
- ethics of cyber-bullying (incorrect behaviour on the internet)/digital citizenship in appropriate use of technology – this is regarded as unacceptable and even illegal in some circumstances
- authenticity – public availability of information about the victim which may not be true, defamatory claims.

- (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** *social networking sites or sms or emails.*  
**What** *are they doing with the IT system - to communicate, interacting with others or to post information, images and videos about the victim eg “uploading files” or “posting information” is insufficient, must make a reference to how and where.*

*Primary stakeholders may include the following:*

- victim of cyber-bullying – the person harassed by the personal information posted to a cell phone (ie SMS) or to a social networking site (*Facebook, Ask.fm*)
- cyber-bully – person using mobile device/desktop computer or cell phone to post hurtful information about a person to a cell phone service or social networking site
- persons viewing the personal information about the victim posted to a social networking site
- developers/companies of the SNS/Websites -Designing the SNS and developing the features that include anonymity used by the victims and bullies.
- parents - they may monitor the SNS/emails/SMS that their children are using to be bullied or to bully with.
- student/users use it to communicate and collaborate, staying in touch with friends, organising personal life, sharing updates, images, media, or messages with their circle of friends (must have some context).

Marks	Level descriptor
0	The response does not reach a standard described by the descriptors below.
1	Either an appropriate social/ethical concern <b>or</b> the relationship of <b>one</b> primary stakeholder to the IT system in the article is identified.
2	Either an appropriate social/ethical concern <b>or</b> the relationship of <b>one</b> primary stakeholder to the IT system in the article is described <b>or</b> both are identified.
3	Either an appropriate social/ethical concern <b>or</b> the relationship of <b>one</b> primary stakeholder to the IT system in the article is described; the other is identified.
4	Both an appropriate social/ethical concern <b>and</b> the relationship of <b>one</b> primary stakeholder to the IT system in the article are described.

**Criterion B — The IT concepts and processes**

**[6]**

2. (a) Describe, step-by-step, how the IT system works.  
IT system: using computer-based technologies and social networks.

*The steps are for access and storage/sharing of information - reference to cyberbullying is not required.*

*Many of the responses will not fit neatly into a mark descriptor, so best fit will need to be applied. There is a large variety of technologies and ways of using them the candidates could include.*

*Candidates may choose to describe the process for using a cellphone service or a social networking site for accessing and storing/sharing information for cyberbullying – a description of either one is sufficient. This may not be clear to the candidates and some may decide to do both and compare them. If they do so they should not be penalized by a lack of some details in their descriptions. It is not necessary to include about anonymity, as not all information sharing is anonymous but this may be written as one of the developments.*

**[1]:** *The candidate 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. If storage or sharing (pics, messages, posts, tags) is not mentioned the highest mark is [1].*

**[2]:** *The student is able to provide a logical step-by-step account of how an IT system is used to access, store/share information – using the information in the article but lacks some details. Best fit if contains information beyond the article but not in step-by-step or does not include both the computer based technology and the social network site.*

**[3]:** *The candidate is able to provide a more detailed step-by-step account of the storage/sharing of materials (pics, messages, video, posts, tags, etc). AND access using the computer based technology (computer or phone or tablet);*

*AND include some information beyond the article (at least one development).*

**[4]:** *The candidate is able to provide a detailed step-by-step account how an IT system is used to access and store/share information (at least three developments - at least one for each of storage/sharing of pics, messages, etc. AND access using the computer based technology.*

*The candidate does not need to describe a step-by-step process which includes both cellphone services (ie SMS) and social networking services. They may focus on one or the other or a combination of both.*

*Answers provided in the article include the following:*

***Access using the computer based technologies***

- examples of SNS in article include Facebook and Ask.fm (line 3, 8)
- from a cell phone (mobile phone) or laptop to another account holder (line 10)
- 24/4 access using cell phone apps to post directly to SNS (line 17)
- via cell phone services (line 23)
- apps are specialized programs downloaded onto mobile devices, that can run on the internet on a computer or on a cell/mobile phone or other electronic device (footnote)

***Storage and sharing***

- the site allows an account holder to send anonymous questions (line 9)
- once a post is received the exchange of messages is posted publicly for anyone to read (line 11)
- receiving a stream of nasty messages (line 11)
- anonymous posting in school (line 15)
- posts can include a range of personal information including photos, videos (line 18, 19)

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

***Access using the computer based technologies***

- setting up the account and the personal information needed to do this
- downloading of the app or logging into the SNS URL
- additional social networking websites (ie Twitter, internet polling site, interactive gaming site, blogs)
- using public wifi/hot spots to avoid IP tracking
- creating fake accounts (not using personal details or other email accounts)

***Storage and sharing***

- users receives an alert(in the form of email/sms/?) that information has been posted to their cell phone or social networking site
- anonymity is allowed on Ask.fm, but may not be possible on other sites
- personal information may include photos and videos that were taken without the user's knowledge
- the information posted may be seen by far more people than the account holders realise
- user may leave identifying information (ie coordinates on photos, what kind of device took the images, background details in the photo) (users may take photos with geo-tagging enabled device and post it )
- search for friends on the SNS to connect with/Use the Search Bar
- use the chat (voice or message) feature in SNS or email
- tagging of photos or videos

- (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 candidate 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.*

*Question 2.(b) clearly asks for a link to question 1.(a), but the link only needs to be generic – eg for a specific concern described in question 1.(a), then in question 2.(b) the candidate can explain further without reference to the specific concern in question 1.(a). If the concern addressed in question 2.(a) is **completely** different from that in question 1.(a), a link cannot be made and hence **[0]**. If identified as privacy in 1(a) and described as anonymity in 1(a) and 2(b) explains anonymity then 2 marks - no double jeopardy penalty.*

***[1]:** If the candidate identifies the relationship between the concern and the IT system. This may be a repeat, or rewording, of the response to 1.(a).*

***[2]:** For concerns regarding a technical aspect of the IT system, candidates would be expected to demonstrate an understanding and use of ITGS terminology for one of the IT systems. Not a general reference, eg “cyber-bully is invisible” for anonymity.*

*Some answers may give adequate explanation with limited technical detail due to the nature of the concern, eg lack of policy, involving the whole system or many aspects of the system.*

*Answers may include the following:  
This is not an exhaustive list.*

- Anonymity is a concern:
  - the social networking site does not have a way of knowing who is cyber-bullying
  - being able to post anonymously on social networking sites or using a fake account (how); not very strong authentication measures or SNS policies, often only a valid but fake email address needed(why).
  
- On-going harassment is a concern:
  - the victim is receiving constant alerts every time information is posted (how). Account settings for SNS/email have been set up to receive alerts every time someone makes a post or are automatic (why)
  - it is possible for multiple persons to be posting information to a common account (how), due to the privacy settings of a user's account - this may be set to friends or public and the number of 'friends' of the account holder (why)
  - the victim is feeling hurt/embarrassed/harassed due to the nature and frequency of the postings to the cell phone service(s) and/or social networking site (how), the ease of being able to spread posts ensures that embarrassing posts can spread quickly and into the hands of others using mobile technologies (why)
  - there is no way of reporting to the social networking site information that specific posts should be deleted (how); there are inadequate built in features to report misuse of SNS. (why).
  
- Privacy is a concern:
  - IT system allows the postings to be publicly accessible (how); the spread of pics/post without the person not being asked permission to be tagged. The tagging spreads it quickly without permission being given (why)
  
- Ethics of cyber-bullying is a concern:
  - cyber-bullying - the sharing of personal information with the intent of harming or embarrassing another through posts, tagged pictures/videos often taken/shared without their permission (how); a bully does not have to ask permission to post a picture or send an email with attachments; they may not realise that it is a form of bullying and that it is just 'fun', public SNS are not fully monitored (why)
  - has legal consequences in some circumstances - victims can sue the bully, by gathering evidence of the bullying or tarnished reputation and take them to court (how); bullies can leave a digital footprint e.g. IP address used, log activities of school networks; emails/SNS posts can be printed as evidence (why)

- Authenticity of person posting information (also connected to anonymity) is a concern:
  - bullies can easily create fake accounts and hide their true identity when creating accounts which they make the bullying posts/messages from (how); as very little authentication is required to set up an account to prove that you are who you say you are (verification is often through email accounts which can easily be made)(why).
  - bullies logging on under other accounts (e.g. friends log on) to share information/bullying posts (how); lack of security of friends accounts by sharing passwords or log on details (why)
  
- Authenticity of information is a concern:
  - bullies can post information about others even if it is not true (how); lack of approval processes on the site to check the accuracy of the content before published (why).

*Candidates are expected to make reference to 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. The list below is not exhaustive. If in doubt contact your team leader.

*Impact = result/consequence/effect/outcome*

*There are a large number of impacts that can be compared and critically analyzed. Given the time constraints not all are needed.*

*At least **two** stakeholders are required for entrance into the top markband.*

**[1]:** *One or two impacts described.*

**[2]:** *More than two impacts described of either type.*

**[3]:** *Analysis by structure – organizing a response in a consistent manner (eg positive/negatives issues and/or various stakeholders).*

**[4–5 ]:** *Must include **linking** analytical connections (between positive/negatives, various stakeholders, various issues) and/or **added** evaluative comments about extent of implications on stakeholders. Candidates who have supplied a good conclusion apply best fit here. Only **one** stakeholder, maximum of **[4]** if includes analysis and evaluations, eg the impacts on the person who has been cyber-bullied only.*

*Notes for markers that you would expect to see in this markband:*

- if NO analytical links and only evaluative comments then maximum of 4 (candidates may be providing many evaluations from their own experience).
- candidates providing a descriptive sequence of impacts is not considered analytical links (and ... and ... and....)
- an analytical example may be when there is a discussion of the impact where the negative is for the victim and positive for the bully (credit for highlighting the relationship between the two)
- a link between impacts such as bullying to health issues to poor grades is another example of analysis.
- an extensive list of benefits of SNS not relevant to the cyberbullying focus of article should not be awarded significant marks without a link to other relevant ideas. Possibly count as one positive impact, especially in the 1-2 mark range
- a wider discussion about the benefits of social networking that builds on the issues linked to cyber bullying could be implicit or explicitly linked e.g., “ ..... although cyberbullying is bad, it may make the person consider the amount of time they spend on social networking sites Overall .....” could be the approach of a level 5 answer because there are analytical connections and evaluations made.
- 4 or more analytical links/evaluations could still be unbalanced and not warrant 6 marks.

**[6]:** *At least two negative per stakeholder; and two positive impacts overall for any stakeholder/s linked explicitly to cyberbullying. At least two stakeholders need to be addressed relatively equally. Number of analyses, links and evaluations, is the most important consideration as well to reach this level. Must be at least FOUR.*

**[7–8]:** *A conclusion **backed** by direct reference to the impacts described is needed. The overall evaluation should focus on the significance of the impacts on the various primary stakeholders. The evaluation may include secondary stakeholders as well. A good conclusion would balance the benefits of SNS with the problems arising from the possibility of cyberbullying. Another conclusion could focus on the evaluation of a range of negatives for various stakeholders (with little reference to positive impacts).*

*Answers may include the following:*

### **Impact on victim**

#### **Positive**

- character building - victims, learn to stand up for themselves
- learning how hurtful cyber-bullying can be and it may discourage the victim from cyber-bullying others.
- the ability to conduct in anonymous postings allows freedom of expression, possibly for shy introverted students, or people living in a oppressive environment
- cyberbullying is in writing - this means that it is easy to show proof of it happening as posts/messages can be printed

#### **Negative**

- sense of being victimized, tormented, hurt, threatened, harassed, embarrassed and/or humiliated
- 24/7 – constant alerts whenever information is posted
- health issues (ie stress-related disorders, fear, anxiety, depression, helplessness)
- need to change schools or club affiliations to avoid personal contact with cyber-bullies
- reluctant to tell an adult (ie teacher or parent) that they are being cyber-bullied drop in grades - due to emotional distraction of being bullied

### **Impacts on the person cyber-bullying**

#### ***Positive***

- sense of power over the victim
- personal recognition from peers involved in the cyber-bullying
- less adult supervision online than face-to-face
- bullying can be done from the safety of their own homes, which is convenient and feels safe from not being caught
- being able to find private information is a positive for the bully
- increased awareness of the implications of his/her actions which may lead to their own more responsible use of technology

#### ***Negative***

- if caught can be punished by the school or face legal battles with the victim and parents

### **Impacts on persons viewing the postings**

#### ***Positive***

- increased awareness and lookout for signs of depression in friends.. help prevent many fatalities
- forces users to be careful and selective of online friends and have increased security settings.
- may include the feeling of power in learning personal information (real or not) about the victim and making judgments about the victim.

#### ***Negative***

- information is posted about the victim to a wide spread audience
- may have little/no awareness if the information is true or not
- may choose to take no action for fear of being cyber-bullied themselves

### **Impacts on school personnel**

#### ***Positive***

- schools have implemented policies and security systems that help prevent cyber-bullying during school hours.
- some schools have developed social education programs that address cyber-bullying
- Schools can monitor public postings of their students and use this to be proactive in dealing with issues
- cyberbullying is in writing - this means that it is easier to support the students who can build a case against the bully.

#### ***Negative***

- teachers may not be aware of their role and responsibility in cyber-bullying cases
- schools may not have a social education program in place that addresses cyber-bullying case
- security systems for monitoring or tracing cyberbullying can be expensive and time consuming to extract the needed information.
- additional pressure on staff to respond to bullying which happens outside of school
- schools with a cyberbullying problem may have a poor reputation

**Impacts on parents**

**Positive**

- parents have learned from other instances to keep aware of the apps and online services that their child is using
- increase parent awareness of possible remedial actions
- parents can monitor their children’s accounts and so protect them from afar.

**Negative**

- parents may not know how to deal with the situation when their child is being cyber-bullied
- parents may need to enroll their child in another schools in order to stop the cyber-bullying
- in some countries, parents are ultimately responsible for the actions of their child who is a minor and a bully and may be sued.

**Impacts on Social networking sites such as Facebook and Ask.fm**

**Positive**

- update policies to address cyber-bullying – this may encourage more students to choose their SNS as it may appear ‘safer’
- increased number of users (parents) who will join the SNS in order to monitor or keep in contact with their children.

**Negative**

- implementation of reporting system for cyber-bullying may need to be created which will require time for developers to write and cost the company money to employ the developers and test out the new features.
- prevent anonymous posting - this may discourage certain users who joined because of that specific feature.
- reputation of the website will go down as a result of repeated cyber-bullying happening in a particular website – result in fewer users – result in less money made by the website.

*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	The impact of the social/ethical issues on stakeholders is described but not evaluated. Material is either copied directly from the article or implicit references are made to it.
3–5	The impact of the social/ethical issues on stakeholders is partially analysed, with some evaluative comment. Explicit references to the information in the article are partially developed in the response. There is some use of appropriate ITGS terminology.
6–8	The impact of the social/ethical issues on stakeholders is fully analysed and evaluated. Explicit, well-developed references to information in the article are made appropriately throughout the response. There is use of appropriate ITGS terminology.

**Criterion D — A solution to a problem arising from the article****[8]**

4. Evaluate **one** possible solution that addresses at least **one** problem identified in **Criterion C**.

*Problem must be specified here, but if this is not done here, it must be one of the impacts/problems identified in Criterion C.*

**[1]:** Solution is identified. If not, the response is usually not well structured.

**[2]:** Solution is described (what, who, where)

*A solution may have more than one part/aspect, e.g. developments for the SNS - monitoring and reporting features, policy has different parts and stakeholders. The solution may be briefly described early and then expanded subsequently when discussing its application - combine descriptions for the 2 marks and other marks for the first positive application and further evaluations.*

**[3]:** **The solution is applied to the problem** directly and not generally – how and why it solves the problem (first positive evaluation). The solution must be **feasible** and can be **applied** to the problem, even if not good “**quality**”. **A description may also include the application to the problem.**

**[4–5]:** Further positive evaluations and at least one negative evaluation is required for 5 marks. Best fit if description is limited.

**[6]:** Fully evaluated strengths and weaknesses requires at least two positive and negative evaluations.

**[7–8]:** Concluding paragraph directly referencing the evaluations. Candidates may propose future developments as part of the conclusion instead of discussion of evaluations – best fit applies. Likewise if a candidate has not fully described the solution or provided the minimum four evaluation best fit applies.

Answers may include the following:

**Solutions to social networking sites allowing anonymous posting**

- social networking sites must store identifying information so that anonymous cyber-bullies can be reported
- instances of cyber-bullying requires a simple method for reporting and prompt action
- policies need to clearly state the penalties for cyber-bullying
- social networking sites should not allow anonymity.

**Solution to educating parents about actions to take against cyber-bullying**

- install web filters on home computers to filter social websites
- keep track of all evidence of cyber-bullying to share with school officials and the police
- solicit advice and help from online organizations that specialize in cyber-bullying.

**Solutions to schools offering education programs to prevent cyber-bullying**

- schools setup safety teams to investigate reported cases of bullying
- implement an anti-bullying program in the school for students
- develop school policies relating to cyber-bullying.

**Solutions to schools implementing security systems to prevent cyber-bullying**

- schools use networking software to block common websites used for cyber-bullying (ie Facebook, Ask.fm).

**Solutions to governments providing laws to address cyber-bullying**

- laws may set the conditions for schools to monitor and report cyber-bullying to police authorities
- training police authorities about reported instances that can be regarded as cyber-bullying and what actions are required.

**Solution to Cyberbullying**

- cancel the SNS account so as not to be part of any cyberbullying communications and so that the bully has less access to the victim.

*Do not accept a solution to cyber-bullying in general.*

*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	<b>One</b> feasible solution to at least <b>one</b> 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	<b>One</b> appropriate solution to at least <b>one</b> 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	<b>One</b> appropriate solution to at least <b>one</b> 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.

**Information technology in a global society**  
**Case study: Asociación de Supermercados Independientes**  
**An investigation into Big Data**

SPECIMEN PAPER

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**Instructions to candidates**

- Case study booklet required for higher level paper 3 information technology in a global society examinations.

## Foreword

The ITGS case study, *Asociación de Supermercados Independientes: An investigation into Big Data*, is the stimulus material for the research investigation required for May and November 2015 higher level paper 3. All of the work related to the case study should reflect the integrated approach explained on pages 15–17 of the ITGS guide.

Candidates should consider *Asociación de Supermercados Independientes: An investigation into Big Data* with respect to:

- relevant IT systems in a social context
- both local and global areas of impact
- social and ethical impacts on individuals and societies
- current challenges and solutions
- future developments.

Candidates are expected to research real-life situations similar to *Asociación de Supermercados Independientes: An investigation into Big Data* and relate their findings to first-hand experiences wherever possible. Information may be collected through a range of activities: secondary and primary research, field trips, guest speakers, personal interviews and email correspondence.

Responses to examination questions **must** reflect the synthesis of knowledge and experiences that the candidates have gained from their investigations. In some instances, additional information may be provided in examination questions to allow candidates to generate new ideas.

Big Data is a commonly used term with no single accepted definition. Most definitions are linked to the analysis of very large data sets, which do not use the traditional relational database model, by organizations to provide a competitive advantage.

## Overview

5 In Mexico, over 300 independent family-owned supermarkets across the country have recently decided to create an association of local supermarkets called the *Asociación de Supermercados Independientes* (ASI). This was proposed so they could use economies of scale when purchasing goods to compete with the larger more established supermarket chains, who currently receive better prices from suppliers. Currently each family-owned supermarket is responsible for the purchasing of stock for their own store. The ASI management has chosen to  
10 have its Head Office in Mexico City.

Since they are local community stores many supermarkets in the ASI have become involved with community organizations such as schools and sports clubs. Based on customers' suggestions, the supermarkets often donate a small percentage of their sales revenue to these community organizations. They believe it is important to be an integral and socially responsible  
15 part of the community they serve.

The managers of the supermarkets do not feel they have a systematic way of analysing data from customer purchases, which may be reducing possible profits and their competitiveness with large supermarket chain stores in the area.

## **Current IT system**

- 20 Currently, each store operates its own independent information system that manages the sales, finance and stock data on a local area network. Various types of EPOS (Electronic Point of Sale) and stock control systems are used by the different stores in these information systems. To order stock from the suppliers a variety of methods are used, such as email, online ordering, phone calls and faxes.

## **The changing situation**

### **The ASI Loyalty Card scheme**

- 25 The management of the ASI realized that customers like to feel that they are being rewarded either altruistically, by giving to good causes, or financially, through price discounts. The introduction of a loyalty card scheme was seen as a mechanism to facilitate the rewarding of customers.

- 30 About five years ago the large supermarket chains developed loyalty card schemes that offer points based on the value of the goods purchased, which are recorded at the checkout. The ASI Loyalty Card will reward customers with 1 point for each 10 peso purchase. The points can be redeemed for a variety of goods and services such as discounts, gifts, travel vouchers and donations to a charity, where 5 points is equivalent to 1 peso.

- 35 Customers can register at any ASI supermarket by filling in a written form with personal details, and are given a card soon after with the customer name and Loyalty ID number (also recorded as a barcode so it can be scanned quickly). This data in the customer database will eventually lead to an online profile being created which will also contain details of purchases along with other information such as time of purchase and store location. Customers will be able to access their profile and purchasing record on the ASI website.

- 40 Whenever a customer in a supermarket taking part in the ASI Loyalty Card scheme makes a purchase, their loyalty card barcode is scanned like a normal product barcode. After payment they receive a receipt. In some cases the receipts may not show the full name of the item, only the amount paid for it. However, the loyalty card ID number, the product code (the name is not needed) of the item, plus additional data, such as the price, store ID number, and time and date of purchase, are put into the store database without the customer being aware of it.
- 45 This data is eventually transferred to the ASI data warehouse and is included in the profile of the customer.

# SHOPCO

PHONE: 078675309  
STORE: 0545  
RECEIPT: 8096  
SERVED BY: MARIA-316

	<b>₱</b>
BANANAS	9.15
TEABAGS	30.99
TEABAGS	30.99
BEANS (LOOSE)	45.50
BAKED BEANS	10.35
BAKED BEANS	10.35
ORANGES	7.55
 SUB TOTAL	 144.88

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TOTAL TO PAY	144.88
CREDIT CARD SALE	144.88
NUMBER :	*****9999
AUTH CODE :	085463
MERCHANT :	84387283
EXPIRY :	09/17
Cardholder Signature Verified	
CHANGE DUE	0.00

**ASI LOYALTY CARD**  
 You have earned 14  
 ASI Loyalty Card points in  
 this transaction for Loyalty Card  
 2793276164719  
 Total points balance: 987  
 Visit [asi.mx/LoyaltyCard/](http://asi.mx/LoyaltyCard/)  
 to redeem your reward

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05/27/14 17:54



## Proposed system

Manuel Arriagada, a member of the senior management team of ASI, realized that in aggregating data from many stores there was an opportunity to find out more about customers and their purchasing patterns. Manuel, while working in the United States, had heard of how businesses had been improved by implementing “Big Data” analysis techniques on the data that their business was collecting from the stores and customers.

ASI will use SUSA Analytics, a company that Manuel has worked with previously, to provide advice and expertise to support local stores with the analysis of the data. He will liaise with Lorena Florentes from SUSA Analytics throughout the process.

ASI will gather large amounts of data about customer behaviour and product purchases through the use of a loyalty card scheme. This can be used for deeper analysis of their business activities. ASI will use the data collected for targeted advertising, marketing to customers who show various behavioural traits and to identify valuable customers.

## 60 Stock management

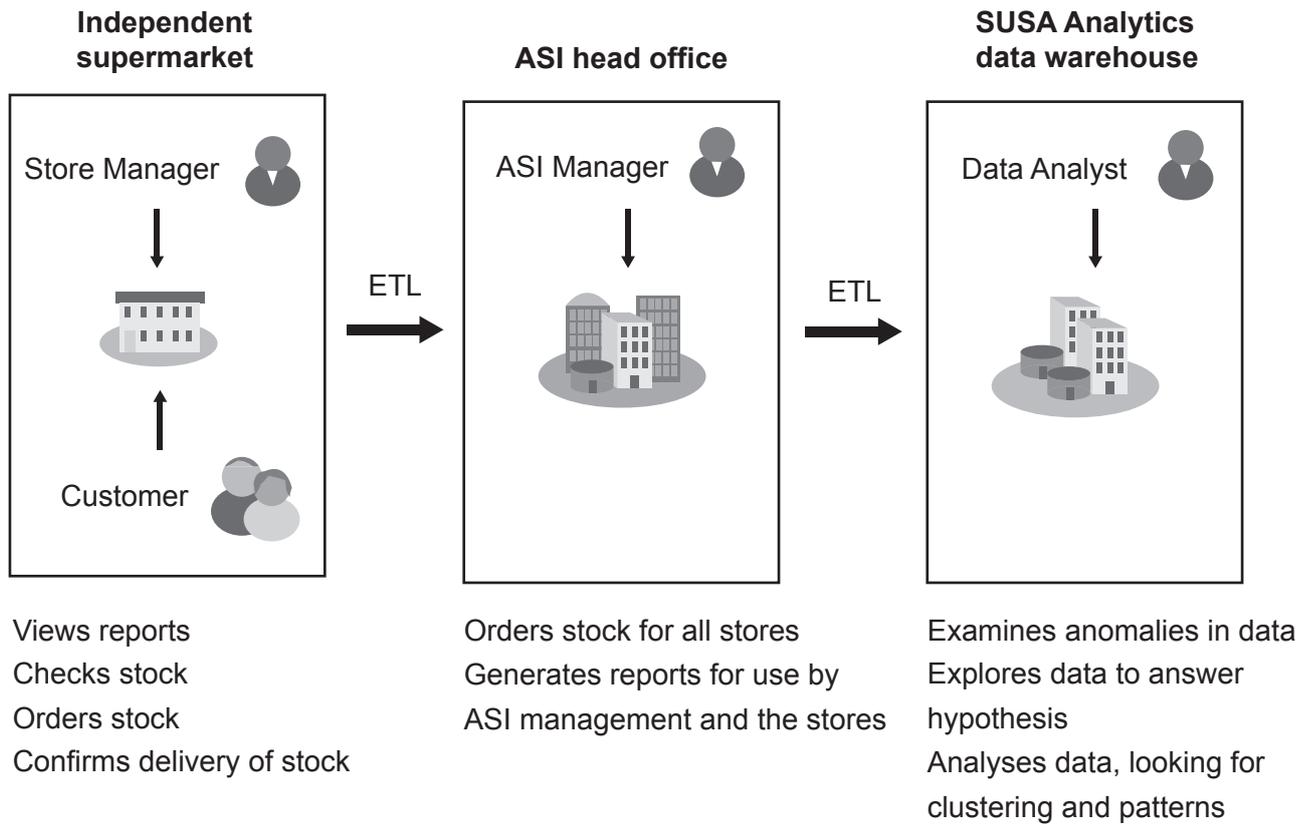
Decisions on what to stock, and when, are based on current sales patterns and the stock control database. As a result of discussions at their monthly meetings the managers of the individual stores have concluded that the current systems are inadequate for the following reasons:

- there has been an increase in customer complaints that certain goods are not available
- managers have noticed that the shelves are either empty or overstocked, and in this case has to sell the goods at a reduced price.

The store managers have recognized that this lack of efficiency in stock management is reducing their ability to make profits and compete with the large supermarket chains.

As a result, the management of the ASI, after further discussions with store managers, is in the process of setting up stock distribution centres in the various regions. The operations of the centres will rely on the information provided by SUSA Analytics and ASI Head Office in Mexico City. This means that stock can be bought in bulk from local and international suppliers at a competitive price to that of the larger supermarket chains. Each distribution centre will use a Just-in-Time (JIT) process to ensure that the volume of stock being held in storage both in the distribution centre and in the individual supermarkets is as low as possible.

**The proposed integrated ASI information system – stock and customer data**



The data from the individual supermarkets may be in a variety of formats.

This data is assimilated into a relational database at the ASI head office.

The data in the SUSA Analytics data warehouse is in a different format to that sent from the head office.

Extract, Transform, Load (ETL) is taking place in the ASI head office and again at the SUSA Analytics data warehouse.

## Challenges faced

### Analysing Big Data

- SUSANAalytics will provide reports based on the data provided by customers in ASI stores. This will allow ASI to create comprehensive customer profiles and to introduce targeted marketing.
- 80 • Strategic data analysis using data mining techniques will be used to discover patterns to inform future decisions and planning. This will include: clustering/pattern analysis, forecasting, hypothesis testing and targeted marketing. The data collected will be used for analysing current customer purchasing patterns and predicting future customer purchasing patterns to allow the supermarkets to create medium- and long-term forecasts for staffing requirements and marketing strategies.
- 85 • Operational reporting and analysis includes exception reporting, querying of the store database to produce regular and customized reports, real-time display of sales and inventory, and data visualization of sales and trends. Data is collected to assist managers in making short-term decisions about appropriate stock levels, numbers of staff for a particular time/day, number of checkout lanes required and opening times.
- 90 • Data analysts have expressed concerns about the homogeneity of such large data sets and the ability of data analysis techniques to determine information that is specific to individual stores. For example, the findings from the analysis of the Big Data may provide suggested pricing levels for products for all of the stores in the ASI, but pricing of individual products may need to vary from store to store.
- 95 • The opening hours of the store and the shift details of staff, as well as their wages, will also be collected and included in the analyses. Recommendations can be made to store managers about managing the store and the staff.

### Communicating the data analytics approach

- 100 • Manuel is concerned that with such a large amount of technical language, he will not be able to explain the way the proposed system would function. Lorena Florentes from SUSANAalytics has been asked to outline how the system would work to senior managers of ASI and to individual store managers (see diagram on page 7). Lorena's ability to explain the technical language in a form that is understandable by the audience is a major advantage.
- 105 • As well as the technical details Lorena will demonstrate and explain the benefits of the analytical techniques identified above, which the individual store managers and ASI managers in the Head Office will be trained to use.

**Ethical and social impacts**

- 110 • With respect to customers involved in the loyalty card scheme, ASI is unsure to what extent customers should be aware of how much information is being collected about them, the purpose for which it will be used, and with whom it will be shared.
- ASI is concerned that customer involvement in the loyalty card system may have implications for their privacy, security and anonymity.
- ASI must develop policies for the ethical use of customer and corporate data.
- 115 • ASI is keen to ensure customer details held in the database can be anonymized when used.
- The implications of using the data collected about customer behaviour for targeted advertising to and preferential treatment for individual customers need to be investigated.

**Implementation issues**

- 120 • ASI management are concerned and stress that according to data privacy laws there must be appropriate access controls to protect customer and store data when accessed from the database system. This is because the data will be accessible in real-time via a web-browser/smartphone dashboard app by managers; and by customers through the loyalty card scheme website and smartphones.
- 125 • Manuel, in consultation with Lorena, will develop a detailed timeline for implementation of the new system.

**Specific information technology items, additional to those in the ITGS guide, which are associated with *Asociación de Supermercados Independientes: An investigation into Big Data***

**Analysis**

Business intelligence software  
Clustering/pattern analysis  
Data analysis/data analytics  
Data extrapolation  
Data mining  
Data querying  
Data visualization  
Data warehouse  
ETL (Extract, Transform, Load) process  
Forecasting and hypothesis testing

**Marketing**

Behavioural marketing  
Targeted advertising  
Targeted marketing

Any individuals named in this case study are fictitious and any similarities with actual entities are purely coincidental.

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**Information technology in a global society**  
**Higher level**  
**Paper 3**

SPECIMEN PAPER

Candidate session number

1 hour 15 minutes

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**Instructions to candidates**

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Read the case study carefully.
- Answer all questions in the boxes provided.
- The maximum mark for this examination paper is **[30 marks]**.



Answer **all** the questions in the boxes provided.

Refer to the *Asociación de Supermercados Independientes: An investigation into Big Data case study* **and** to your own related research in responding to the following questions.

1. (a) Identify **two** characteristics of a data warehouse. [2]

.....  
.....  
.....  
.....

- (b) Outline **one** reason why an extract, transform, load (ETL) process should be used when moving data from one computer system to another. [2]

.....  
.....  
.....  
.....















# Markscheme

## Specimen paper

### Information technology in a global society

#### Higher level

#### Paper 3

This markscheme is **confidential** and for the exclusive use of examiners in this examination session.

It is the property of the International Baccalaureate and must **not** be reproduced or distributed to any other person without the authorization of the IB Assessment Centre.

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.

If candidates answer more than the prescribed number of questions:

- In the case of an “identify” question read all answers and mark positively up to the maximum marks. Disregard incorrect answers.
- In the case of a “describe” question, which 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.
- In the case of an “explain” question, which asks for a specified number of explanations *eg* “explain two reasons”, mark the **first two** correct answers. This could include two full explanations, one explanation, one partial explanation *etc.*

1. (a) Identify **two** characteristics of a data warehouse.

[2]

*Answers may include:*

- integrating or collecting data from one or more different data sources
- a central repository of data for a business, organization or enterprise or government
- data warehouses store current and historical data
- data warehouses store a variety of data such as sales data, customer data that have a common focus, eg from a business
- data in a data warehouse is added to but not changed, and often not deleted but archived.
- data in a warehouse is stored in a non-normalised form (which is easier for summative data)
- May use a non-relational database which allows statistical querying eg an olap / cube
- Data in a warehouse may be anonymised or have non-relevant details excluded
- stored a huge volume of data?
- Often outsourced to/managed by a third party

**NB:** *Answers that identify the use/purpose of a data warehouse are not characteristics, eg support management decisions, for data mining, etc, but the answer may include characteristics.*

*Simple answers such as “a collection of data”, “central repository of data” and “it’s where most of the data analysis takes place” are too general and do not identify the integrated storage aspect of the data, the sources of the data or the type of data that separate the data warehouse from other data storages such as personal hard drives, USB memory devices and backups/archives of data.*

- (b) Outline **one** reason why an extract, transform, load (ETL) process should be used when moving data from one computer system to another.

[2]

*Answers may include:*

- the main reason is to transform/convert data from its previous format so that it can be placed into another database with a different format/structure
- data from a source database cannot be processed or stored in another database (simple, RDMS, special) unless it is in a format that matches the receiving database, eg a customer's name, NAME (George Smith), stored in one database may need to be separated into FIRSTNAME (George) and FAMILY NAME (Smith) in another database
- an automated ETL process is required because modifying the format or structure of data in the process of moving it from one database to another is too difficult and time consuming by hand
- data in one database may not be "clean", *i.e.* corrupt, not validated, incomplete, ill-defined, non-standard format, or inaccurate, for a number of reasons so it cannot be processed easily. Therefore "cleaning" the data so it can be used by moving it to another database is required
- saves time, compared to writing a program(eg i a DML such as SQL) which does this
- ETL is configurable for many different data structures and can easily be modified by non-technical users
- an ETL tool understands all common data formats by default (databases, flat files, etc) therefore can extract data from many different systems , including legacy systems, transform it to a standard format and load it into the data warehouse format.

**NB:** *The answer must address the transformation process as the extract and load processes are included in the question. The details of how the transformation happens using lookup table and processing rules is not required.*

*Award [1] for a basic comment related to the transformation process.*

*Award [2] for outline of the reason the process is needed.*

2. (a) Distinguish between data mining and data querying.

[2]

*Answers may include:*

- data mining is a tool that analyses data from different perspectives and summarizes it into useful information; data querying is more focused on retrieving information from a database which then needs to be analysed
- in contrast to a query which simply returns the data that fulfills certain constraints as expressed in a database query statement (usually in SQL format), data mining constructs models of the data in question. The models produced by data mining can be viewed as high-level summaries of the underlying data
- data querying is a low-level extraction of information from a database; data mining is a high-level extraction of information that produces more complex and comprehensive results than a single query. Data querying is a tool used in data mining and the results are then processed further to look for patterns and formulas
- the results of a set of data queries performed on a database by a person can be summarized into a pattern or conclusion by that person. Data mining techniques automate this process
- data queries produce a set of data matching a specific set of constraints usually expressed in a database query language such as SQL. Data mining produces statistical summaries, patterns of data and formulas that explain patterns.

***NB:*** Essentially these answers are the same but focus on a slightly different type of comparison: results, methods, purposes. Basically data querying is a sub-set/process of data mining and there is significant overlap as the data querying becomes more complex – either automated or by hand.

*Award [1] if data mining and/or data querying are described in isolation up to [2 marks].  
Award [1] for each distinction made between the two up to [2 marks]*

- (b) “ASI [Asociación de Supermercados Independientes] management are concerned that according to data privacy laws there must be appropriate access controls to protect customer and store data when accessed from the database system” (lines 119–121).

Explain **one** control that can be applied to staff access, and **one** control that can be applied to customer access.

[4]

*Answers may include:*

**General**

- managers and employees need to have system logon names and passwords (or other form of security such as fingerprint, eye-scans or cards that need scanning) to enter system
- audit logs of activity on the database that can be examined for unusual/suspicious activity at unusual times and that track the type and extent of data accessed
- access levels to the data and the data mining software depending on the needs of the managers and employees
- legal agreements, user agreements and policies are an acceptable way of control (ie. the answer does not need to just focus on technical solutions).

**Accessed in real-time via a web-browser/smartphone dashboard app by store managers**

- access to secure website using logon name and password
- limited search and access capabilities from the web-browser/app to summary data only. Detailed search and analysis capabilities restricted to use while on the network in their offices
- set up a VPN that can use the full capabilities of the search and analysis software using client software, or receiving results directly from the database software
- access can be from a locally connected LAN computer only, or limited by a white list of MAC addresses
- access could also be limited by time, ie during their specified working hours.

**Accessed by customers through the loyalty card scheme website and smartphones**

- users need a logon (loyalty card number, logon name or both) and password to access a secure site using HTTPS
- having a set of security questions that can be used to identify the customer
- registering the identity (IP address, MAC number) of the computer/smartphone that is accessing the site. If accessed from an unknown device a security question is asked
- using a one-time password sent by SMS to the phone or via email each time access is attempted.

*Reponses need to explain how the security will be achieved by the measures described.*

*For each unique control method, one for staff and one for customers:*

*Award **[1]** for identification of the control method used.*

*Award **[2]** for explanation of control method and how data will be protected.*

*If the control method outlined is identical for staff AND customers, award a maximum of **[2 marks]***

3. The information obtained by SUSA Analytics revealed that the number of staff working at various times was not always appropriate to the level of sales (lines 96–98). Based on this information, ASI management recommended that patterns of staff working hours should be reviewed by the store managers.

Discuss whether store managers should use this information to decide the hours the staff should work.

[8]

*Answers may include:*

**General**

- sales may be seasonal or promotions so data could be misleading
- if based on value of sales rather than volume then perhaps a lot of work but little profit or vice versa, ie. do larger but more expensive items sell at a certain time of day which would imply needing more staff but workload may be lower.
- different types of staff - more customers may mean more salespeople required but not necessarily more managers, office staff etc. so a proper ratio would need to be found
- examine the data collected initially that was used to decide the number of staff at various working times Train staff to develop skills in areas that need development.

**Considerations for:**

**Staff**

- greater recognition of skills and abilities in a more organized and efficient workplace
- higher wages due to greater recognition and less staff required – productivity increase benefits.

**Managers/Business**

- less staff needed to pay – save money
- more productivity from each staff member as less staff used.

**Considerations against:**

**Staff**

- reduced working hours as less staff may be needed
- higher work load as minimal staff allocated each shift
- less flexible working hours due to decreased staff and more rigid shift requirements
- forced to work at certain times due to need for specialized staff in each shift.

**Managers/Business**

- unhappy staff who have the problems above
- need to spend more time and effort organizing rosters of staff
- need to negotiate with staff, especially those with other commitments such as children
- minimal staff could be a problem if something unusual happens
- managers need to be aware of the specific skill sets of staff so that departments are appropriately staffed.

**Note to examiners:** Please use the following simplified version of the markband

If there is **no** awareness of the **different** impacts (positive and negative) on staff and/or the managers/business award **[0]**.

To enter the 1/2 markband the response needs to present **different** types of considerations, but **without** an attempt at a comparison or a conclusion.

To enter the 3/4 markband, responses need to have an attempt at a conclusion that is based on at least two **different** types of considerations for **either** staff **or** the managers/business.

To enter the higher markbands, 5/6 and 7/8, the conclusion needs to be based on **explicit** considerations **for** and **against** for **both** the staff **and** the managers/business. However three types of considerations covering **both** staff and managers/business and used to support a detailed analysis may warrant entry to the 5/6 markband – best fit for detailed analysis.

At least one for each type of the four types of considerations is needed to enter markband 7/8 and are used to support a conclusion.

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

<p><b>No marks</b></p>	<ul style="list-style-type: none"> <li>• No knowledge or understanding of the relevant ITGS issues and concepts.</li> <li>• No ITGS terminology.</li> </ul>
<p><b>Basic</b> <b>1–2 marks</b></p>	<ul style="list-style-type: none"> <li>• Shows only a little ITGS knowledge</li> <li>• Makes at least one argument.</li> <li>• May not have any comparison/conclusion</li> </ul>
<p><b>Adequate</b> <b>3–4 marks</b></p>	<ul style="list-style-type: none"> <li>• Shows a little more ITGS knowledge but still weak.</li> <li>• Has more arguments, (at least two) and possibly from different stakeholders.</li> <li>• Has a conclusion or judgements which are probably not backed by much reasoning</li> </ul>
<p><b>Competent</b> <b>5–6 marks</b></p>	<ul style="list-style-type: none"> <li>• Shows good ITGS knowledge and detail</li> <li>• Has more arguments and they are balanced (+ and -) and for different stakeholders</li> <li>• Conclusion/judgements are supported by the arguments and is well thought out</li> </ul>
<p><b>Proficient</b> <b>7–8 marks</b></p>	<ul style="list-style-type: none"> <li>• Shows very good ITGS knowledge</li> <li>• Arguments are very balanced and detailed.</li> <li>• Conclusion is based completely on the arguments</li> </ul>

4. With reference to your independent research, to what extent do the benefits for ASI's customers of receiving targeted advertising outweigh the ethical concerns that these customers may have about the impacts on their privacy, security and anonymity (lines 108–117)?

[12]

*Answers may include:*

### **Positives**

- profile of customer purchases used to send advertising to customers may be seen by some customers as a benefit as it provides them with access to the latest product and sales information in a timely manner without the need to do extra research
- targeted personal advertising can remind them of a need without having to make an effort to check
- access to products before others have the chance to purchase them
- access to special deals that others may not be offered
- targeted advertising is cheaper than bulk advertising and more effective so the business will make more money and hopefully pass this on to the customer
- by enrolling in the loyalty card scheme the customers have opted into the target advertising and expect to benefit from it with rewards.

### **Negatives**

- invasion of privacy – profile of customer purchases used to send advertising to customers may be a concern to some customers
  - “How much do they know about me?”
  - “What else will they do with the information?”
- intrusion into personal life – targeted, personal advertising may be intrusive as it will be pushed out to the customer who may not want that amount or type of advertising
- the advertising may be targeted but not fully appropriate to the needs of the customer due to the lack of detail in the profile and the changing needs of the customer which could be annoying
- the customer may prefer to research their own purchases themselves
- is it wrong to force advertising on customers when clearly it is being pushed out to the customer and not to some others?
- is it wrong to use information in the profile without asking specific permission of the customer? Has this been done?
- customers may want to be able to cancel the use of these advertisements so this facility will need to be included in the website. Cancelling requires an effort from the customer
- customers who are targeted with extra advertising may feel pressured to purchase when not able to control their spending or they do not have the money – such as the elderly, children and immature adults for whatever reason
- the customer profile may be sold or hacked into which could have negative impacts on the customer such as unexpected advertising from unknown companies
- also it may be stored in another country with different laws and security arrangements which could lead to the data being unlawfully accessed, sold and used
- by enrolling in the loyalty card scheme the customers have opted into the target advertising but may not have realized the extent to which it would impact them
- customers may be concerned that their purchases may be used to infer other things about them (medical insurance if health products are purchased etc)
- customers might be concerned that their credit card details may be compromised if stored with the profile.

*The response must focus on the customer. When business orientated impacts and actions are included they need to be linked to a positive or negative impact on the customer, eg “loss of market share due to customers being annoyed at the advertising” should focus on the annoyance for the customer and not the loss impact for the company.*

*The focus of the response must be a judgement about the decision that has been made: overall, is the decision good or bad for the customer, or a mixture of both. The judgement needs to be defended by comparing the impacts.*

**HL paper 3 question 4 markband**

<b>Marks</b>	<b>Level descriptor</b>
<b>No marks</b>	<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>
<b>Basic 1–3 marks</b>	<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, conclusions or future strategies.</li> <li>• No reference is made to the information in the case study or independent research in the response.</li> <li>• The response may be no more than a list.</li> </ul>
<b>Adequate 4–6 marks</b>	<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, judgments or future strategies 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 information in the case study or independent research in the response.</li> </ul>
<b>Competent 7–9 marks</b>	<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 information in the case study or independent research are made at places in the response.</li> </ul>
<b>Proficient 10–12 marks</b>	<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, judgments or future strategies that are well supported and underpinned by a balanced analysis.</li> <li>• Explicit references are made appropriately to the information in the case study and independent research throughout the response.</li> </ul>