

Information technology in a global society
Higher level
Paper 1

Tuesday 19 May 2015 (afternoon)

2 hours 15 minutes

Instructions to candidates

- Do not open this examination paper until instructed to do so.
- Section A: answer two questions.
- Section B: answer one question.
- Section C: answer one question.
- Each question is worth **[20 marks]**.
- The maximum mark for this examination paper is **[80 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: reprinted from the Mayo Clinic website. <http://www.mayoclinic.org/medical-professionals/clinical-updates/cardiovascular/new-technology-enables-novel-remote-health-care> © Mayo Foundation for Medical Education and Research. All rights reserved. Image courtesy Preventice and Mayo Clinic.]

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.

* 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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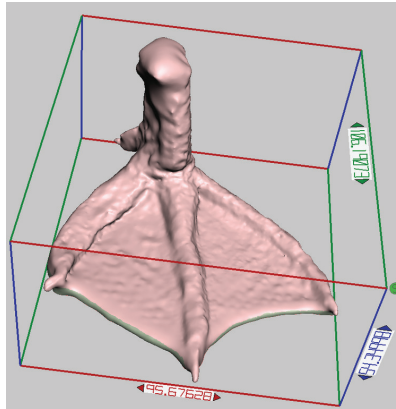
(Question 1 continued)

- (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

Buttercup is a duck who hatched with a deformed left foot that had to be amputated. 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: Courtesy of the Feathered Angels Waterfowl Sanctuary]

Figure 3: Charlie's new plastic foot



[Source: Courtesy of the Feathered Angels Waterfowl Sanctuary]

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(Question 2 continued)

Figure 4: A 3D printer

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Please go to: http://en.wikipedia.org/wiki/3D_printing#/media/File:MakerBot_Replicator_2.jpg

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 Buttercup'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 Buttercup'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: © International Baccalaureate Organization 2015]

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(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

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Please go to: http://www.thestar.com/life/travel_blog/2014/01/singing_the_toronto_pearson_airport_polar_vortex_blues__things_improving_but_shutting_down_the_airport_tuesday_was_a_mistake.html

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(Question 4 continued)

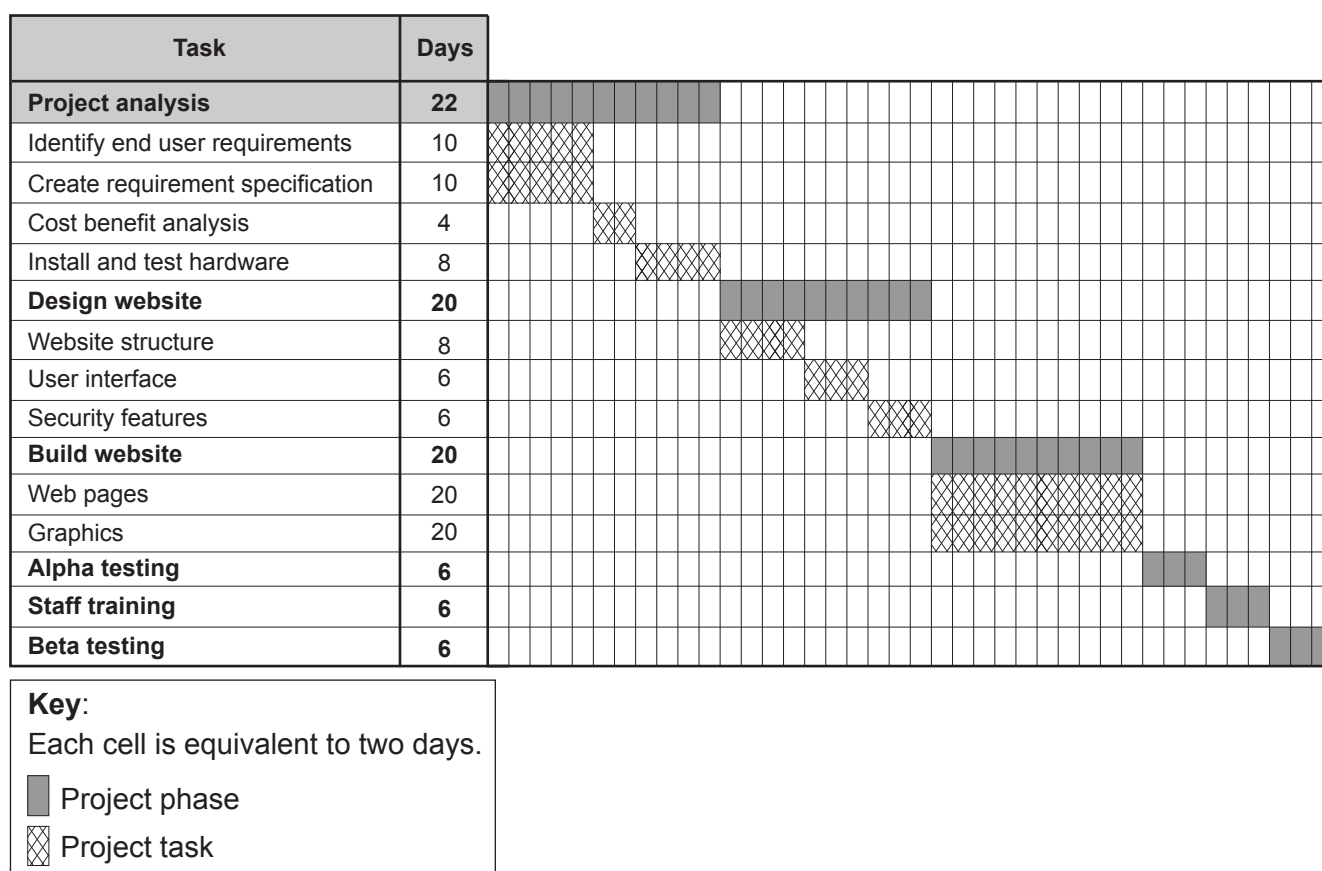
- (a) (i) Identify **two** key stakeholders in this automated baggage system project. [2]
- (ii) Identify **two** characteristics of a “prototype”. [2]
- (iii) Identify **two** types of information that should have been gathered at the beginning of the automated baggage system project. [2]
- (b) Explain **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



[Source: © International Baccalaureate Organization 2015]

- (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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Section C

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

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: VGo Communications. Used with permission.]

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(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

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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

Images removed for copyright reasons

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".

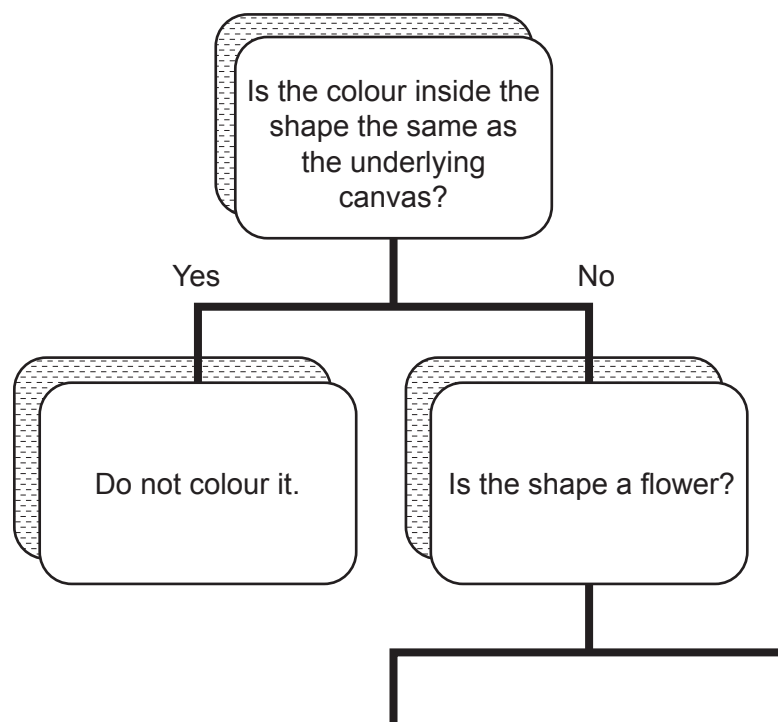
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(Question 7 continued)

- (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]