Diploma Programme
Programme du diplôme
Programa del Diploma

Information technology in a global society
Higher level
Paper 1

Thursday 3 May 2018 (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.
- Each question is worth **[20 marks]**.
- The maximum mark for this examination paper is **[60 marks]**.

11 pages

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Section A

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

1. **IT support for staff laptop computers at *RZX***

    The role of the IT department at *RZX* is to provide IT support to the staff at the head office.
    As many of the employees spend a considerable amount of time travelling between the various
    RZX offices, they are given a laptop computer. This laptop needs to be maintained once a year, so
    each employee must hand in their laptop before they go on vacation so that this can be done. The
    IT team will carry out the maintenance and have it ready for the employee when they return from
    their vacation.

    Employees at *RZX* are expected to store their files in the cloud. However some employees have
    saved many files on their laptops, and *RZX* has informed them that they are responsible for
    keeping secure backups of this information.

    During maintenance, hard disk drives are cleaned, defragmented or reformatted and the random
    access memory (RAM) is increased. A new version of the operating system may be installed and
    other software programs will be added, re-installed or upgraded to a newer version.

    [Source: © International Baccalaureate Organization 2018]

    (a) (i)   Identify **two** functions of an operating system.   [2]

         (ii) Identify **two** characteristics of random access memory (RAM).   [2]

         (iii) Identify **two** devices that could be used to store a backup of the files that
               employees have saved on their laptops.   [2]

    (b) Analyse the advantages and disadvantages of using cloud-based storage for an *RZX*
         employee's work files.   [6]

    (c) The disposal of old IT equipment is becoming a problem. *RZX* is considering two
         options:
         • donating the equipment to a charitable organization
         • sending the equipment to a recycling service.

         Evaluate the implications of these **two** options.   [8]

Turn over

2. Medical centre budgets

Dr Schultz is the head doctor and manager at the Okavango Medical Center, Botswana. This medical centre is located eight hours away from the capital city, Gaborone. The medical centre is able to cope with routine cases, but when the doctors at the centre encounter an unusual case they have to communicate with specialists at the main hospital in Gaborone using either a telephone or voice over internet protocol (VOIP).

Currently the Okavango Medical Center does not have any medical equipment connected to the IT systems at the hospital in Gaborone in real time. When there are unexpected changes in a patient's condition, this makes it hard to give the necessary information to specialists in Gaborone. Because of this, at times Dr Schultz has to ask a specialist doctor from Gaborone to come to Okavango Medical Center to carry out treatment.

The area is becoming popular with tourists, and Dr Schultz is concerned that the doctors and nurses at Okavango Medical Center will be unable to treat the increasing number of patients. He believes Okavango Medical Center needs better equipment in order to improve patient care.

Dr Schultz created a spreadsheet of the treatments carried out by the centre over a week. A small part of the spreadsheet is shown below in **Figure 1**.

Figure 1: Part of Dr Schultz's treatment record spreadsheet

	Doctor	Gender of patient	Procedures	Day
	C10		Emergency	
1	Doctor	Gender of patient	Procedures	Day
2	Dr Schultz	F	Surgery	MON
3	Dr Gerber	F	Surgery	MON
4	Dr Schultz	M	Emergency	MON
5	Dr Gerber	M	Surgery	MON
6	Dr Gomez	M	Check-up	MON
7	Dr Schultz	F	Follow-up	MON
8	Dr Gerber	M	Follow-up	MON
9	Dr Tirbau	F	Emergency	MON
10	Dr Schultz	F	Emergency	MON
11	Dr Gomez	F	Check-up	MON
12	Dr Tirbau	M	Surgery	TUE
13	Dr Schultz	M	Check-up	TUE
14	Dr Gomez	F	Emergency	TUE
15	Dr Gerber	M	Emergency	TUE

[Source: © International Baccalaureate Organization 2018]

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(Question 2 continued)

(a) (i)   Identify **two** characteristics of voice over internet protocol (VOIP).   [2]

(ii) Identify the steps that Dr Schultz must follow to list only the surgeries carried out by Dr Tirbau using the spreadsheet software.   [2]

(iii) Identify **two** reasons why Dr Schultz would use a spreadsheet instead of a database for record keeping.   [2]

(b) Dr Schultz has arranged to speak to the local authorities in an attempt to get more funding for the medical centre. He intends to use presentation software to create a slideshow to support this speech. Dr Schultz is aware that many people in the audience are annoyed when slideshows are poorly designed.

Explain **three** design errors Dr Schultz should avoid when creating his slideshow for the local authorities.   [6]

(c) The Okavango Medical Center has received additional funding from the local authority. The centre is investigating the possibility of using these funds to purchase IT equipment that would allow surgeons in Gaborone to carry out surgery remotely.

Evaluate the impact of the purchase of this IT equipment on the medical centre and its patients.   [8]

Turn over

3. **Digital currency**

Bitcoin is a type of digital currency (cryptocurrency). This is money that can be sent via the internet and exchanged for goods, services or money in different currencies. Users can buy Bitcoins using real money, and then Bitcoins can either be spent or stored in a digital wallet for later use. Bitcoins can be used in every country, and sending Bitcoins is as simple as sending an email.

The Bitcoin wallet is an application that can be installed on a computer or mobile device. Once a Bitcoin wallet is installed, the user will get a Bitcoin address to use when transferring Bitcoins to and from the wallet. This transfer uses private and public key encryption. Users should have a strong password to access their Bitcoin wallet.

Bitcoin operates on a peer-to-peer (P2P) network and users of Bitcoins are identified by their Bitcoin address. Some users of Bitcoins wish to remain anonymous, but this is not always possible.

[Source: © International Baccalaureate Organization 2018]

(a) (i)   Identify **two** characteristics of a peer-to-peer (P2P) network. [2]

(ii) Identify **two** characteristics of a strong password. [2]

(iii) The use of a password is one method of authentication.

Identify **two** other methods of authentication. [2]

(b) (i)   Explain **one** reason why Bitcoin makes use of private key and public key encryption. [2]

(ii) Explain **one** reason why it may be difficult to ensure the security of information in a large peer-to-peer network such as Bitcoin. [2]

(iii) Some users of Bitcoins are concerned that their anonymity may be compromised by their Bitcoin address.

Explain **one** way the Bitcoin address may be used to reveal information about a Bitcoin user. [2]

(c) Bitcoin is a form of digital currency. Bitcoin transactions are made between individuals without the knowledge of banks, governments or credit card companies. Some governments are investigating whether they should regulate digital transactions, such as those made using Bitcoins.

To what extent is it appropriate for governments to regulate digital transactions, such as those made using Bitcoins? [8]

Section B

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

4.   **The future of police robots**

In 2016, police in Dallas, Texas in the United States used a remotely-controlled robot loaded with explosives to kill a suspect who had barricaded himself at the end of a hallway in a community college. Fifty-eight staff and students were still trapped in the building. Eight of them were in a room on the floor below the suspect. Before the police used the robot, they had exchanged gunfire with the suspect. The suspect refused to surrender; negotiations with him had broken down, and he told police that he had planted bombs in the area. The police discussed the issue for 20 minutes, and then decided to send in the robot and detonate the explosives.

Law enforcement agencies, the American Civil Liberties Union and the Police Executive Research Forum have all expressed opinions about the legal and ethical aspects of sending a robot to detonate explosives that would kill or severely injure a suspect. There is concern that this action will be more widely used by police departments in the future.

This kind of robot is typically used to enable police to see into areas where it would be too dangerous to send in a human being, such as defusing explosives or removing hazardous material. Robots can also be used to conduct negotiations with suspects so that police officers are not in danger while negotiating. The robot can be operated wirelessly or using a cable.

[Source: © International Baccalaureate Organization 2018]

(a)   (i)   Identify **two** characteristics of a robot.   [2]

      (ii)   Identify **two** output devices the robot might have.   [2]

      (iii) The police department has technical support staff.

             Identify **two** duties of the staff that supports the robot.   [2]

(b)   (i)   The company that supplied the robots spoke with both end-users and clients.

             Distinguish between an end-user and a client.   [2]

      (ii)   Explain **two** reasons why product development involving robots would require an
             agile project management method.   [4]

(c)   Toby Walsh, professor of Artificial Intelligence at the University of New South Wales,
      Australia, notes that the use of police robots raises "many important questions that we,
      as a society, have to think about".

      To what extent should police departments rely on the human element of policing, rather
      than robots?   [8]

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5.   Artificial intelligence (AI) in health care

Google's DeepMind uses a machine learning algorithm and neural network to analyse data. *Google* is now collaborating with the United Kingdom's National Health Service (NHS) to develop systems that can improve the quality of healthcare.

Its first project is to create a system that can analyse digital scans of eyes, and thus help doctors diagnose sight-destroying diseases in time for them to be treated. This is a complex problem for pattern recognition.

Google needs large quantities of retinal scans to test the algorithm. Moorfields Eye Hospital in London has the largest collection of retinal scans in the world, and will share them with *Google* for free. The scans will be anonymized. Patients can opt out of sharing their data by emailing an NHS data protection officer. *Google* will use the knowledge gained from this project to help create future software that can eventually be marketed to health care providers.

For this project, *Google* needs to pay attention to the needs and concerns of multiple stakeholders, including patients, doctors and the NHS. *Google* plans to hold four patient forums a year and set up a panel of independent reviewers to oversee what the company is doing. Ultimately, *Google* hopes to make a profit from this technology.

[Source: © International Baccalaureate Organization 2018]

(a)   (i)   Define *algorithm*.   [2]

       (ii)   Identify **two** characteristics of pattern recognition.   [2]

       (iii)   During the development of the algorithm, *Google* may use a data flow diagram.

                Define *data flow diagram*.   [2]

(b)   *Google* has chosen to use a neural network for this project, rather than an expert system.

       Distinguish between an expert system and neural network.   [6]

(c)   It is claimed that the NHS's partnership with *Google* is beneficial for both stakeholders. However, concerns have been raised about the ethical implications of this data sharing agreement.

       To what extent is it ethical for the NHS to share patient information about eye scans from Moorfields Eye Hospital with *Google*?   [8]

6. **Exoskeletons[1] for workers**

Many jobs in modern manufacturing still require human workers, and many of these jobs involve lifting and carrying heavy loads. Some jobs require workers to maintain unnatural positions for a long period of time or hold tools for many hours. Workers doing these jobs are exposed to possible injuries, resulting in sick days or even a shortened work life. The European Union's Robo-Mate project is an attempt to address these problems (see **Figure 2**).

Robo-Mate is a lightweight, powered exoskeleton that uses motors and sensors to enable workers to bear only a small part of the weight of any load they are carrying.

Robo-Mate has three supporting modules: one for the arms to help with lifting, one for the torso[2] to support the back and spine, and one for the legs to support the inner thigh so lifting is easier.

Figure 2: The Robo-Mate exoskeleton

Arm module   Torso module

Leg module
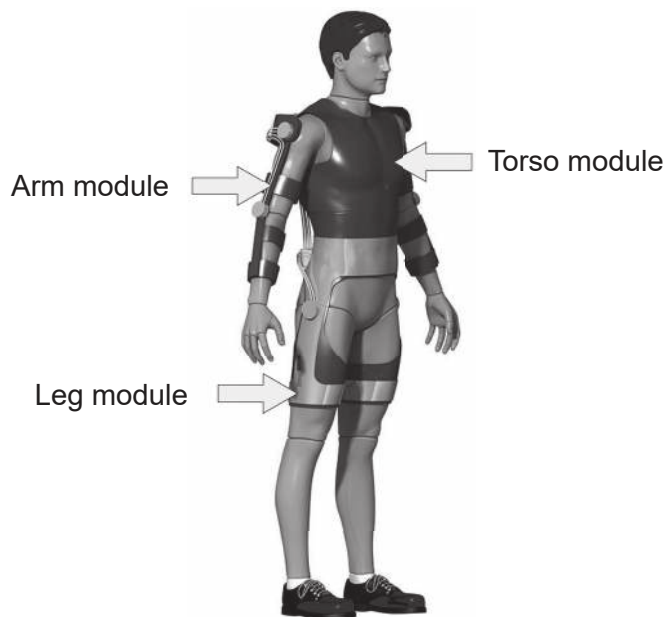
[Source: Robo-Mate Project (Zurich University of Applied Science)]

A group of designers and engineers worked for three years to develop the prototype of the Robo-Mate arm module shown in **Figure 3**.

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(Question 6 continued)

Figure 3: Prototype of Robo-Mate arm module

[Source: Robo-Mate Project (Ludmilla Parsyak/Frauenhofer IAO)]

In addition to preventing injuries, exoskeletons can collect data about the worker's location, vital signs and neural signals, as well as other information relating to the user. Overall, Robo-Mate should make workers' jobs easier and faster. The ultimate goal is to make Robo-Mate available for sale to European industries for them to purchase for their workers.

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1 exoskeletons: external wearable frameworks that strengthen a human's natural physical ability
2 torso: the part of the human body that does not include the head, arms or legs

    (a)   (i)   Identify **two** reasons why the Robo-Mate requires sensors. [2]

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

            (iii)   Identify **two** key stakeholders involved in this project. [2]

    (b)   The researchers involved in the Robo-Mate project decided to use a Pert chart instead of a Gantt chart to guide the project.

            Explain why the researchers used a Pert chart instead of a Gantt chart to guide the project. [6]

    (c)   Other than for the prevention of injuries, discuss the impacts for workers and employers of the use of exoskeletons in the workplace. [8]